EPIDEMIOLOGICAL STUDIES RELATED TO CORONARY HEART DISEASE: CHARACTERISTICS OF MEN AGED 40—59 IN SEVEN COUNTRIES

By

Ancel Keys

and

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EPIDEMIOLOGICAL STUDIES RELATED TO CORONARY HEART DISEASE: CHARACTERISTICS OF MEN AGED 40—59 IN SEVEN COUNTRIES*

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Dr. J. K. Kihlberg, R. Willis Parlin and Norris Schulz, of the University of Minnesota, were responsible for the statistical work on the data from all of the areas in this cooperative program. Ernest Klepetar, now at Columbus, Ohio, provided advice.

FOREWORD

The data presented and discussed in the following pages are the result of truly cooperative efforts, actually a series of inter-connected collaborations, on an international scale. In effect, what is presented here is a progress report on a long-time study of the epidemiology of coronary heart disease.

The persons primarily responsible for the establishment of the samples and the field work in the various areas are identified as authors of Sections C1 through C9. Dr. Henry Blackburn wrote Section G. The senior editor wrote Sections A, B, D, E, F, and H, after much consultation with the persons listed on the title page who also checked preliminary drafts of these sections.

Mr. R. Willis Parlin had a major responsibility in preparing and checking the tables and graphs, as well as in the assembly of the materials for the printers. Dr. Martti J. Karvonen shepherded the whole work through the printers.

A. K.

A. PURPOSES, ORGANIZATION, GENERAL CONSIDERATIONS

1. Introduction

The purpose of the present communication is to report data, and their analysis, on some variables presumed to be relevant to the epidemiology of coronary heart disease. These variables are anthropometric characteristics (including relative body weight and fatness), blood pressure, serum cholesterol concentration, electrocardiographic items, and smoking habits, as recorded for middle-aged men.

The materials comprise data obtained from 1957 through 1962 on more than 12,000 men by 9 collaborating teams of investigators, centrally coordinated. Comparability was assured by the use of identical methods, exchange of professional personnel among the teams, and centralized chemical and data analysis. The data are from 17 samples of men aged 40 through 59 in the U.S.A., Japan, Yugoslavia, Finland, Italy, the Netherlands and Greece and one sample of men aged 45—64 in Italy. Thirteen of these samples represent all men of given age in geographically defined areas; 5 of the samples represent railroad employees.

Subsequent status in regard to health and other variables is being followed in all these men. Results from the follow-up will be presented in later reports. The present report concerns only the findings in the cross-section surveys for the variables noted above; other variables and clinical interpretations will be covered in separate reports.

Publication, and ascription of "authorship", of the results from the efforts of so many collaborators present difficult practical problems. The present title page lists the "responsible investigators" or heads of the investigative teams who were concerned with the variables covered here. The principal collaborators and professional assistants are listed in the appropriate sections of this report. All of these persons share credit for the work reported here.

Dietary surveys were an important integral part of these epidemiological studies but the data are not reported here; the persons responsible for the dietary work will be identified in separate publications on the dietary findings.

2. Coronary Heart Disease

Coronary heart disease is the leading cause of death in many of the economically more advanced and prosperous regions of the world but the incidence differs greatly among populations. Such data as in Table A1 present implications for the public health and for the understanding of the etiology of this disease, the limitations of such vital statistics point to the need for large-scale, detailed epidemiological studies in contrasting populations on the frequency of the disease and on variables that may be involved in its etiology.

Table A1 summarizes 1959 death rates ascribed to various causes among men aged 40—59 in the countries concerned in the present studies. These official vital statistics indicate great differences in the reported mortality from coronary heart disease, the highest (Finland and the U.S.A.) being of the order of six to eight times the lowest rates (Greece, Japan, and Yugoslavia). Smaller, but still very large, differences are reported for deaths from all circulatory diseases. Finally, death rates from the sum of all causes are highest in those countries (Finland and the U.S.A.) reporting the highest mortality from coronary heart disease, suggesting a true great excess of that disease in those countries.

The data of Table A1 for mortality from diseases of the circulatory system are expressed in Table A2 as percentage of mortality from all causes excluding infectious diseases and violence. These latter causes are ascertained with relatively high reliability and would seem to have little or no etiological relationship to coronary heart disease. On the other hand, though the broad category of circulatory diseases may be relatively comparable among countries, there is more question about sub-categories. Cases of sudden death that would be labelled "coronary" in some countries (e.g., U.S.A. and Finland) may be certified as "cerebrovascular" in some other countries (e.g., Japan). It is probable, also, that in some countries "other heart disease" includes many deaths that might more properly be attributed to coronary heart disease in contrast to the situation in the United States where there is probably a tendency to attach the "coronary" label on inadequate grounds. But no matter what efforts are made to allow for these considerations and to minimize the contrasts indicated in vital statistics, great differences still persist among the countries in regard to coronary heart disease or the sum of coronary plus other heart disease plus hypertension.

Though Tables A1 and A2 raise important and intriguing questions, it is obvious that it does not suffice to analyse vital statistics and similar official records gathered for purposes other than the investigation of the etiology of the disease. As Dawber and Kannel (1963) point out, such "macro-epidemiological" materials would have limited value even if the data from different regions were strictly comparable. Systematic studies are needed on contrasting populations using rigidly standardized methods and criteria so as to characterize them more precisely not only in respect to the frequency of the disease but also in respect to the distribution of variables that may be associated with the development of the disease (Keys and White, 1956; Study Group, 1957; Keys, 1958; Research Committee, 1959; Morris, 1961, 1962). For, if there are differences in the incidence of the disease, comparisons of populations in respect to associated characteristics are essential in an effort to explain the differences.

Among characteristics suggested to be contributory to the development of coronary heart disease, importance is frequently attributed to overweight or obesity, elevated blood pressure, high concentration of cholesterol in the blood, lack of physical exercise, and the habit of cigarette smoking. The present series of papers is concerned with these characteristics and with electrocardiographic findings among middle-aged men in populations reputed to vary widely in the frequency of the disease, from very high (the United

TABLE A1

Death rates, per 100,000 men, in 1959, from W.H.O. Annual Epidemiological and Vital Statistics, Geneva, 1962, classified according to the Intermediate (A) and Abbreviated (B) lists in the Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death (1957, Geneva). "Infection" comprises B1-17; "All Violence," B45-50; "All Circulatory," B22, B24-29, A85-86; "Cerebrovascular," B22; "Coronary," B26; "Other Heart," B27; "Hypertension," B28-29.

CAUSE	FINLAND	GREECE	ITALY	JAPAN	NETHER-LANDS	U.S.A. WHITE	YUGO-SLAVIA
				MEN AGED 40-44			
All Causes	500.0	260.0	330.0	420.0	240.0	420.0	378.1
Infection	55.4	32.3	39.5	71.6	9.8	8.3	78.1
Violence	118.4	46.7	66.4	88.9	44.3	92.2	97.0
All Circulatory	178.9	36.7	77.1	88.7	62.1	170.6	54.2
Cerebrovascular	26.4	9.6	12.7	51.2	7.1	14.2	13.6
Coronary	117.5	8.7	42.1	24.7	42.7	126.8	13.6
Other Heart	11.1	12.2	5.5	4.5	2.8	6.2	21.9
Hypertension	10.2	2.1	3.8	4.3	1.5	6.1	-
				MEN AGED 45-49			
All Causes	780.0	450.0	520.0	640.0	390.0	690.0	577.7
Infection	64.9	48.8	49.2	93.4	11.5	13.1	111.7
Violence	144.3	60.3	75.6	102.5	44.5	103.1	93.8
All Circulatory	317.6	90.0	139.9	174.1	120.2	338.3	106.0
Cerebrovascular	51.9	24.6	28.8	112.2	14.0	27.4	25.1
Coronary	223.7	30.1	78.4	41.3	85.3	259.2	30.5
Other Heart	14.5	25.5	10.6	6.8	7.5	11.5	40.3
Hypertension	9.1	4.7	7.7	8.5	4.1	14.3	2.1
				MEN AGED 50-54			
All Causes	1290.0	650.0	890.0	1020.0	690.0	1150.0	984.3
Infection	109.0	55.7	73.7	115.6	14.3	21.0	165.4
Violence	159.7	51.6	94.6	111.9	58.0	115.8	113.9
All Circulatory	569.9	157.6	260.3	352.4	218.7	608.5	201.9
Cerebrovascular	85.7	48.0	63.7	240.7	21.0	56.7	54.7
Coronary	422.6	48.0	145.5	70.9	162.1	465.8	51.1
Other Heart	24.1	44.8	17.9	14.1	12.0	17.5	81.8
Hypertension	19.9	5.4	15.9	16.2	7.0	27.4	7.1
				MEN AGED 55-59			
All Causes	2030.0	1120.0	1460.0	1680.0	1210.0	1790.0	1637.5
Infection	151.5	68.7	87.3	149.3	17.9	32.1	233.4
Violence	171.2	63.2	97.1	133.2	82.4	125.4	133.4
All Circulatory	926.3	291.7	509.3	659.8	423.3	988.0	397.5
Cerebrovascular	159.8	83.4	144.3	468.4	63.1	102.4	100.5
Coronary	643.2	95.4	270.1	114.9	297.5	748.2	112.0
Other Heart	56.0	85.1	35.1	28.9	21.7	26.3	158.8
Hypertension	31.1	14.2	36.0	31.5	11.1	49.6	13.5

TABLE A2

Per cent of all deaths, other than those ascribed to infections and parasitic disease (B1-17) or to violence (B47-50), accounted for by deaths ascribed to all circulatory diseases, to cerebrovascular disease (B22), to coronary heart disease (B26), and to all other heart disease and hypertension (B27-29).

COUNTRY	MEN AGED 40-44				MEN AGED 45-49			
	ALL CIRCUL.	B22	B26	B27-29	ALL CIRCUL.	B22	B26	B27-29
Finland	55	8	36	7	56	9	39	4
Greece	20	5	5	8	26	7	9	9
Italy	34	6	19	4	35	7	20	5
Japan	34	20	10	3	39	25	9	3
Netherlands	33	4	23	2	36	4	26	3
U.S.A., White	53	4	40	4	59	5	45	4
Yugoslavia	27	7	7	10	28	7	8	11
	MEN AGED 50-54				MEN AGED 55-59			
Finland	56	8	41	4	54	9	38	5
Greece	29	9	9	9	30	8	10	10
Italy	36	9	20	5	40	11	21	6
Japan	44	30	9	4	47	34	8	4
Netherlands	35	3	26	3	38	6	27	3
U.S.A., White	60	6	46	4	61	6	46	5
Yugoslavia	29	8	7	13	31	8	9	14

States and Finland), to low incidence (Japan and countries of the Eastern Mediterranean).

3. The Epidemiological Approach

Epidemiological investigations alone seldom, if ever, yield final proof of causation, but they offer a powerful tool to discover associations among variables, to provide clues for further investigations, to test hypotheses of cause and effect, and to indicate practicalities to consider for possible programs of prevention and control (Keys, 1957).

The utility and even the necessity of the epidemiological approach as a major but not exclusive method in the effort to develop methods to control coronary heart disease is emphasized by the limitations of clinical and experimental approaches.

Serious questions arise about the relevance of data from experiments on animals to the actual interplay of causal influences in the etiology of the disease in man. These questions concern the progression from atherosclerosis to infarction as well as the development of the primary atherosclerosis. The basic arterial disease may be mimicked in some experiments on animals — though exact correspondence is debatable — and details of pathogenetic mechanisms may be studied in this way. But the quantitative equivalents of the variables that promote pathogenesis in man cannot be specified for other species. The etiology of the disease in man concerns quantitative influences that operate over many years; these must be evaluated in man himself.

As to the clinical approach, it may be suggested that often it is only epidemiology applied to inadequate numbers; in any case it has serious limitations. The causative influences of the basic disorder begin to operate long before coronary heart disease is clinically recognizable and may even have disappeared before that time. Furthermore, in populations beset with this disease in epidemic proportions, comparison of patients with so-called controls is complicated by the fact that many of the controls themselves are afflicted with severe but as yet silent coronary atherosclerosis and any analysis is necessarily probabilistic (White *et al.*, 1950; Larsen, 1954; Keys and White, 1956; Larsen and Bortz, 1960). Finally, the high early mortality in the first heart attack means that clinical studies generally cover only certain kinds of coronary patients, those who survive long enough to be studied.

The ultimate clinical event of myocardial infarction or acute coronary thrombosis is a distinct entity but angina pectoris is by no means so sharply defined and the underlying arterial disease shows no clear demarcation in the transition from the "normal, clean" artery to the situation that is grossly pathological. There is reason to believe that causative influences, too, operate quantitatively and in an additive fashion. It is obvious, then, that the relevant variables should be measured and analyzed quantitatively and with due regard to interrelationships among variables.

4. Cross-Section versus Follow-up Studies

Cross-section surveys on coronary heart disease may reveal prevalence but they do not indicate incidence or the sequence of events and they tell us nothing about the characteristics of persons who die suddenly. The importance of this latter fact in the case of coronary heart disease is apparent when it is realized that the acute mortality (first 30 days) of the first heart attack is of the order of 30 per cent (Biörck *et al.*, 1960).

Data from cross-sectional surveys depict characteristics of the population at the time and allow comparison to be made between "healthy" persons and certain kinds of patients with coronary heart disease. In estimating prevalence, the greatest security is with the select group of survivors of myocardial infarction who happen to show persisting electrocardiographic evidence of previous infarction or for whom convincing old records can be found to prove that infarction occurred at some time in the past. To these may be added individuals who are judged to have classical angina pectoris, though if the criteria are rigidly specified the number of doubtful cases will outnumber those who unquestionably merit the diagnosis. Finally, there are persons in the "greay area", those with non-specific electrocardiographic abnormalities — flat or depressed ST segments and T waves, the various disturbances of rhythm.

Obviously, unless great conservatism is exercised false diagnosis will be frequent. But if conservative diagnosis is adhered to, missed diagnosis will be at least equally frequent. Finally, whatever criteria are used, the prevalence survey will result in a group of patients about whom we must ask whether some of their other characteristics may not be results of the clinical disease and not representative of them in the pre-disease situation.

Some of these difficulties in cross-section surveys can be avoided and others reduced in prospective studies which start with the study of persons, initially healthy, who are followed until enough of them have developed the disease to allow comparison with the persons in the cohort who remain healthy. Longitudinal studies of this type require much more time and effort but are correspondingly more significant.

5. Current Epidemiological Studies in the U.S.

The incidence of coronary heart disease among middle-aged men is such that in many populations a few thousand subject-years follow-up will provide an adequate number of cases for statistical analysis. Such a study was started in Minnesota in 1947 (Keys *et al.*, 1963) and others began later at Framingham (Dawber *et al.*, 1957; Dawber and Kannel, 1961), at Albany (Doyle, *et al.*, 1957, 1959), at Los Angeles (Chapman *et al.*, 1957), at Chicago (Paul *et al.*, 1963), and elsewhere in the United States.

Important findings are emerging from these follow-up programs in the United States. It is gratifying to note the consistency in the results but this also points to several limitations. In the first place, all these studies concern men in one particular culture, that of contemporary urban United States and some of the associations among variables that emerge may not be universal to other cultures, socio-economic patterns and regions. In the second place, the samples are by no means random; they were selected by employment or availability except in the case of the Framingham study. In the latter, though a random roster of the small town of Framingham was used for eligibility to enter the study, about a third of the men eligible did not come into the study; they selected themselves out of it (Dawber *et al.*, 1957). Finally, these American population samples are characterized by a relatively high degree of homogeneity in certain respects of mode of life so that they throw little light on the effect of differences in mode of life. The incidence rates of coronary heart disease are so similar in all of these studies that there is little basis of contrast on which to compare the several samples. Physical activity and diet, too, do not show great contrasts among the samples and even within the samples variability in these items is restricted.

The association among variables which seem to be most important in the etiology of this disease in one population may not apply or may be overshadowed by other factors, in other populations. Universals in the disease will be clear only when populations of differing habits and cultures are included in broader studies.

6. Epidemiology in Contrasting Populations

Epidemiological studies, comparing populations affording great contrasts, especially in regard to the diet and the reputed frequency of ischemic heart disease have provided useful data in cross-section surveys of contrasting socio-economic groups in Madrid (Keys *et al.*, 1954a), Naples (Keys *et al.*, 1955), Guatemala City (Scrimshaw *et al.*, 1957), and of different racial groups in Cape Town (Bronte-Stewart *et al.*, 1955). But complicating, and perhaps confounding, variables are introduced when comparisons are made among differing socio-economic classes, especially when the lower end of the scale is represented by a population seriously underprivileged in many respects, including medical services and food. The addition of the variable of race involving great differences in mortality in youth and in exposure to infectious and parasitic disease, further complicates the picture.

7. An Ideal Epidemiological Program

Consideration of the points made in the foregoing sections tends to define the character of ideal epidemiological studies concerned with the universals of this disease. They should begin with detailed measurements and examinations of samples of persons in contrasting populations and should cover a number of variables that are of potential relevance to the etiology of or susceptibility to the disease. Careful follow-up will then reveal incidence and will relate the development of the disease to pre-disease characteristics. Because comparisons are so vital in such studies, we reiterate the point noted previously — rigidly standardized methods and criteria must be applied.

The practicalities to meet these requirements are formidable and could scarcely be met by any single investigative unit let alone any single investigator. But it proved to be feasible to organize a group of investigative teams in different countries who would agree on indentical protocol, methods, criteria, and analytical treatment, and to make arrangements to maintain comparability by exchange of professional personnel and centralization of analytical work.

8. The Present Report

The present report concerns data from the first phase, the cross-section survey, of an attempt at such a broad cooperative epidemiological study involving parallel studies on many samples of men by independent but coordinated teams in a number of countries. It will be evident that, though the program was ambitiously conceived and has operated well within the limits originally set, it is far from a close approach to the ideal. The subjects comprise 12,293 men, yet the number is too small to allow more than limited conclusions about coronary heart disease itself, unless, as hoped, the follow-up extends to 10 or more years. The number of variables studied is also limited, partly because of limited funds, partly because suitable methods have not yet been developed for epidemiological application.

However, from the initial cross-section surveys the numbers are adequate to indicate in some detail distributions and interrelationships of the measured variables and to make some population comparisons. Attention to the avoidance of bias in sampling has avoided some common faults in population studies but questions remain. The "chunk" samples dealt with in Europe and Japan, though unbiassed in respect to the particular areas selected for study, are not claimed to be necessarily good samples of the whole region in which they reside, let alone of the countries. The U.S. railroad employees studied are not claimed to be an ideal sample of all U.S. railroad employees; there were too many men in the samples who refused to cooperate. And the Roman sample may be unrepresentative of railroad employees in Italy as a whole. But we should not deprecate too much; the samples are better than those previously studied. Besides, a good theoretical argument can be made that no sample can perfectly represent a population unless it corresponds in all particulars of the distributions of all relevant variables in that population; since this fact can never be guaranteed in any real situation, no sample can be perfect.

9. Features of the Cooperative Program

The basic plan of the program from which data are reported here was to organize parallel studies on men aged 40—59 in areas differing in the diet or in the reputed incidence of heart disease, or both, but with areas so chosen that within each area there would be relative homogeneity. In Europe, rural areas dominated by simple agricultural pursuits were selected in which virtually all men of given age would be covered, an optimistic plan justified, as shown in Section 12, below, by previous explorations. In Japan the farming and fishing village areas of Tanushimaru and Ushibuka were similarly covered by such "chunk" samples. A departure from the concentration on rural populations is the study of the men of Zutphen, a small town in central Holland in which, unlike the rural areas, most of the men are not farmers but are engaged in trade and light industry.

In the United States it was not feasible to organize a program with rural populations that would be reasonably comparable to the European populations. However, a parallel program was organized to study several occupational categories of men aged 40—59 employed by railroads operating in the northwest sector of the country. The sampling procedure used in this study will be described in detail in the specific section of this report covering U.S. railroad employees. Three major occupational categories of the railroad employees in the U.S.A. were distinguished: clerks, yard switchmen, and executives; the switchmen are physically moderately active while the men in the other two categories are sedentary. More careful scrutiny showed that certain types of U.S. railroad "clerks" are not sedentary in their occupation; eventually, the clerks were distributed into sedentary and non-sedentary clerk categories.

The sample of railroad employees in Rome comprised four categories: station masters and dispatchers (sedentary), switchmen (rather comparable to the U.S. switchmen), maintenance-of-way workers (heavy work), electrical maintenance workers (generally active but variable in level of activity).

A major feature of the entire program was the adoption of rigidly standardized methods and criteria, a common protocol and battery of observations and tests, and central coordination to assure, so far as possible, complete comparability of the data collected. Further, to assure such comparability, arrangements were made for interchange of professional personnel among the teams working in the several areas and for centralization of statistical and some analytical services. It was not possible to arrange such interchange for Japan but Prof. Kimura worked with the other teams in Minnesota, Greece, and Italy and Prof. Keys participated with Prof. Kimura's group in an earlier exploratory survey in Japan (Keys *et al.*, 1958 a).

Accordingly, the idea of "chunk sampling" of a defined geographical area was tried out in 1957 with studies on men aged 45—64 at the large village of Nicotera (Calabria), Italy, and in a series of villages in the central part of the Island of Crete, Greece. The experience in 1957 showed the feasibility of obtaining nearly complete coverage of such designated samples in villages by detailed examinations and emphasized the value of using international teams in these programs. The professional staff working together at Nicotera and Crete represented nine countries (England, Finland, France, Greece, Italy, Japan, the Netherlands, U.S.A. and Yugoslavia).

10. Preceding Experience in Field Work

The studies from which data are reported here were preceded by extensive experience in field explorations directed towards the question of the epidemiology of coronary heart disease and possible relationships with predisease characteristics and mode of life, including the diet and physical activity. This work began in 1952 in Italy, Spain, and England, and later extended to South Africa, Japan, and Finland (Keys, 1952, 1953; Keys *et al.*, 1954 a, 1954 b, Keys and Keys, 1954; Bronte-Stewart *et al.*, 1955; Keys *et al.*, 1955, 1956; Brozek *et al.*, 1957; Keys *et al.*, 1958 a, 1958 b; Karvonen *et al.*, 1959). Explorations with U.S. railroad employees began in 1956 and a start on systematic, larger scale studies was made in 1957 (cf. Taylor *et al.*, 1962).

These studies disclosed significant contrasts, especially in regard to serum cholesterol and the diet, and pointed to the need for larger and more systematic operations with careful attention to sampling and uniform protocol.

11. Organization of Programs Providing the Present Data

The extensive explorations prior to 1957 led to more systematic programs with a plan to follow-up the men examined for 5 or more years. It was agreed that a suitable age range would be 40—59, and that a series of population samples should be studied in parallel. Accordingly, new programs, from which data are here reported, were started in 1957 with the railroad employees in the U.S.A. and in 1958 in Dalmatia and Slavonia, Yugoslavia, and were followed by the programs which began in two areas of Finland in 1959, and in 1960 at Crevalcore and at Montegiorgio in Italy, at Zutphen, the Netherlands, and again on Crete. In 1961 the sample on Corfu, Greece, was examined. In 1962 another study was added at the village of Velika Krsna, 50 km. south of Belgrade, Yugoslavia, and the sample of railroad employees was examined in the same summer. The program in Japan, not strictly comparable in all details, began in 1958, at the farming village of Tanushimaru and in 1960 at the fishing village of Ushibuka. The present publication reports initial examination findings in all these areas.

Members of the Central Organization (Prof. Keys and Dr. Blackburn) work closely with teams in each of the countries. During the period of the initial examinations in each area the Central Organization provided help to the local organizations in the form of supplies, equipment, and professional personnel.

Financial support is indicated on the front page of the report. Many persons and organizations aided the work and, so far as space permits, these are indicated in the appropriate separate sections below.

12. Establishment of Rosters

The starting point in any program that aims to cover properly defined samples is to establish a true roster of all persons of the designated age and sex in the area under study. The procedure developed at Nicotera and on Crete in 1957 was later applied to the other areas in Europe and so may be described here.

In the areas of work in Europe and Japan, official lists of residents, with birth dates, are locally available. However, such lists require careful scrutiny. Men who migrate away from the area are often long retained on the list of residents while newcomers, particularly from the same general region, may not be listed for years. And, inevitably, there are clerical errors in names and dates and delays in correcting for deaths. Parish church registers, electoral and taxation lists provide additional data but detailed local enquiry among responsible residents is essential. As examples, Table A3 summarizes the roster development and eventual examination coverage in the studies in 1957 at Nicotera and on Crete.

At Nicotera it was found that many "residents" had long since moved to other parts of Italy or had emigrated abroad, 2 men had simply not been seen or heard from for many years, and 9 men recently dead were still listed as residents. In contrast to the reduction of 81 men by net corrections at Nicotera, in the villages of Crete the rolls failed to list many men who years previously had moved to these villages from nearby, so there was a net correction of +31 men.

In such rural areas it is possible to obtain remarkable cooperation with very few refusals of examination. At Nicotera and on Crete in 1957 such refusals amounted, respectively, to only 2.1 and 1.7 per cent of the men.

This method of establishing rosters was applied to all samples except the railroad employees. Wage rolls and employment records were used to develop the lists of men aged 40 through 59 in the selected occupations in the railroad samples.

Ages indicated in the rosters were checked against birth dates as personally stated and on identity papers; in cases of possible doubt these were further checked against birth registries in churches and elsewhere. The men studied were 40 through 59 years old (attained age) at the time of examination, except in the Nicotera sample in which the age range was 45—65.

13. Sample Coverage

Twelve of the samples concerned the total population of men of specified ages resident in the defined rural geographical areas. By "resident" was meant men who regularly resided in the area, even though they might be temporarily absent at the time of the examinations. A few men were excluded

TABLE A3

Development of sample rosters and eventual coverage in examinations of men aged 45-65 in 1957 in Nicotera, Italy, and in 12 villages near Heraklion, Crete, Greece.

ITEM	NICOTERA	CRETE
Initial "official" resident rolls	703	631
Corrections		
Emigrated or long settled elsewhere	-81	-22
Additions from incomplete registry, etc.	0	+53
True roster, eligible sample	622	662
Not examined		
Pulmonary t. b., in hospital	3	2
Disabling illness, verified not cardiovascular	8	1
Not in area, reputed "healthy"	0	3
Refused, apparently healthy	12	11
Refused, possible heart disease	1	0
Total not examined	24	17
Total examined	598	645
Sum	622	662

who, coming from more than a few kilometers away, had moved into the sample areas only in recent years. A few other "newcomers", originally from nearby villages of the same type, were accepted into the samples.

In one area (Zutphen, the Netherlands) the total population of men aged 40—59 was too large to be covered by the resources of the team. For that area, after establishing the roster, 5/9ths of the names were drawn at random by an independent statistician and the resulting 1088 men constituted the eligible roster.

Accordingly, there were 13 "chunk" samples of all men of specified age in the defined areas. Among the total of 9564 eligible men, 9170 were examined in full, the coverage being 95.9 per cent. Details are given in Table A4.

Five samples of railroad employees were studied as shown in Table A4. In addition, some railroad employees in other occupations, as well as volunteers, were studied; data on these men are not included in the present report which concerns 2908 railroad employees who represented about 70 per cent of the eligible men. For all 18 samples, the data on the 12,078 men reported here cover 87.9 per cent of all men eligible.

It is notable that the coverage was nearly perfect in the rural areas, less satisfactory in the small town of Zutphen, and considerably poorer among the railroad employees. The latter result in the U.S.A. was not attributable to lack of opportunity for the men to be examined or of effort in recruitment, as will be seen in the separate section below dealing with the U.S. railroad employees.

Most of the men missed in all of the samples represented refusals on emotional grounds — dislike of doctors or examination procedures — especially venipuncture, apprehension that some "catch" was involved, or general perversity. In the "chunk" samples many of the men missed were temporarily absent from the area at the time of examinations; some of these men were examined later but their data are not included in the present analysis. Very few men failed to be examined because of illness. Among the U.S. railroad employees information from other sources indicated that few of the refusals were related to the state of health, though in some cases fear of possible discovery of illness that might affect employment was a factor — in spite of repeated assurances that all findings were completely confidential.

14. Examination Procedure

The methods used in the examinations are described in detail in Section B, METHODS, below, which also gives data on reproducibility.

Great efforts were made to assure comparability of methods and procedure in the several areas. Except at Zutphen and in the two areas in Japan, the locally responsible team was aided in the field by professional experts from the teams in other countries. Electrocardiograms were independently classified by two or more electrocardiographers, at least one of whom was from another country.

The general procedure for the examinations in the field, developed at Nicotera and Crete in 1957, was applied thereafter in the programs elsewhere. After the roster was established, a schedule of examinations was adopted and headquarters were organized, both for the examination and for housing the team of investigators and assistants. For the U.S. railroad men, specially fitted railroad cars were used for the examinations. For the Roman railroad men, examination rooms were provided at the central railroad station (Stazione Termini) in Rome. For the other areas,

TABLE A4

Examination coverage. "Roster" gives the true total number of all eligible men. "No. Examined" does not include a few men examined at a later date.

AREA OR GROUP	DATE	ROSTER No. Men	EXAMINED No. Men	%
Nicotera, Italy	Fall, 1957	626	607	97.0
Switchmen, U.S.A.	1957-1959	1414	835	59.1
Sedentary Clerks, U.S.A.	1957-1959	1163	861	74.0
Non-Sedentary Clerks, U.S.A.	1957-1959	233	155	66.5
Executives, U.S.A.	1957-1959	363	251	69.1
Tanushimaru, Japan	Spring, 1958	509	509	100.0
Dalmatia, Yugoslavia	Fall, 1958	742	727	98.0
Slavonia, Yugoslavia	Fall, 1958	815	749	91.9
East Finland	Fall, 1959	823	817	99.3
West Finland	Fall, 1959	887	860	97.0
Crevalcore, Italy	Spring, 1960	1012	994	98.5
Montegiorgio, Italy	Spring, 1960	727	719	99.0
Zutphen, Netherlands	Summer, 1960	1088	917	84.3
Ushibuka, Japan	Summer, 1960	506	504	99.6
Crete, Greece	Fall, 1960	703	686	97.6
Corfu, Greece	Fall, 1961	555	529	95.3
Railwaymen, Rome, Italy	Summer, 1962	(1000)*	806	(80.6)
Velika Krsna, Yugoslavia	Fall, 1962	571	552	96.7
Total, All groups		13737	12078	87.9

*A total of 1241 men were eligible from the roster but, because of known conflicts in schedule, only about 1000 were actually invited examination sites were located in schools, farm houses, etc.

In each area local assistants made appointments with the subjects and then reminded or escorted them on the appointed day so as to assure attendance at the examination centers. Transportation was provided when needed. Efforts were made to prevent the men from indulging in heavy exercise or a heavy meal beforehand. While waiting, smoking was not allowed. When called in, the procedure was as follows:

a. *Registration* — assignment of serial number, record name, address, father's name, age and birth date (giving a check on age), marital status and other family data, present and past occupation, habitual physical activity, smoking habit.

b. *Anthropometry* — disrobe, record height (without shoes), weight (in underclothes), sitting height, bi-acromial and bi-cristal diameters, arm and scapula skinfold thicknesses.

c. *Medical* — medical history, physical examination, record supine blood pressure twice, take venous blood sample.

d. *ECG* — record 12-lead ECG in rest and again immediately after a 3-minute exercise test (step test).

e. *Urine* — urine sample qualitatively tested for sugar and albumin.

f. *Respiration* — record vital capacity and timed forced expiration. (This procedure was introduced with U.S. railroad workers in 1958 and in Finland in 1959. It was not used at Zutphen or in Japan.)

g. *Dismissal* — after brief remarks by physician.

15. Forms and Codes

Comparability of data, convenience in recording and subsequent statistical analysis are greatly aided, or even require, suitable standard forms and codes. Such forms and codes, developed for common use in these collaborative studies, cover medical history, the physical examination, parental mortality, family status, smoking habits, anthropometry, etc., but for the present purpose it is not necessary to refer to all of these.

The OCCUPATION CODE is given in the Appendix. This code is intended to identify the general character of the occupation and to suggest the probable socio-economic status of the man as indicated by occupation. It is not intended to indentify all specific occupations but it distinguishes 98 categories (thereby requiring only two columns of a punch card) into which most men are readily classified; the remaining men can be fitted in without serious distortion for the purpose of this code. For some purposes it is useful to compare the professional and management occupations with craftsmen or clerical workers, without regard to the particular professions or crafts or clerical jobs concerned. The Occupation Code allows this to be done readily.

The ELECTROCARDIOGRAPHIC CODE is given in detail in the Appendix. The "Minnesota Code" (Blackburn *et al.*, 1960), is intended to give an objective picture of the electrocardiogram without insisting on any particular interpretation, though the items classified are those commonly accepted as being important for interpretation. The revision of the original published S-T depression coding should be noted in the version of the Appendix.

The SMOKING CODE, given in the Appendix, classifies men into more categories than are necessary or useful for the present purpose. As will be seen in Section F, SMOKING, below, various categories were combined in a simpler classification in the actual analysis of the data.

16. Physical Activity

Physical activity is a variable in the mode of life that may well be an important factor in susceptibility to coronary heart disease. Accordingly, the attempt was made to classify every man into one of three categories in regard to general level of habitual activity: 1) sedentary, 2) moderately active, 3) heavy physical activity.

This is a coarse gradation but further refinement was considered to be unjustifiable without the use of much more elaborate means of ascertainment than available from a few questions and answers. At the extremes of this 3-class scale might be 0) bed ridden, and 4) extremely heavy activity but the few bed ridden invalids are otherwise identifiable and the line between 3) and 4) would be difficult to draw.

It should be noted that the physical activity classification is not necessarily dependent on the occupational category, though in many cases there is a close connection, especially in this age range and in rural populations where voluntary physical activity for recreation seldom amounts to much in comparison with the occupational activity.

17. Practicalities of Field Work

Each area has its peculiarities that affect practical details of organizing and operating cardiovascular surveys and related field work but the following notes are generally applicable to the studies reported here.

It is difficult to engage first-class professional personnel to stay in the field, away from their home headquarters, for more than a few weeks at a time, so the schedules for field work were planned accordingly. Selection of the period for field work in a given area required consideration of the seasonal activity of the subjects as well as that of the proposed staff and in general this means concentration of the examinations in a period of not over one month. Before the field work proper begins, the final roster of subjects must be established, local headquarters arranged, suitable local assistants engaged, and provision made for local transportation of both subjects and staff.

In general it was found to be efficient to organize schedule and staff so as to "process" from 150 to 200 men per 6-day week; this required making effective arrangements to have the subjects available on schedule. It proved to be suitable to concentrate the examinations in the mornings (say 8 to 13 o'clock), leaving the afternoons for "book work", ECG classification, working up blood samples, etc., plus handling a few stragglers that cannot be examined in the mornings. The clinicians' schedule had to allow for the fact that in many areas it is impossible to avoid some demands for medical advice, particularly for local women and children.

Such a program for cardiovascular field surveys requires a staff as follows (asterisks denote personnel who need not be natives of the country): Director of Field Operation (one other senior professional person should be designated as his deputy); two internists to take histories and make physical examinations; one electrocardiographer*; one physician or physiologist to conduct respiratory tests; one biochemist or chemical technologist*; one anthropometrist*; one registrar (may be local); one or more clinical consultants*; two assistants for ECG recording (one may be local); and about four helpers (a recorder, a "man catcher" to bring in subjects and run errands, a driver, and a dishwasher and general helper).

Every effort should be made to assure that the relationship with the subjects is developed from the start on a warm and personally sympathetic basis. The subject may seem to be only a serial number on the roster and appointment schedule but he must never be treated that way. Ideally, a brief note about the findings on each man is provided to the local physician or public health nurse, *not* to the subject himself. When it is not feasible, each subject should be given a few words of reassurance at the end of the examination. When medical care is really needed, efforts must be made to provide this through local sources.

The experience of the teams in the field in Europe and Japan quickly made convinced internationalists of most staff members. Political arguments were avoided and concentration was on the professional and purely individual human aspects of the work and life together; the result was the development of true friendships among staff workers of all nationalities and the most cordial cooperation of the subjects, their families and the local official. Though the subjects frequently had little comprehension of what the work was all about, the good will on both sides was readily apparent; it was often a problem to escape too much local hospitality in the villages.

Headquarters and laboratories for the work on the Roman railroad employees were established at the main railroad station of Rome. The studies on U.S. railroad employees posed special practical problems. Headquarters consisted of two specially fitted railway cars with all necessary apparatus installed in them. After suitable advance preparation, including meetings with the unions in each town, these cars were hauled into the railroad yards or stations of each of the several locations where men were to be examined. In spite of letter, 'phone and personal solicitation, many men on the roster did not appear for examination when the team visited the locations and a second round of travel to these locations was necessary to reduce the number of "no shows".

All of these efforts still resulted in less complete coverage of the rosters of railway employees than obtained in the villages abroad, though the percentage response was similar to that obtained in other surveys in the U.S. (cf. Dawber *et al.*, 1957). The discrepancy between responses in the U.S. and abroad reflects basic differences in attitudes of the populations and not in the effort or attitudes of the investigators. In general, the response of the populations to the appeal to participate in such surveys tends to be inversely proportional to the size of the community; the response is better in villages than in towns, and better in towns than in cities.

B. METHODS

1. Anthropometry

The standard examination battery included anthropometric items to be used as indices of gross body size (height and weight), of skeletal form or configuration, of relative body weight, and of body fatness. The recommendations of the Committee on Nutritional Anthropometry (1956), Food and Nutrition Board of the National Research Council were followed for the items of measurement to which they apply.

Height. Standing height (stature) was measured as the distance from the soles of the feet to the top of the head, without shoes. The subjects stood erect and both the heels and the scapulae were in contact with the wall to which a steel tape, graduated in mm., was affixed. The head was held so as to make the line of sight horizontal. A wooden or metal L-bar, held against the tape, was lowered until it made firm contact with the top of the head. Stature was measured to the nearest millimeter.

Body Weight was measured with the men wearing light underwear. When anything but light socks and light underwear were worn, a correction was made before recording the weight. Such a correction was required only rarely, principally in areas in which the examinations were made in the cool weather of late fall. The measurements were made to the nearest 0.5 kilogram.

Skinfolds, indicating subcutaneous fatness and, by inference, relative obesity or leanness, measured with calipers exerting a constant pressure of 10 g. per square mm. and a jaw face of 20 square mm., were recorded at two sites, on the upper arm and below the scapula. The upper arm site is located at the dorsum of the right arm, at the level midway between the tip of the acromial process and the tip of the elbow. The skinfold is parallel to the long axis of the arm. The "skin" is lifted and the fold is held firmly between the index finger and the thumb of the examiner's left hand, placed about 1 cm. above the level at which the measurement is to be made. If arm circumference is measured, at the same level, it is advantageous to mark the level with a dermatographic pencil. The scapular skinfold is measured just below the tip of the right scapula. The skinfold is lifted along the line of least resistance, typically forming an angle of about 45° with the spine, the line going downward. For most of the analyses in the present work the sum of these two skinfolds, in mm., was used as an index of fatness or relative obesity.

Several makes of calipers were used but no significant differences in the results were observed when different calipers were used for repeated measurements on the same men. Table B1 summarizes a comparison of the "Lange" (Cambridge Scientific Industries, Inc., Cambridge, Maryland) and "John Bull" (Harpenden, British Indicators, Ltd Sutton Road, St. Albans, Herts, England, and H. E. Morse C. 455 Douglas Ave. Holland, Michigan) calipers which have become the standard instruments in our skinfold measurements. With these particular samples of calipers, the Lange tended to give a slightly smaller reading than the John Bull caliper but the mean difference of 0.233 mm. for the 10-second reading is entirely trivial. Even when the reading is delayed until the skinfold has been under pressure of the caliper spring for 60 seconds, the discrepancy between the two calipers, though larger (mean $\Delta = 0.407$ mm.) is negligible.

The skinfold deforms under the pressure of the caliper so that the reading becomes smaller as the time extends from a quick reading at 5—10 seconds to a slow reading at 60 seconds. Table B2 shows this effect and the fact that the deformation increases with increasing thickness of the skinfold. This produces no significant error except in very fat or edematous persons, but the effort is made to avoid the effect by reading rapidly.

The Sitting Height was measured to the nearest mm. with the subjects seated, in erect position, on a firm stool with a horizontal surface. The subject's back was in contact with the wall at the regions of both scapula and buttocks. The line of sight was horizontal and the manipulation involved in determining level of the top of the head was identical with that used in measuring standing height.

The Bi-acromial Diameter, a measure of the width of the shoulder girdle, was obtained as the distance between the most lateral margins of the acromial process of the scapulae as measured with a pelvimeter to the nearest mm. Definite effort was made to have the subject relax the shoulders, since the position of the shoulders affects importantly the apparent value of the bi-acromial diameter. The aim is to obtain the maximal value of the bony diameter.

The Bi-cristal Diameter, a measure of the width of the pelvic girdle, is defined as the greatest distance between the lateral margins of the iliac crests. Systematic endeavor was made to avoid or at least to minimize the contamination of the bony measurement by the overlying soft tissues. This was achieved by exercising pressure, when necessary, on the contact surfaces of the pelvimeter, the measurement, again, being made to the nearest mm.

Anthropometry — Derived Indices. Indices of body type and configuration or shape may be derived from such items of measurement as indicated above and are commonly expressed in relative terms in view of the lack of agreed absolute measures. In spite of the obvious need for such indices, there is little or no agreement even about relative measures. Those chosen for the present studies have the advantages of being simple, objective, numerical expressions of what seem to be reasonably acceptable concepts of typology, though their interpretation may provoke more argument than agreement.

Relative Body Weight has been expressed in so many ways that it is clear no one way is ideal or even theoretically of outstanding merit. A main purpose of attempting to provide a measure of relative body weight is to enable individuals to be compared with the population as a whole, having due regard to age and sex. The most common application of such comparison is to estimate relative overweight, this being assumed to be a measure of

TABLE B1

Comparison of Lange and "John Bull" (Harpenden) skinfold calipers in duplicate measurements on farmers aged 40-59. Lange values minus John Bull values in mm. Lange calipers used first with 25 men, second with another 25 men.

ITEM	READINGS AT 5-10 SECONDS		READINGS AFTER 60 SECONDS	
	Lange First, John Bull Next		Lange First, John Bull Next	
	Triceps	Scapula	Triceps	Scapula
Mean Δ	-0.236	-0.188	-0.408	-0.368
S.E.M.	0.259	0.249	0.349	0.348
	John Bull First, Lange Next		John Bull First, Lange Next	
	Triceps	Scapula	Triceps	Scapula
Mean Δ	-0.404	-0.104	-0.576	-0.276
S.E.M.	0.371	0.277	0.474	0.350

$(S.E.M.)^2 = (\Sigma\Delta^2)/2N$, where N is number of pairs of observations.

TABLE B2

Change in skinfold measurement under a pressure of 10 gm. per square mm. Measurements on 50 farmers aged 40-59. N = number of pairs of measurements after 5-10 seconds and after 60 seconds of comparison.

LOCATION	Range, mm., after 5-10 secs.	N	Δ after 60 seconds, mm. Mean	S.D.	S.E.
Triceps	Under 4.1	24	-0.38	0.145	0.030
"	4.1 to 6.0	45	-0.49	0.216	0.032
"	6.1 to 8.0	25	-0.58	0.216	0.043
"	8.1 or More	6	-0.90	0.110	0.045
Scapula	Under 6.1	22	-0.46	0.144	0.031
"	6.1 to 8.0	46	-0.53	0;157	0.023
"	8.1 or More	32	-0.67	0.315	0.056

obesity or body fatness. The assumption can lead to serious errors. Extreme overweight is certainly associated with excess fat but at lesser degrees of departure from the population average the correlation is far from perfect; it is possible to be overfat and not overweight or the reverse (cf. Keys, 1955a, 1955b). Sedentary men are less muscular than men who habitually do manual labor, with the result that their body weight is less than might be expected to correspond to their degree of body fatness.

Besides this complication of body composition in the interpretation of relative weight, there is an equally serious effect of differences in skeletal type. The man with short legs and wide pectoral and pelvic girdles must necessarily be relatively heavy for his height. So relative body weight is a complicated index which often has no simple interpretation.

Insurance company studies on the mortality of their policy holders have long stressed relationships between relative body weight and morbidity and mortality, especially from heart disease (Society of Actuaries, 1959), so it seemed important to consider this variable in the present study. Moreover, this consideration also suggested the desirability of using the same method of estimating relative weight as used in the insurance studies.

Accordingly, in the present studies relative body weight was calculated as percentage of the average weight of men of given height and age as reported in the Medico-Actuarial Investigations (1912). These averages have no universal significance in the bio-medical sense, being simply the averages for American men, mostly in urban centers on the eastern seaboard of the United States, who applied for life insurance in the general period of about 1890 to just after the turn of the century. Their virtue is that they provide a single set of standards that have had wide distribution and application. The basic data used in the calculation of relative body weight are given in the Appendix.

Relative Height of Trunk Plus Head is useful in classifying individuals in regard to one aspect of skeletal form, the length of trunk. The index is simply the standing height minus the sitting height (i.e. trunk plus head height), expressed as a percentage of the standing height.

The Laterality — Linearity Index is the ratio of the sum of the bi-acromial and bi-cristal diameters to the height or total body length. This is a simple measure of the general shape of the body; the larger the index, the greater the relative breadth or laterality of the skeleton.

The Ratio of Shoulder to Pelvis Width, or more precisely the ratio of the bi-acromial to the bi-cristal diameter is a basic item of the skeletal form which is related to the masculinity — femininity scale. The greater this ratio, the more "masculine" is the skeleton.

2. Blood Pressure

Instruments used for indirect arterial blood pressure measurement were all upright mercury columns with wrap-around arm cuffs, bladder size 12 x 23 cm. Personal stethoscopes were employed. Formal training and testing of observers was limited to explanation of the principles involved in standard measurement, demonstration of technique, and supervision. Conditions of measurement and procedure included comfortable room temperature which caused no shivering or sweating in subjects unclothed to the waist. Smoking, eating, and vigorous activity were avoided for a minimum of 30 minutes and usually over an hour, and venipuncture usually preceded the pressure measurement by 30 minutes. The standard instructions were as follows,

"After at least 5 minutes' rest supine at the end of the examination two successive readings are made in the right arm allowing the mercury to return to zero between readings. Read to the nearest 2 mm. mark and record the fourth and fifth phase diastolic."

Means of the replicate readings in each subject were used in analysis and the diastolic pressures reported here are fifth phase, i.e., at the point of disappearance of the sound.

It was not feasible to arrange for the same physicians to read blood pressures in the different countries. This would not, in fact, have been desirable because of language limitations and the inevitable reactions of the subjects to examination by a foreign doctor. However, within countries the same physicians were generally involved in the examinations in the different areas, Dalmatia and Slavonia in Yugoslavia, Crete and Corfu in Greece, etc.

In general, two physicians worked simultaneously in the physical examinations, taking alternate subjects, so that each reported on a supposedly random sample of men in the area. In some cases three or more physicians rotated in the parallel examination lines. It is instructive to compare the observers in terms of the distributions of blood pressures they reported. Figures B1—B12 summarize such comparisons by giving the cutting points for the 20th, 50th and 80th centiles for both systolic and diastolic blood pressure in the subjects grouped by age. The observers are identified by letters at the 80th centile points on the charts; N=number of subjects.

In some areas discrepancies between observers were small but significant. For example, at Crevalcore Observer A consistently reported higher diastolic pressure at the 80th centile than did Observer B, while Observer C tended to be intermediate. On the average, at the 80th centile for diastole, A's reading is 5.5 mm. higher than B's. At Crevalcore the systolic pressure distributions showed no clear trend to differ among observers.

At Velika Krsna, compared with Observer B, Observer A tended to read higher values at the lower end of the distribution but lower values at the upper end, particularly in diastole.

Great discrepancies among observers were noted in Greece, Finland, Dalmatia, and Slavonia. In West Finland, discrepancies in the distributions were small for diastolic pressure but very large for systolic pressure; at the 80th centile, in systole, the average for Observer B was 14.5 mm. higher than that of Observer A. In Corfu, Observer A's readings were substantially higher than those of Observer B at all ages in both systole and diastole. Similar consistent differences are apparent in the data from Dalmatia and in Slavonia. In Slavonia the 80th decile for diastolic blood pressure in B's distribution averaged 10.3 mm. higher than in A's distribution.

Such differences among observers as noted here have a large effect on the reported prevalence of hypertension. For example, if a diastolic pressure of 90 mm. or more is taken as the criterion, it is noted that at Corfu, Observer A's men aged 50—59 (N=127) have a prevalence of 34 per cent hypertension while for B's 166 men the prevalence is only 13 per cent; the difference has very high statistical significance (chi-square = 16.46). There is no way of knowing which observer is more nearly correct. Conceivably, one observer's bias could account for the whole discrepancy; it is equally possible that both observers were biassed but in opposite directions. Since A and B examined roughly equal numbers of

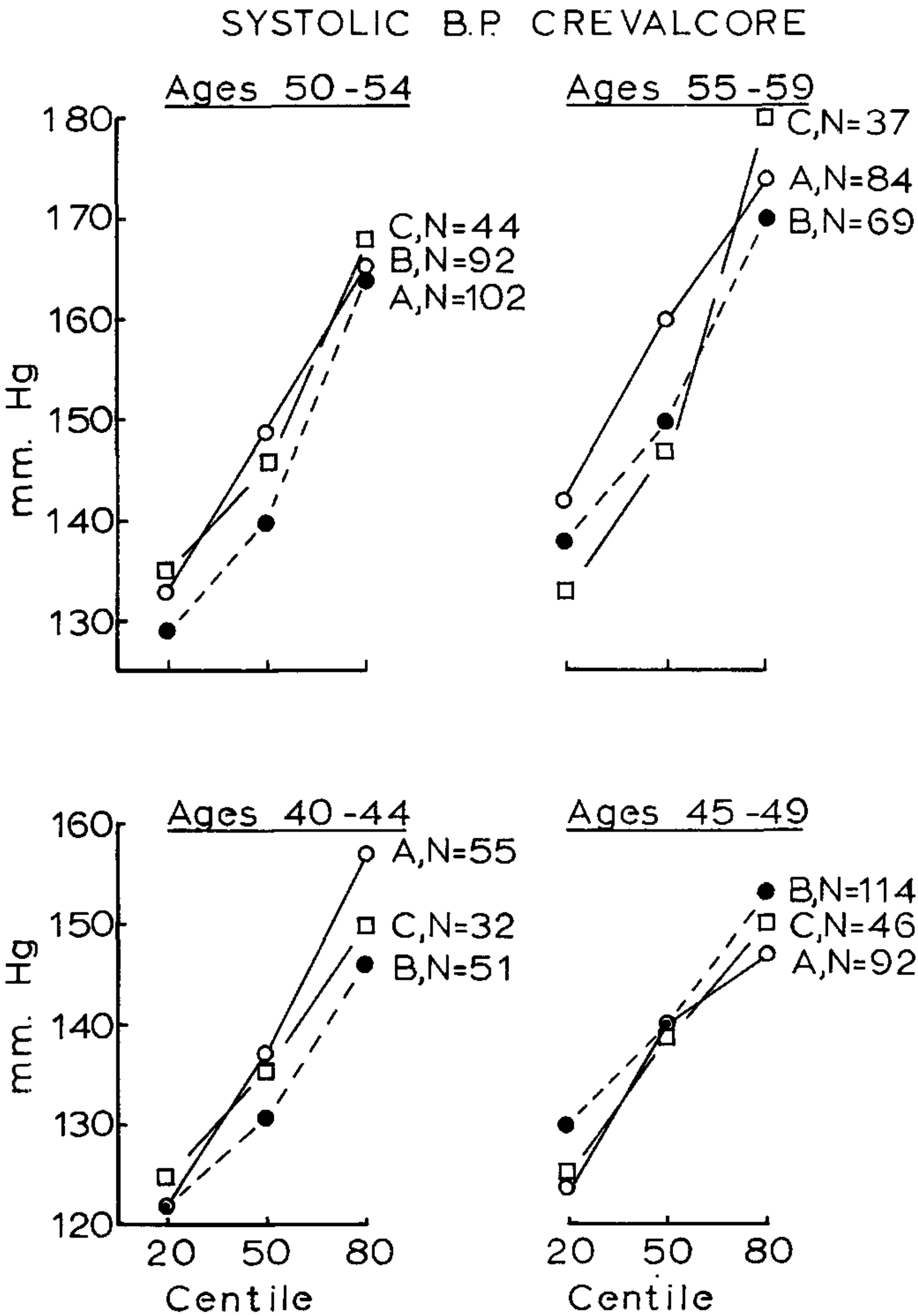

SYSTOLIC B.P. CREVALCORE
Ages 50-54
Ages 55-59
Ages 40-44
Ages 45-49
mm. Hg
180
170
160
150
140
130
120
C,N=44
B,N=92
A,N=102
C,N=37
A,N=84
B,N=69
A,N=55
C,N=32
B,N=51
B,N=114
C,N=46
A,N=92
20
50
80
Centile

Figure B1

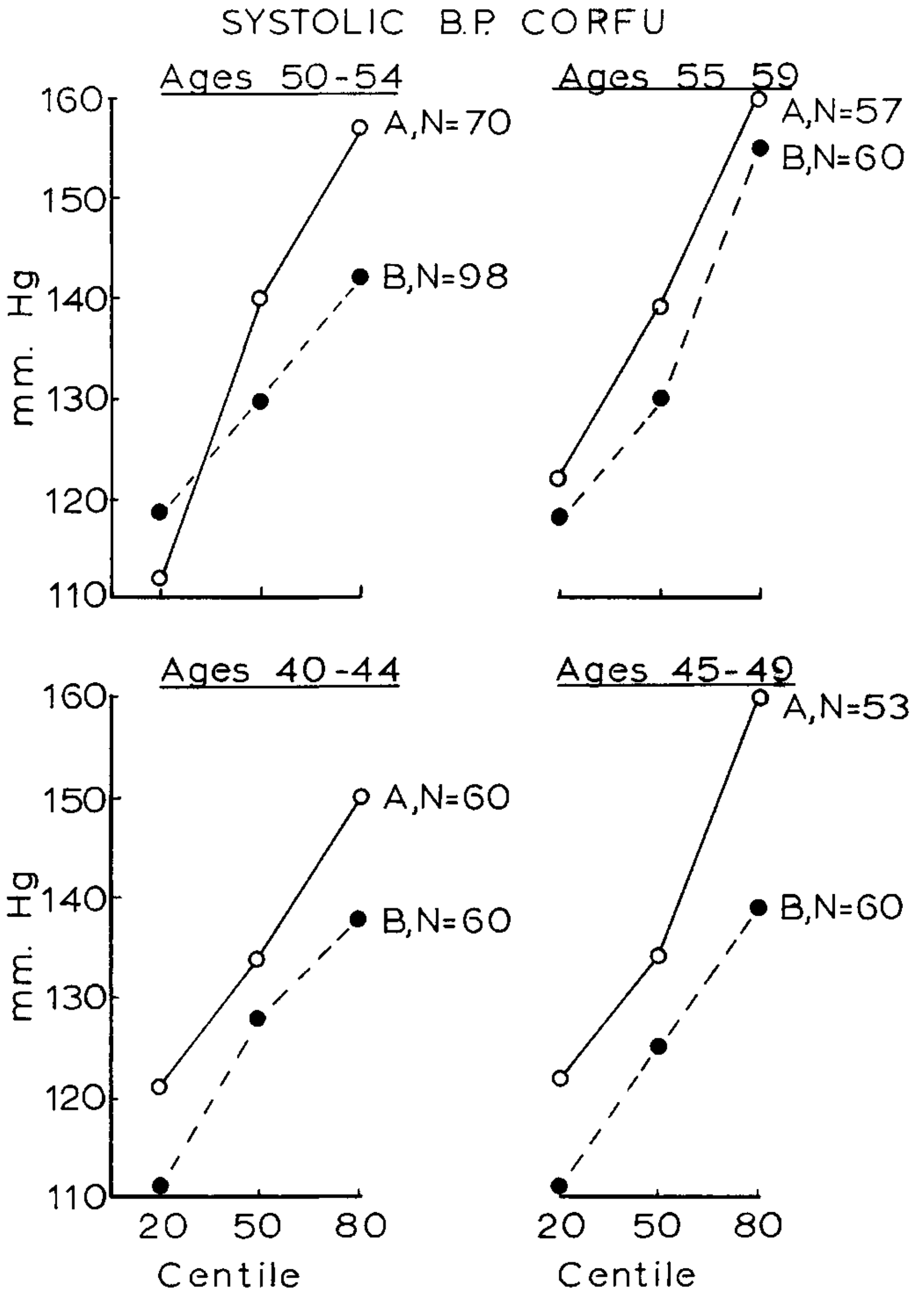

SYSTOLIC B.P. CORFU
Ages 50-54
Ages 55 59
A,N=70
B,N=98
A,N=57
B,N=60
Ages 40-44
Ages 45-49
A,N=60
B,N=60
A,N=53
B,N=60
160
150
140
130
120
110
mm. Hg
20 50 80
Centile

Figure B2

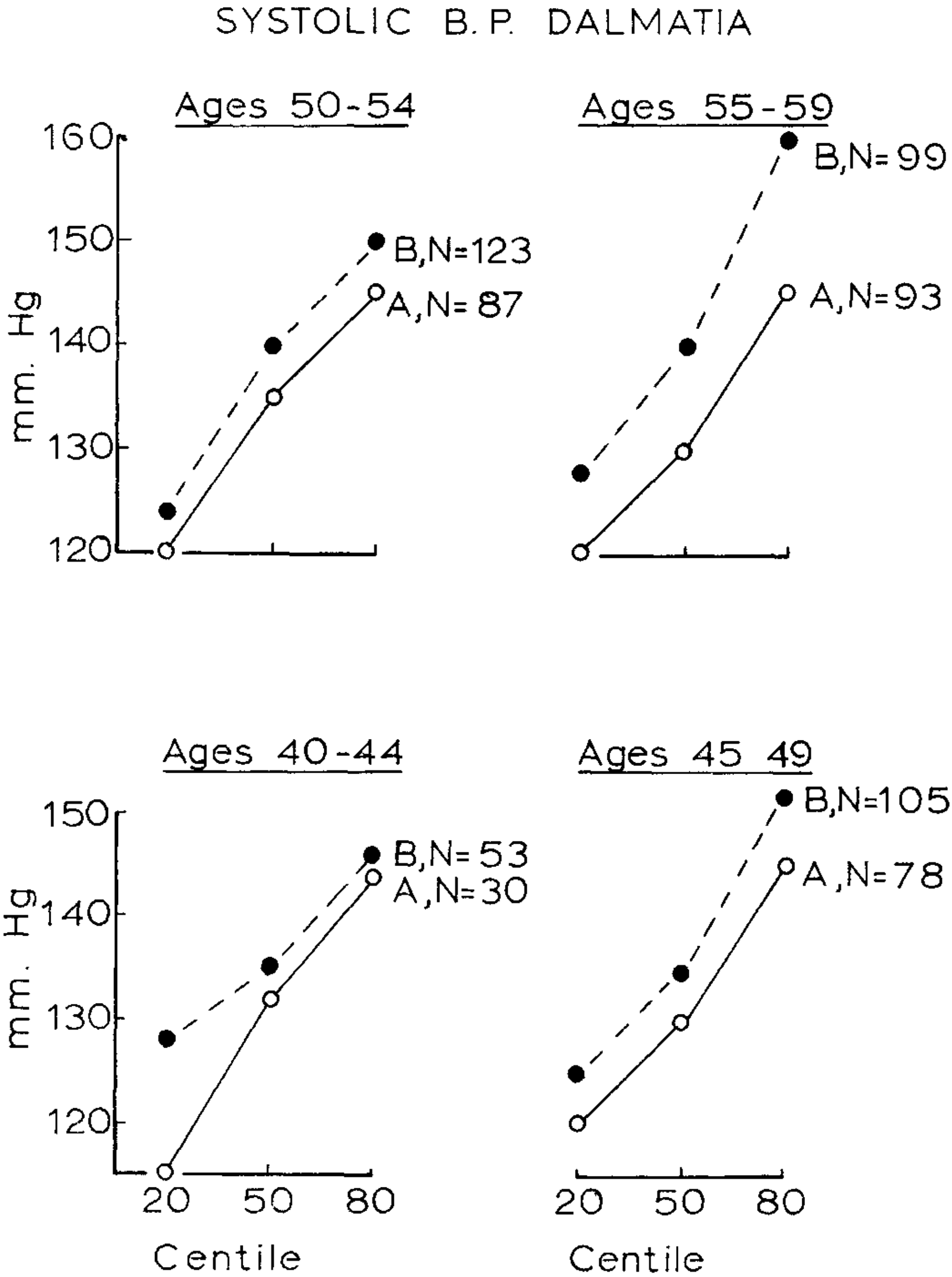

SYSTOLIC B.P. DALMATIA
Ages 50-54
Ages 55-59
160
150
140
130
120
mm. Hg
B,N=123
A,N= 87
B,N= 99
A,N=93
Ages 40-44
Ages 45 49
150
140
130
120
mm. Hg
B,N= 53
A,N=30
B,N=105
A,N=78
20 50 80
Centile
20 50 80
Centile

Figure B3

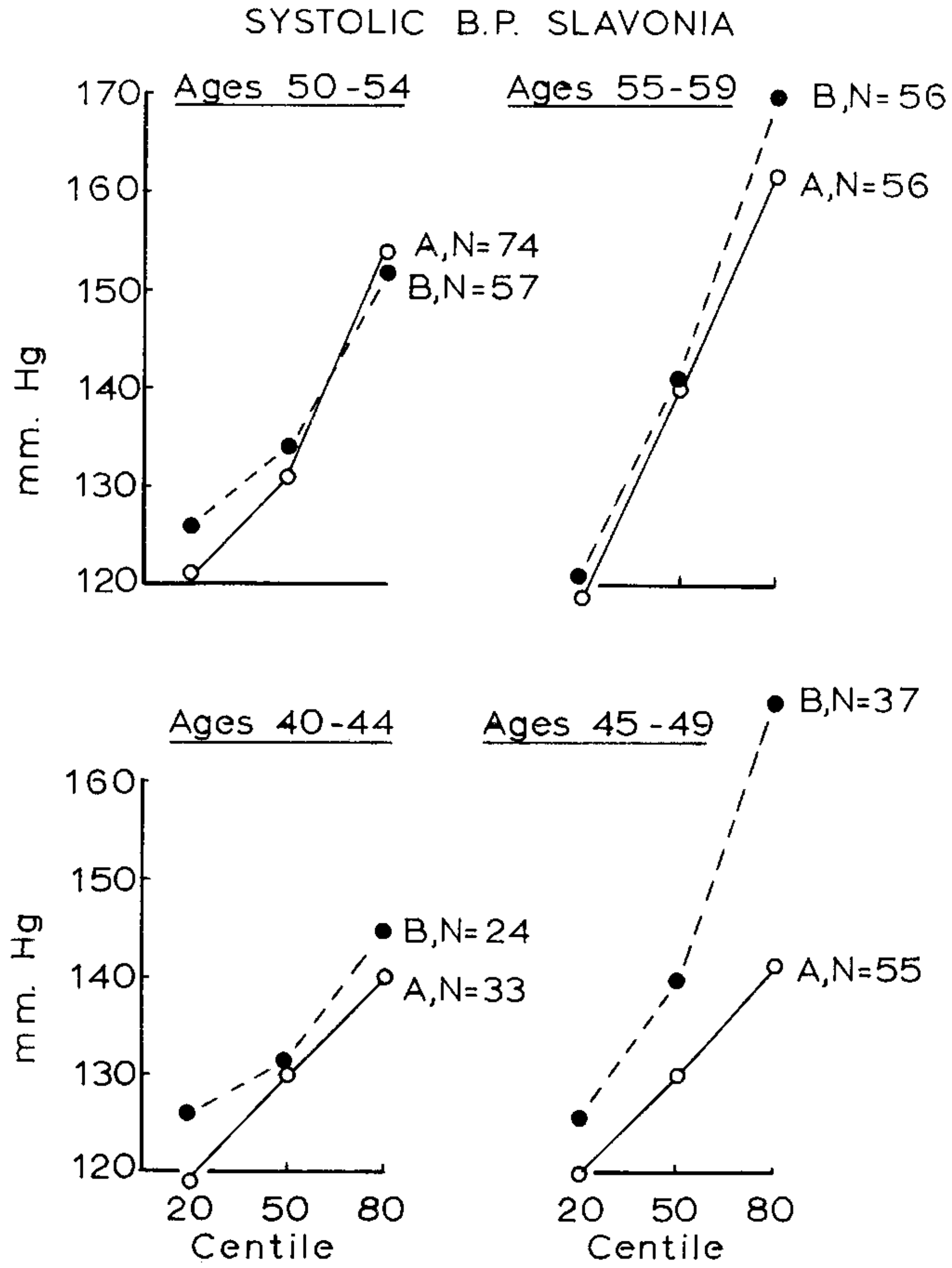

SYSTOLIC B.P. SLAVONIA
Ages 50-54
Ages 55-59
Ages 40-44
Ages 45-49
mm. Hg
170
160
150
140
130
120
A,N=74
B,N=57
B,N=56
A,N=56
B,N=24
A,N=33
B,N=37
A,N=55
20 50 80
Centile

Figure B4

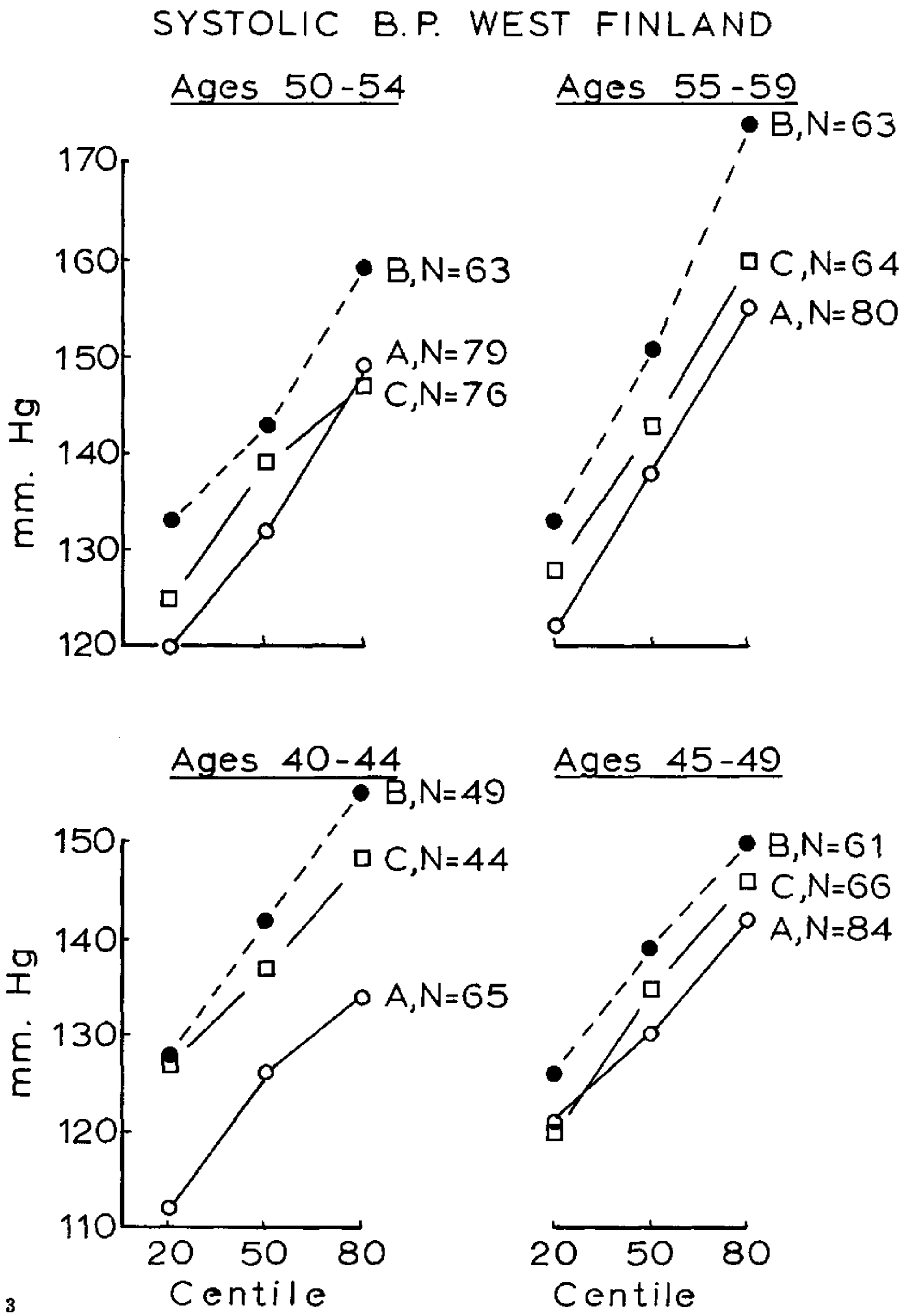

SYSTOLIC B.P. WEST FINLAND
Ages 50-54
Ages 55-59
Ages 40-44
Ages 45-49
mm. Hg
170
160
150
140
130
120
110
B,N=63
A,N=79
C,N=76
B,N=63
C,N=64
A,N=80
B,N=49
C,N=44
A,N=65
B,N=61
C,N=66
A,N=84
20
50
80
Centile

Figure B5

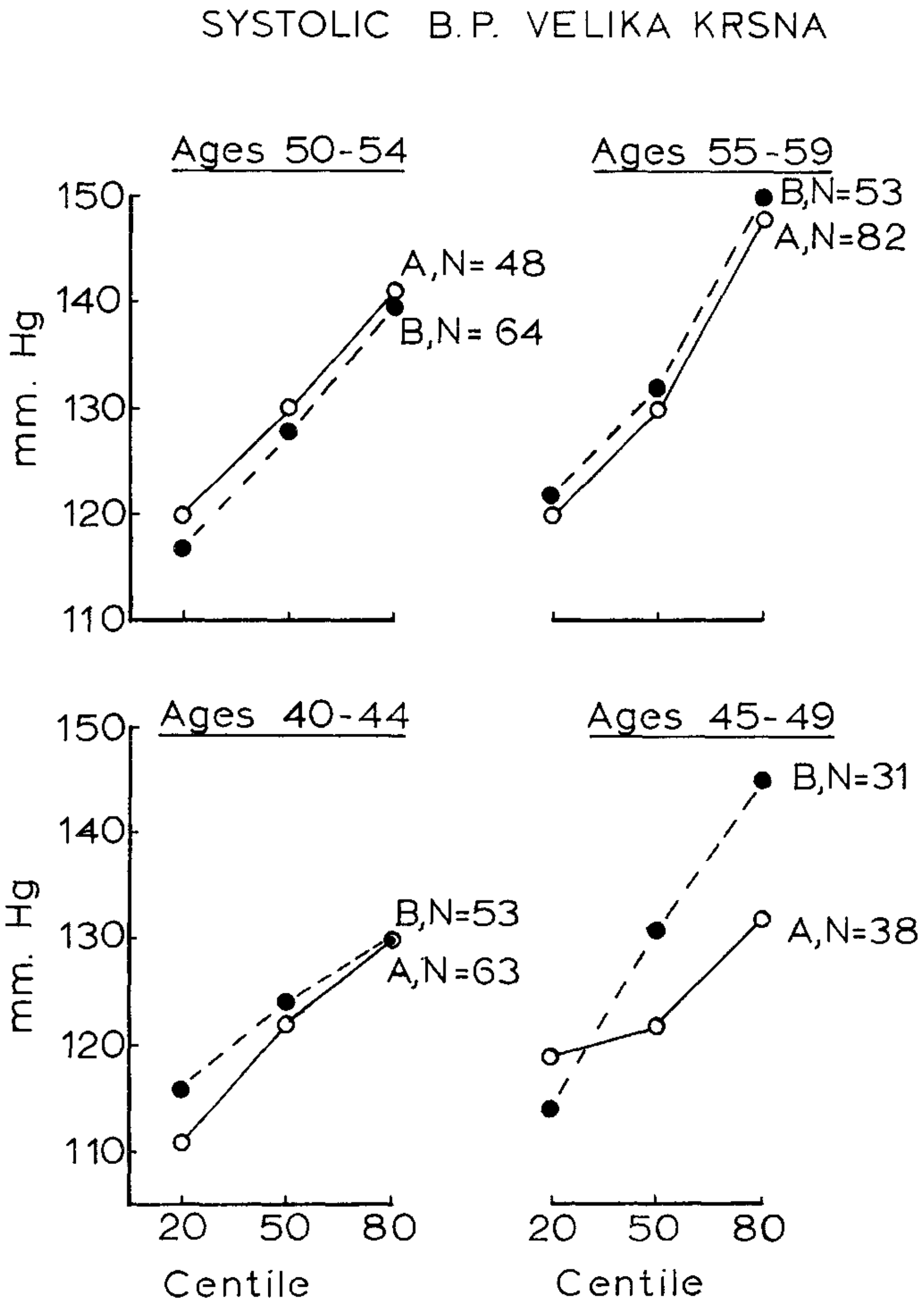

SYSTOLIC B.P. VELIKA KRSNA
Ages 50-54
Ages 55-59
Ages 40-44
Ages 45-49
A,N= 48
B,N= 64
B,N=53
A,N=82
B,N=53
A,N=63
B,N=31
A,N=38
mm. Hg
150
140
130
120
110
20
50
80
Centile

Figure B6

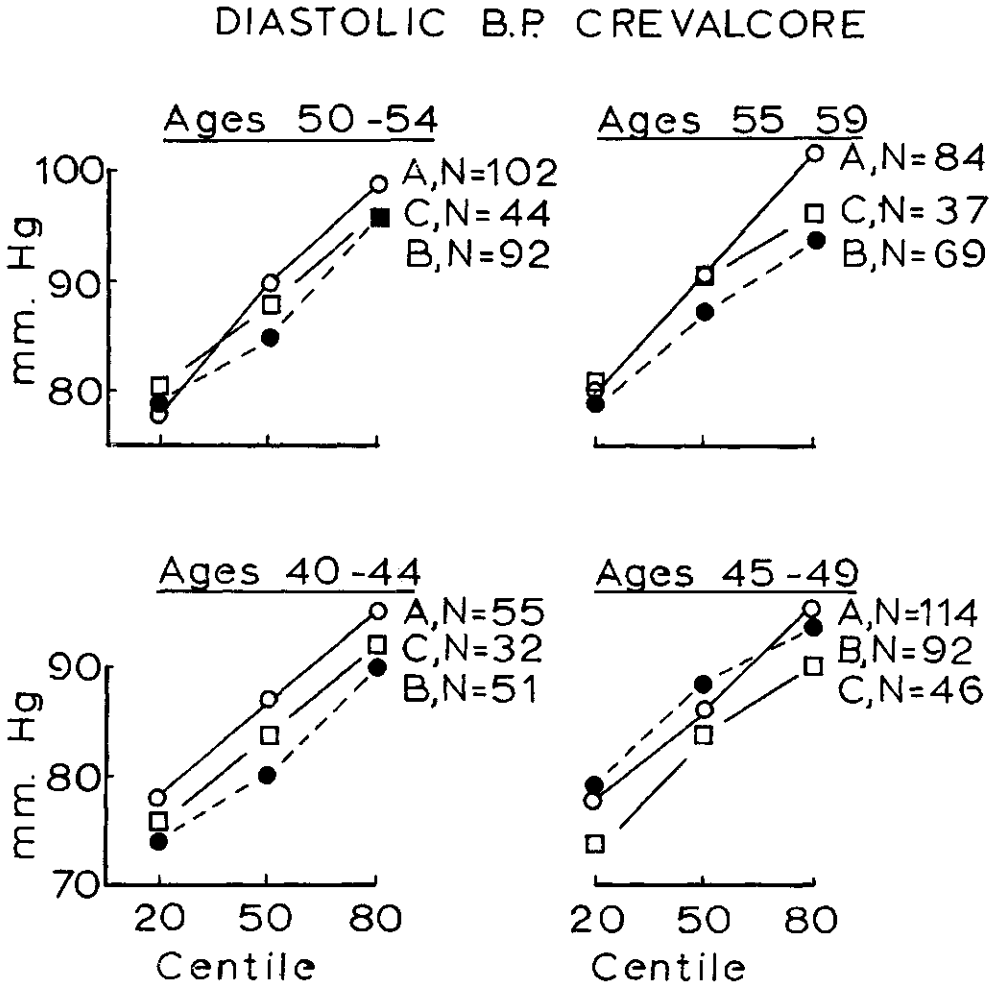

DIASTOLIC B.P. CREVALCORE
Ages 50-54
Ages 55 59
Ages 40-44
Ages 45-49
A,N=102
C,N=44
B,N=92
A,N=84
C,N=37
B,N=69
A,N=55
C,N=32
B,N=51
A,N=114
B,N=92
C,N=46
mm. Hg
100
90
80
70
20
50
80
Centile

Figure B7

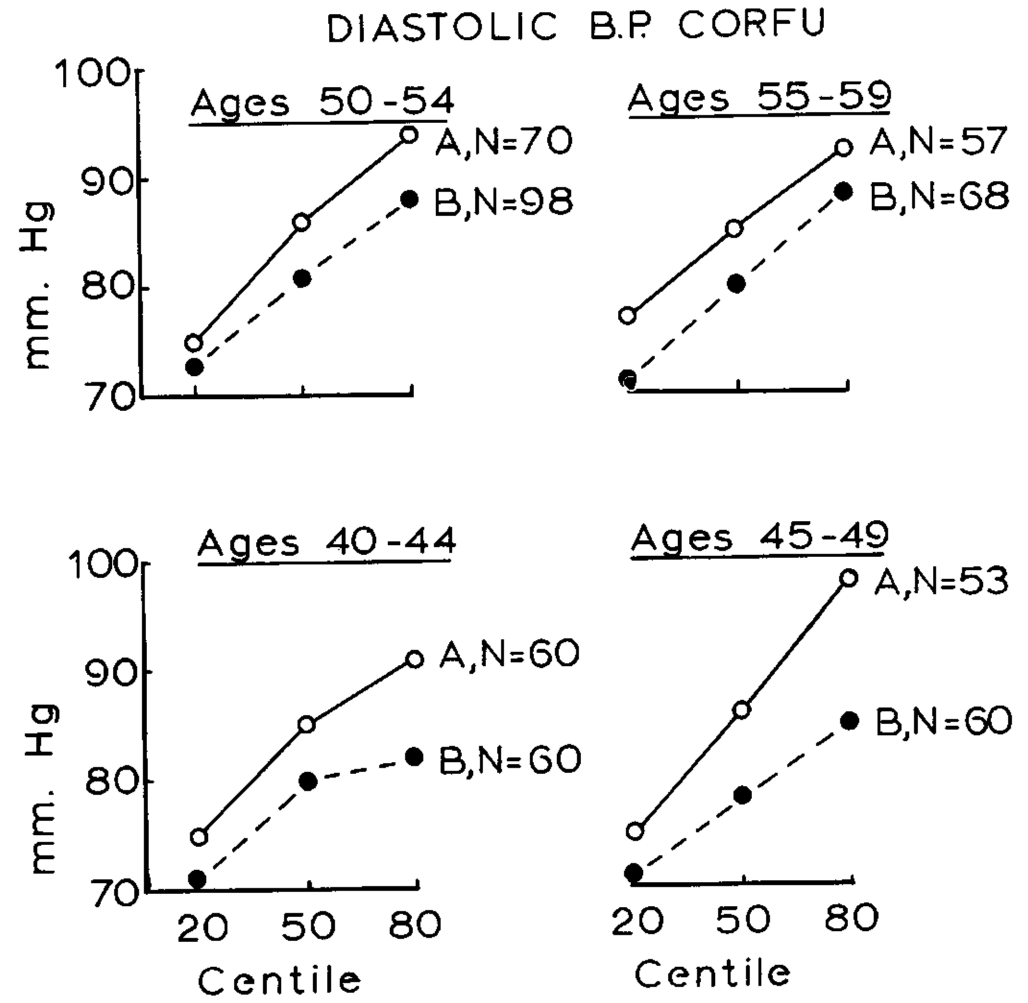

DIASTOLIC B.P. CORFU
Ages 50-54
A,N=70
B,N=98
Ages 55-59
A,N=57
B,N=68
Ages 40-44
A,N=60
B,N=60
Ages 45-49
A,N=53
B,N=60
mm. Hg
100
90
80
70
20 50 80
Centile

Figure B8

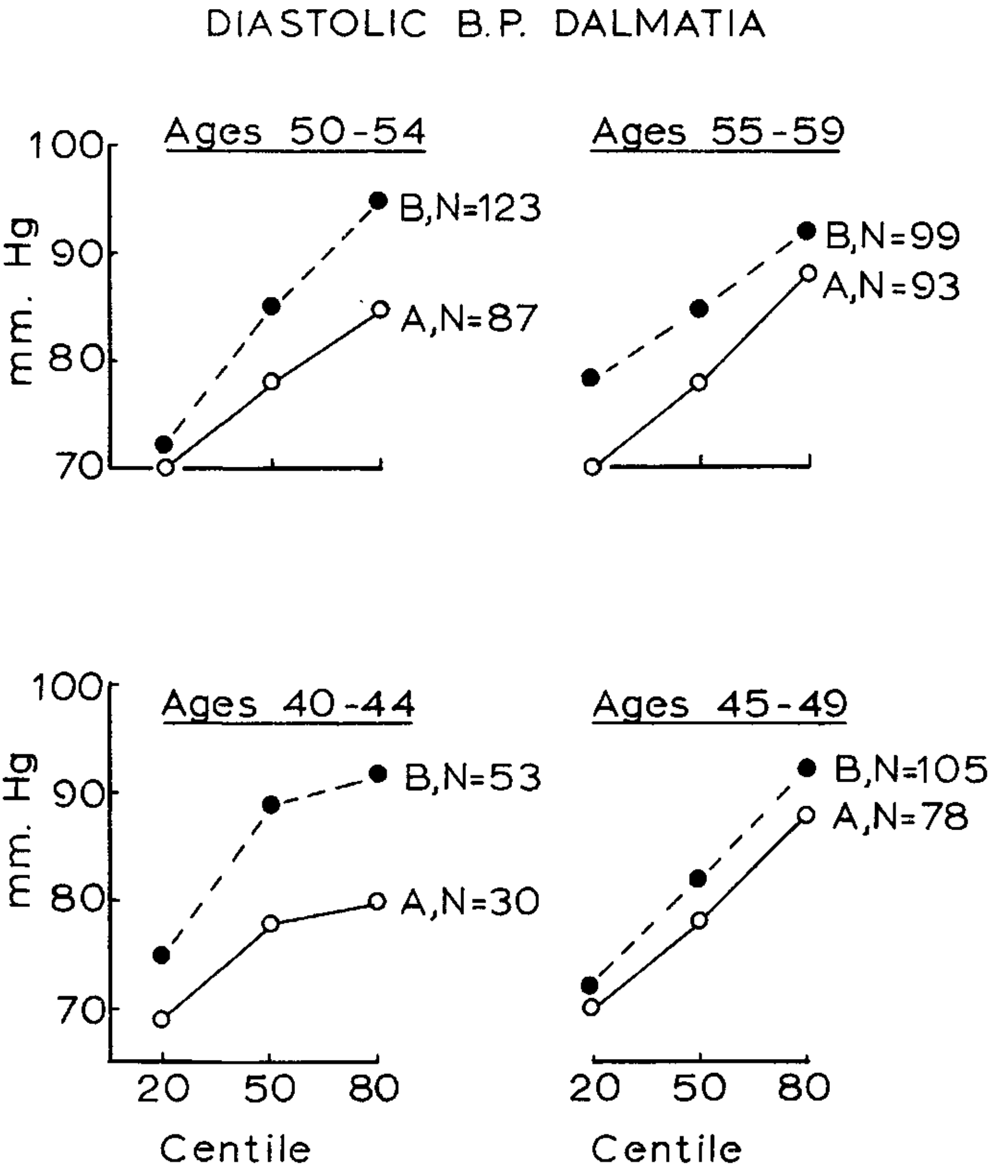

DIASTOLIC B.P. DALMATIA
Ages 50-54
B,N=123
A,N=87
Ages 55-59
B,N=99
A,N=93
Ages 40-44
B,N=53
A,N=30
Ages 45-49
B,N=105
A,N=78
mm. Hg
100
90
80
70
20
50
80
Centile

Figure B9

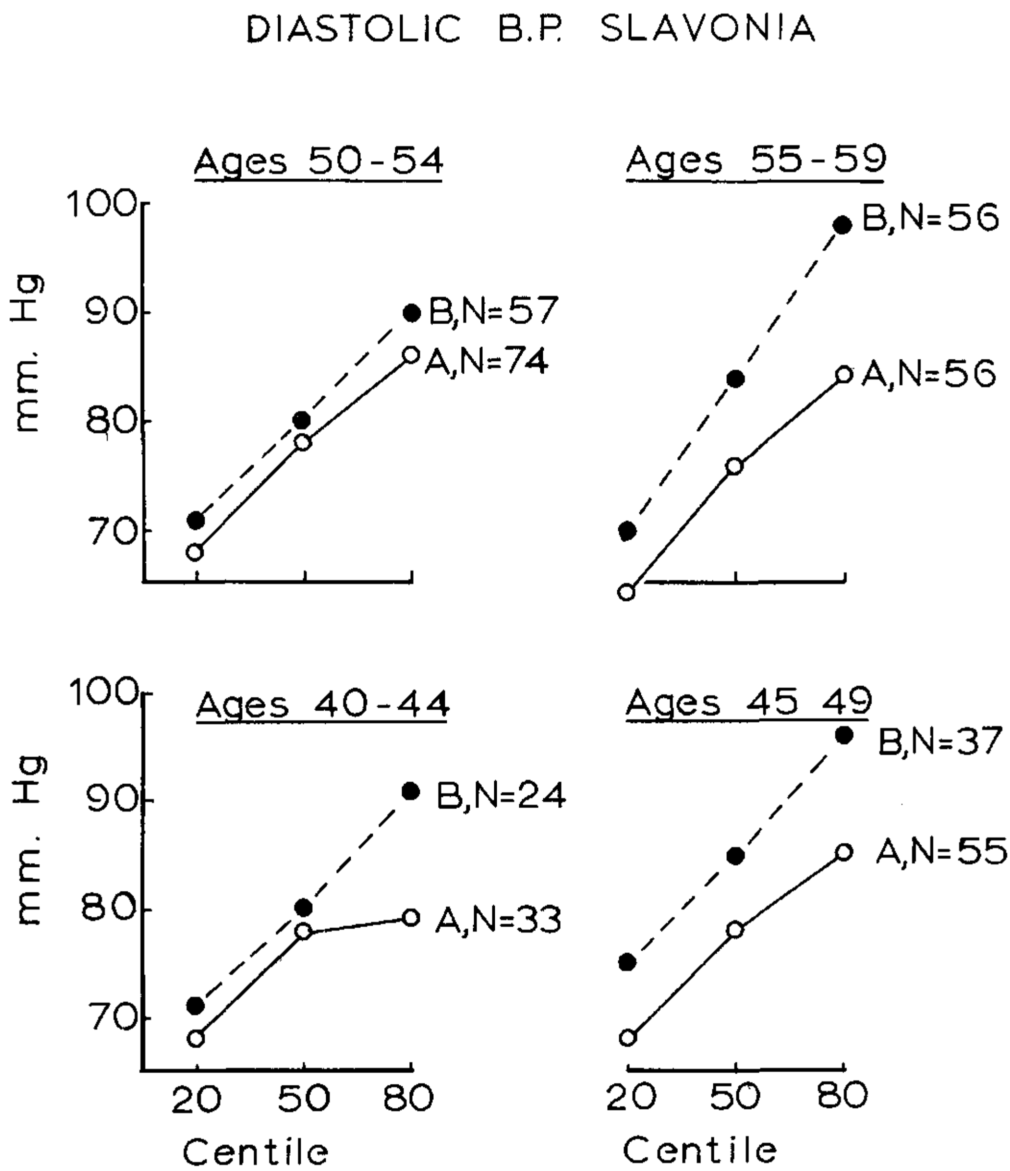

DIASTOLIC B.P. SLAVONIA
Ages 50-54
Ages 55-59
Ages 40-44
Ages 45 49
100
90
80
70
mm. Hg
B,N=57
A,N=74
B,N=56
A,N=56
B,N=24
A,N=33
B,N=37
A,N=55
20
50
80
Centile

Figure B10

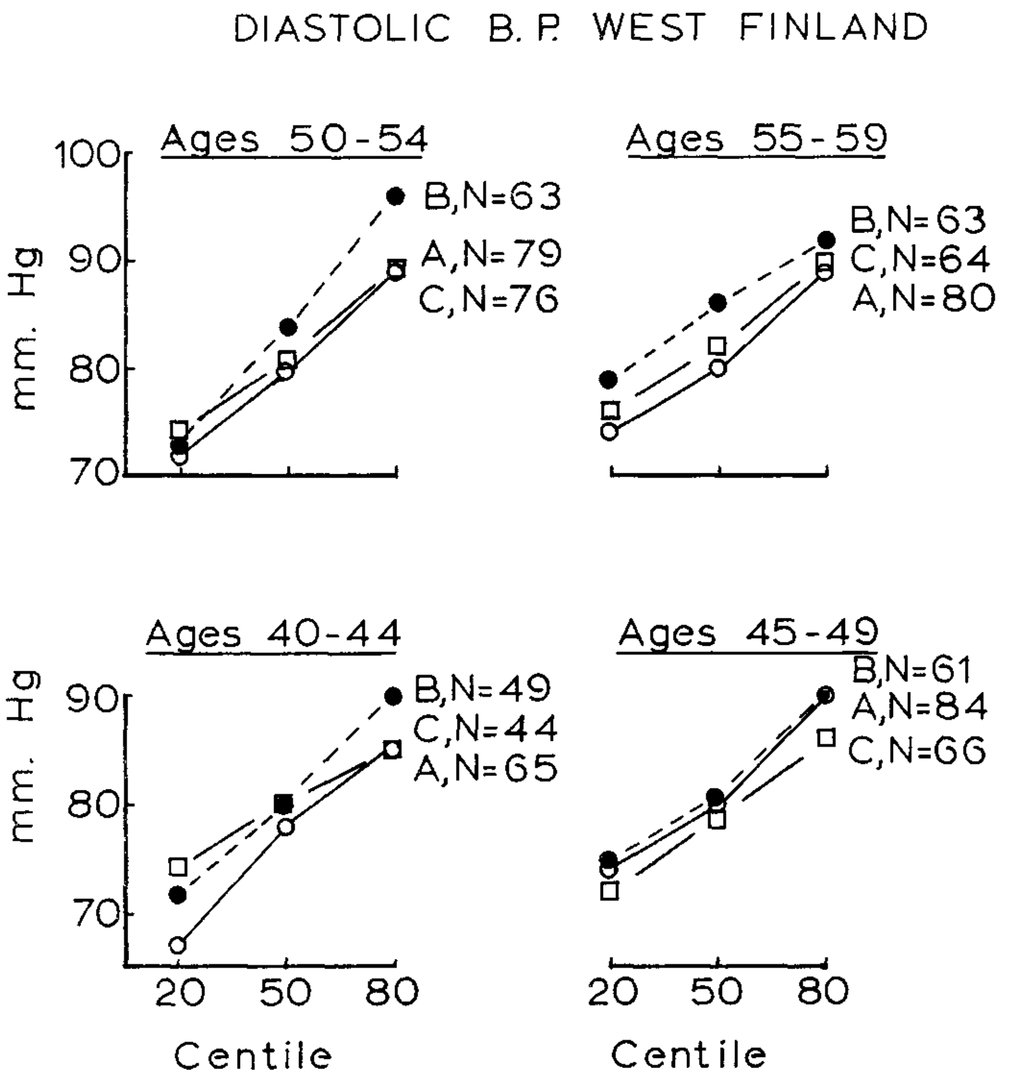

DIASTOLIC B.P. WEST FINLAND
Ages 50-54
Ages 55-59
Ages 40-44
Ages 45-49
mm. Hg
100
90
80
70
B,N=63
A,N=79
C,N=76
B,N=63
C,N=64
A,N=80
B,N=49
C,N=44
A,N=65
B,N=61
A,N=84
C,N=66
20 50 80
Centile

Figure B11

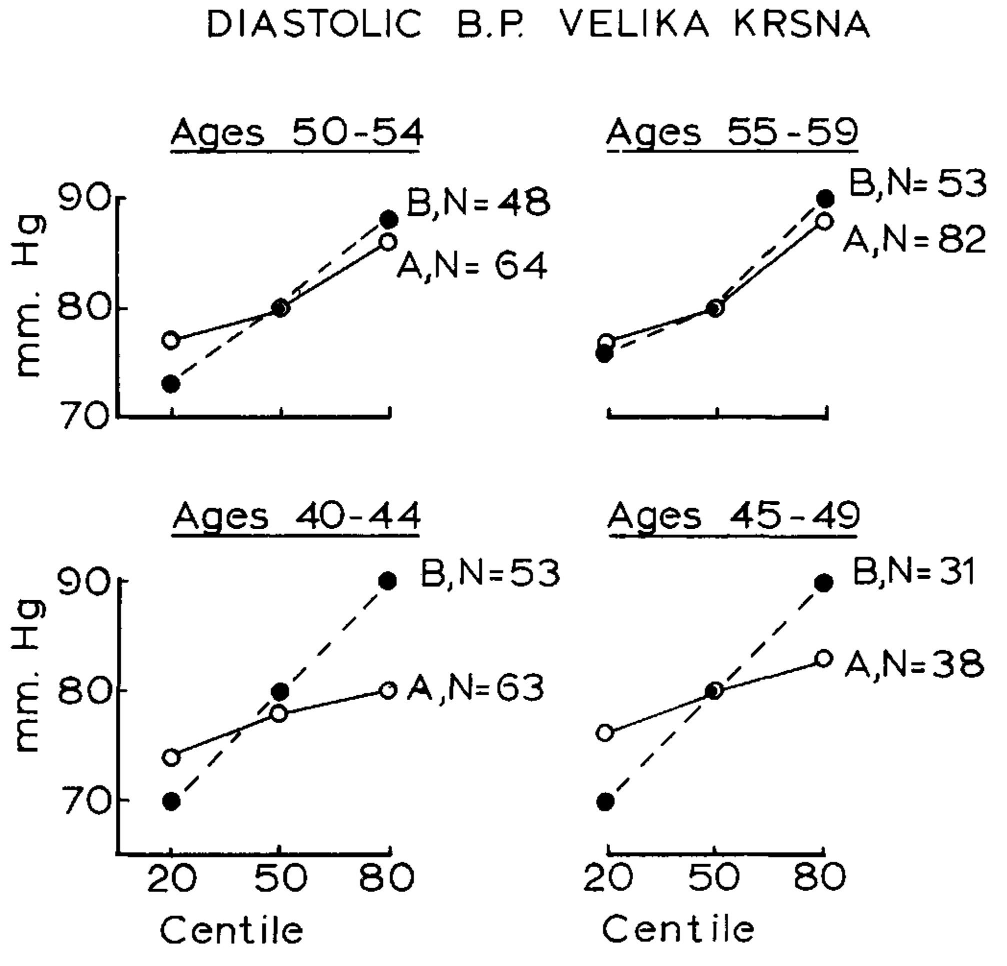

DIASTOLIC B.P. VELIKA KRSNA
Ages 50-54
B,N=48
A,N=64
Ages 55-59
B,N=53
A,N=82
Ages 40-44
B,N=53
A,N=63
Ages 45-49
B,N=31
A,N=38
mm. Hg
90
80
70
20
50
80
Centile

Figure B12

men, the reported combined prevalence of about 23 per cent hypertension by this criterion could be anywhere from 68 to 177 per cent of the true prevalence.

This analysis of discrepancies between observers indicates the need for great caution in comparing countries in regard to blood pressure distribution or the prevalence of hypertension. Comparisons between areas where the same physicians measured the blood pressure is much safer, of course. And discrepancies between observers within a single area should not seriously distort relationships, within that area, between blood pressure and other variables. In effect, the result of observer differences would be that of introducing a large but presumably randomly distributed error.

Practically all published records of individual blood pressure show digit preference, with the terminal digit zero being much the most frequent and five being the next in popularity. The records from the present series all show a strong preference for terminal zero. Figure B13 summarizes the frequency of reporting the terminal digits in the systolic blood pressure readings. Such digit preferences limit the possibilities of detailed analysis of blood pressure distributions but should not seriously distort relationships between blood pressure and other variables. Further, mere avoidance of digit preference is no guarantee of accuracy in the reading.

3. Serum Cholesterol

Blood samples were drawn, with a minimum of stasis, from a vein in the antecubital fossa of the arm; the subjects were not required to be in the basal, fasting state. After being allowed to clot for at least 30 minutes, the bloods were centrifuged and the serum was taken off. With exceptions noted below, 0.1 ml. portions were measured onto filter paper (Whatman no. 1 or equivalent), the filter papers were hung up in room air until dry (1 to 3 hours) before being packed in envelopes and sent by letter mail to the central laboratories in Minnesota or in Naples for analysis by the method of Abell *et al.* (1952) as modified by us (Anderson and Keys, 1956).

This method includes hydrolysis of the cholesterol esters with alcoholic KOH. After hydrolysis, total cholesterol is extracted from the alcoholic solution by shaking with petroleum ether. The solvent is evaporated from the petroleum ether solution by a stream of warm air, fresh Liebermann-Burchard reagent is added, and the color is developed and read under specified conditions of time and temperature. Blanks and reference serum standards are processed in the same way and are included in each batch of analyses. If pure cholesterol or reference serum standards are not carried through with filter paper, the calculated results from unknowns are about 4 per cent too low.

This method applied to either fresh serum or to serum dried on filter paper gives results that tend to be 1 to 2 per cent higher than those obtained with the most careful estimation using digitonin precipitation. This slight discrepancy is attributed to tiny losses of the digitonin precipitate in transfer.

The results are about 15 per cent lower than those obtained with the old Bloor and similar methods that do not involve hydrolysis of the cholesterol esters and use pure cholesterol standards. The reason for this discrepancy is the fact that the Liebermann-Burchard reagent gives a more intense color with cholesterol esters than with free cholesterol. The ratio of ester to free cholesterol is remarkably constant in blood serum except in some serious disorders that are generally readily

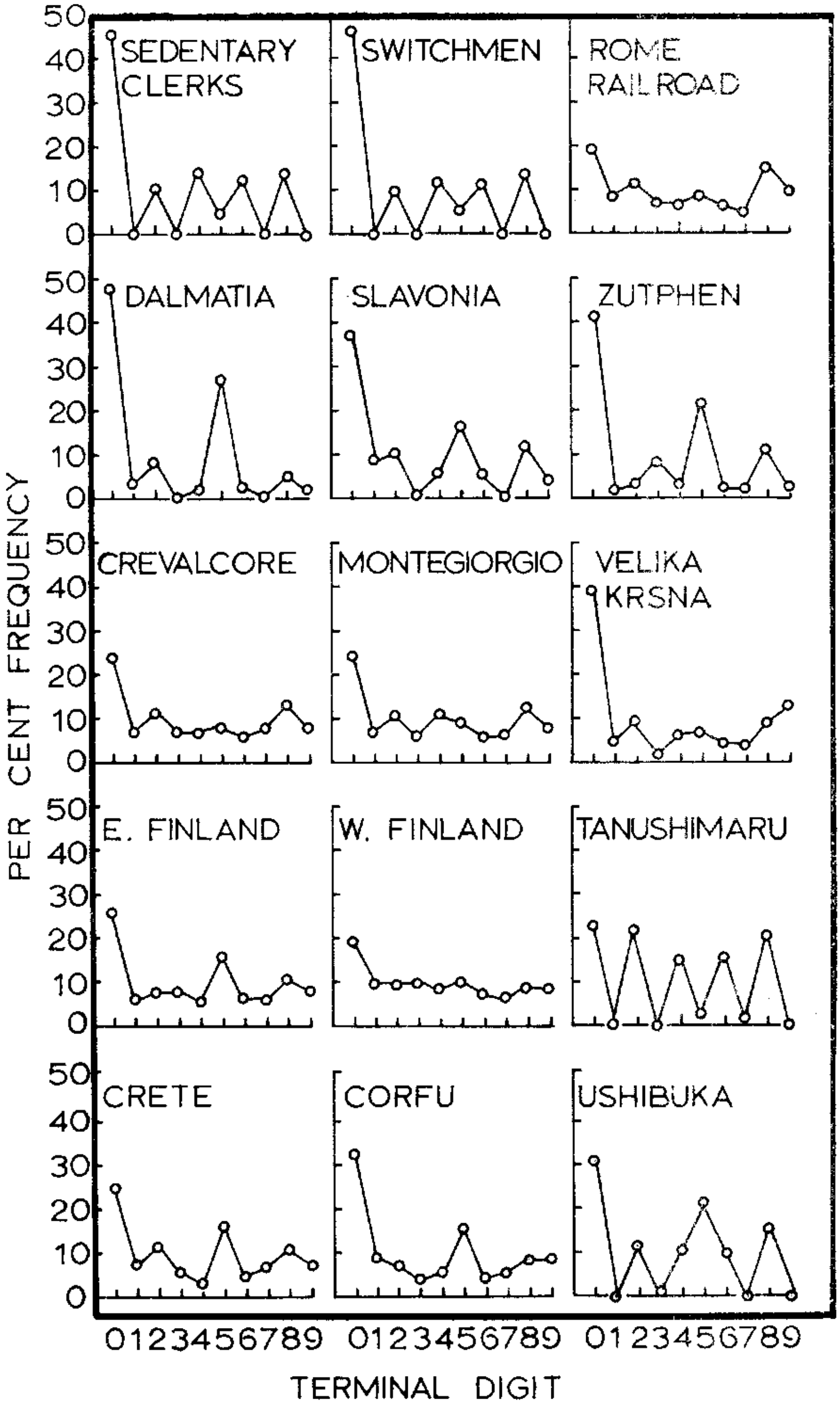

PER CENT FREQUENCY
50
40
30
20
10
0
SEDENTARY CLERKS
SWITCHMEN
ROME RAILROAD
DALMATIA
SLAVONIA
ZUTPHEN
CREVALCORE
MONTEGIORGIO
VELIKA KRSNA
E. FINLAND
W. FINLAND
TANUSHIMARU
CRETE
CORFU
USHIBUKA
0123456789
TERMINAL DIGIT

Figure B13

recognized and Bloor analysis results, on fresh serum, can be corrected to true total cholesterol concentration from the following considerations.

In a series of 134 serum samples analyzed in duplicate with the Bloor method and with the present method, least-squares analysis gave the result:

$$Y=0.827X+2.58,$$

where Y is cholesterol (mg. per 100 ml.) by our method and X is the value by the Bloor method. The standard error of estimate for this equation was $\pm$ 10.14. If it is insisted that the line must go through the zero-zero origin, the least-squares solution is: $Y=0.836 \pm 10.23$. Hence Bloor values, obtained by analysis of fresh serum shortly after blood sampling, can be corrected by the multiplication factor 0.836. This may not be true with serum subjected to prolonged storage because auto-hydrolysis reduces the proportion of ester cholesterol.

Prolonged storage in air at room temperature of serum dried on filter paper results in alteration of some of the cholesterol molecules. This can be shown by column chromatography which separates the cholesterol and its derivatives into fractions differing in the intensity of color produced by the Liebermann-Burchard reagent. Fortunately, the net color intensity is unchanged with the method used here, though great changes are noted when ferric ion intensification of the color is used.

Exceptions to the practice of making all analyses on dried serum were the Zutphen series, in which analyses of fresh serum were made locally in addition to the analyses of the dried serum in Minnesota, and at Tanushimaru and Ushibuka where fresh serum, after saponification, was analysed by the method of color development with ferric ion intensification (cf. Zlatkis, *et al.*, 1953; Henley, 1957). A few checks made on dried serum samples sent from Japan to Minnesota indicated only fair agreement so the cholesterol values reported here from the Japanese samples may not be perfectly comparable with the other series.

The reliability of the cholesterol method as measured in Minnesota was tested over a period of three years during which blind analyses were made of serum samples supplied by the Communicable Disease Center, of the U.S. Public Health Service at Atlanta, Georgia. The standard errors of measurement were reported by the Atlanta center; in none of those series of tests did S.E.M. exceed ± 5 mg. cholesterol per 100 ml.; $(S.E.M.)^2 = (\Sigma\triangle^2)/2N$, where $\triangle$ is the difference between analyses of duplicates and N is the number of pairs.

The comparability of the results from the Minnesota and Naples laboratories has been checked for many years by frequent exchange of duplicates, including batches of lyophilized plasma or serum which serve as common reference materials. Table B3 summarizes results with two different batches, one sampled, reconstituted and analyzed in 1963, 7 times in Minnesota and 25 times in Naples, the other, in 1965, 11 times in Minnesota and 27 times in Naples.

Among methods for checking the comparability of cholesterol analyses on liquid plasma or serum and on the same material dried on filter paper and then subjected to analysis, one device is to sample periodically a batch of lyophilized plasma, reconstitute this and analyze one portion in the liquid state and analyze another portion after first drying it on filter paper. The lyophilized material is stored at room temperature between samplings. The results from such tests on 4 batches of material are given in Table B4. The data show essential identity of results from both dried and liquid material and also demonstrate the stability of

TABLE B3

Cholesterol analyses in Minnesota and in Naples. Lyophilized reference serums reconstituted, and independently analyzed, in Minnesota and in Naples. N = number of samples analyzed.

MATERIAL	MINNESOTA			NAPLES		
	N	Mean	S.E.	N	Mean	S.E.
1963 Reference	7	152.4	0.48	25	153.0	0.33
1965 Reference	11	148.5	0.55	27	147.9	1.02

TABLE B4

Cholesterol values, mg. per 100 ml., from analyses of four batches of lyophilized plasma repeatedly reconstituted and analyzed in the liquid state and also after the liquid was dried on filter paper before analysis. N = number of reconstituted samples independently analyzed.

BATCH	PERIOD COVERED	LIQUID				DRIED			
		N	Mean	S.D.	S.E.	N	Mean	S.D.	S.E.
3.57	12 Mos.	10	211.0	2.04	0.65	16	212.9	5.42	1.36
10.58	2 Mos.	10	173.6	6.86	2.17	10	175.0	6.00	1.90
8.59	2 Mos.	7	243.3	5.55	2.09	7	240.7	7.07	2.68
7.60	6 Mos.	8	208.4	4.36	1.54	20	204.7	5.01	1.07

cholesterol in the lyophilized material for as long as a year.

Repeatability of the cholesterol values from the analysis of 0.1 ml. serum samples dried on filter paper is substantially as good as the repeatability of values on liquid serum. The best test, of course, is to repeat the analysis on two different occasions recording the values "blind", i.e. without knowledge of the first result when the second analysis is made. Four series of such tests, covering 62 samples, are summarized in Table B5.

In the first several years (1955, 1956) of trial of the method of cholesterol analysis on 0.1 ml. serum spots dried on filter paper and transmitted by mail to a central laboratory for analysis, analyses were made on the fresh serum at the point of collection and the dried duplicates were later analyzed without knowledge of the results on the fresh serum. The results of two such tests are given in Table B6. Analysis of the dried samples from Naples was completed in 3 weeks after the blood was drawn and dried in the field. In the case of the 126 samples from Cape Town the storage period was 3 to 5 weeks for half of the samples but the other half were delayed (because of insufficient postage) and were analyzed 3 to 4 months later. In all cases, however, the dried and fresh sample results agreed satisfactorily, the mean difference being 1.6 mg. per 100 ml. in the Cape Town material and 0.2 in the Naples material. These trivial average differences represented slightly higher values in the dried material than in the fresh serum. Results of special storage tests are in Table B7.

Before the start of the surveys reported here, exhaustive tests were made of the comparability of casual blood samples with blood samples drawn in the fasting state early in the morning. The results of such tests are given in Table B8. No significant difference was found between fasting and non-fasting samples in these tests. It is notable that even when breakfast included an extremely large dose of cholesterol added to a cholesterol-rich breakfast, the post-meal sample was only slightly higher in cholesterol (3.95 mg. per 100 ml.) than the pre-breakfast sample.

4. Electrocardiography

The reasons have been detailed for the attempt to characterize these populations by electrocardiography (ECG) (Blackburn *et al.*, 1960) as have been the problems in standardized application (Blackburn, 1965). The instruments and procedures employed in these studies in efforts to reduce the variability of the ECG are here outlined.

Instruments. Multichannel, direct-writing, research type instruments were used in all areas, as they were found to be sufficiently portable, rugged and stable in operation, with adequate response at the low and high ends of the frequency spectrum, and they considerably facilitated rapid recording of the resting and post-exercise tracing. Two-, three- and four-channel models of the Elema, Siemens, Schwarzer, Phillips and Sanborn machines were employed. Calibration and paper speed were controlled, and records made routinely at 25 mm./sec. speed.

Procedure was standard in all areas and consisted of a supine resting record made of leads I, II, III, aVR, a VL, aVF, $V_{1,2,3,4,5,6}$ after at least 30 minutes avoidance of eating, heavy activity or smoking. Room temperature was comfortable for men unclothed to the waist. The skin was prepared by cleaning with a fat solvent and vigorous rubbing followed by application of electrode jelly or paste. One to six per cent of the subjects in most areas were

TABLE B5

Cholesterol analyses of 0.1 ml. serum dried on filter paper. Duplicates independently analyzed on different occasions. Values in mg. per 100 ml.

SOURCE	N	FIRST		SECOND		S.E.M.
		Mean	S.E.	Mean	S.E.	
Yugoslavia	20	130.8	3.57	130.8	3.67	2.59
Greece	22	145.0	5.58	145.8	5.76	2.18
Yugoslavia	10	214.1	15.56	211.4	14.65	4.93
Netherlands	10	233.3	11.78	237.0	11.72	3.85

TABLE B6

Comparison of cholesterol values, mg. per 100 ml., from analyses of fresh serum and of 0.1 ml. aliquots dried on filter paper and analyzed in Minnesota 3 to 6 weeks later. N = number of samples.

FRESH SERUM	N	FRESH SERUM		FRESH - DRIED	
Analyzed at:		Mean	S.E.	Mean	S.E.M.
Cape Town	126	196.1	6.3	-1.6	7.0
Naples	112	175.2	3.7	-0.2	4.9

TABLE B7

Stability of cholesterol in serum dried on filter paper and stored in envelopes at room temperature. "%" is the average value from the stored spots as percentage of the average value obtained in the original analyses on the fresh serum. N = number of samples.

STORAGE (Weeks)	N	%	STORAGE (Weeks)	N	%
3	3	99	5	3	100
4	3	96	16	3	99
5	8	101	18	3	94

TABLE B8

Absence of significant effect of breakfast on serum cholesterol concentration in men. The "Before" sample was drawn in the a.m. fasting state; a heavy breakfast was then eaten and 2 hours later the "After" sample was taken. All values in mg. cholesterol per 100 ml. serum.

N	BEFORE Mean	AVERAGE Δ, Before-After	S.E. of Δ	S.E.M.
66	206.4	-2.91	1.39	8.75
12	207.0	0.00	2.96	7.24
21	256.4	+4.38	2.03	7.59
73*	216.4	-3.95	1.37	8.77

*Breakfast for these 73 businessmen, aged 50-60, included 10,000 mg. of cholesterol added to a 2-egg omelette.

excluded from a standard exercise test because of manifest heart disease. In the oldest age group among U.S. railroad men 20 per cent were excluded and among East Finland men 24 per cent for the same reason. The remainder performed a single step test (12" or 30 cm. in height), mounting and descending to a metronome count, 20 ascents per minute, for 3 minutes. Immediately (30 sec. to 1 minute) after completion of the step test leads I, II, aVL, aVF, V_{3-6} inclusive were recorded in the supine position. In those with any suggestion of early change a 3- to 4-minute recovery record was made. The procedure varied only in the study on U.S. railroad employees in which the work load was a 3-minute treadmill walk at 3 m.p.h. and 5 per cent grade.

Records were labelled with the name, subject number, study code and date, and each contained notes if and why the exercise test was incomplete, and a 1 mV calibration signal. Records were mounted on stationery-sized cardboard, and if pressure sensitive were covered by cellophane. Ink-written records were folded into numbered envelopes.

Classification. In the absence of a generally applicable means of precise measurement of the ECG a classification system was developed to characterize more objectively the ECG items of diagnostic or prognostic interest (Blackburn *et al.*, 1960). This system provides clearly defined quantitative criteria for codifying major and minor variations in Q waves, axis, peak amplitudes, S-T and T findings, A-V and ventricular conduction defects and arrhythmias.

Records in these first-round studies were scanned independently by 2 or 3 medical readers experienced in use of the code, at the rate of 30 to 60 cases per hour and all codable items were tabulated for the record of each subject. All disagreements were arbitrated by the readers met together. Considerable information is available on the degree of observer variation encountered in coding by this system (Blackburn, *et al.*, 1960; Higgins, *et al.*, 1963; Kagan, 1965; Blackburn, 1965). The experience within a laboratory is considerably better than between laboratories when no formal training in use of the code has been involved. Within a laboratory repeated trial comparisons yield figures on agreement (between two observers about the presence of a codable ECG finding) on the order of 70 per cent for detailed subclasses, 80 per cent for general classes, and 90 per cent for the results of the system of an adjudicated third reading.

Explicit coding procedures and more recent experience in reading by clerks and paramedical personnel are available (Kagan, 1965; Rose and Blackburn, 1966).

5. Statistical Methods and Data Processing

All measurement data were put on IBM or Remington-Rand punch cards for analysis with counter-sorter machines and electronic computers at the University of Minnesota.

For statistical analysis the men in each area or occupation group were generally grouped by quinquennia of age (40—44, 45—49, 50—54, 55—59) and the complete distribution of each variable was obtained for each of these groups. For many purposes, the men in each of these age-area groups were classified into deciles with respect to each variable; the decile cutting points for the variables, plus those for the 5th and 95th centile, adequately describe the distributions. Ordinary means and standard deviations were also computed, though the non-normality of some of the distributions limits the utility of these statistics.

One of the variables that departs most from the normal distribution is the sum of the skinfolds; this has an unusually high degree of skewness to the right and has a lower limit of 3 to 4 mm. No simple transformation of this variable could be found to produce entirely satisfactory normalization but a transformation was developed which produces distributions of the transformed sums of skinfolds that are very close to normality (Kihlberg and Keys, to be published). For the purpose of estimating the significance of differences in the distributions of a given variable in two population groups, chi-square tests or tables of the summed binomials, applied to the numbers of men segregated by a series of common cutting points, were frequently made in preference to t or F tests in order to avoid assumptions about the character of the distributions. Yates' correction was applied in all chi-square calculations. All chi-squares mentioned in the text and tables are values with one degree of freedom. Table B9 gives probabilities associated with selected chi-square values and will facilitate interpretation where probabilities are not specifically set forth. In general, the convention has been adopted of considering p values of 0.05 or smaller as "significant", i.e., reguiring rejection of the null hypothesis that the variables under consideration are unrelated (independent).

Classification of the men by deciles of the distribution of all men of the same age in the same area has several advantages. For example, it is thus easy to combine age groups so as to identify the men in an area who are in the top 10 or 20 per cent of the distribution of men all of equal age (within a range of 5 years) in respect to a given variable. This can provide adequate numbers for the examination of various questions about the relationships among variables, on an age-free basis.

A frequent application of the decile classification was in regard to the search for relationships such as between "hypertension", suitably defined, and relative body weight or serum cholesterol. A simple plot of the number of hypertensive men against decile class (number or percentage of hypertensive men on the ordinate in each decile class of the other variable on the abscissa), at once makes visible trends (which may be curvilinear or rectilinear), or the absence of a trend (indicated by a series of points approximating a random distribution about the horizontal line of the average number of hypertensive men per decile class). The significance of such trends is readily estimated by the chi-square test.

Coefficients of correlations are not conspicuous among the statistics presented here. In many cases misleading answers, or erroneous conclusions, result from the computation of the ordinary product-moment coefficient. That calculation concerns only linear relationships and it involves assumptions about the character of the distributions. But many of the relationships of interest are not linear and many of the distributions are not normal.

Examples where a different approach is much more revealing than the usual correlation analysis are shown in several sections below, particularly in Sections F and G. Relative body weight is importantly related to smoking habits but a coefficient of correlation between relative weight and amount smoked can be grossly misleading. Blood pressure is related to skeletal shape but ordinary correlation analysis would scarcely suggest this. In many situations major biological and medical interest concerns relationships towards the ends of the distributions. We have attempted to focus on this by examining the distribution of men in the tops and bottoms of the arrays of the two variables

TABLE B 9

Critical values of chi-square with one degree of freedom calculated from two-by-two tables. Probabilities are those of obtaining, as a result of chance deviation from expectation, values of chi-square as large or larger than those shown when the variables of interest are independent.

CHI-SQUARE	PROBABILITY	CHI-SQUARE	PROBABILITY
2.71	0.10	6.64	0.01
3.24	0.07	7.88	0.005
3.84	0.05	10.83	0.001
5.02	0.25	12.12	0.0005

concerned. Two-by-two tables of numbers of men in decile classes 1, 2 and 9, 10 for each of two variables repeatedly showed highly significant differences that were missed by simply comparing mean values or calculating correlation coefficients. Examination of the shapes of distributions and their relative locations in different age groups or samples is conveniently accomplished by plotting cumulative frequencies on arithmetic probability scales. Such plots are easily identified by their non-uniform but symmetrical ordinate scales. A normal distribution, when so plotted appears as a straight line with slope in direct relation to the standard deviation of the distributions. Non-normality is indicated by a curved line plot, and the direction of skewness can be inferred from the curvature.

Many pairs of variables (x, y) were subjected to regression analysis where one of the variables (y) is expressed as a linear function of the other (x), thus

$$y^* = a + bx$$

The regression (or slope) coefficient b tells how much, on the average, y will increase for an increase of x by one unit. Most commonly, b is determined so that the sum of the squares of the deviations of the actual y values from the predicted y^* values is as small as possible. In some situations, however, it is useful to compute the regression coefficient so that variations in both x and y directions are minimized at the same time (Cramer, 1946). This orthogonal regression coefficient, b^*, represents the main axis of the elliptical x, y configuration so that if x increases by one unit, y^* increases by b^* units; if y increases by one unit, x^* will increase by $1/b^*$ units.

6. Samples

The General Question of Samples

In the present study samples of middle-aged men were studied in various regions of a number of countries. No pretence is made that these samples truly represent whole large regions let alone the countries concerned. However, there is no reason to suggest that the samples of rural men are in any way atypical of the men in the general areas of their residence. For example, the sample of men in East Finland (Karelia) covered all men of prescribed age in a defined area centering at Ilomantsi; it is not a random sample of men in all of East Finland. But there is no basis to suggest that the sample seriously misrepresents the generality of rural men in Finnish Karelia.

From long experience and careful consideration, the conclusion can be defended that it is not actually possible to draw and examine in detail a strictly random sample of any large population in such epidemiological work. Data on the population distribution is seldom accurate enough and fully up to date to draw a perfect sample even on paper. And when the attempt is made to examine in detail the persons in the theoretical sample the percentage of non-respondents is always very substantial except in such favorable spots as villages similar to those involved in the present study.

A response rate of as high as 80 per cent would be very good in cities but this is far from enough to provide an accurate inventory of disease prevalence, especially when the response, or lack of it, is influenced by the presence of the diseases in question. On the other hand, even a relatively poor response rate does not necessarily mean a biased sample in regard to many attributes and relationships between attributes.

In the present studies emphasis is put on such questions as these: Does blood pressure tend to be related to serum cholesterol level? Is body fatness related to skeletal shape? How do smokers compare with non-smokers in relative body weight? Insofar as common patterns in the answers to such questions emerge from 18 such widely disparate samples, inferences can be made about apparently universal relationships. Insofar as answers from the several samples are clear but disparate for different samples, the results point for the need of further studies to discover underlying influences; the explanation will not emerge from repetitions with "better" samples but from the search for and consideration of other interrelated variables.

Sample Bias from Examination Refusals

The high examination coverage achieved in these cooperative studies provide data for consideration of the situation in which the respondents form a small percentage of the sample. In population surveys involving detailed medical examination the final coverage is usually well under 90 and may be as little as 50 per cent of the sample. Though in the latter case it is doubtful whether the sample is often usefully representative, it is important to consider the common situation where 15 to 30 per cent of the persons in the sample do not respond.

Much depends on the variables of interest, of course, and in some situations practically complete coverage is required to assure that the prevalence of the variable in the invited sample is accurately reflected. If the invitees fear that revelation of a defect or disease in the examination may carry economic or social penalty, those who know or suspect they may have the defect or disease will tend to refuse examination. But even in this circumstance some indication of the extent of the bias will be given by comparing the findings on the most reluctant examinees with those who volunteered more readily.

In our first survey in 1957 of men aged 45—64 at Nicotera, in southern Italy, all men of those ages were invited to avail themselves of what was assured to be a painless and confidential examination; the community leaders — officials, priests, doctors, teachers and the most respected men — publicly urged participation; place and time of examination were arranged to be convenient. About ten per cent of the men on the roster, the "eager beavers", presented themselves at the first opportunity; thereafter men registered with no great pressure until about three-fourths of the roster was covered; increasing efforts at persuasion brought the coverage up to about 85 per cent and then a concerted drive of public pressure and inducement was required to reach the 96.1 per cent coverage finally achieved.

Similarly, in the villages of Crete in 1957, very high coverage was finally achieved (91.4 per cent) but the last 20 per cent to be examined were decidedly reluctant and came in only as a result of heavy community pressure from the village officials, priests, teachers and other leaders. In Crete, as at Nicotera, some information about state of apparent health, working habits, etc., was obtainable about the men who remained obdurate. Except for one man at Nicotera, there was no ground for any suspicion that cardiovascular disorder was present in any of the men who were not examined.

Accordingly, for these two samples it is interesting to compare the early or non-reluctant volunteers with those

TABLE B 10

Age distribution of respondents, by number of men, among occupation-matched farmers. The 59 most reluctant volunteers at Nicotera are compared with the 59 men in that village who came in first and the 85 most reluctant respondents in Crete are compared with the first 85 village-matched men who responded to the invitation.

SAMPLE	45-49		50-54		55-59		60-64	
	Early	Late	Early	Late	Early	Late	Early	Late
Nicotera farmers	25	22	16	14	11	12	7	11
Crete farmers	15	16	37	32	15	18	20	20
Both samples	40	38	53	47	26	30	27	31

TABLE B 11

"Ready" versus reluctant volunteers for medical examination. Comparison of 59 early with 59 reluctant men in Nicotera, Italy surveyed in 1957; and comparison of 85 "late comers" with 85 village-matched non-reluctant ("ready") men in eleven villages on the island of Crete, Greece surveyed in 1957. Column entries are numbers of men.

ITEM	NICOTERA		CRETE	
	EARLY	RELUCTANT	EARLY	RELUCTANT
Relative body wt., under 90%	36	32	52	53
" " " 90% or more	23	27	33	32
Σ Skinfolds, under 13 mm.	37	31	53	52
" " 13 mm. or more	22	28	32	33
Systolic B. P., under 140 mm.	42	37	59	53
" " 140 mm. or more	17	22	26	32
Diastolic B. P., under 90 mm.	50	47	72	66
" " 90 mm. or more	9	12	13	19
E. C. G., "normal"	46	37	59	66
" "abnormal"	13	22	26	19

most reluctant, the men who would have been non-respondents if it had not been possible to bring so much pressure on them. In order to assure highest comparability in other respects, the reluctant and non-reluctant men were matched as to village and lifelong occupation (farmers). The result was 59 reluctant men at Nicotera and an equal number of "eager" respondents, and in Crete 85 men in each category.

Table B10 shows the age distribution of the two sets of men contrasted in willingness to respond. There is no significant trend for the reluctant respondents to differ in age distribution from those ready or eager to be examined. Table B11 summarizes examination findings in these men. In none of the items is there even an approach to a significant difference between the men when they were classed by willingness to volunteer for medical examination.

These findings pertain to populations of men who had no reason to believe that social position or occupation or financial security would be affected by the discovery of disease other than tuberculosis. However, in such populations the discovery of tuberculosis means transport to a sanatorium or hospital and it is interesting that at Nicotera two of the three men on the roster known to have a history of tuberculosis refused examination.

A different situation is to be expected among an employed group in which disclosure to the employer of serious cardiovascular disease would probably mean enforced disability retirement with a major reduction in income. Even though the U.S. railroad employees were emphatically re-assured about the confidentiality of the examination results, this fear probably played a role in their attitude toward participation. Significantly, disability retirements for cardiovascular disease in the next few years after the examination were proportionately more among the U.S. railroad employees who had refused examination than among those who were examined.

Obviously, such a disease-related bias may produce serious errors in estimates of prevalence of the disease in the population which the sample was supposed to represent. It may well be that the prevalence of coronary heart disease among U.S. railroad employees is greater than found in the surveys; the findings in those surveys must be considered to indicate minimum prevalence. On the other hand, there is reason to believe that in the population "chunk" surveys in Europe and Japan, the non-respondents did not tend to include men who had any disability or suspicion that they might have cardiovascular disease. If anything, then, the prevalence data may lead to very slight over-estimates; if present such an error would be exceedingly small.

But these surveys were not directed primarily at providing estimates of prevalence; the long-range aim was to provide data on pre-disease characteristics for follow-up analysis of incidence; a major short-range aim was to obtain distributions and information on interrelations among characteristics that may be involved in etiology and clinical developments of cardiovascular disease. For these purposes some bias in the samples would be tolerable so long as the bias does not distort the interrelations among variables. There is no reason to suspect such distorting bias in the samples studied.

CI. RAILROAD EMPLOYEES IN THE UNITED STATES

by Henry L. Taylor, Henry Blackburn, Josef Brozek, R. Willis Parlin & Thomas Puchner.

Introduction

For the analysis of characteristics of railroad employees, data were available on 3049 railroad employees in the northwestern quadrant of the United States who were examined in 1957—59. The data and analysis presented here concern men in statistically pre-determined samples who were aged 40 through 59 years at the time of examination and who were classified as sedentary clerks ($N = 860$), switchmen ($N = 837$), and executives ($N = 251$).

In the U.S.A., as in many other countries, railroad employees tend to be stable in their occupations and in the employ of the industry, their ossupations are relatively fixed in regard to physical activity, and they have long been covered by a kind of social security system, providing pensions, insurance and other benefits, that maintains detailed records of employment, disabilities, retirements and deaths. In the U.S.A., the Railroad Retirement Board operates this system and maintains the necessary records. These considerations, and the fact that the number of employees in the industry is large, suggested that railroad employees would be particularly suitable for epidemiological studies.

These advantages are accompanied by a number of problems that had to be resolved in order to organize a successful epidemiological study with railroad employees. Besides obtaining the essential permission and assurance of cooperation from the railroad companies, it was necessary to have agreement and help from the various labor unions involved both at the national or regional level and in each of the localities where the work was to be done. The cooperation of local brotherhood officials is important in persuading men to report for examination.

The cooperation of the Railroad Retirement Board is useful in many respects and is almost indispensable for evaluating the relevance of particular samples to the industry as a whole and for the analysis of the effects of withdrawals from the industry, job transfers, etc.

Besides these questions of permission and cooperation, the operation of a program that involves examination of railroad employees encounters problems because of the geographic dispersion of the men. It is not possible to sample the industry properly by concentrating on a few large centers; men are employed at every place where there is a railroad station and at other places along the line as well. An obvious answer to the question, adopted in the present study, is the provision of mobile examination and laboratory quarters, railroad cars specially fitted out for the purpose, that can be moved from place to place along the railroad on a suitable schedule.

The Population for Study

The cooperation of 20 railroad companies operating in the northwestern quadrant of the United States circumscribed by Chicago, St. Louis, San Francisco and the Canadian border was solicited. Only two important railroad companies operating principally in this area refused. The 20 companies that agreed to cooperate included 15 line haul, first class railroads, 4 switching and transfer companies operating within metropolitan areas and one depot company serving a metropolitan area. The study population then was drawn from these 20 cooperating companies which include all the types of organizations employing both switchmen and clerks. The cooperating railroads are listed in Table Cl. 1.

Each company was asked to supply the names of all male clerks, switchmen, dispatchers, and executives whose age in 1957 was 40 or more and who were employed in the summer or fall of 1957. A total of 12,586 names were delivered to the Laboratory, along with the social security number, location of work, title of job, etc. A roster of the study population was then compiled showing the numbers of men employed by each railroad in the various towns and cities served by the road in question. Men who were stationed at those locations where less than 10 switchmen and clerks were employed were not included in the final tabulation. The number of men whose ages were 40 to 59 in the three occupations reported here (clerks, switchmen, executives) totaled 8,053.

The men potentially available in the study population were in towns with populations as small as 5,000 and as large as several million and in regions differing in climate and other features. Accordingly, for the purposes of sampling and subsequent analysis, areas were distinguished as indicated in Table Cl. 2. The men examined in St. Louis were omitted from this analysis by size of community because the number of switchmen in St. Louis was very small and the characteristics of the community are such that it seemed to be illogical to combine these men with those in Chicago.

Clump sampling was used. A statistician selected units consisting of an installation of a particular company in a particular location. Thirty units were selected in such a way as to ensure approximately proportional representation from each of the geographical areas and each of the sizes of urban area classifications.

A systematic approach was made to each unit in an attempt to develop interest in and response to the program. Contact was made with the general chairman for each "brotherhood" (union) for the railroad in question and he was asked to write a letter endorsing the project. This letter was reproduced and enclosed with an invitation to each man at the unit to participate in the program. The chairman of the local brotherhood lodge was also contacted and permission was obtained to attend a regular meeting of the lodge. The meeting was advertised throughout the clerical and yard offices of the railroad in the town or facility selected. The union meeting was attended by a staff member of the Laboratory, the program was explained, and the questions were answered. It was the practice of the Laboratory staff members attending the meeting to check the

TABLE Cl. 1

The Cooperating Railroads in the Study on U. S. Railroad Employees. (Note that railroads 1 through 16 operate completely within the area under study; railroads 17 through 20 have divisions in this area but also operate in other areas).

	RAILROAD		RAILROAD
1.	Great Northern	11.	Minnesota Transfer
2.	Northern Pacific	12.	Belt Railroad of Chicago
3.	Milwaukee Road	13.	Indiana Harbor Belt
4.	Burlington	14.	Duluth, Mesabi and Iron Range
5.	Chicago and Northwestern	15.	Chicago River and Indiana
6.	Western Pacific	16.	Spokane, Portland and Seattle
7.	Soo Line	17.	Chicago, Rock Island and Pacific
8.	Minneapolis and St. Louis	18.	Southern Pacific
9.	Chicago Great Western	19.	Chesapeake and Ohio
10.	St. Paul Union Depot	20.	St. Louis and San Francisco

TABLE Cl. 2

Geographical areas for sampling U. S. railroad employees.

Area I. -- Chicago and Milwaukee
Area II. -- The region west of Area I to the Rocky Mountains
B, cities with populations of 150, 000 to 1, 000, 000
C, " " 50, 000 to 150, 000
D, " " less than 50, 000
Area III. -- The Rocky Mountain region
Area IV. -- The West (Pacific) Coast

union membership list against the list supplied by the railroad company. Names of men who had been omitted from the invitation list but who were in the correct age group and occupation were added to the list.

Personal invitations were then issued by mail to each individual on the invitation list. Those individuals wishing to participate returned a letter by mail stating when they could attend the examination. Clerks were examined on company time but due to operating problems it was impossible for management to extend this privilege to switchmen.

Two railroad cars, remodelled to serve as mobile laboratories visited each of the locations at least twice; three visits were made to the large metropolitan areas where it was more difficult to persuade the men to come in for the examination. On arrival at the location with the Laboratory railroad cars, efforts were made to recruit all the men on the invitation list. In some cases men were discovered who were not on the examination list but were in the correct occupation and age class. The privilege of examination was extended to such men but they were classed as volunteers since they had not been approached in the same way as the men on the invitation lists. A number of additional volunteers were examined in cases where it was believed to be useful in terms of good will and of developing an interest in the program in men influential in the local railroad community. These 149 men are listed under "Self-Selected" as "other occupations" in Table C1.3.

A number of special jobs were not included in the major categories of clerks or switchmen. Chief clerks were not considered to be eligible for the clerk cohort since they carry a substantially larger responsibility and are paid at a higher rate. For the same reasons, yard masters were not included in the switchmen cohort. Switchtenders were also excluded from this cohort since their physical activity level is definitely lower than switchmen as a group. A substantial number of chief clerks, yard masters and switchtenders appeared on the invitation lists. Therefore, this group of 69 men is listed under "other occupations" in the "Sample" in Table C1.3. Table C1.3 also indicates the men found to be under 40 or over 59 at the time of examination; these men were not included in the later analysis presented here.

Occupational Classification of Physical Activity

Physical activity was considered to be an important variable in this study and the original selection of occupations for inclusion in the study attempted to provide clear contrasts in this respect — switchmen on the one hand versus clerks, executives and dispatchers on the other. The category of switchmen was chosen to represent relatively high physical activity and it includes an adequate number of men. However, more careful scrutiny showed the situation to be more complicated than anticipated.

The 129 broad occupational classifications set up by the U.S. Interstate Commerce Commission were reviewed in regard to physical activity. It was found that the number of tasks involving physical work required of switchmen is relatively small in comparison with that of some other occupations so the general level of activity required by switchmen places them in a moderately active group. In a four-level scale, desk workers, switchmen, maintenance-of-way employees, and lumberjacks can be regarded, respectively, as examples of sedentary, moderately active, active, and extremely active groups.

TABLE CI.3

Distribution of examined U.S. railroad men. Numbers of men classed by age, sample status and occupation.

OCCUPATION	SAMPLE			SELF-SELECTED		
	Under 40	40-59	Over 59	Under 40	40-59	Over 59
Clerks, sedentary	15	860	82	28	63	13
Clerks, non-sedentary	1	156	15	6	16	1
Switchmen	19	837	63	29	41	8
Executives	12	251	34	21	66	13
Dispatchers	8	65	13	3	3	2
Other occupations	10	69	10	34	149	32
Total	65	2238	217	121	338	69

Study of the duties of railroad employees classed as clerks revealed that a significant fraction of these men have duties that take them into the yards for the purpose of checking car numbers or on to the baggage platform where they are engaged in walking or baggage handling to such an extent that they could not be classed as sedentary employees. These men, therefore, were classed as non-sedentary clerks and are listed under this heading in Table C1.3. Some of these clerks were as active as switchmen but a great many of them appeared to be in the grey zone which made them not active enough to be included in the moderately active class. It was felt that since an important part of the program was focused on physical activity, this group should be analyzed separately.

Executives were found to be a mixed group some of whom spend the great majority of their time at their desks, while others are relatively active in walking as required on inspection tours and in some instances in supervision of shops, etc.

Dispatchers are completely sedentary in their working hours. The duties of a dispatcher require that he be at his desk almost continuously during the period that he is on duty. These employees will be discussed in separate publications.

Observations have been made of the energy expenditure of both switchmen and clerks during the working day. The oxygen requirement for each of the several tasks required of men in these occupations was estimated with on-the-job direct measurements. This was followed by time-and-task measurements and finally a dietary survey was carried out on a small group in each occupation. Switchmen do more on-the-job work than clerks the year around, the difference increasing in the winter and at certain peak load periods due to overtime. Switchmen appear to average about 600 calories a day more energy expenditure than clerks; in some special situations the difference may be as high as 1200 calories. The detailed data will be reported elsewhere.

Details of Age and Occupation Distribution

The distribution of the examined population by occupation, age and sample status is presented in Tables C1.4 and C1.5. This report deals with findings in sedentary clerks, switchmen and executives whose age at the time of examination was 40 to 59 inclusive and who qualified for admission to the sample, i.e. were on the invitation list and received mailed invitations. The distributions for "all U.S." in Table C1.4 are based on men employed in 1954. The inclusion of men over the age of 59 in the sample is due in part to some errors in the initial rosters but mainly to the fact that the rosters were compiled in 1957 but examinations did not cover all of the men until early 1960, by which time some of the men had become over age. Errors in the original reports of age by railroad companies are largely responsible for inclusion of some men under 40 in the sample. A few men on the original invitation list had changed jobs by the time of examination. These men are reported here as "other occupations" under "Sample" in Table C1.3.

Tables C1.4 and C1.5 show that the distribution by age of the examined population, the invited population, and the study population, are all very similar in the clerks and switchmen classes of occupation. Moreover, the clerks in the national population ("all U.S.") have much the same age distribution as the clerks in the study population. On the other hand, the same data suggest that the study population is

TABLE C1.4

Age distribution of U.S. railroad employees: Numbers of men and percentages (in brackets).

OCCUPATION	POPULATION	YEAR	40-44	45-49	50-54	55-59	40-59
Sed. Clerks	All U.S.	1954	6336 (15.9)	9769 (24.5)	12286 (30.8)	11511 (28.8)	39902 (100.0)
" "	Study	1957	575 (18.2)	629 (19.9)	904 (28.6)	1050 (33.2)	3158 (100.0)
" "	Invited	1957-59	220 (18.9)	254 (21.8)	317 (27.2)	372 (32.0)	1163 (100.0)
" "	Examined	1957-59	167 (19.4)	185 (21.5)	240 (28.0)	267 (31.1)	859 (100.0)
Switchmen	All U.S.	1954	8057 (26.5)	5988 (19.7)	7553 (24.9)	8768 (28.9)	30366 (100.0)
"	Study	1957	1205 (31.6)	1004 (26.3)	800 (21.0)	808 (21.2)	3817 (100.0)
"	Invited	1957-59	449 (31.8)	391 (27.7)	275 (19.4)	299 (21.1)	1414 (100.0)
"	Examined	1957-59	280 (33.5)	244 (29.2)	153 (18.3)	158 (18.9)	835 (100.0)
Executives	Study	1957	213 (19.8)	200 (18.6)	315 (29.2)	350 (32.5)	1078 (100.0)
"	Invited	1957-59	65 (17.9)	54 (14.9)	104 (28.9)	140 (38.6)	363 (100.0)
"	Examined	1957-59	48 (19.4)	35 (14.1)	68 (27.4)	97 (39.1)	248 (100.0)

TABLE C1.5

U.S. railroad employees classed by age and occupation, men examined as % of invited sample (response) and as % of study population (representation).

OCCUPATION	ITEM	40-44	45-49	50-54	55-59	40-59
Sed. Clerks	Response	75.9%	72.8%	75.7%	71.8%	73.9%
"	Represent.	29.0	29.4	26.5	25.4	27.2
Switchmen	Response	63.4	62.2	55.6	52.8	59.1
"	Represent.	23.2	24.3	19.1	19.5	21.9
Executives	Response	73.8	64.8	65.4	69.3	68.3
"	Represent.	22.5	17.5	21.6	27.7	23.0

not representative of the age distribution of the switchmen in the national population. There is a suggestion that switchmen in the older age groups in the study population were under-represented. It is not known whether or not this is due to errors in reporting by the railroad companies or to employment practices. The examined population of switchmen is proportionately smaller in the older age groups when compared to the study population. Finally, the response rate to the invitations is definitely smaller in the older switchmen. It is clear, then, that the age distribution of the clerks is related to industry conditions while that of the switchmen is influenced by selection against the experiment.

The response rate by geographical area is presented for the three occupations in Table C1.6 and the same information by size of community in Area II is contained in Table C1.7. The poorest response rate occurred in Area I (Milwaukee-Chicago) and the best in cities whose populations were less than 150,000. The very poor response of switchmen in Area I is largely due to a very low response rate (25 %) in one installation in which management-labor relations were strained and it proved impossible to capture the confidence of the switchmen.

To ensure reasonable distribution of sampling and adequate numbers, it was felt that at least 20 % sample of the study population roster should be examined. The data on the percentage of the roster examined presented in the Tables show that this goal was reached in all cases with three exceptions: 1) switchmen on the West Coast, 2) clerks and 3) switchmen in towns with population less than 50,000 in Area II (great plains west of Milwaukee and Chicago).

Executives are not classed by areas since those men are moved from one location to another during the period in which they are "moving up" in the ranks and on attaining a position in the general office do a great deal of traveling.

Since atherosclerosis, underlying coronary heart disease, develops slowly over a long period of time, it was of interest to know how long men had been in the railroad industry and in the specific occupation. This information was also pertinent to follow-up studies on deaths and retirements since it was planned to obtain death certificate data and information on retirement cause from the files of the Railroad Retirement Board. The Board deals with death benefits and retirements only on those men who have had ten years of service in the industry. Tabulations by five-year age groups of the length of service were made. The age-adjusted prevalence of men with less than ten years of service in the 40—49 decade of age was 5.5 per cent in the sedentary clerks and 6.3 per cent in switchmen. In the 50—59 decade of age, there were no switchmen with less than 10 years of service and only 1.4 per cent of the sedentary clerks fall into this category. Executives with less than 10 years of service in the industry were found only in the 40—44 years old group where the prevalence was 6.5 per cent. The median number of years in the industry for sedentary clerks was 20.5 in the 40—44 year age group, 23.5 for clerks in the 45—49 year old group, 32.1 in the 50—54 age group and 38.0 in the 55—59 age group. In the switchmen, the corresponding values at the medians were 16.8, 18.9, 24.3 and 33.4 for age groups 40—44, 45—49, 50—54 and 55—59 respectively. Length of service in the principal areas did not show large variations except in the Rocky Mountain area where median values for clerks aged 40—54 were 3 to 7 years of service less than in the other areas and for switchmen aged 50—59 were

TABLE C1.6

U.S. railroad employees classed by geographical areas: I - Major Metropolitan (including Chicago and Milwaukee); II - Midwestern Plains; III - Mountains; IV West Coast. Numbers are: in the study population; in the invited sample and of examined respondents. Percentages are: of men responding in invited sample and in study population.

OCCUPATION	AREA	STUDY	INVITED	EXAMINED	RESPONDENTS, % OF INVITED	STUDY
Clerks	I	841	388	261	67.3	31.0
"	II	1433	471	365	77.5	25.4
"	III	269	75	54	72.0	20.1
"	IV	615	232	179	77.2	29.1
"	All	3158	1166	859	73.7	27.2
Switchmen	I	1064	516	253	49.0	23.7
"	II	1494	475	311	65.5	20.9
"	III	352	149	106	71.1	30.1
"	IV	911	274	165	60.2	18.1
"	All	3817	1414	835	59.1	21.9
Executives	I	236	55	46	83.6	19.5
"	II	529	200	135	67.5	25.5
"	III	85	16	14	87.5	16.5
"	IV	228	92	53	57.6	23.2
"	All	1078	363	248	68.3	23.0

TABLE C1.7

U.S. railroad employees in area II classed by size of community; metropolis (population 150,000 to one million), city (50,000 to 150,000), town (less than 50,000), number of men in the roster, invited, and examined and men examined as % of men invited and in the roster.

OCCUPATION	COMMUNITY	ROSTER	INVITED	EXAMINED	RESPONDENTS, % OF INVITED	ROSTER
Clerks	Metropolis	572	162	131	81.4	22.9
"	City	352	117	99	84.6	28.1
"	Town	393	82	61	74.4	15.5
"	All	1317	361	291	80.6	22.1
Switchmen	Metropolis	706	230	135	58.7	19.1
"	City	362	127	103	81.1	28.5
"	Town	368	74	53	71.6	14.4
"	All	1436	431	291	67.5	20.6
Executives	Metropolis	271	80	61	76.2	22.5
"	City	103	33	25	75.8	24.0
"	Town	98	29	21	72.4	21.4
"	All	472	142	107	75.4	22.7

6 to 9 years less than those in the other areas. The medians were 15.6, 17.1, 18.5 and 25.5 years in the job for switchmen for ages 40—44, 45—49, 50—54 and 55—59, respectively. Clerks had substantially fewer years in their present occupations; the medians being from 9 to 15 years. However, these values are biased toward the low side since the questionnaire used did not properly distinguish between changes in jobs within the occupation and changes to jobs outside the occupation. Studies of occupation mobility in a 4 per cent sample of all men employed by the railroad industry for ten years or more did show that clerks who were 40—59 at the beginning of the study transferred to jobs outside of the occupation twice as often as the switchmen during a six-year follow-up. Retirements, withdrawals from the industry and deaths were of the same order of magnitude in the two occupations. It is concluded that switchmen remain in their jobs over longer periods of time than clerks.

Other Characteristics of the Occupational Samples

Differences in national background, particularly of foreign-born groups, may be associated with different prevalences of risk factors (Epstein *et al.*, 1957, Stamler *et al.*, 1960), so nationality of the occupational groups was examined. Men brought up in families with both parents of the same national origin were felt to represent potential bias and the analysis centered on this group. The data are presented in Table C1.8. Sixty per cent of the clerks reported both parents to be of the same nationality, for switchmen and executives the percentages were of the same order of magnitude but slightly lower. The distributions of the several national groups in the three occupations had only a few important differences. Thirty-six per cent of the clerks had German parents while only 22 per cent of the switchmen and 24 per cent of the executives had German parents. Only 1.7 per cent of the executives had parents of Slavic origin while the percentage for clerks was 13 and for switchmen 13.9. The executives also had a larger proportion who stated that their parents were of English-Scottish origin (38 per cent) than the clerks (17.0 per cent) or the switchmen (21.7 per cent). Area differences did not appear to be great except that more than half of all the men of Slavic origin were employed by one Company in Area I.

The marital status is presented in Table C1.9. The age-adjusted prevalence of married men among executives was 97.2 per cent, for clerks 89.5, and for switchmen 94.1. The major difference between clerks and switchmen was found in the never-married group in which the age-adjusted prevalence was 6.7 per cent in the clerks and 1.8 per cent in the switchmen.

Railroad employees as a group are known to have a sub-group of heavy drinkers. An estimate of the extent of this behavior was obtained by calculating the age-adjusted prevalence of men who were or had been members of Alcoholics Anonymous. The age-adjusted rate in switchmen was 3.9 per cent, in clerks 4.2 per cent and zero among executives. Presumably, alcoholics did not become executives, or were eliminated from their jobs, or handled their problem in other ways. Variability in the area breakdown was not remarkable except that clerks in Area A had a rate of 7 per cent.

Switchmen and clerks have approximately the same average rate of pay — 18—19 dollars a day for clerks, 21—23 dollars a day for switchmen. Switchmen collect more overtime pay but clerks have a better chance of being

TABLE Cl. 8

Nationality of the parents of sedentary clerks, switchmen and executives. Paternal nationality includes all subjects reporting. "Pure" refers to identical paternal and maternal nationality.

	Sedentary Clerks			Switchmen			Executives		
	Nationality		Pure	Nationality		Pure	Nationality		Pure
	Paternal	Pure	%	Paternal	Pure	%	Paternal	Pure	%
1. Scandinavian	11.1	15.9	86.6	12.0	16.1	72.8	9.3	13.3	80.0
2. Russian-Polish	9.1	13.0	86.6	8.0	13.9	94.4	1.4	1.7	66.7
3. Hungarian-Rumanian	1.2	1.3	66.7	0.7	1.4	100.0	0.5	0.8	100.0
4. German	33.0	36.0	66.3	23.7	21.8	49.7	26.1	24.2	51.8
5. Italian	2.3	3.6	94.1	2.1	3.3	85.7	2.3	3.3	80.8
6. French-Spanish	3.2	1.6	29.1	4.0	1.6	22.2	2.8	2.5	50.0
7. Irish	16.6	11.6	42.3	22.7	19.9	47.4	19.5	15.8	45.2
8. English-Scottish	23.5	17.0	43.7	26.8	21.7	44.0	38.1	38.4	56.1
	100.0	100.0		100.0	100.0		100.0	100.0	
N	739	447		679	367		215	120	

TABLE Cl. 9

Percentages of married, single (never married), widowed, divorced and separated men among executives, sedentary clerks and switchmen.

	Executives				Sedentary Clerks				Switchmen			
age	40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
married	100	100	99	90	85	95	89	88	93	93	94	96
single	--	--	--	5	10	3	7	6	3	2	1	2
widowed	--	--	1	3	1	1	--	4	--	1	1	1
divorced	--	--	--	1	3	1	3	2	3	4	3	--
separated	--	--	--	1	1	--	1	--	1	--	1	1
N	46	35	72	95	165	183	237	267	282	242	153	159

promoted to a substantially better paying job. Executives, of course, have much higher salaries.

Distribution of the Measured Variables

The personal characteristics related to the development of coronary heart disease found in the several occupations are presented in Table C1.10 as the value at the median for the four age groups along with the same figure expressed as per cent of the average of the medians for the 18 population samples covered by the cooperative studies. With the exception of both diastolic and systolic blood pressure, all medians for all occupations are larger than the averages for the groups as a whole. In general the American railroad employees were taller, heavier for their height, fatter and had higher serum cholesterol concentrations than the averages of the medians. Clerks and switchmen had comparable heights. But the executives were significantly taller than any of the other occupations and were the tallest of any group studied. Switchmen were heavier for height and age at all ages and were thinner in the younger age groups than clerks. Executives were as heavy as the switchmen but were also a little fatter. In both relative body weight and fatness the employees of the American railroads were markedly heavier and fatter than the averages of all groups. The men of Crevalcore had relative body weights that were comparable to employees of the American railroads while those of the Italian railroad were larger. All occupations had skinfolds which were markedly larger than in any other groups studied. The blood pressures in the several occupations do not show striking trends except that non-sedentary clerks and executives tended to have lower blood pressures in the younger age groups and the non-sedentary clerks were found to have the highest systolic and diastolic blood pressures in the oldest age group. Serum cholesterols were markedly elevated above the average for all groups and did not differ significantly between occupations. However it should be noted that the executives tended to have higher serum cholesterol concentrations than the other occupational groups. These men had serum cholesterol concentrations which were substantially lower than those of the Finns and were in the same range as those of the men of Zutphen.

The relative body weights have a trend to lower values with age in all occupations. There is no trend in the skinfolds with age. The systolic and diastolic blood pressures show the expected increase with age. Serum cholesterol is not related to age in a uniform way in the four groups. Switchmen have an increased serum cholesterol in the 55—59 age group while the other three occupations do not. The complete distributions of all the measured variables are to be found in the Appendix. The data are presented in Figures C1.1 through C1.4 as cumulative frequency distributions plotted with a probability scale in the ordinate. All ages have been pooled for those variables which showed no age trend, i.e. height, sum of the skinfolds, and serum cholesterol concentrations. In the case of the other variables, systolic and diastolic blood pressure and relative body weight, the distributions for the age decade 40 to 49 are shown by a heavy line and the 50 to 59 decade is represented by a light line. Normal distribution is indicated by a straight line. Examination of the data for sedentary clerks and switchmen reveals that the largest departures from normality occur in the blood pressure measurements. Serum cholesterol concentration shows a minor bowing. An unusual

TABLE C1.10

Medians for U.S. railroad employees and these values expressed as percentages of the average, of the medians for all 18 samples of men.

VARIABLE	SAMPLE	MEDIAN VALUES				MEDIAN, % OF AVERAGE			
		40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
Height (cm.)									
	Switchmen	175	175	174	172	103.1	103.6	104.0	102.6
	Sed. Clerks	175	174	172	172	103.1	103.0	102.8	102.6
	Non-Sed. Clerks	173	172	172	173	101.9	101.8	103.4	103.2
	Executives	177	177	177	176	104.2	104.7	105.8	104.9
	All Men	175	174	173	172	103.1	103.0	103.4	102.6
Rel. Wt. (%)									
	Switchmen	106	103	105	104	108.1	107.1	110.3	110.5
	Sed. Clerks	103	102	102	101	105.0	106.0	107.1	107.3
	Non-Sed. Clerks	104	100	105	101	106.0	104.0	110.3	107.3
	Executives	106	103	103	101	108.1	107.1	108.2	107.3
	All Men	105	103	104	102	107.0	107.1	109.2	108.4
Skinfolds (mm)									
	Switchmen	31	29	33	32	146.2	142.2	159.4	160.8
	Sed. Clerks	33	34	33	32	155.7	166.7	159.4	160.8
	Non-Sed. Clerks	37	34	37	31	174.5	166.7	178.7	155.8
	Executives	33	31	38	34	155.7	152.0	183.6	170.9
	All Men	32	31	34	32	150.9	152.0	164.3	160.8
Syst. B. P. (mm)									
	Switchmen	130	133	136	140	99.2	100.1	99.3	99.6
	Sed. Clerks	134	133	142	140	102.3	100.1	103.6	99.6
	Non-Sed. Clerks	130	133	138	144	99.2	100.1	100.7	102.4
	Executive	123	130	139	133	93.9	97.8	101.5	94.6
	All Men	130	133	139	139	99.2	100.1	101.5	98.9
Diast. B. P. (mm)									
	Switchmen	83	84	85	88	102.5	103.2	101.9	104.4
	Sed. Clerks	83	85	88	86	102.5	104.4	105.5	102.0
	Non-Sed. Clerks	80	80	88	90	98.8	98.3	105.5	106.8
	Executives	80	81	89	85	98.8	99.5	106.7	100.8
	All Men	82	84	87	86	101.2	103.2	104.3	102.0
Serum Chol. (mg%)									
	Switchmen	233	232	232	250	112.9	111.9	111.1	120.9
	Sed. Clerks	234	234	232	242	113.4	112.9	111.1	117.1
	Non-Sed. Clerks	228	230	255	221	110.5	111.0	122.1	106.9
	Executives	242	241	243	247	117.2	116.3	116.3	119.5
	All Men	234	234	234	243	113.4	112.9	112.0	117.6

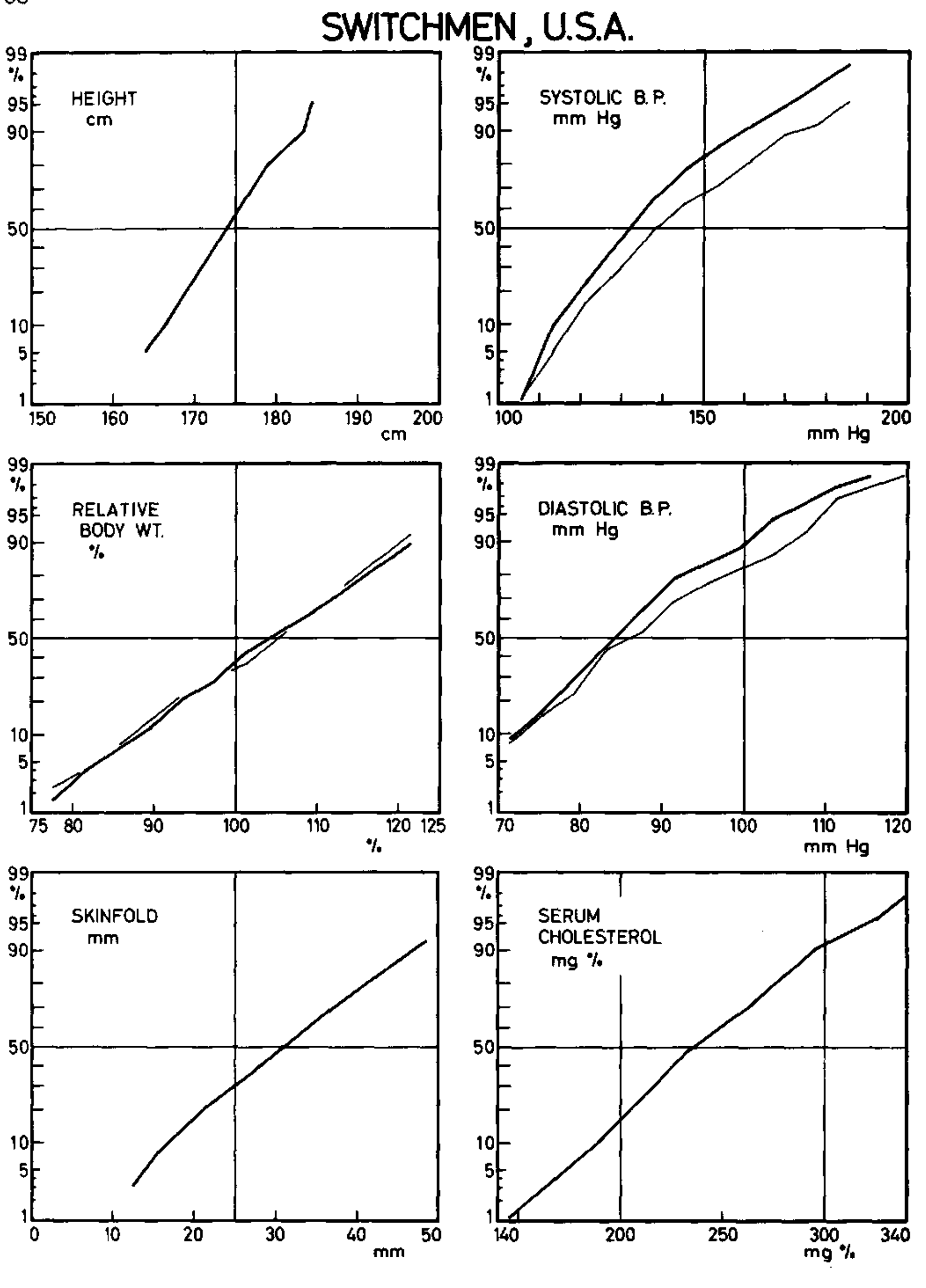

SWITCHMEN, U.S.A.
HEIGHT
cm
SYSTOLIC B.P.
mm Hg
RELATIVE
BODY WT.
%
DIASTOLIC B.P.
mm Hg
SKINFOLD
mm
SERUM
CHOLESTEROL
mg %
99
%
95
90
50
10
5
1
150 160 170 180 190 200
cm
100 150 200
mm Hg
75 80 90 100 110 120 125
%
70 80 90 100 110 120
mm Hg
0 10 20 30 40 50
mm
140 200 250 300 340
mg %

Figure C1.1

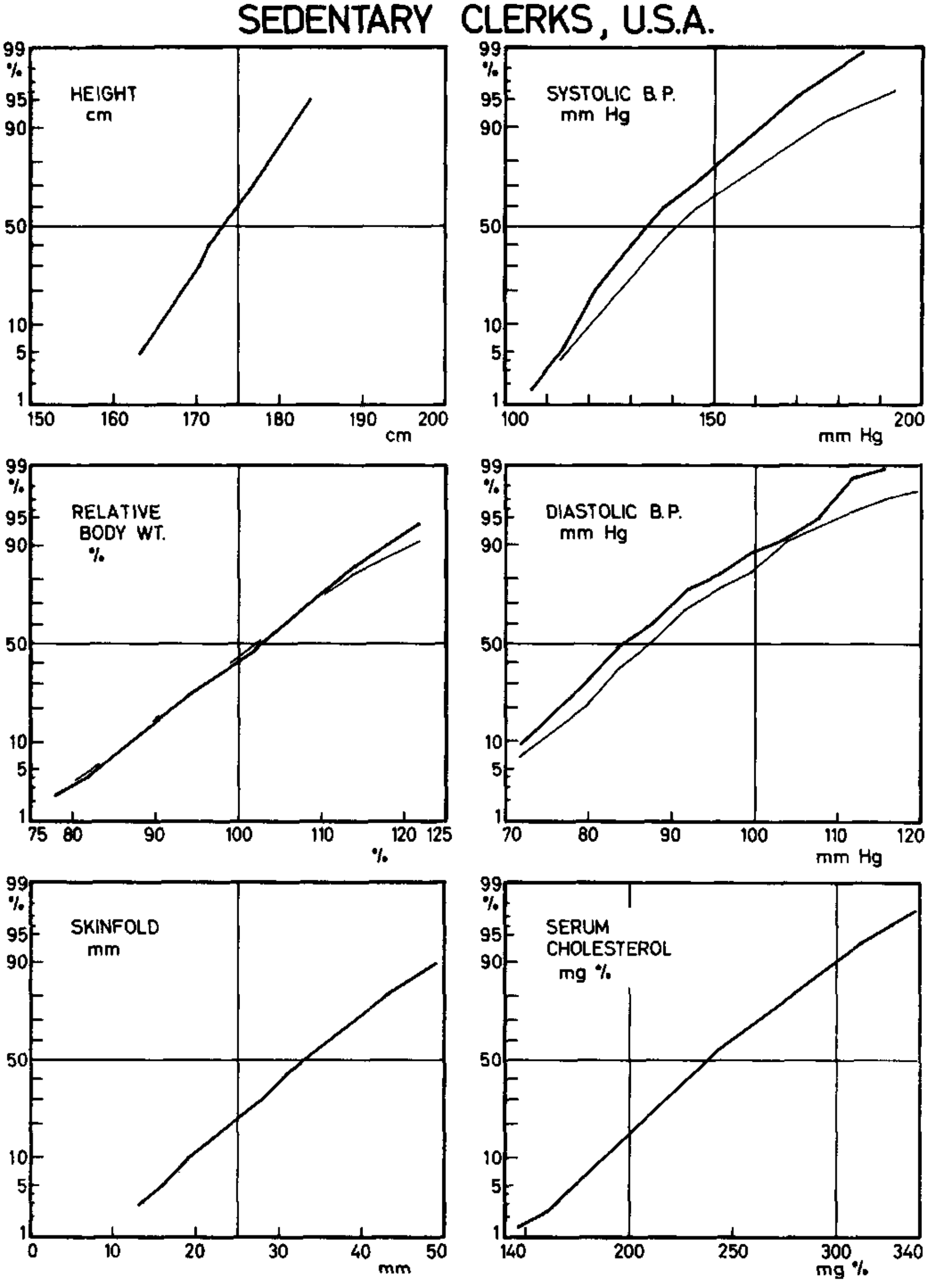

SEDENTARY CLERKS, U.S.A.
HEIGHT cm
99 %
95
90
50
10
5
1
150 160 170 180 190 200
cm
SYSTOLIC B.P. mm Hg
100 150 200
mm Hg
RELATIVE BODY WT. %
75 80 90 100 110 120 125
%
DIASTOLIC B.P. mm Hg
70 80 90 100 110 120
mm Hg
SKINFOLD mm
0 10 20 30 40 50
mm
SERUM CHOLESTEROL mg %
140 200 250 300 340
mg %

Figure C1. 2

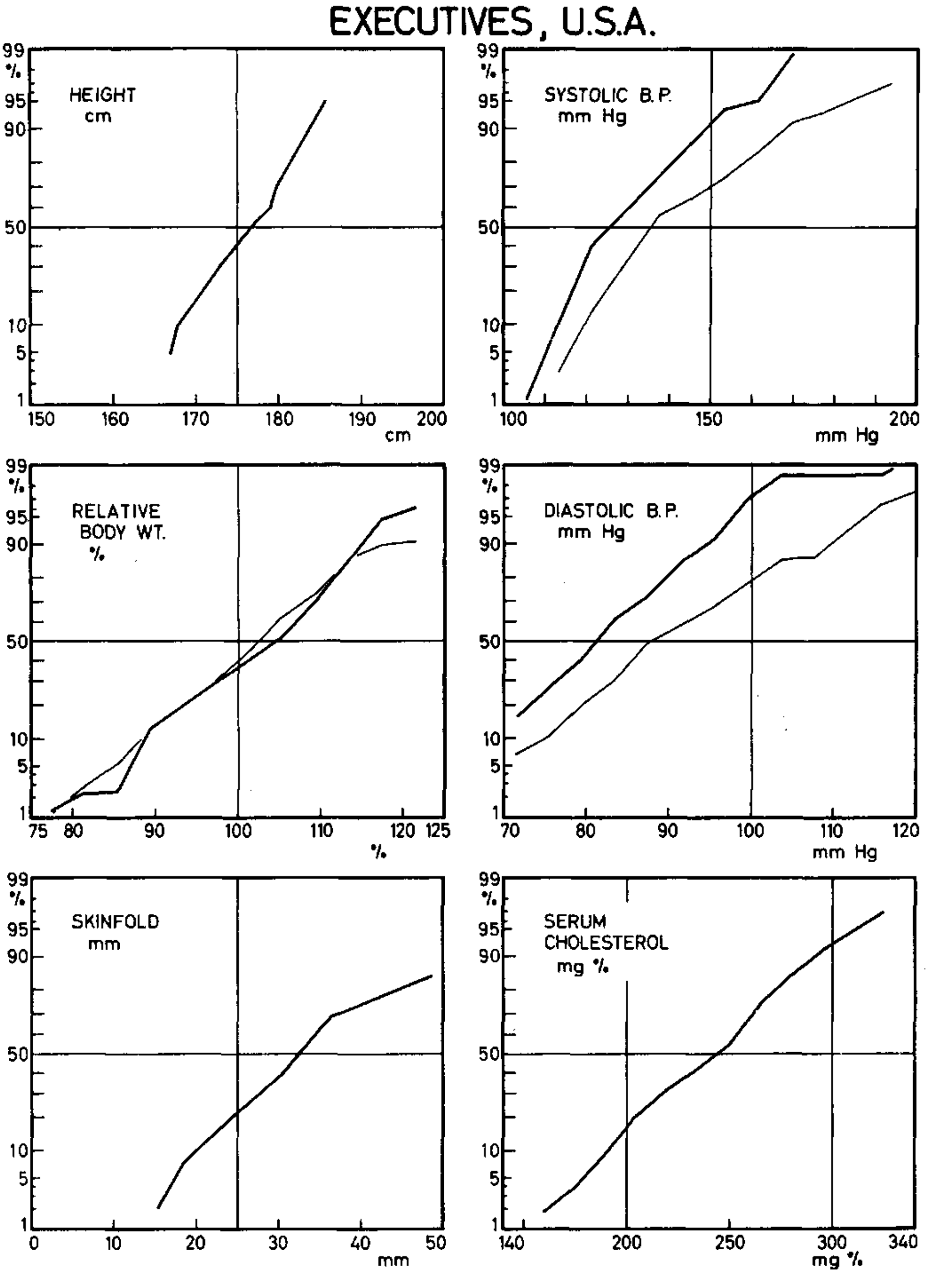
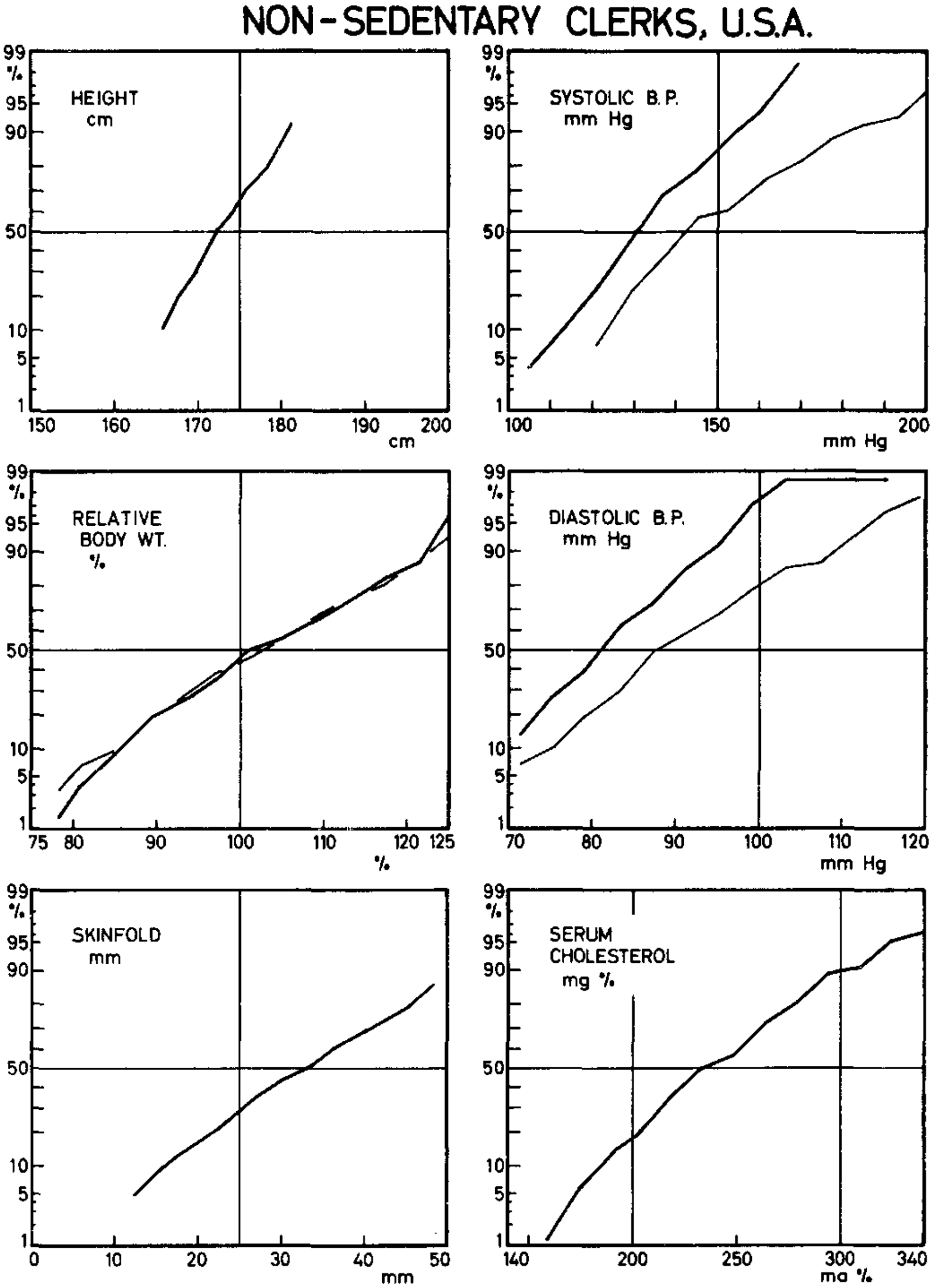

EXECUTIVES, U.S.A.
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT. %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C1. 3



NON-SEDENTARY CLERKS, U.S.A.
HEIGHT
cm
SYSTOLIC B.P.
mm Hg
RELATIVE
BODY WT.
%
DIASTOLIC B.P.
mm Hg
SKINFOLD
mm
SERUM
CHOLESTEROL
mg %

Figure C1.4

finding is the apparently normal distribution for skinfolds among sedentary clerks. Switchmen show a minor departure from the straight line and both groups have normal distributions of relative body weights and heights. The small numbers of men in the executive and non-sedentary clerks result in less stable graphs. The same general picture emerges except for sum of the skinfolds in executives which has a definite bow and irregularities in the graph make it difficult to be sure that relative body weight has a normal distribution in either occupation.

Smoking habits of the occupational groups are presented in Table C1.11. A larger fraction of switchmen smoke cigarettes (64.8 %) than clerks (52.1 %) or executives (53 %). There were 30.2 % of switchmen and 28.3 % of executives who smoked more than 20 cigarettes a day while only 16.6 % of the clerks were heavy smokers. Relationships between smoking categories and the measured variables in switchmen and clerks are presented in Table C1.12.

In non-smokers there was an excess of men observed over that expected above the median value in both occupations for relative body weight (126 % for switchmen and 114.4 % for clerks) and sum of the skinfolds (123.5 % for switchmen and 113.7 % for clerks). The reverse relationship was found in heavy smokers where a smaller fraction of men was observed than expected above the median in both occupations. No substantial relationship to smoking was found in either the systolic and diastolic blood pressures or the serum cholesterol concentration.

The Electrocardiographic Findings

The ECG findings for the four groups are presented in Tables C1.13 through C1.20. The large Q waves (code I, 1) which can be taken as evidence of old myocardial infarction have very low frequencies in all groups and it is not possible to make any statements regarding differences in prevalence rates between groups. There were no important differences between clerks and switchmen in all reportable items, clerks had fewer total Q waves in the 40 to 49 decade while the reverse was true in the older decade of age. Switchmen had fewer cases of left axis deviation than clerks at all age groups. The most striking finding between occupations was found in the S-T depressions after exercise. Clerks showed an age-adjusted rate of 67.3 and switchmen of 25.6. The difference is highly significant. The number of men in the executive group is too small to draw firm conclusions. Age-adjusted rates per 1000 for the men classified as having an "ischemic pattern" (code XI, 1—3) were sedentary clerks 29.0, switchmen 15.3, and executives 23.4. For code XI, 4 (non-ischemic pattern) the corresponding rates were 38.3, 10.3 and 16.6 for sedentary clerks, switchmen and executives.

Prevalence of Hypertension versus Other Variables

The prevalence of hypertension in switchmen, clerks and executives does not differ markedly between occupational classes but is definitely higher than the average prevalence for all samples. Table C1.21 presents prevalence rates based on two criteria of blood pressure by age and occupation. The age-adjusted rates of hypertension defined as 95 mm. Hg or more in the fifth phase of diastole in numbers per thousand are 210, 230, 273 and 212 for switchmen, sedentary clerks, non sedentary clerks and executives respectively while the rate for all areas was

TABLE C1. 11

Cigarette smoking habits of men of the U. S. Railroad. Percentage of men who never smoked, who had stopped, who smoked 1-10, 11-20, more than 20 cigarettes daily at the time of their examination.

SAMPLE	AGE	NEVER	QUIT	1-10	11-20	MORE THAN 20
Switchmen	40-44	15.6	13.8	6.7	27.0	36.9
"	45-49	15.3	19.4	4.5	32.3	28.5
"	50-54	18.8	22.1	6.5	26.0	26.6
"	55-59	17.0	23.3	4.4	30.8	24.5
"	40-59	16.4	18.8	5.6	29.0	30.2
Sedentary Clerks	40-44	25.7	16.8	4.8	38.9	13.8
"	45-49	26.5	20.6	4.3	26.4	22.2
"	50-54	27.6	20.1	7.1	30.1	15.1
"	55-59	28.2	23.8	8.2	23.8	16.0
"	40-59	27.2	20.7	6.4	29.1	16.6
Executive	40-44	26.1	17.4	-	30.4	26.1
"	45-49	20.0	20.0	2.9	22.9	34.2
"	50-54	26.0	24.7	1.4	17.8	30.1
"	55-59	25.8	22.7	6.2	19.6	25.7
"	40-59	25.1	21.9	3.2	21.5	28.3
Non-Sedentary Clerks	40-44	22.6	19.4	6.5	38.6	12.9
"	45-49	23.1	15.4	7.7	35.9	17.9
"	50-54	21.1	15.8	7.9	39.4	15.8
"	55-59	21.3	25.5	17.0	21.3	14.9
"	40-59	21.9	19.4	10.3	32.9	15.5

TABLE C1.12

Smoking. Number of men in the U. S. Railroad below (LOW) and above (HIGH) the age-specific medians, for age and area, of measured variables, classed according to smoking habits. HEAVY = more than 20, OTHER = 1-20 cigarettes daily.

VARIABLE	SAMPLE	NON-SMOKERS		HEAVY		OTHER	
		LOW	HIGH	LOW	HIGH	LOW	HIGH
Relative Weight	Switchmen	108	185	136	115	173	116
" "	Clerks	175	234	75	68	178	126
Σ Skinfolds	Switchmen	112	181	130	122	176	114
" "	Clerks	177	233	76	67	176	129
Systolic B.P.	Switchmen	135	159	123	129	160	130
" "	Clerks	209	202	70	71	151	155
Diastolic B.P.	Switchmen	135	159	124	128	159	131
" "	Clerks	206	205	67	74	157	149
Serum Cholesterol	Switchmen	144	145	123	125	145	141
" "	Clerks	209	199	77	66	141	161

TABLE C1.13

SWITCHMEN, U.S.A.

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (282)	45-49 (241)	50-54 (153)	55-59 (159)
Total with reportable ECG Items	I - IX		56 (198.6)	58 (240.7)	37 (241.8)	45 (283.0)
Q Waves	I	1	3 (10.6)	2 (8.3)	3 (19.6)	0
		2	3 (10.6)	5 (20.7)	3 (19.6)	5 (31.4)
		3	1 (3.5)	5 (20.7)	0	1 (6.3)
Axis Deviation	II					
Left		1	4 (14.2)	3 (12.4)	4 (26.1)	3 (18.9)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	1 (3.5)	6 (24.9)	3 (19.6)	3 (18.9)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	0	1 (6.5)	0
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	0	0	0	3 (18.9)
No S-T-J plus segment downward		3	1 (3.5)	2 (8.3)	0	3 (18.9)
S-T - J 1 mm. or more, upward segment		4	0	0	0	0
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	0
- 1 mm. to -5 mm.		2	1 (3.5)	1 (4.1)	1 (6.5)	2 (12.6)
0 ± 1 mm.		3	7 (24.8)	5 (20.7)	5 (32.7)	8 (50.3)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	0	0	1 (6.5)	3 (18.9)
Accelerated Conduction		4	2 (7.1)	2 (8.3)	0	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	2 (13.2)	0
Right Bundle		2	0	2 (8.3)	3 (19.9)	3 (18.9)
Incomplete Right Bundle		3	5 (17.7)	1 (4.1)	3 (19.9)	3 (18.9)
Intraventricular Block		4	0	1 (4.1)	0	0
Arrhythmias	VIII					
Premature Beats		1	0	3 (12.4)	0	0
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	0	0
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	0	0
Sinus tachycardia		7	3 (10.6)	3 (12.4)	0	3 (18.9)
Sinus bradycardia		8	3 (10.6)	1 (4.1)	4 (26.5)	2 (12.6)
Technically poor records	IX	8	0	4 (16.7)	0	0

TABLE C1.14

SWITCHMEN, U.S.A.

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (278)	45-49 (233)	50-54 (141)	55-59 (143)
Exercise tests not made or	X 1				
incomplete	X 2	4 (14.2)	8 (33.2)	12 (78.4)	16 (100.6)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	0	1 (4.2)	0	1 (7.0)
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	2 (7.1)	5 (21.5)	2 (14.2)	1 (7.0)
No S-T-J plus segment downward	3	0	0	0	0
S-T - J 1 mm. or more, upward					
segment	4	0	3 (12.9)	2 (14.2)	2 (14.0)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	2 (8.6)	1 (7.1)	0
0 ± 1 mm.	3	1 (3.6)	0	0	1 (7.0)
Arrhythmias post-exercise	XV				
(none at rest)	1	0	2 (8.6)	0	1 (7.0)
Technically poor post-exercise					
records	XI 8	6 (21.6)	5 (21.5)	6 (42.6)	7 (49.0)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

At Rest					
Large Q Waves	I 1	3 (10.6)	2 (8.3)	3 (19.6)	0
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	0	0	0	0
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	0
Other Negative T as sole	V 2, 3				
anomaly	only	6 (21.3)	2 (8.3)	3 (19.6)	5 (31.4)
S-T Depression as sole	IV 1-4				
anomaly	only	1 (3.5)	1 (4.1)	0	2 (12.6)
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	0	0	1 (6.5)	1 (6.3)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	0	3 (12.4)	5 (32.7)	3 (18.9)
Arrhythmias	VIII 2-6	0	0	0	0
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	2 (7.1)	6 (25.8)	3 (21.3)	3 (21.0)
Negative T as sole	XII 1-3				
anomaly	only	0	0	0	0
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	0
Arrhythmias	XV 1				
as sole anomaly	only	0	2 (8.6)	0	1 (7.0)

TABLE C1.15

SEDENTARY CLERKS, U.S.A.

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (165)	45-49 (184)	50-54 (234)	55-59 (264)
Total with reportable ECG Items	I - IX		28 (169.7)	37 (201.1)	62 (265.0)	66 (250.0)
Q Waves	I	1	1 (6.1)	2 (10.9)	1 (4.3)	6 (22.7)
		2	1 (6.1)	0	3 (12.8)	5 (18.9)
		3	0	0	1 (4.3)	9 (34.1)
Axis Deviation	II					
Left		1	4 (24.2)	7 (38.0)	8 (34.2)	16 (60.6)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	3 (18.2)	4 (21.7)	10 (42.7)	12 (45.5)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	0	1 (4.3)	6 (22.7)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	2 (12.1)	0	6 (25.6)	3 (11.4)
No S-T-J plus segment downward		3	0	0	2 (8.5)	1 (3.8)
S-T - J 1 mm. or more, upward segment		4	0	1 (5.4)	0	1 (3.8)
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	1 (3.8)
- 1 mm. to -5 mm.		2	2 (12.1)	2 (10.9)	5 (21.4)	7 (26.5)
0 ± 1 mm.		3	3 (18.2)	3 (16.3)	4 (17.1)	13 (49.2)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	0	0	1 (4.3)	1 (3.8)
Accelerated Conduction		4	1 (6.1)	0	1 (4.3)	3 (11.4)
Ventricular Blocks	VII					
Left Bundle		1	1 (6.1)	0	6 (25.6)	2 (7.6)
Right Bundle		2	0	0	0	2 (7.6)
Incomplete Right Bundle		3	1 (6.1)	2 (10.9)	1 (4.3)	4 (15.2)
Intraventricular Block		4	0	0	0	1 (3.8)
Arrhythmias	VIII					
Premature Beats		1	0	2 (10.9)	1 (4.3)	6 (22.7)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	1 (4.3)	3 (11.4)
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	1 (6.1)	0	0	0
Sinus tachycardia		7	4 (24.2)	3 (16.3)	6 (25.6)	10 (37.9)
Sinus bradycardia		8	2 (12.1)	1 (5.4)	2 (8.5)	0
Technically poor records	IX	8	0	2 (10.9)	2 (8.5)	1 (3.8)

TABLE C1. 16

SEDENTARY CLERKS, U. S. A.

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (159)	45-49 (176)	50-54 (209)	55-59 (219)
Exercise tests not made or	X . 1				
incomplete	X 2	6 (36.4)	8 (43.5)	25 (106.8)	45 (170.5)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	0	2 (11.4)	2 (9.6)	4 (18.3)
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	1 (6.3)	3 (17.0)	1 (4.8)	7 (32.0)
No S-T-J plus segment downward	3	1 (6.3)	1 (5.7)	0	1 (4.6)
S-T - J 1 mm. or more, upward					
segment	4	5 (31.4)	5 (28.4)	9 (43.1)	11 (50.2)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	2 (11.4)	1 (4.8)	2 (9.1)
0 ± 1 mm.	3	1 (6.3)	2 (11.4)	1 (4.8)	5 (22.8)
Arrhythmias post-exercise	XV				
(none at rest)	1	0	2 (11.4)	0	1 (4.6)
Technically poor post-exercise					
records	XI 8	5 (31.4)	11 (62.5)	7 (33.5)	12 (54.8)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

ECG FINDING	ECG Code	40-44 (159)	45-49 (176)	50-54 (209)	55-59 (219)
At Rest					
Large Q Waves	I 1	1 (6.1)	2 (10.9)	1 (4.3)	6 (22.7)
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	0	0	0	1 (3.8)
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	0
Other Negative T as sole	V 2, 3				
anomaly	only	3 (18.2)	5 (27.2)	2 (8.5)	5 (18.9)
S-T Depression as sole	IV 1-4				
anomaly	only	0	1 (5.4)	4 (17.1)	1 (3.8)
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	0	0	1 (4.3)	3 (11.4)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	1 (6.1)	0	6 (25.6)	5 (18.9)
Arrhythmias	VIII 2-6	1 (6.1)	0	1 (4.3)	3 (11.4)
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	6 (37.7)	6 (34.1)	11 (52.6)	13 (59.4)
Negative T as sole	XII 1-3				
anomaly	only	1 (6.3)	2 (11.4)	3 (14.4)	6 (27.4)
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	0
Arrhythmias	XV 1				
as sole anomaly	only	0	1 (5.7)	2 (9.6)	2 (9.1)

TABLE CI. 17

EXECUTIVES, U.S.A.

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (46)	45-49 (35)	50-54 (73)	55-59 (96)
Total with reportable ECG Items	I - IX		6 (130.4)	8 (228.6)	23 (315.1)	33 (343.8)
Q Waves	I	1	1 (21.7)	1 (28.6)	1 (13.7)	1 (10.4)
		2	0	1 (28.6)	4 (54.8)	4 (41.7)
		3	0	0	2 (27.4)	0
Axis Deviation	II					
Left		1	1 (21.7)	0	3 (41.1)	6 (62.5)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	0	0	1 (13.7)	2 (20.8)
Right type		2	0	1 (28.6)	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	1 (28.6)	0	0
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	0	0	1 (13.7)	0
No S-T-J plus segment downward		3	0	0	1 (13.7)	3 (31.2)
S-T - J 1 mm. or more, upward segment		4	0	0	1 (13.7)	0
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	1 (28.6)	0	0
- 1 mm. to -5 mm.		2	0	0	1 (13.7)	1 (10.4)
0 ± 1.mm.		3	1 (21.7)	0	3 (41.1)	4 (41.7)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	0	0	0	0
Accelerated Conduction		4	0	0	0	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	1 (10.4)
Right Bundle		2	0	0	1 (13.7)	2 (20.8)
Incomplete Right Bundle		3	0	0	2 (27.4)	1 (10.4)
Intraventricular Block		4	0	0	1 (13.7)	2 (20.8)
Arrhythmias	VIII					
Premature Beats		1	0	0	0	3 (31.2)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	0	0
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	0	0
Sinus tachycardia		7	0	0	2 (27.4)	1 (10.4)
Sinus bradycardia		8	0	1 (28.6)	0	2 (20.8)
Technically poor records	IX	8	0	1 (28.6)	0	1 (10.4)

TABLE C1.18

EXECUTIVES, U.S.A.

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

		AGE GROUP (Number of Men)			
ECG FINDING	ECG Code	40-44 (45)	45-49 (33)	50-54 (68)	55-59 (81)
Exercise tests not made or	X 1				
incomplete	X 2	1 (21.7)	2 (57.1)	5 (68.5)	15 (156.2)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	0	0	2 (29.4)	2 (24.7)
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	0	0	1 (14.7)	2 (24.7)
No S-T-J plus segment downward	3	0	0	0	0
S-T - J 1 mm. or more, upward					
segment	4	0	0	2 (29.4)	3 (37.0)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	1 (12.3)
-1 to -5 mm.	2	0	0	0	1 (12.3)
0 ± 1 mm.	3	0	0	1 (14.7)	1 (12.3)
Arrhythmias post-exercise	XV				
(none at rest)	1	0	0	0	1 (12.3)
Technically poor post-exercise					
records	XI 8	0	2 (60.6)	1 (14.7)	4 (49.4)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

At Rest					
Large Q Waves	I 1	1 (21.7)	1 (28.6)	1 (13.7)	1 (10.4)
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	0	0	0	1 (10.4)
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	0
Other Negative T as sole	V 2, 3				
anomaly	only	1 (21.7)	0	0	1 (10.4)
S-T Depression as sole	IV 1-4				
anomaly	only	0	0	0	1 (10.4)
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	0	0	1 (13.7)	0
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	0	0	2 (27.4)	5 (52.1)
Arrhythmias	VIII 2-6	0	0	0	0
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	0	0	3 (44.1)	5 (61.7)
Negative T as sole	XII 1-3				
anomaly	only	0	0	0	2 (24.7)
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	2 (24.7)
Arrhythmias	XV 1				
as sole anomaly	only	0	0	0	0

TABLE C1.19

NON-SEDENTARY CLERKS, U.S.A.

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (32)	45-49 (39)	50-54 (38)	55-59 (46)
Total with reportable ECG Items	I - IX		10 (312.5)	9 (230.8)	14 (368.4)	23 (500.0)
Q Waves	I	1	0	1 (25.6)	1 (26.3)	0
		2	1 (31.2)	0	1 (26.3)	1 (21.7)
		3	1 (31.2)	0	2 (52.6)	0
Axis Deviation	II					
Left		1	0	1 (25.6)	1 (26.3)	3 (65.2)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	2 (62.5)	2 (51.3)	3 (78.9)	3 (65.2)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	1 (31.2)	0	0	0
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	0	0	0	2 (43.5)
No S-T-J plus segment downward		3	0	0	1 (26.3)	1 (21.7)
S-T - J 1 mm. or more, upward segment		4	0	0	0	0
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	1 (21.7)
- 1 mm. to -5 mm.		2	2 (62.5)	0	1 (26.3)	1 (21.7)
0 ± 1 mm.		3	0	0	2 (52.6)	0
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	0	1 (25.6)	1 (26.3)	1 (21.7)
Accelerated Conduction		4	0	0	0	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	0
Right Bundle		2	0	0	0	4 (87.0)
Incomplete Right Bundle		3	1 (31.2)	0	1 (26.3)	0
Intraventricular Block		4	0	1 (25.6)	2 (52.6)	0
Arrhythmias	VIII					
Premature Beats		1	0	0	0	3 (65.2)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	0	1 (21.7)
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	0	0
Sinus tachycardia		7	1 (31.2)	0	2 (52.6)	1 (21.7)
Sinus bradycardia		8	1 (31.2)	0	0	0
Technically poor records	IX	8	1 (31.2)	0	0	1 (21.7)

TABLE C1.20

NON-SEDENTARY CLERKS, U.S.A.

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

		AGE GROUP (Number of Men)			
ECG FINDING	ECG Code	40-44 (30)	45-49 (38)	50-54 (30)	55-59 (41)
Exercise tests not made or incomplete	X 1 X . 2	2 (62.5)	1 (25.6)	8 (210.5)	5 (108.7)
S-T Depression post-exercise (none at rest)	XI				
S-T - J 1 mm. or more, horiz. or downward segment	1	0	0	1 (33.3)	2 (48.8)
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	2 (66.7)	0	2 (66.7)	1 (24.4)
No S-T-J plus segment downward	3	0	0	0	0
S-T - J 1 mm. or more, upward segment	4	0	2 (52.6)	1 (33.3)	0
T Wave Negativity post-exercise (none at rest)	XII				
-5 mm. or more	1	0	0	1 (33.3)	0
-1 to -5 mm.	2	0	0	0	1 (24.4)
0 $\pm$ 1 mm.	3	0	0	0	0
Arrhythmias post-exercise	XV				
(none at rest)	1	0	0	1 (33.3)	2 (48.8)
Technically poor post-exercise records	XI 8	1 (33.3)	1 (26.3)	2 (66.7)	1 (24.4)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

At Rest					
Large Q Waves	I 1	0	1 (25.6)	1 (26.3)	0
Lesser Q Waves with Negative T Waves	I 2, 3 + V 1, 2	2 (62.5)	0	0	0
Deeply Negative T as sole anomaly	V 1 only	0	0	0	0
Other Negative T as sole anomaly	V 2, 3 only	0	0	1 (26.3)	0
S-T Depression as sole anomaly	IV 1-4 only	0	0	0	2 (43.5)
High Amplitude R with S-T Depression	III 1 + IV 1-4	0	0	0	1 (21.4)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	0	1 (25.6)	2 (52.6)	4 (87.0)
Arrhythmias	VIII 2-6	0	0	0	1 (21.4)
Post-exercise					
S-T Depression as sole anomaly	XI 1-4 only	1 (33.3)	1 (26.3)	1 (33.3)	2 (48.8)
Negative T as sole anomaly	XII 1-3 only	1 (33.3)	2 (52.6)	3 (100.0)	6 (146.3)
Ventricular Conduction Defect as sole anomaly	XIV 1, 2, 4 only	0	0	0	0
Arrhythmias as sole anomaly	XV 1 only	0	1 (26.3)	2 (66.7)	2 (48.8)

TABLE Cl. 21

Prevalence of diastolic hypertension (95 or more, 100 or more mm Hg, fifth phase) among men classed by age. Percentage of U.S. railway men who are hypertensive, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm
U.S. Switchmen	14.2	9.6	20.6	14.0	22.2	15.0	27.0	20.8
U.S. Sedentary clerks	19.8	12.6	21.2	12.0	26.4	17.6	24.6	17.5
U.S. Non- " "	9.7	3.2	17.9	5.1	36.8	28.9	44.7	27.7
U.S. Executives	13.0	8.7	8.6	5.7	42.3	28.2	21.1	13.7
Mean, 18 samples	13.6	7.9	15.6	8.9	20.9	13.5	21.5	13.8

TABLE Cl. 22

Prevalence of overweight (110 or more and 120 or more per cent of "standard" average for height and age). Percentage of U.S. railway men classed by age, who are overweight, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	110%	120%	110%	120%	110%	120%	110%	120%
U.S. Switchmen	39.9	15.0	31.8	11.7	38.0	9.3	36.1	11.0
U.S. Sedentary clerks	28.8	9.2	22.1	6.6	29.9	10.7	24.5	10.3
U.S. Non- " "	38.7	29.0	28.2	5.1	34.2	18.4	29.8	17.0
U.S. Executives	32.6	4.3	22.9	2.9	31.6	8.2	20.6	8.2
Mean, 18 samples	20.9	8.4	19.4	6.9	18.1	6.7	16.8	7.3

179. Details of the comparisons between occupations will be presented below.

The distribution of hypertensive switchmen, sedentary clerks and executives (95 mm. or more in the fifth phase of diastole) into age specific decile classes of relative body weight, Σ skinfolds and serum cholesterol concentrations are presented in Figures C1.5, C1.6 and C1.7. Distributions were prepared for non-sedentary clerks but the small numbers resulted in highly variable prevalence rates in the decile groups. For this reason, the non-sedentary clerks have been omitted from the analysis. If one considers the lower 20 % and the upper 20 % of the relative body weight distribution, the per cent frequencies show 3.3, 3.2 and 2.7 fold increases for switchmen, clerks and executives respectively. These are all highly significant increases of the prevalence of hypertension with increasing relative body weight. Chisquare values are for switchmen (25.33), sedentary clerks (28.06) and executives (4.72). However, the rise of prevalence of hypertension with increasing obesity as measured by the sum of the skinfolds was significant for switchmen (chi-square 22.63) and sedentary clerks (chi-square 14.21) but not for executives. The prevalence of hypertension increased with increasing serum cholesterol only in switchmen where the chi-square was highly significant (chi-square 7.49, $p<0.01$). In executives there was a definite trend toward more frequent hypertension among men with high serum cholesterol concentration but the significance is doubtful (chi-square 2.56, $p>0.10$). Since there is no difference between sedentary clerks and switchmen (Table C1.28) or sedentary clerks and executives (Table C1.29), and there is no age trend in serum cholesterol concentration, it would appear to be permissible to pool all occupations. When this is done it is found that the men in the upper 20 % of the cholesterol concentration distributions have 69 % more cases of hypertension than those in the lower 20 %, and this is highly significant (chi-square 12.23, $p<0.0005$).

Overweight vs. Other Variables

The prevalence of overweight as defined by 110 % or more and 120 % or more of expected weight for height and age is presented in Table C1.22 for the four occupations by five year age groups. The average prevalence rate for the 18 samples is included for purposes of comparison.

Overweight (relative body weight of 110 % or more) was most common (36.5 %) among switchmen and least common among sedentary clerks (26.3 %). Executives (26.9 %) did not differ from the sedentary or the non-sedentary clerks (32.7 %). By this criterion the tendency of the switchmen to be heavier than the sedentary clerks is statistically highly significant. The prevalence of overweight in non-sedentary clerks tends to be greater than in sedentary clerks but the statistical significance is doubtful.

The prevalences of overweight (defined as a relative body weight of 110 % or more) by deciles of the other variables are presented in Figures C1.8, C1.9 and C1.10. Inspection of the figures reveals that the prevalence of overweight tends to increase with increasing systolic and diastolic blood pressure for all occupations. Chi-square tests of the difference in prevalence found in the lower two deciles and the upper two show the increase in prevalence of overweight among switchmen is highly significant with increasing systolic blood pressure (chi-square 33.15) and diastolic blood pressure (chi-square 17.84). Similar values were found for sedentary clerks (systolic blood pressure, chi-square 21.58;

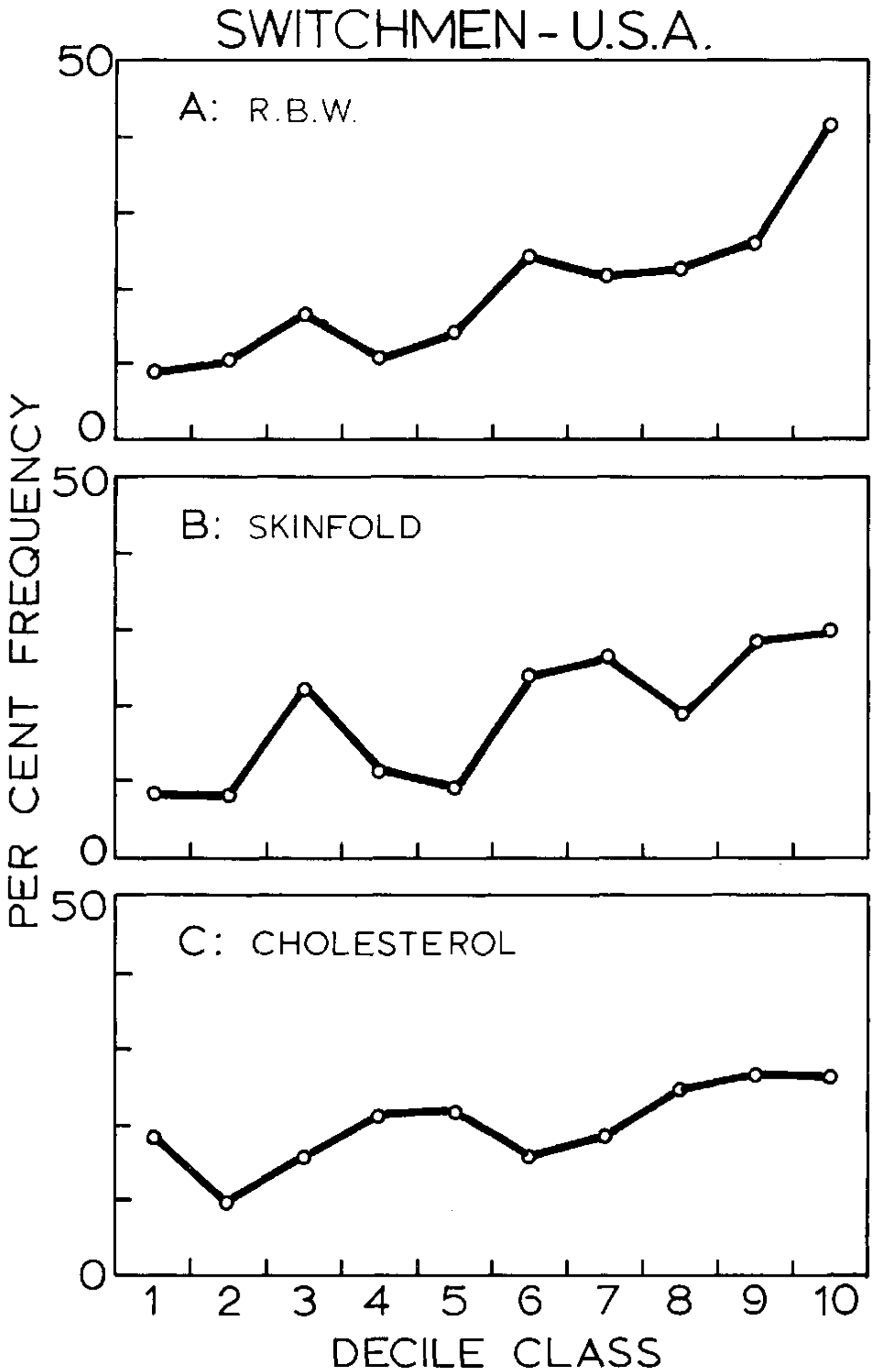

SWITCHMEN - U.S.A.
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
50
0
50
0
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C1.5

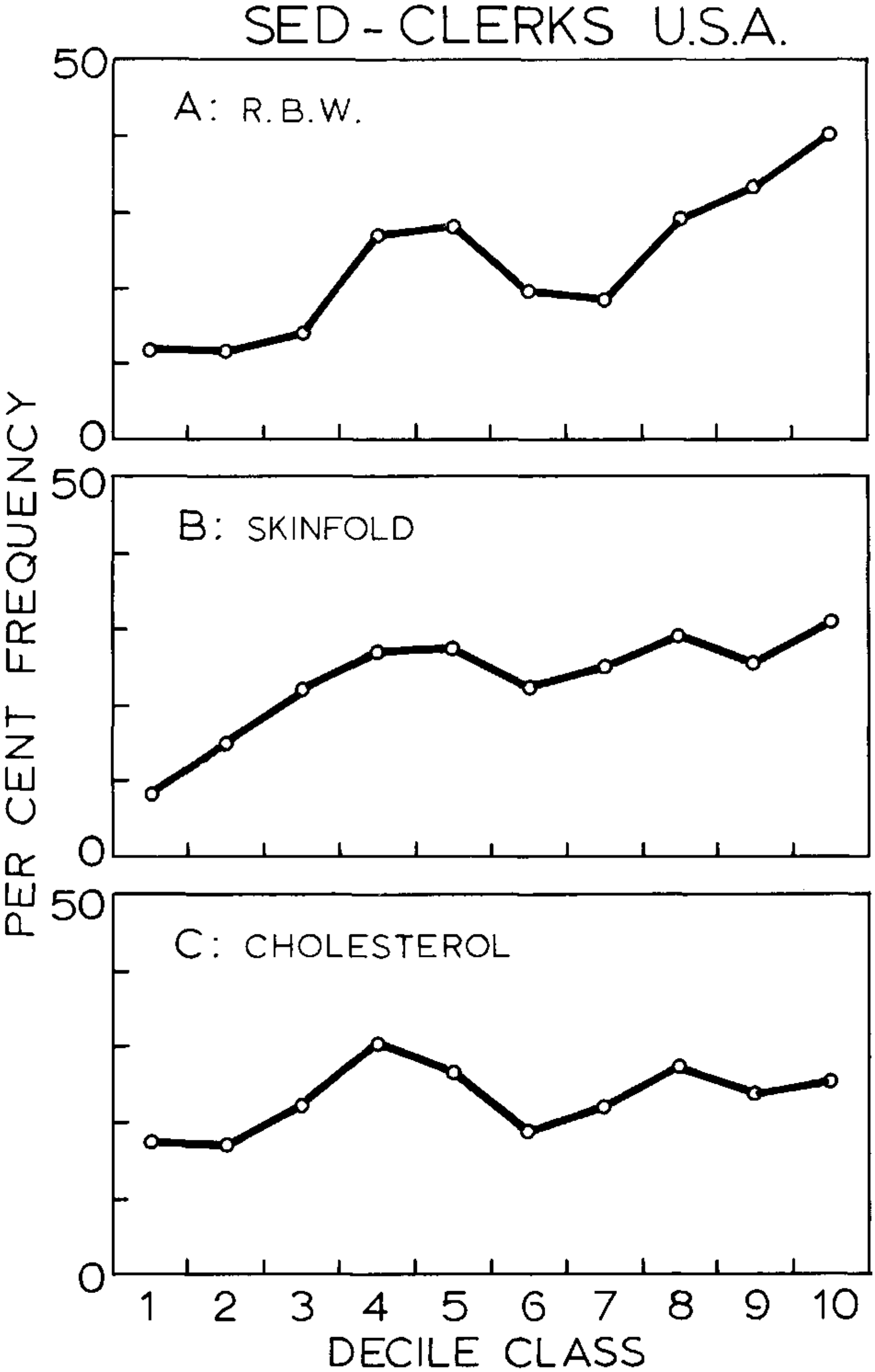

SED - CLERKS U.S.A.
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C1. 6

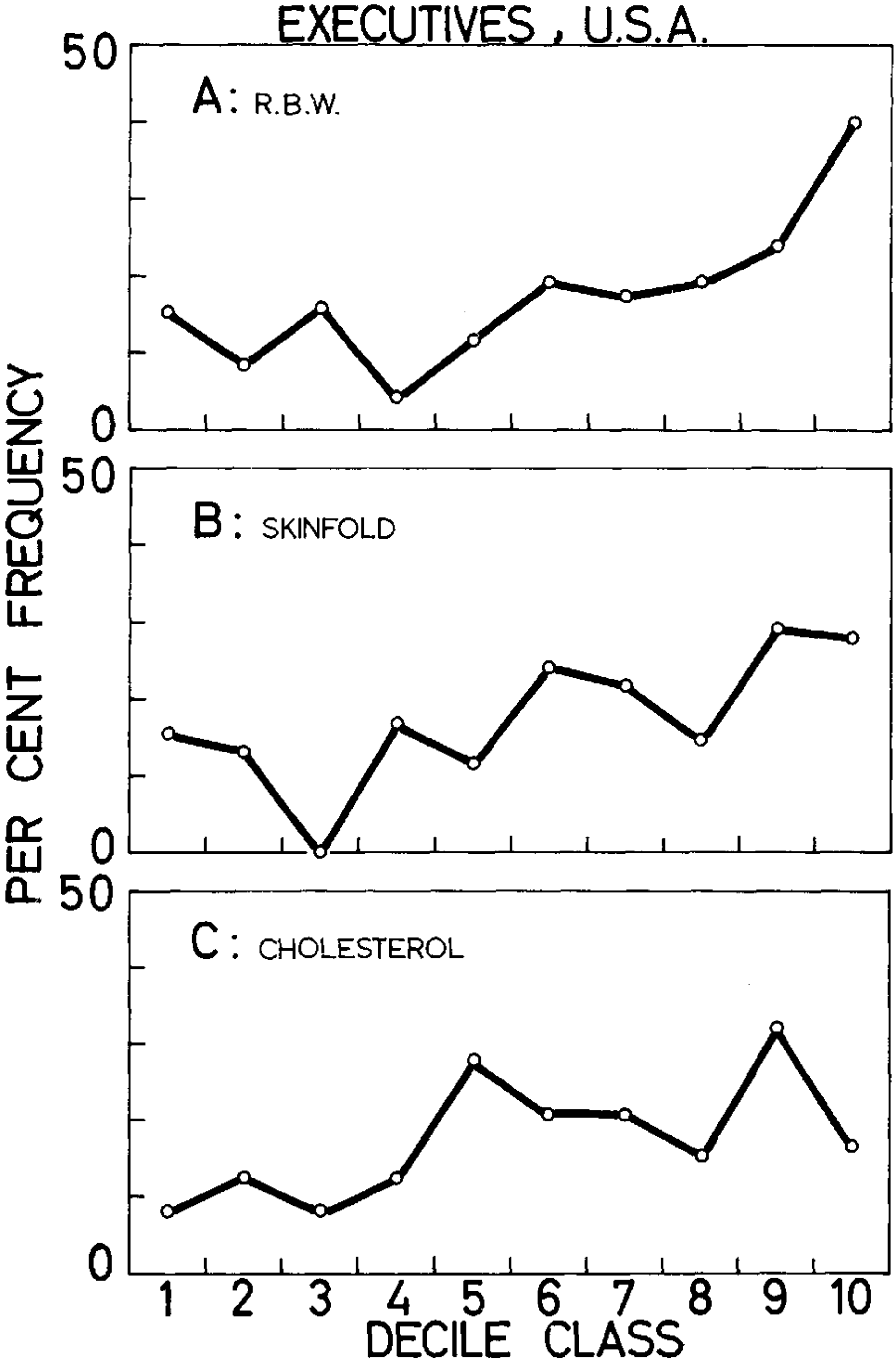

EXECUTIVES, U.S.A.
PER CENT FREQUENCY
50
0
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C1.7

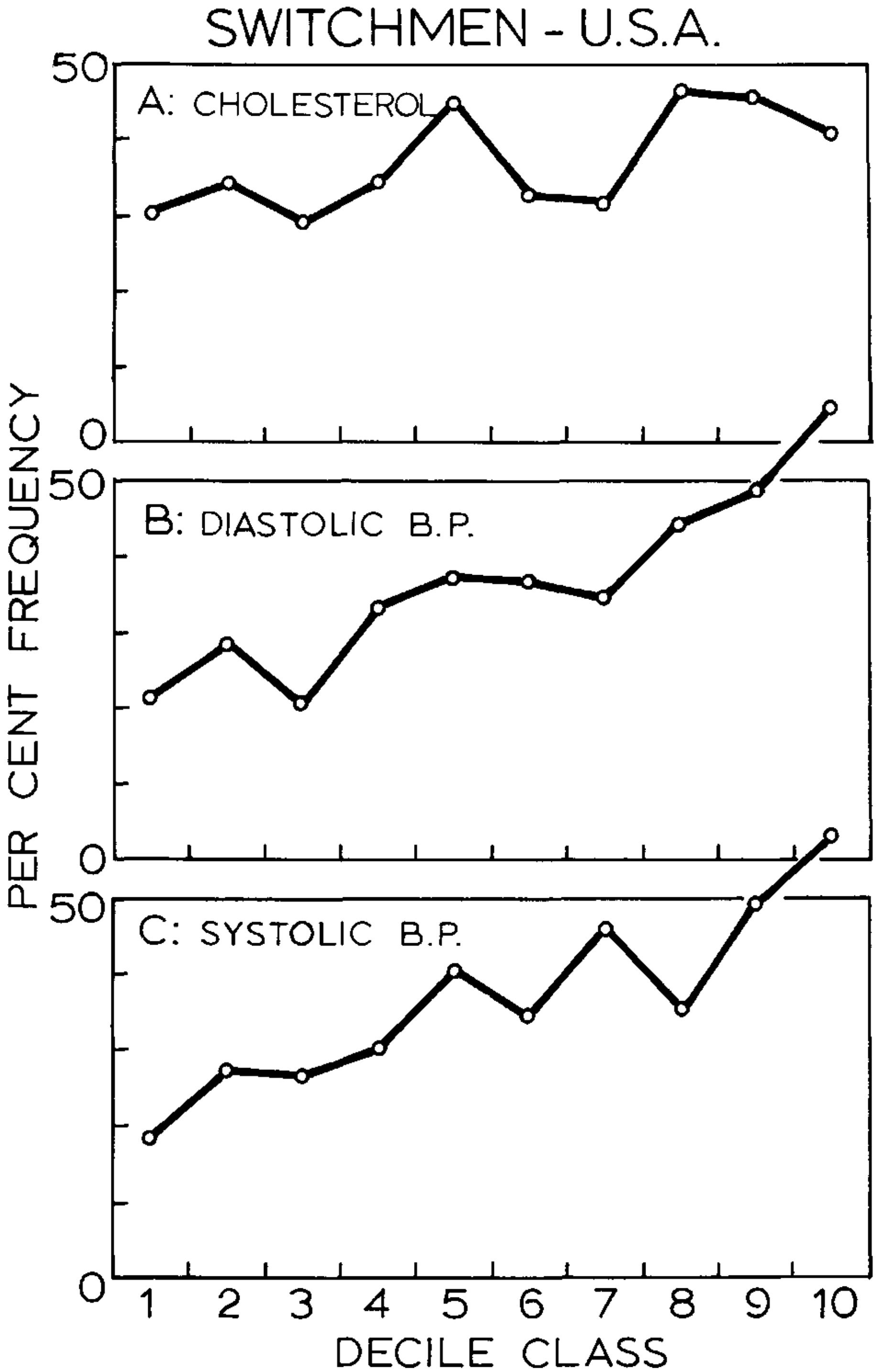

SWITCHMEN - U.S.A.
A: CHOLESTEROL
B: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C1.8

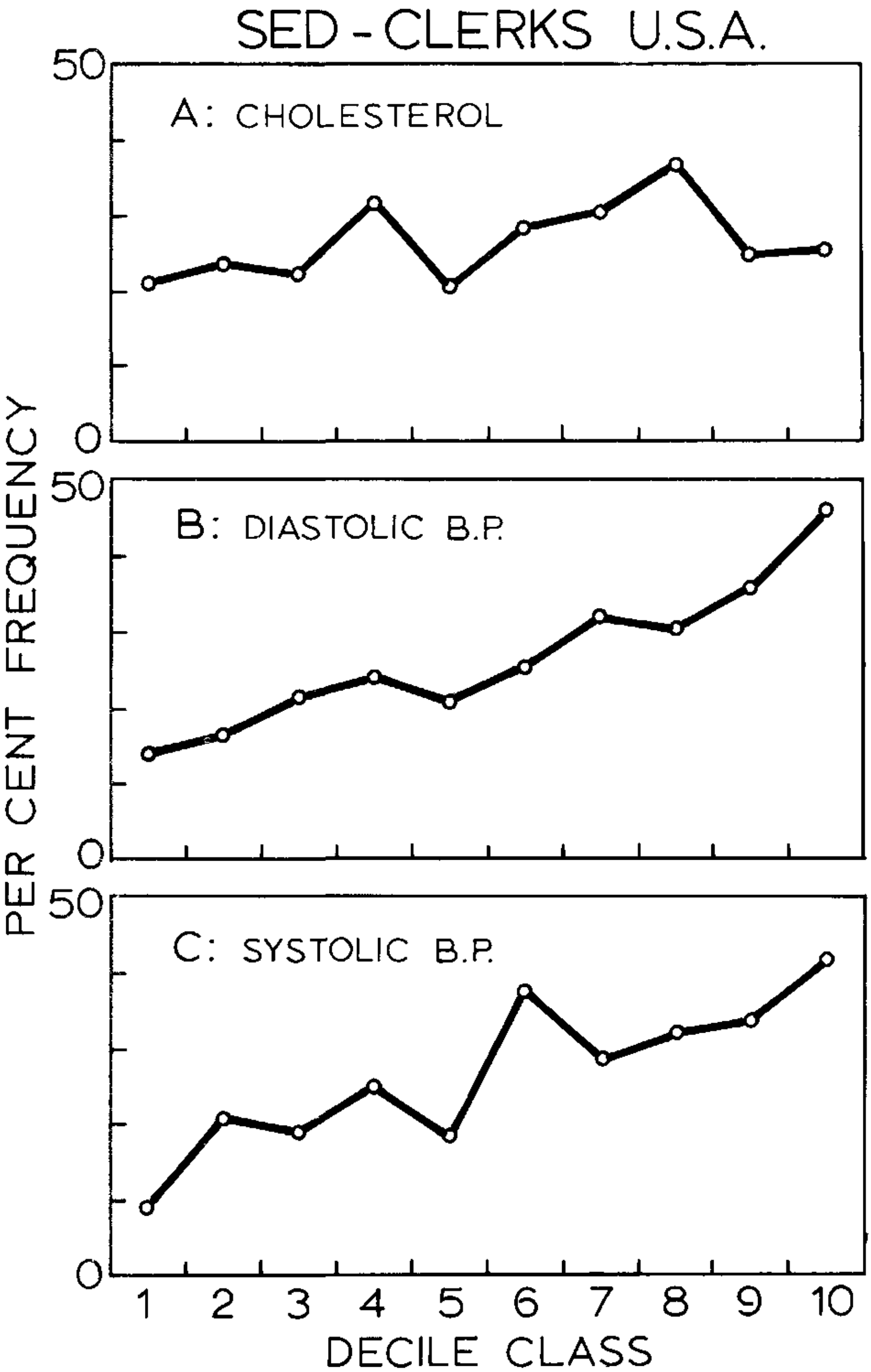

SED - CLERKS U.S.A.
A: CHOLESTEROL
B: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C1. 9

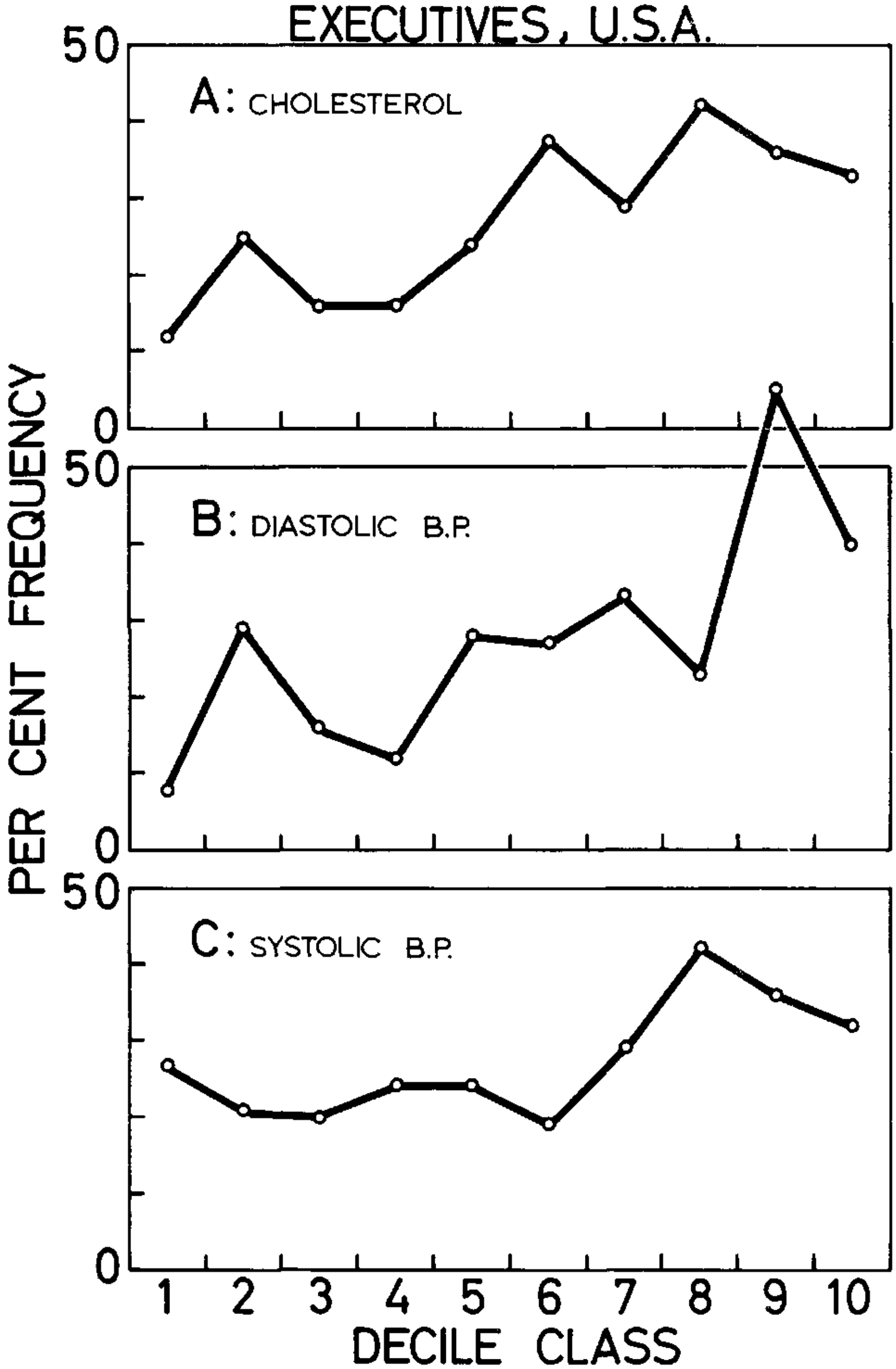

EXECUTIVES, U.S.A.
50
A: CHOLESTEROL
0
50
B: DIASTOLIC B.P.
0
50
C: SYSTOLIC B.P.
0
PER CENT FREQUENCY
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C1. 10

diastolic blood pressure, chi-square 26.72), but in the executives the prevalence of overweight shows a significant increase from the low to the high end of the distribution only in diastolic pressure (chi-square 10.03). On the other hand, the only increase in overweight with increasing cholesterol concentration in any of the occupations which approached statistical significance was found in the switchmen (chi-square 3.73, $p>0.05$).

Differences in Measured Variables between Areas within Occupations

The men in this study were examined at 27 separate locations. Five locations were in the Milwaukee-Chicago area (I) and include yards and offices that are located in the suburbs of Chicago. Area II included 13 locations. Four locations were visited in area III and three in area IV. The small numbers of locations in these areas reflect the low population density and the practice of railroad management to concentrate operations in widely separated division points in the Rocky Mountains and in the few large population centers of the West Coast. These locations are found in geographical areas differing substantially in the incidence of death from arteriosclerotic heart disease among middle-aged males. Such death rates (per year per 100,000) are highest in area IV (594.3) and lowest in area III (440.8) with areas I (535.2) and II (520.1) intermediate (Enterline and Stewart, 1956). It seemed worthwhile then to examine the differences in the distributions of the personal characteristics related to the development of heart disease in the several geographic areas. In addition, urban centers were visited in area II whose population was in the order of magnitude of 1,000,000 and towns whose population was less than 50,000 along with communities of intermediate size.

Since the mode of living of a clerk holding a sedentary job in Olewein, Iowa (population 8,000 in 1957) is clearly quite different from a clerk holding a comparable job in a general office and commuting to work in Chicago or driving to work in heavy traffic in Minneapolis-St. Paul, the distribution of the measured variables in cities of different sizes has been examined to identify differences of consequence. In area II-B there were five locations whose populations were in the range 500,000 to 1,000,000 population. There were two locations in area II-C whose population was in the range of 50,000 to 500,000 and five in area II-C whose populations were less than 50,000.

To provide a guide to the absolute levels of the measured variables in several areas the averages of the medians of the four age groups in the geographic areas of switchmen and clerks are presented in Table Cl. 23. Comparable data for cities and towns in area I and II are presented in Table Cl. 24. The executives are not included in this analysis because of their high inter-area mobility. A more precise and detailed analysis of the differences between areas is given in Table Cl. 25. For each occupation within a geographic area, the number of men whose value of a variable was above the median for occupation and age was determined. This number is expressed in the body of the table as a ratio to the number expected (50%) and a similar ratio was computed for men found above the 80th percentile. Chi-squares were calculated and are shown where the probability of a chance occurrence is small enough to make it worthwhile. The clerks showed very few important differences. However, fewer clerks on the West Coast had skinfold thickness that were above the median for all clerks. Similar data were

TABLE Cl. 23

Averages of medians of age groups of the measured variables for sedentary clerks and switchmen in the geographical areas. Refer to Table Cl. 2 for definition of areas.

Occupation	Area	Relative Weight (per cent)	Sum of skinfolds (mm)	Blood Pressure Systolic (mm. Hg)	Blood Pressure Diastolic (mm. Hg)	Serum Cholesterol (mg. %)
Sedentary Clerks	I	101.8	33.8	137.4	88.8	233
	II	102.2	33.1	135.9	86.6	235
	III	102.9	35.0	132.6	86.8	244
	IV	101.2	29.6	136.4	90.0	236
Switchmen	I	108.8	33.1	138.9	88.8	241
	II	105.7	31.5	136.2	86.0	236
	III	99.2	27.0	130.4	84.6	235
	IV	101.4	29.6	133.6	86.5	241

TABLE Cl. 24

Averages of medians of age groups of the measured variables for sedentary clerks and switchmen in area I and II broken down into size of city as follows: area I (Chicago-Milwaukee), area II-B (cities with populations of 150,000 to 1,000,000), area II-C (cities with populations of 50,000 to 150,000) and II-D (cities with population of less than 50,000).

Occupation	Area	Relative Weight (per cent)	Sum of Skinfolds (mm)	Blood Pressure Systolic (mm. Hg)	Blood Pressure Diastolic (mm. Hg)	Serum Cholesterol (mg. %)
Sedentary Clerks	I	101.8	33.8	137.4	88.8	233
	II-B	104.2	32.6	140.9	89.9	243
	II-C	102.0	34.2	136.8	85.6	225
	II-D	97.8	32.0	132.8	84.8	244
Switchmen	I	108.8	33.1	138.9	88.8	241
	II-B	105.9	32.5	135.6	87.6	234
	II-C	105.9	33.5	135.0	88.8	233
	II-D	104.7	31.2	135.6	86.1	241

TABLE Cl. 25

The ratio of numbers of sedentary clerks or switchmen observed in each area to the number expected above the age specific median and 80th percentile as determined for all men for each of five variables. Numbers expected based on distribution of men in all areas. The chi-square values are given in parentheses. Definition of areas are presented in Table Cl. 2.

Occupation	Area	Relative Weight	Sum of Skinfolds	Blood Pressure Systolic	Blood Pressure Diastolic	Serum Cholesterol
Switchmen						
	I	1.23 (18.91)	1.12 (5.20)	1.10	1.17	1.05
Median	II	1.06	1.06	1.06	1.09	0.96
	III	0.65 (13.27)	0.69 (10.66)	0.73 (8.62)	0.79 (5.33)	0.94
	IV	0.74 (12.53)	0.89	0.93	0.93 (14.76)	1.05
	I	1.30 (7.08)	1.36 (10.57)	1.30 (6.94)	1.24 (4.28)	1.12
80th	II	1.20	1.15	0.92	1.05	1.03
Percentile	III	0.62	0.57 (4.87)	0.71	0.62 (3.83)	0.76
	IV	0.76	0.45 (14.36)	0.91	0.82	0.91
Sedentary Clerks						
	I	0.98	1.05	1.00	0.93	0.99
Median	II	1.04	1.04	1.05	1.03	0.97
	III	1.11	1.19	0.81	0.85	1.15
	IV	0.89	0.81 (8.17)	0.94	1.04	1.01
	I	1.02	1.17	1.04	0.85	1.00
80th	II	1.04	1.01	1.13	1.20	1.06
Percentile	III	1.11	1.38	0.37 (5.03)	0.65	0.93
	IV	0.81	0.61 (7.77)	0.92	0.94	0.92

obtained when the 80th percentile for all clerks was applied to those on the West Coast. In area I, switchmen were found in larger numbers than expected above the median and also above the 80th percentile when the values for both relative body weight and the sum of the skinfolds were examined. In the Rocky Mountains, the switchmen were thinner and therefore a significant deficit in numbers was found above both criteria for the sum of the skinfolds. Also there were fewer switchmen with relative body weights above the median. At the 80th percentile, only 62 % of the expected number with relative body weights above this cutting point were found but the difference failed to reach significance because of the small numbers involved. The blood pressures of switchmen in area III were lower than in the other areas. In this area, significantly fewer men than expected were found above the median value for systolic and diastolic blood pressures but only the diastolic blood pressure showed a significantly lower rate above the 80th percentile. In area I switchmen had an excess of men with blood pressures above the age and occupation specific 80th percentile. Finally switchmen on the West Coast had fewer men than expected with diastolic blood pressures above the median.

Comparisons between size of cities and towns showed no differences in the distribution of the measured variables except for an apparently accidental deficiency of clerks above the serum cholesterol median in area II-C. The data are presented in Table Cl. 26.

Table Cl. 27 presents the distribution of smoking habits in the switchmen and clerks in the several areas. The only important difference occurred in the switchmen in area III who were characterized by fewer heavy smokers (more than 20 cigarettes a day) and more non-smokers (quit and never smoked) than in the other areas.

Differences in the Measured Variables between Occupations within Areas

Inspection of the data revealed that important differences existed between sedentary clerks and switchmen in relative body weights and in skinfolds. The medians of these two variables are plotted by age and occupation for the major geographic areas in figures C1.11 and Cl. 12 while figures Cl. 13 and Cl. 14 present the data by age and occupation (areas combined) for each of the four variables. The significance of the differences is assessed by data presented in Table C1. 28. These data were developed from area and age specific distributions of the combined occupations (switchmen plus sedentary clerks). The observed and expected numbers of men above both the median and the 80th percentile (of the distribution of the combined occupations) were determined for each age group.

Switchmen had heavier relative body weights than clerks in area I and in the total for all areas. The excess in numbers of switchmen above the medians and 80th percentiles of combined occupations are statistically significant for area I (chi-square for median cut 20.64, for 80th percentile 7.79) and for the total of all areas (chi-square for median cut 14.91, for 80th percentile 5.20). While in area II the excess number of switchmen above the median yields a chi-square of 5.74, the distinction fails to appear at the 80th percentile.

On the other hand, switchmen appear to be leaner than clerks on the basis of Σ skinfold medians in the total for all areas (chi-square 4.94) but this distinction is largely accounted for by the occupational difference in the Rocky Mountain area (III) where only 39.6 % of the switchmen were found to have Σ skinfold measurements above the combined median (chi-square 9.51) and only 15.1 % above the 80th percentile

TABLE C1.26

The ratio of numbers of sedentary clerks or switchmen observed to the number expected above the age and occupation specific medians and 80th percentiles of all men for each of five variables. Areas I and (by size of city) II. Numbers expected based on distribution of men in all areas. Definitions of areas and city sizes are presented in Table C1.2.

		Relative Body Weight	Sum of Skinfolds	Blood Pressure Systolic	Blood Pressure Diastolic	Serum Chol.
Occupation	Area	Ratios Based on Median				
Sed. Clerks	I	0.96	0.99	1.00	0.98	0.99
"	II-B	1.12	0.94	1.09	1.16	1.18
"	II-C	1.21	1.13	0.98	0.94	0.69
"	II-D	0.87	0.94	0.90	0.86	1.13
Switchmen	I	1.14	1.02	1.02	1.03	1.05
"	II-B	0.94	1.00	1.03	0.93	0.96
"	II-C	0.94	1.02	0.94	1.01	0.99
"	II-D	0.97	0.86	0.96	1.00	0.92
		Ratios Based on 80th Percentile				
Sed. Clerks	I	0.95	1.10	0.97	0.85	0.92
"	II-B	0.93	0.78	1.18	1.31	1.11
"	II-C	1.03	1.00	0.85	0.91	0.86
"	II-D	0.85	1.08	1.00	1.17	1.31
Switchmen	I	1.13	1.07	1.17	1.07	1.04
"	II-B	1.77	0.85	0.97	0.94	0.97
"	II-C	1.07	1.08	0.78	1.01	0.88
"	II-D	0.83	0.92	0.67	0.83	1.18

TABLE Cl. 27

U. S. railroad area comparison of smoking habits. Observed (O) and expected (E) numbers of non-smokers, moderate and heavy smokers and chi-squares. Expected numbers based on men in all areas for each occupation and age class. Non-smoker= never and quit; moderate=10-20 cigarettes per day; heavy=more than 20.

		Switchmen				Clerks			
	Area	O	E	Ratio	Chi^2	O	E	Ratio	Chi^2
Non-smokers	I	80	91.5	0.87	n.s.	129	125.4	1.03	n.s.
	II	112	108.2	1.04	n.s.	170	174.9	0.97	n.s.
	III	47	37.4	1.26	3.88	25	25.7	0.97	n.s.
	IV	57	59.0	0.97	n.s.	87	85.3	1.02	n.s.
Moderate smokers	I	70	73.0	0.96	n.s.	81	75.5	1.07	n.s.
	II	82	89.2	0.92	n.s.	98	105.5	0.93	n.s.
	III	32	30.8	1.04	n.s.	14	16.1	0.87	n.s.
	IV	57	48.0	1.19	n.s.	57	52.9	1.08	n.s.
Heavy smokers	I	84	75.3	1.12	n.s.	37	43.4	0.85	n.s.
	II	99	95.2	1.04	n.s.	71	61.0	1.16	n.s.
	III	22	33.5	0.66	6.03	13	9.0	1.44	n.s.
	IV	48	48.9	0.98	n.s.	22	30.1	0.73	n.s.

TABLE Cl. 28

Men expected (E) and observed (o) above age and area specific medians of the combined distribution of clerks and switchmen in the geographic areas for each of five measured variables.

	Sedentary Clerks			Switchmen		
Area	E	O	O/E	E	O	O/E
Relative Body Weights						
I	128.5	102	0.79	123.5	149	1.20
II	175.0	157	0.89	150.5	164	1.09
III	26.5	30	1.13	52.0	47	0.90
IV	88.5	86	0.97	80.0	82	1.02
All	418.5	375	0.90	406.0	442	1.09
Σ Skinfolds						
I	130.0	133	1.02	125.5	121	0.96
II	180.5	187	1.04	155.0	144	0.93
III	27.0	36	1.33	53.0	42	0.79
IV	89.5	90	1.01	82.0	81	0.99
All	427.0	446	1.04	415.5	388	0.93
Systolic Blood Pressure						
I	129.5	129	1.00	125.5	124	0.99
II	181.0	192	1.06	155.0	140	0.90
III	27.0	30	1.11	53.0	48	0.91
IV	89.5	95	1.06	82.0	75	0.92
All	427.0	446	1.04	415.5	387	0.93
Diastolic Blood Pressure						
I	129.0	116	0.90	125.5	137	1.09
II	180.5	187	1.04	155.0	149	0.96
III	27.0	29	1.07	52.5	48	0.91
IV	89.5	104	1.16	82.0	70	0.85
All	426.0	436	1.02	415.0	404	0.97
Serum Cholesterol						
I	129.5	122	0.94	122.5	130	1.06
II	177.5	171	0.96	152.0	153	1.01
III	26.5	29	1.09	53.0	49	0.92
IV	88.5	84	0.95	79.5	83	1.04
All	422.0	406	0.96	407.0	415	1.02

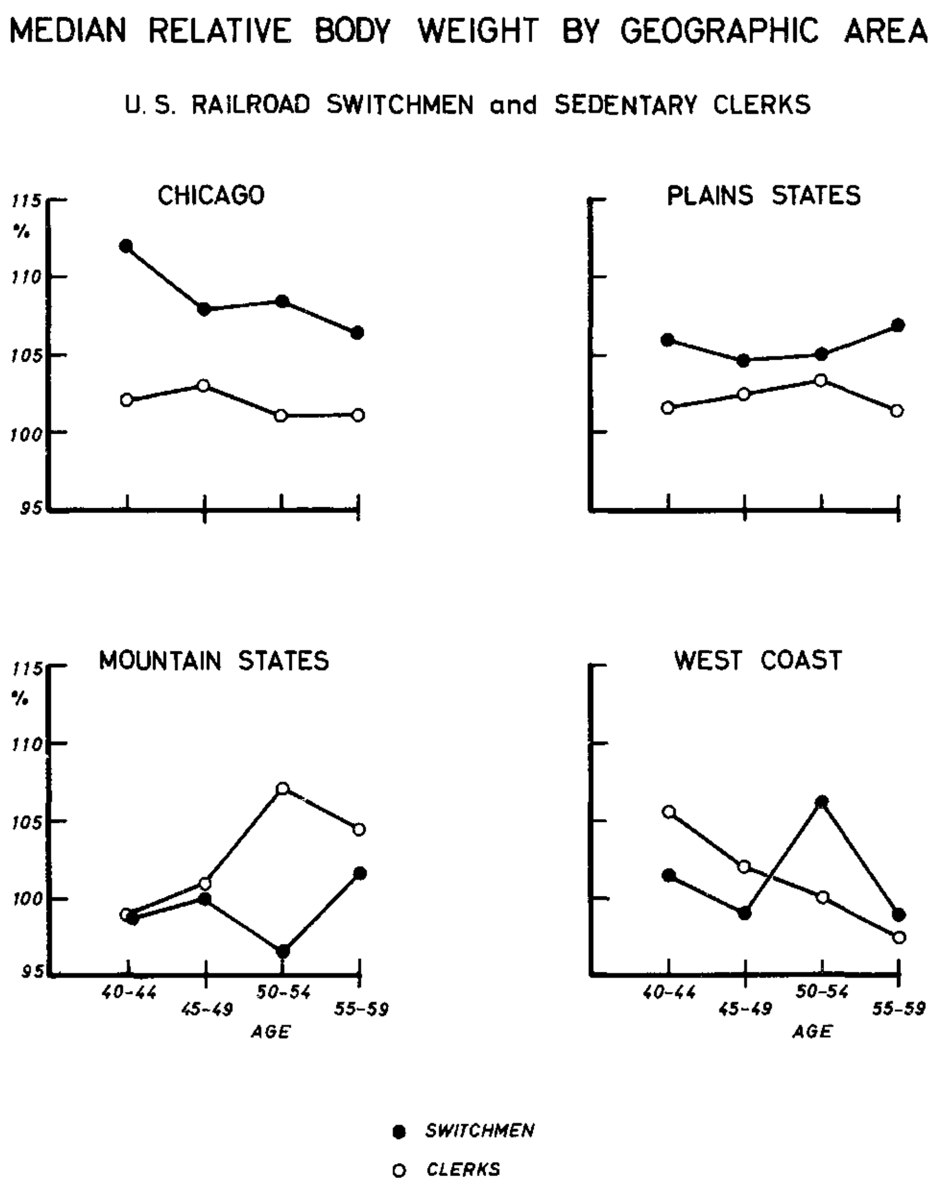

MEDIAN RELATIVE BODY WEIGHT BY GEOGRAPHIC AREA
U. S. RAILROAD SWITCHMEN and SEDENTARY CLERKS
CHICAGO
PLAINS STATES
MOUNTAIN STATES
WEST COAST
115
%
110
105
100
95
40-44
45-49
50-54
55-59
AGE
SWITCHMEN
CLERKS

Figure C1. 11

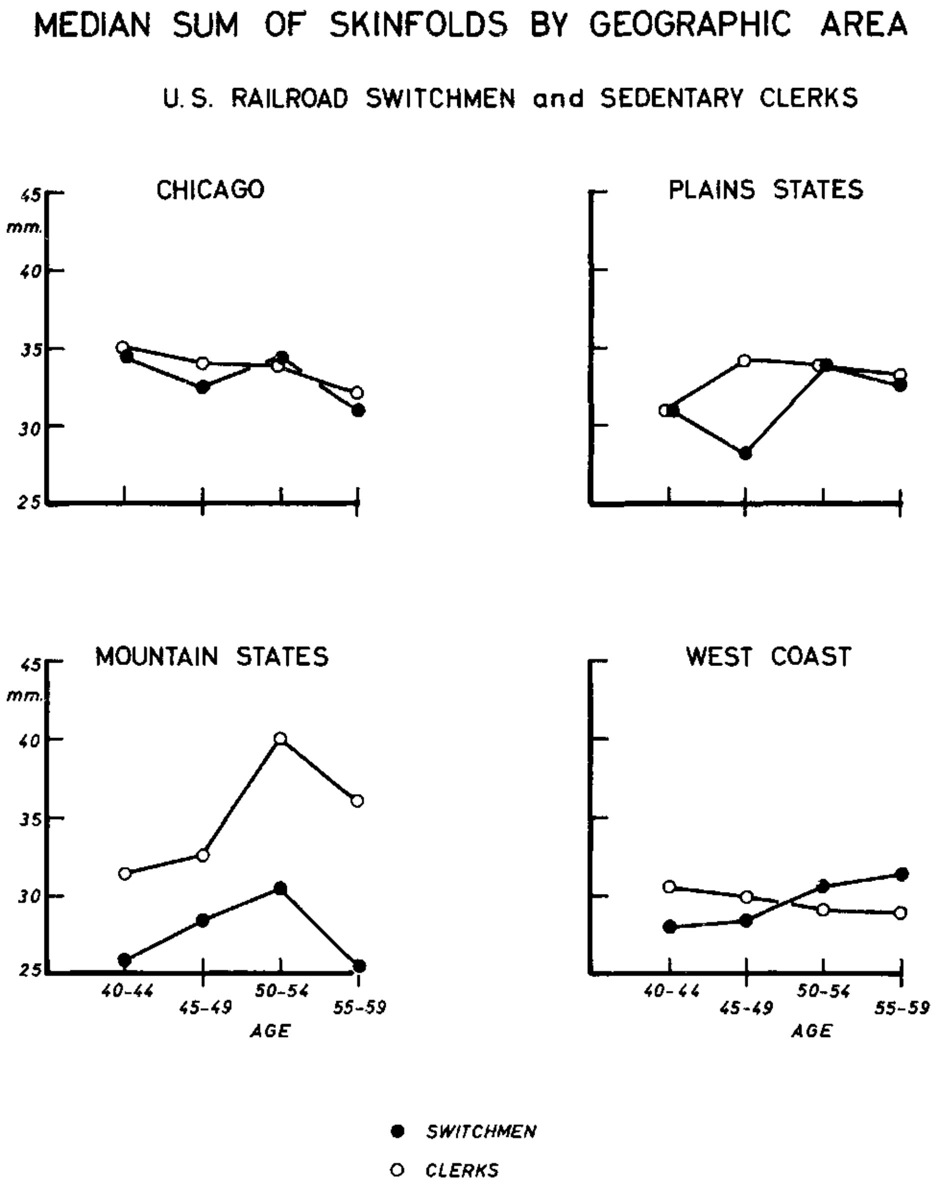

MEDIAN SUM OF SKINFOLDS BY GEOGRAPHIC AREA
U. S. RAILROAD SWITCHMEN and SEDENTARY CLERKS
CHICAGO
PLAINS STATES
MOUNTAIN STATES
WEST COAST
45
mm.
40
35
30
25
40-44
45-49
50-54
55-59
AGE
SWITCHMEN
CLERKS

Figure C1. 12

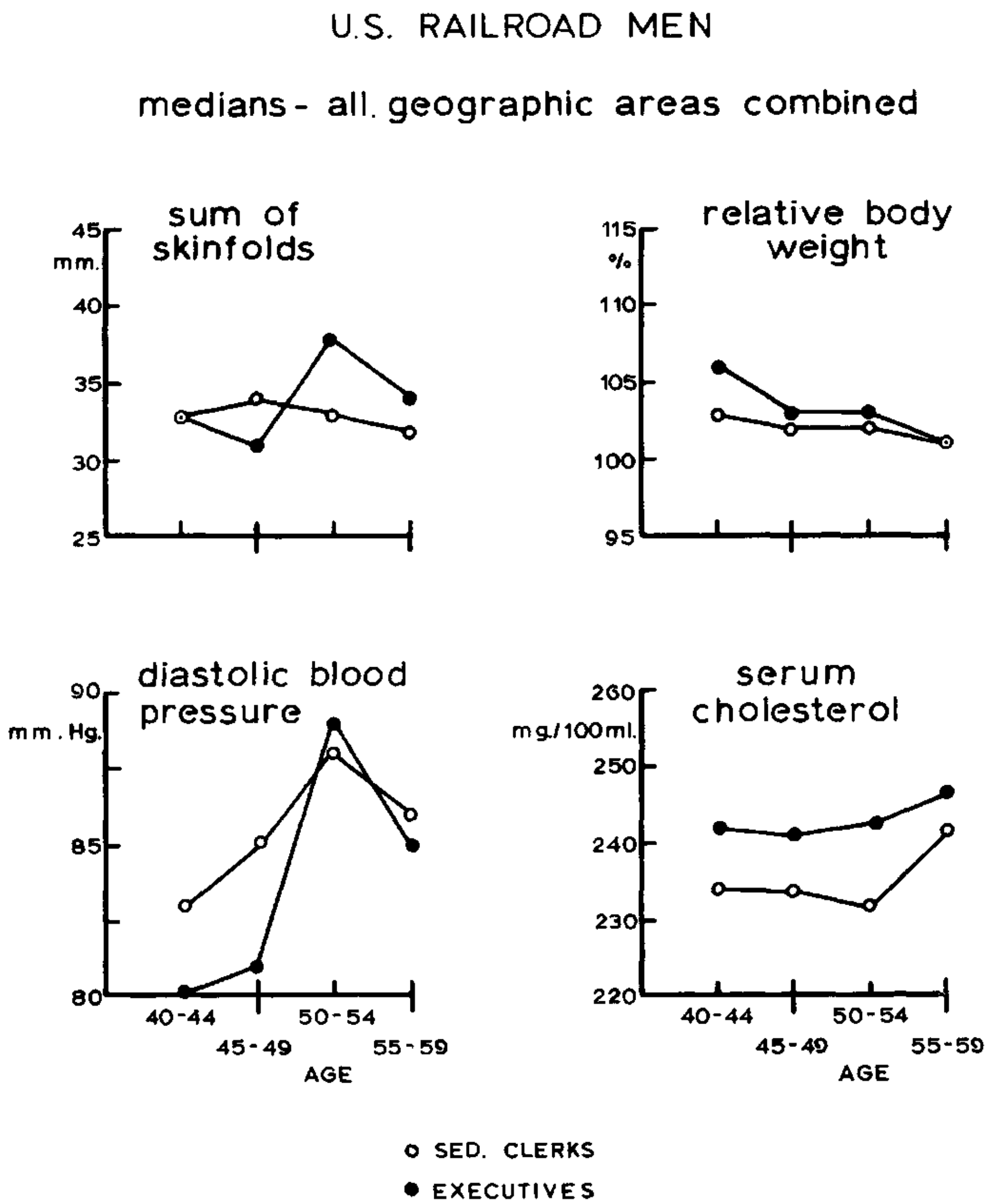

U.S. RAILROAD MEN
medians - all geographic areas combined
sum of skinfolds
45
mm.
40
35
30
25
relative body weight
115
%
110
105
100
95
diastolic blood pressure
90
mm. Hg.
85
80
40-44
45-49
50-54
55-59
AGE
serum cholesterol
260
mg./100ml.
250
240
230
220
40-44
45-49
50-54
55-59
AGE
o SED. CLERKS
● EXECUTIVES

Figure C1..13

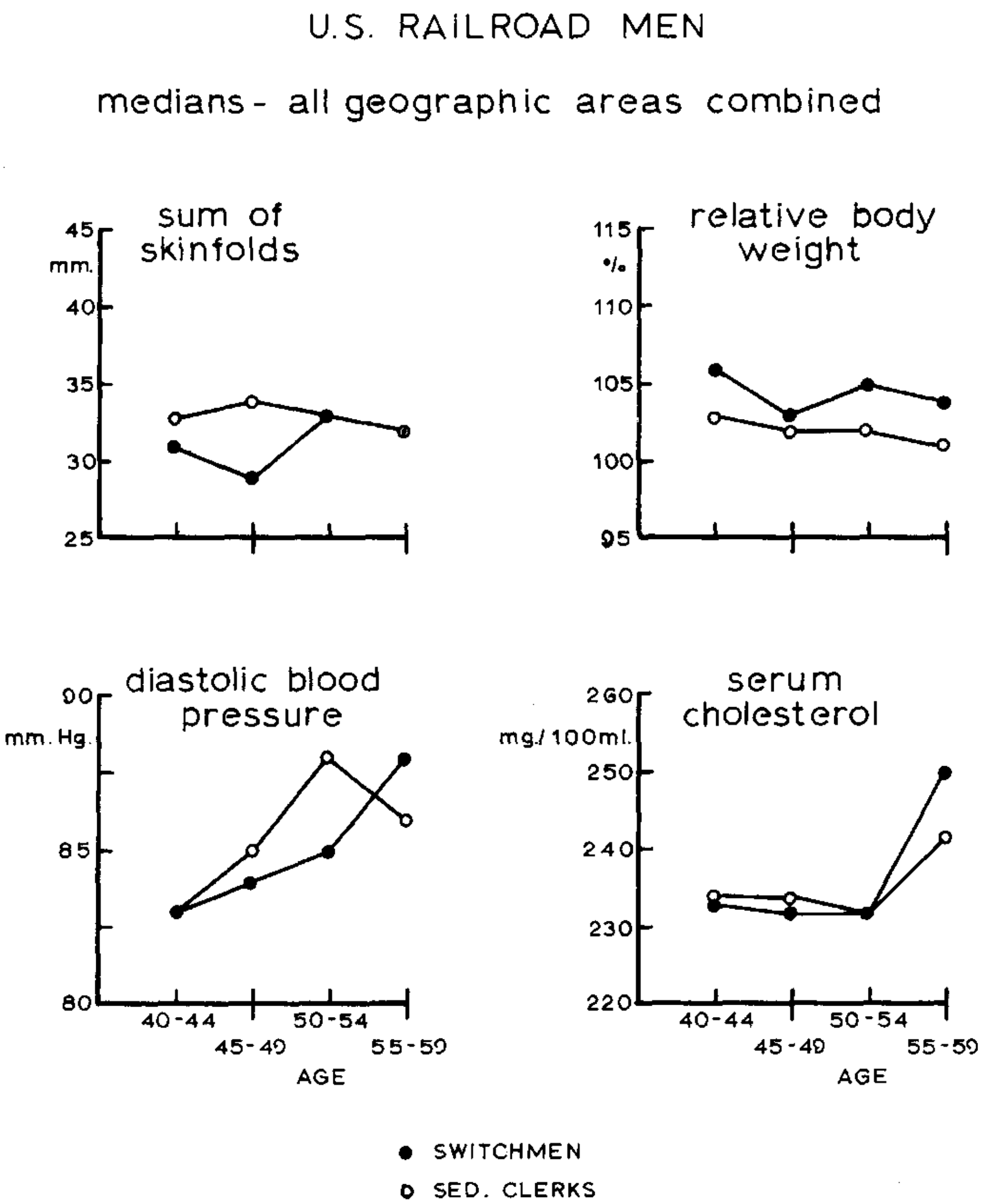

U.S. RAILROAD MEN
medians - all geographic areas combined
sum of skinfolds
mm.
45
40
35
30
25
relative body weight
%
115
110
105
100
95
diastolic blood pressure
mm. Hg.
90
85
80
serum cholesterol
mg./100ml.
260
250
240
230
220
40-44
45-49
50-54
55-59
AGE
SWITCHMEN
SED. CLERKS

Figure C1. 14

(chi-square 3.86). It is of interest to note that, contrary to the general pattern of relative body weight relationships noted in the preceding paragraph, switchmen also had lower relative body weights than clerks in area III, but the difference is not statistically significant. This, however, is consistent with the earlier observation that Rocky Mountain switchmen were noticeably lighter for their height and age than switchmen in other areas.

It is of considerable interest that removal of area III switchmen and clerks from the all area totals reduces the occupational difference to a non-significant level both at the median and 80th percentile cutting points.

In all areas, fewer than 50 % of the switchmen had systolic blood pressures above the combined median. In area II, this deficiency is statistically significant (chi-square 3.93 at median, 4.14 at 80th percentile). For all areas combined, only 41.6 % of switchmen exceed the median systolic blood pressure resulting in a chi-square value of 5.51. The distributions of diastolic blood pressures follow essentially the same pattern except for area I where switchmen seem to have somewhat higher pressures than clerks on the basis of the median cut (chi-square 4.35). There is, however, no statistical significance in the differential occurrence of diastolic hypertension (defined as values exceeding the 80th percentile) in any area.

Occupational differences in the distribution of serum cholesterol concentrations were not demonstrable though in most areas the values found among switchmen tended to be higher than those found in clerks. The one area exception was found in the Rocky Mountains (area III) where the reverse was true, but none of the differences approached statistical significance.

The observed and expected numbers about the area and age-specific medians were next combined by age and occupation (for all areas) in order to determine whether any of the occupational differences are related to age in a systematic fashion. In all age groups, less than 50 % of the clerks were found to have values of relative body weight above the combined median and less than 20 % above the 80th percentile, but these deficiencies were of statistical significance only for the youngest (age group 40—44, chi-square 5.46) and oldest (age group 55—59, chi-square 4.08) subjects. With the exception of the age group 50—54, a disproportionately large number of clerks fell above the Σ skinfold median and 80th percentile values, but statistical significance is found only in age group 45—49 (chi-square 6.87 for a median partition). Similarly, though clerks consistently had systolic blood pressures above the median and 80th percentile values more frequently than switchmen in all age groups, the tendency was statistically significant only among 50—54 year old men at the median (chi-square 4.60). With respect to diastolic blood pressures and serum cholesterol concentrations, no occupational distinctions were demonstrable.

Executives vs. Sedentary Clerks

Executives have been compared to clerks as a group without consideration of area breakdown for reasons given above. The medians of the measured variables by age of the two occupations are presented in Figure Cl. 13. The values of the medians suggested that the younger executives might have lower diastolic blood pressures than clerks and that executives might have higher serum cholesterol concentrations at all age groups. However, tests of significance of the differences in these variables in the two occupations demonstrated that only the systolic blood pressure difference was important. Table C1.29 pre-

TABLE C1.29

Numbers of U. S. railroad executives observed (O) and expected (E) above the age-specific medians and 80th percentiles for sedentary clerks for each of five measured variables and chi-squares. Number of expected based on combined occupations.

Medians

	O	E	Ratio	Chi-square
Σ skinfold	138	129.2	1.07	N.S.
Relative body weight	128	128.2	1.00	N.S.
Systolic blood pressure	86	116.7	0.74	18.98
Diastolic blood pressure	131	127.5	1.03	N.S.
Serum cholesterol	136	128.1	1.06	N.S.

80th Percentile

	O	E	Ratio	Chi-square
Σ skinfold	50	50.2	1.00	N.S.
Relative body weight	39	47.6	0.82	N.S.
Systolic blood pressure	32	46.2	0.69	6.44
Diastolic blood pressure	46	49.5	0.93	N.S.
Serum cholesterol	41	48.0	0.85	N.S.

sents the observed and expected numbers of executives found above the values of the age specific medians and 80th percentiles of the sedentary clerks along with chi-squares. When the data were examined by age groups it was found that significantly fewer executives than expected had systolic blood pressures above the value at the median in the 40—44 year old group (chi-square 12.62) and the 55—59 year old group (chi-square 6.68) at the 80th percentile, the same age groups showed fewer men than expected above the cutting point but the 40—44 age group just failed to reach the conventional value of chi-square which is considered significant (chi-square 3.61) and the oldest 5-year group was non-significant (chi-square 2.41).

Non-Sedentary Clerks vs. Sedentary Clerks

The cumulative distributions of the measured variables show little or no difference between non-sedentary clerks and sedentary clerks in height, relative body weight, Σ skinfolds and serum cholesterol concentration. But in blood pressures there are differences which appear to be large and are reversed with age. Non-sedentary clerks in the ages 40—49 have lower systolic and diastolic blood pressures than sedentary clerks while at ages 50—59, the reverse appears to be true.

The significance of the differences was evaluated by comparing the number of non-sedentary clerks whose systolic and diastolic blood pressures were above the median and 80th percentile of the sedentary clerk group for each of the five-year age groups. None of the chi-square values based on the median cutting points reached significance in the four systolic and four diastolic blood pressure comparisons. However, difference between the occupations in systolic blood pressure at ages 40—44 gave chi-square 3.71 and in diastolic blood pressure for the 45—49 year old group the value was chi-square 3.54. The analysis based on the 80th percentile reference point yielded only one chi-square value of significance (4.29), that for the systolic blood pressure in the 55—59 year old group.

The small numbers of non-sedentary clerks in the separate age groups ($N = 32$ at 40—44, $N = 39$ at 45—49, $N = 38$ at 50—54, $N = 47$ at 55—59 years) make it difficult to draw firm conclusions regarding this group, especially in view of accidents of classification and job selection.

Comparison of Early Employment and Survey Examination Data

It has been recognized for many years that hiring practices of management and personal preferences of employees may result in special situations in an excess of disease-prone individuals in a particular occupation. Morris *et al.*, (1956) provided evidence derived from uniform size measurements that men hired as conductors (a physically active job) were not as fat at the time of employment as those hired to drive the busses (a relatively inactive job). When these men were examined at the age of 40 to 59, the drivers were found to be more overweight than the conductors. In this case the characteristic of "overweightness" among drivers as compared to conductors was, at least in part, the result of selection at the time of first employment.

Evidence for this kind of selection among the railroad employees was sought by examining the records of employment examinations or the first examination of record during the early years of employment. Due to long standing policy of management it was not possible to examine these records on certain railroads. However, systolic and diastolic blood pressures and age at the time of examination were obtained on 417 switchmen and 297 clerks who were 40—59 in 1958—59. The age range at the time of the first examination was 17 to 49 on both switchmen and clerks and the medians were in the age range of 30 to 34 years.

Height, weight and age data at the first examination were found in 381 clerks and 405 switchmen who had been examined in 1958—59. In this group the median for the relative body weights at the first examination for the clerks was in the 20—24 year old age class and in the 30—34 age group for the switchmen.

The data are not ideal since the groups are not random samples and are deficient in data on clerks because certain railroads did not keep such records. Age-adjusted quartiles and age-adjusted cumulative frequencies were constructed to look for differences between clerks and switchmen. The age-adjusted cumulative frequencies for the several variables are presented in Figures C1.15 through C1.18. Initially, clerks were slightly taller than switchmen but at the time of the survey examination the switchmen were taller than the clerks; perhaps the physical activity required of the switchmen helped them maintain a more upright posture. Switchmen had a larger body weight at the first examination and this relationship was maintained at the survey examination. In both systolic and diastolic blood pressure the initial data showed almost identical cumulative frequencies. On the other hand, at the survey examination, the clerks tended to have higher blood pressures than the switchmen but the difference did not reach statistical significance. There is evidence, then, that occupational selection was in large part responsible for the difference in relative body weight observed at the time of the survey. On the other hand, there was no evidence that the blood pressure was influenced by the occupation; indeed, it appears if anything that the occupation tended to result in a higher systolic and diastolic blood pressure in clerks.

Another example of occupational selection of a characteristic appears in the data on height. The executives are consistently taller than either clerks or switchmen. Since changes in height with age are small, it appears reasonable to conclude that the executives were taller than either clerks or switchmen when they were first employed in the railroad industry.

The Estimation of Prevalence of Coronary Heart Disease among Men Differing in Physical Activity

Technical difficulties in estimating physical activity of individuals have caused investigators to rely mainly on classification by occupations. The present discussion will focus on problems in estimating the relative prevalence of coronary heart disease among men employed in physically active and sedentary occupations.

The roster of men aged 40 to 50 in any occupation is constantly changing as men are leaving and entering the occupation for many reasons. With the aid of U.S. Railroad Retirement Board records some estimates of this turnover can be made. Study of a 4 per cent sample of all men employed by the railroads in the United States in 1954 revealed that 68 per cent of the clerks, 77 per cent of the switchmen and 56 per cent of the maintenance-of-way employees were still in the same occupation at the end of 6 years.

During the 6 year period, 3.3 per cent of the clerks age 40 to 59 at the start left the railroad industry, 17 per cent changed jobs within the industry,

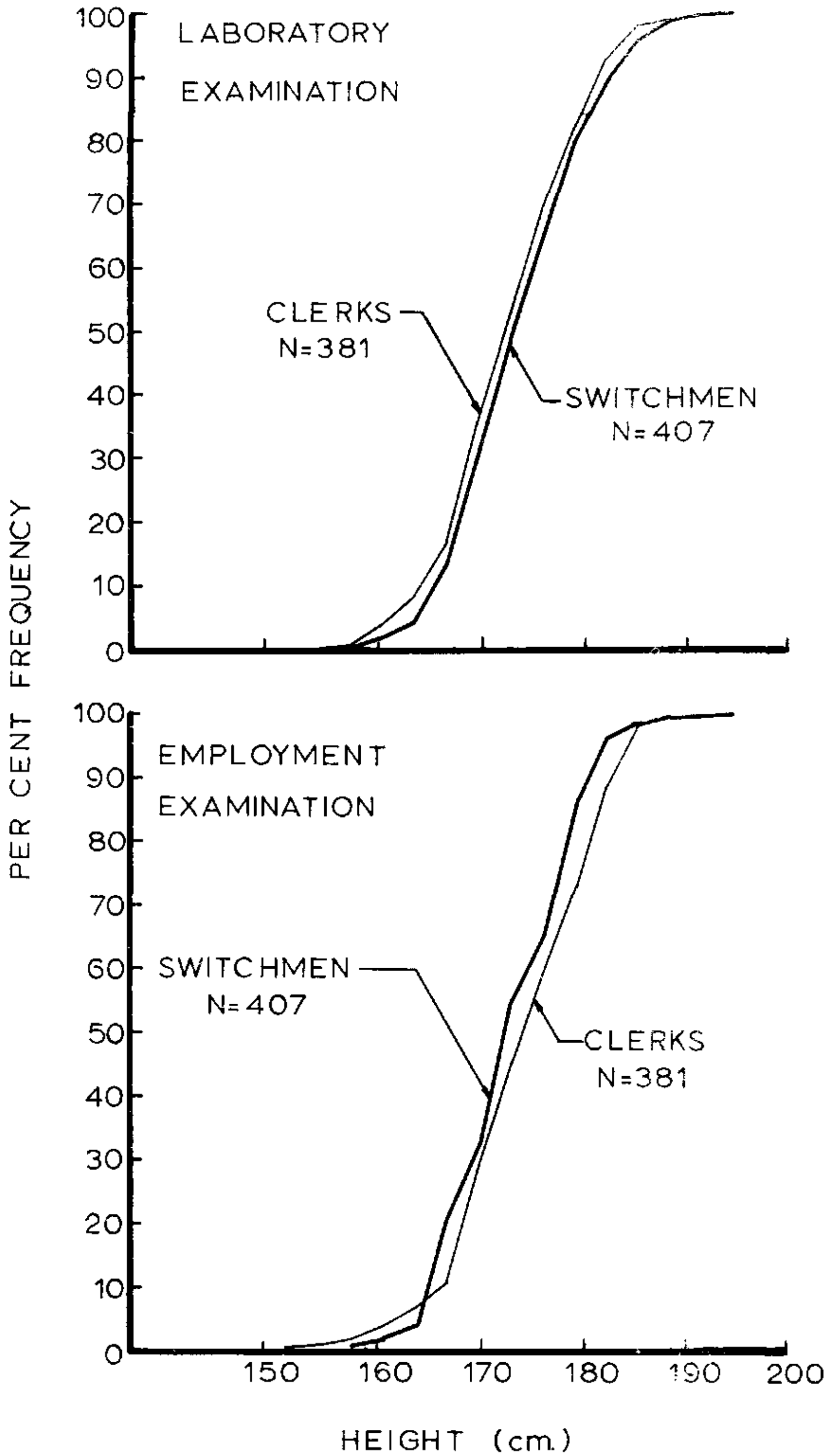

LABORATORY
EXAMINATION
CLERKS
N=381
SWITCHMEN
N=407
EMPLOYMENT
EXAMINATION
SWITCHMEN
N=407
CLERKS
N=381
PER CENT FREQUENCY
0
10
20
30
40
50
60
70
80
90
100
150
160
170
180
190
200
HEIGHT (cm.)

Figure C1. 15

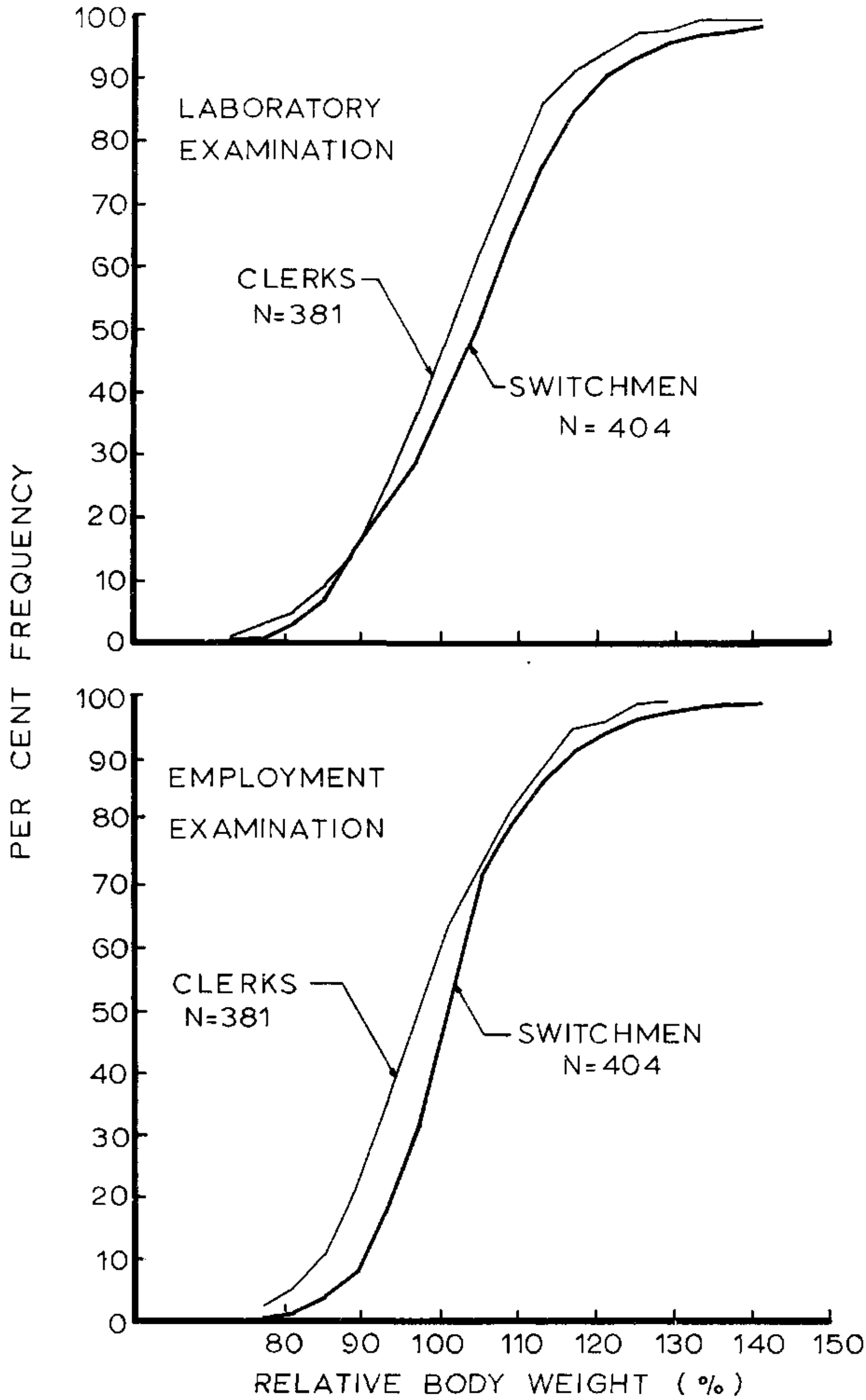

PER CENT FREQUENCY
LABORATORY EXAMINATION
CLERKS N=381
SWITCHMEN N=404
EMPLOYMENT EXAMINATION
CLERKS N=381
SWITCHMEN N=404
0 10 20 30 40 50 60 70 80 90 100
80 90 100 110 120 130 140 150
RELATIVE BODY WEIGHT (%)

Figure C1. 16

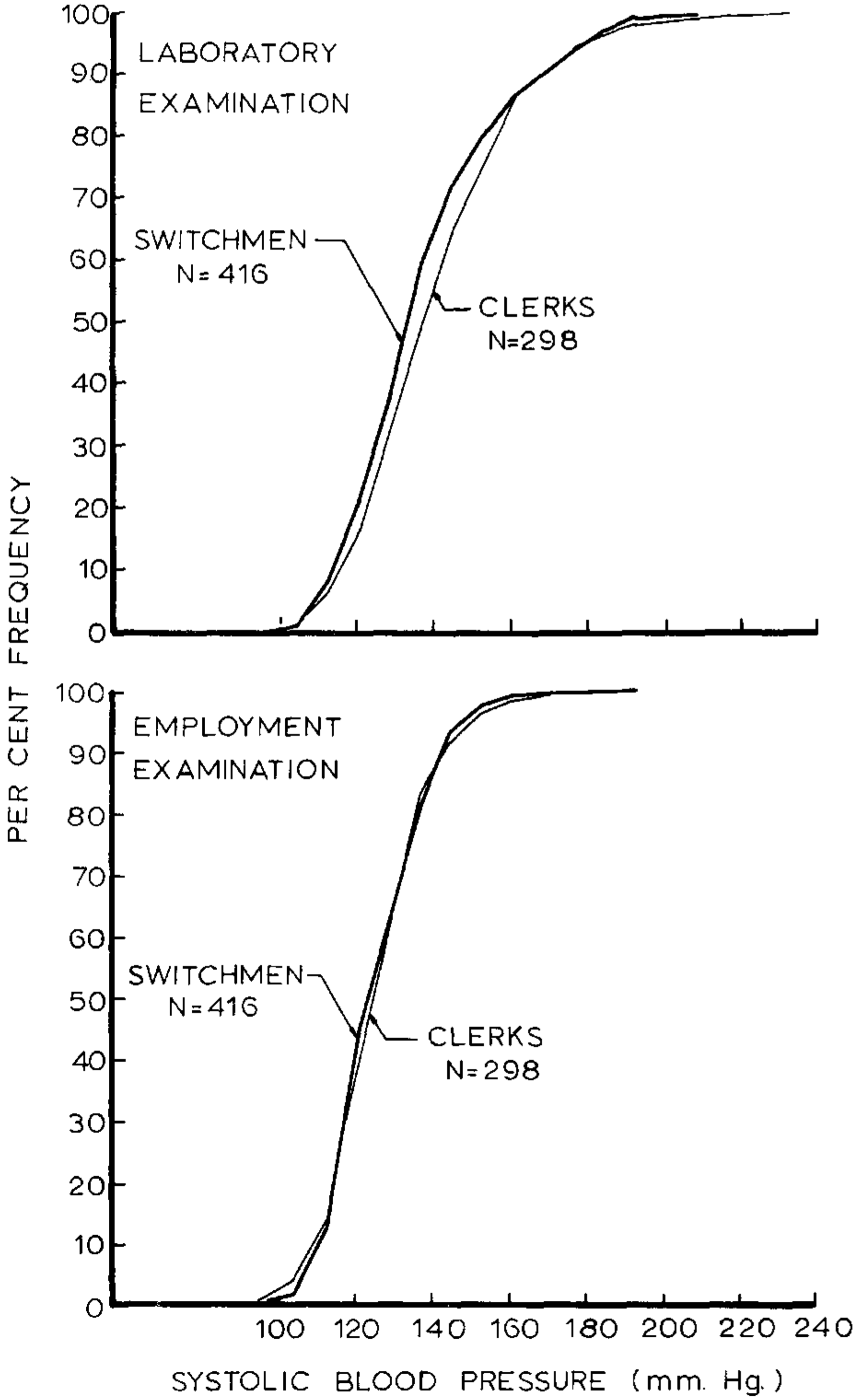

LABORATORY
EXAMINATION
SWITCHMEN
N=416
CLERKS
N=298
EMPLOYMENT
EXAMINATION
SWITCHMEN
N=416
CLERKS
N=298
PER CENT FREQUENCY
0
10
20
30
40
50
60
70
80
90
100
100 120 140 160 180 200 220 240
SYSTOLIC BLOOD PRESSURE (mm. Hg.)

Figure C1. 17

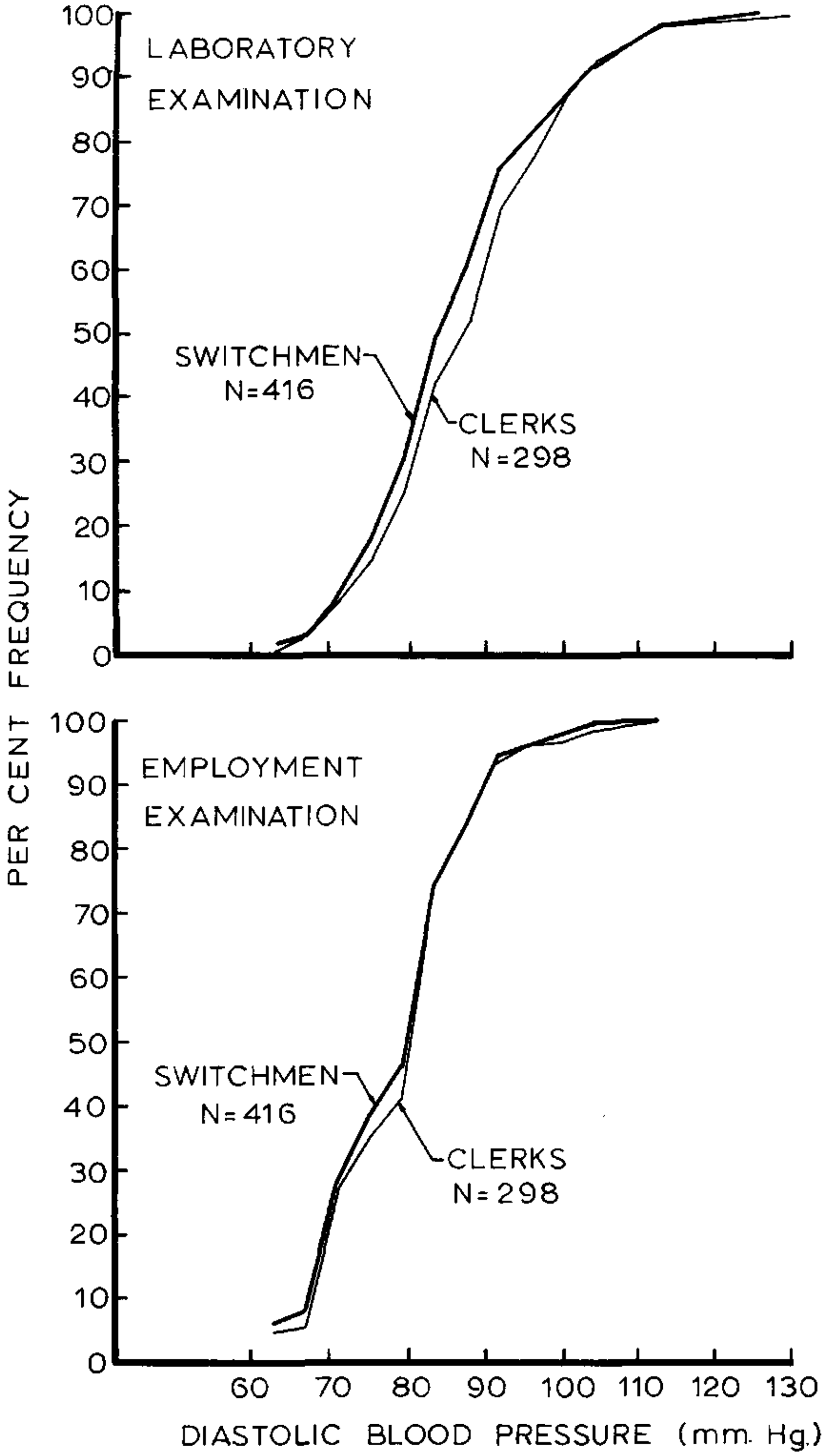

LABORATORY
EXAMINATION
SWITCHMEN
N=416
CLERKS
N=298
EMPLOYMENT
EXAMINATION
SWITCHMEN
N=416
CLERKS
N=298
PER CENT FREQUENCY
DIASTOLIC BLOOD PRESSURE (mm. Hg.)

Figure C 1.18

4.8 per cent sought and obtained disability retirements and 5.7 per cent died. The lower mobility of the switchmen was due principally to the fact that only 9.4 per cent moved to new jobs within the industry. Disability retirement among switchmen was of the same order of magnitude. The maintenance-of-way employees showed a different pattern, with 6.9 per cent leaving the industry and 24.3 per cent taking other jobs within the industry. Disability retirements accounted for approximately 9 per cent of the original cohort of maintenance-of-way employees.

With respect to changing activity within an industry, Kahn (1963) studied white postal clerks and carriers in Washington, D. C., who entered employment between 1906 and 1940 and found that 35.6 per cent of the carriers switched to clerical jobs while only 8 per cent of the clerks switched to the carrier category. While in the railroad industry, if one classifies the physical activity of the jobs that the railroad employees moved into, it appears that roughly one-half of the clerks took a new job at the same physical activity level while 92 per cent of the switchmen choosing a new occupation within the railroad industry did not change the level of the physical activity required by the job. Two-thirds of the maintenance-of-way employees changing jobs moved to an occupation in which less physical activity was required. It is clear that the mobility patterns are not the same in different occupations and each situation must be investigated separately. In addition, it can be inferred that the opportunity exists for differential effects on the distribution of one or more of the risk factors. However, there are no data to document this.

A more important question is how the mobility of men who develop coronary heart disease compares with the over-all mobility rate of the occupation. The first indication from our data is that the withdrawal rate of men either with the disease or who are destined to develop it is different from over-all occupational mobility. Evidence supporting this can be found by tabulating the deaths from all causes that occurred in the 4 per cent sample of the cohort over the follow-up period of 6 years. There were no differences in over-all mortality between switchmen and clerks who changed jobs. On the other hand, the deaths in retirement accounted for approximately 28 per cent of all deaths among switchmen and 18 per cent of all deaths among clerks. These data suggest that men with coronary heart disease or with potential coronary heart disease were leaving the switchmen's group at a faster rate than the clerks'.

Death rates over a 2-year period of all men employed in the railroad industry in the occupations of interest during 1954 were available for 1955 and 1956 (Taylor *et al.*, 1962). These were compared with a 6-year study of deaths in the same cohort which includes deaths occurring in men who have moved to other occupations or who had retired (Taylor *et al.*, unpublished data). There were 39,750 clerks and 30,237 switchmen age 40—59 in the cohort at the outset. The numbers were large enough to allow one to calculate valid age-adjusted mortality ratios of deaths ascribed to coronary heart disease among switchmen and clerks. The mortality ratio (switchmen/clerks) of in-service, in-occupation coronary heart disease death rates was 0.69 while that in the 6-year study was 0.81. These data suggest that the mobility of switchmen with coronary heart disease was greater than that of clerks but it was also clear that many men who develop coronary heart disease *de novo* after leaving the ranks of the occupation were included in the 6-year follow-up study of deaths.

To obtain evidence on the mobility

of clerks and switchmen who actually developed coronary heart disease before moving out of the occupation, data in a 5 year follow-up were obtained by searching the files of the Railroad Retirement Board for disability retirements of the men who had been examined as participants in the survey described here.

Among the examined personnel, 10 sedentary clerks and 6 switchmen were found who sought and obtained disability retirement awards because of documented coronary heart disease. These withdrawals from active service indicate the magnitude of the selective influence which precedes the initial survey examination. These numbers, though small, increase in importance when compared with the 41 cases of clinical coronary heart disease (including angina pectoris) found among sedentary clerks and 18 cases found among switchmen in the initial examination of the invited sample.

That this influence may operate differentially among clerks and switchmen or among examinees and "no-shows" can be suggested by consideration of the following distribution of disability retirements for coronary heart disease (rates per 100 in parenthesis):

Age	Examined Sample		Invited Sample	
	Sedentary clerks	Switchmen	Sedentary clerks	Switchmen
40—49	0 (0.0)	5 (0.9)	0 (0.0)	6 (0.7)
50—59	10 (2.1)	1 (0.3)	12 (1.9)	11 (1.9)
Total	10 (1.1)	6 (0.6)	12 (1.0)	17 (1.3)

Among men who submitted to examination, retirements tended to occur more frequently among clerks than among switchmen. Among the "no-shows", the occupational difference is of the same order of magnitude but in the opposite direction. It is interesting to also note that these retirements tended to occur in the younger decade among examined switchmen and in the older decade among clerks. The numbers of cases here are very small and it is clear that more extensive studies of withdrawal due to coronary heart disease are needed. It happens, however, that these preliminary data are consistent with the suggestion found in the death data, i.e. that the occupational mobility of switchmen with coronary heart disease is greater than that of clerks.

Mobility and occupational conditions present other problems in prevalence rates. It is difficult to obtain information on all men in the desired age group unless both management and labor agree to making the survey examination mandatory. In the current study on men in U.S. Railroads, only 74 per cent of the clerks and 59 per cent of the switchmen were examined. It is of interest to examine coronary heart disease withdrawal rates in the examined and "no-show" group to investigate the distribution of coronary heart disease between these examined and those who refused. For this purpose, deaths ascribed to coronary heart disease which occurred in retirement or in other occupations as well as in-service, in-original occupation were pooled with disability retirements because of coronary heart disease. Since the actual examinations were carried out in 1957—59 (70 men were examined in the spring of 1960), the follow-up time is variable. However, clerks and switchmen were examined in equal numbers each year so that neither occupational group has an elapsed time advantage. The population at risk was calculated on the basis of age in 1958 and the death and disability retirement data are complete up to 1 July 1964. The results are presented in Table C1.30. For both occupations the withdrawal rates for the "no-shows" are larger than those for the men examined but the difference between the two categories is not the same. It is clear that a larger number of switchmen than clerks with actual or potential coronary heart disease refused examination. It is equally clear that the prevalence rates are worse than useless in this situation since not only were coronary cases moving out of the population before the examination but differential occupational bias existed in recruitment.

Experience with the railroad employees indicates that a man who develops angina pectoris is confronted with a great variety of problems in trying to decide whether he should withdraw from the occupation of his choice, particularly if his occupation required physical activity. He is usually at an age when it is difficult to obtain another form of employment outside the railroad industry, seniority regulations also make seeking a job in another railroad craft difficult and disability retirement benefits do not provide financial support at a desirable level. The result frequently is that he seeks consultation with a private physician and then waits for some time before he makes up his mind about what he is going to do. Alternatively, he may avoid physicians at all costs during a long period of indecision. Employment is occasionally changed (if the opportunity arises) without consulting a physician. Behavior in other industries and occupations may differ but this matter needs consideration if angina pectoris is to be counted as evidence of coronary heart disease.

These facts must be considered in evaluating prevalence in any study in which physical activity is inferred from occupational classification. Studies such as those of Brown *et al.*, (1957), of a heterogeneous population, simply make the situation more complicated since it is necessary to have some knowledge of factors affecting disability retirements and occupational changes in each of the many occupations.

Studies in which incidence is estimated over a very short period of time (compared to the length of time that elapses before a man with angina dies, has an infarction, or consults a physician for the first time), and in which the population was not examined at the beginning of the incidence period, are open to question because the reservoir of unreported angina is unlikely to be identical in active and sedentary occupations and some of these cases may move out of the population under study because of what appears to be voluntary retirement or change in occupation. Questions of this type can be raised regarding the studies of Zukel *et al.* (1959), in which an area was studied, and Morris *et al.* (1953), in which occupations were studied. It appears that the majority of the factors affecting observed prevalence rates operate to exaggerate any true excess that may exist in an active population over that in a sedentary population.

Summary

Data on a population for study of 8,053 clerks, switchmen and executives were assembled with the cooperation of 20 railroad companies operating in the northwest quadrant of the United States. A sample of 1163 sedentary clerks, 1414 switchmen and 363 executives who were located in 26 separate towns and cities was selected for examination which was conducted in a mobile laboratory parked close to the place of work. Of those invited, 73.9 per cent of the sedentary clerks (N=859), 59.1

TABLE C1.30

Five year withdrawal rates ascribed to arteriosclerotic heart disease (deaths plus medical retirements) in the examined and "no-show" groups in a sample of sedentary clerks (N = 1088) and switchmen (N = 1424).

	Clerks				Switchmen			
	%	Withdrawals/100			%	Withdrawals/100		
Age	sample exam.	exam.	no-show	total	sample exam.	exam.	no-show	total
40-44	75.9	----	4.08	0.88	63.4	1.70	1.16	1.50
45-49	72.8	1.66	----	1.25	62.4	3.38	4.20	3.69
50-54	75.7	5.00	1.54	4.26	55.6	1.81	4.76	3.08
55-59	71.8	7.76	5.95	7.28	52.8	4.70	9.42	6.97
Age adjust. rate	73.9	3.61	2.90	3.42	59.1	2.90	4.89	3.81

per cent of the switchmen (N=835) and 68.3 per cent of the executives (N=251) responded to the invitation and were examined. In addition, 156 men, classified as clerks by management but whose job required physical activity at a level above that considered sedentary, were examined and are reported here as non-sedentary clerks. It is estimated that the switchmen performed physical work which resulted in an energy expenditure per day of 600 kilocalories greater than that of the sedentary clerks. In general, the sedentary clerks had been in the railroad industry longer than switchmen but they changed jobs more often than switchmen. The switchmen and clerks had a homogeneous distribution of parental nationality. But the executives showed some differences in this respect. Executives were more often married than switchmen who were more frequently married than clerks. Both clerks and switchmen were on the same economic level.

These American railroad employees were taller, fatter, and heavier for their height and age and had higher serum cholesterol concentrations than the average of all the groups as a whole. Switchmen were heavier cigarette smokers than either sedentary clerks or executives. The analysis of the classification of the electrogardiograms showed no important difference in Q items between occupations nor were there any differences of consequence in other resting items. However, the prevalence of post-exercise S-T depressions was significantly larger in clerks than in switchmen. The prevalence of hypertension was not remarkably different in the three occupations. The executives had fewer numbers of men with diastolic blood pressures above the criteria. But all the groups had a higher prevalence of hypertension than the mean of all the other groups in the study. The prevalence of hypertension increased with increasing relative body weight in all groups but only switchmen and clerks had an increase of hypertension with increasing fatness as measured by the sum of the skinfolds. When the three occupations were pooled, prevalence of hypertension increased with increasing serum cholesterol concentration. The prevalence of overweight was greatest among switchmen and least among clerks. The frequency of overweight men increased with increasing systolic and/or diastolic blood pressure in switchmen and clerks but this was only true of diastolic blood pressure in executives.

The sedentary clerks and switchmen were tabulated by geographic areas in which the West Coast had the highest reported death rate from coronary heart disease and the Rocky Mountain area the lowest. The "plain states" area (defined as that portion east of the Rocky Mountains and west of Chicago-Milwaukee) and Chicago-Milwaukee had intermediate coronary heart disease death rates. The distributions of the measured variables in clerks were uniform in these areas. Switchmen had large differences in distributions of relative body weight, skinfold and blood pressures. In the Milwaukee-Chicago area switchmen were found to be both heavier and fatter than in the other areas. The Rocky Mountain switchmen were thinner and lighter, had lower blood pressures, smoked less and had a shorter period of employment in the railroad industry than the other switchmen. There was no difference in the measured variables between the men living in small towns and large cities.

Switchmen were heavier and thinner than the clerks when taken as a group. But the difference in skinfolds between occupations does not reach significance if the switchmen and clerks in the Rocky Mountains are removed from the analysis. The serum cholesterol concentrations were not different between occupations within geographical areas or within occupations between geographical areas.

Executives differed from sedentary clerks only in that the systolic blood pressure of the executives was lower than that of the clerks.

The most striking difference between switchmen and clerks was the difference in relative body weight and to a lesser degree the difference in systolic blood pressure. Examination of employment records revealed that there was no difference in the blood pressure of clerks and switchmen at the time of employment but that the switchmen had larger relative body weights than the clerks at the time they entered the industry. The difference persisted until the survey examination which occurred from 10 to 38 years later. It was concluded that occupational selection played an important role in the results. A second example of occupational selection was seen in the height difference between executives and both switchmen and clerks.

Data are presented to illustrate the problems of estimating the true prevalence of coronary heart disease in the physically active as compared to the sedentary occupations. In this study, the observed prevalence of coronary heart disease was influenced by greater withdrawal of younger switchmen with coronary heart disease as compared to clerks and selection against the experiment by switchmen with coronary heart disease.

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C2. MEN IN RURAL ITALY

by Flaminio Fidanza (Naples), Vittoria Puddu (Rome), Alfonso del Vecchio (Milan) and Ancel Keys (Minneapolis)

Introduction

Considerations of diet were prominent in the selection of geographical areas in Italy for comparative studies on cardiovascular disease in stable rural populations. Nicotera, a village in the far south of Italy, was originally selected as an area for study because the diet was believed to be high in olive oil but low in other fats and because, from local contacts in the area, it seemed likely that such good cooperation would be obtained from the population that substantially all middle-aged men could be covered in detailed examinations. These expectations were borne out in the subsequent experience.

For comparison, it was desired to study another rural area in Italy in which the habitual diet would be far richer in fat, especially of the saturated type. The lower part of the Po River valley is commonly believed by Italians to have such a diet. In that area the village of Crevalcore seemed suitable because of population size, distance from urban centers, and offered cooperation. Finally, excellent local contacts and facilities were available in the village of Montegiorgio and it was considered likely that the diet there might be intermediate between that of Nicotera and Crevalcore in regard to fats.

In all three areas the aim of examining a very high percentage of all men in the specified age range was achieved. For Nicotera, this coverage was 97.0 per cent; the corresponding figures for Crevalcore and Montegiorgio were 98.5 and 99.0 per cent, respectively. In almost all cases it was possible to obtain some useful information from and about the men who refused or were unable to participate in the detailed examinations. It is believed to be unlikely that any cases of clinical cardiovascular disease were in the non-examined group.

The Area of Nicotera

Before the rise of Rome, Greek colonizers settled on the lowland, close to the shore of the Tyrrhenian Sea, about 60 kilometers north of the Straits of Messina (the water between Scylla and Charybdis of classic history). Later they established Nicotera in a more defensible position several hundred meters higher on a spur of the mountains overlooking the sea and the small hamlet of Nicotera Marina close below.

The main railroad line from Naples and the north of Italy passes through Nicotera Marina on the way to Reggio Calabria and Sicily but only a few local trains pause there. Nicotera itself is not far off the main highway from the north to the toe of Italy but the secondary branch road from the highway to Nicotera carries only a little local traffic; no one goes through Nicotera en route to someplace else.

Nicotera produces olives, grapes, figs, wheat, some flowers for the perfume trade and for local use, a little meat and poultry. The climate is warm-temperate, with a long, hot, dry season. A few families at Nicotera Marina are engaged in fishing. There is no manufacturing industry. The population is poor and there is a steady migration of young people away from the area to other parts of Italy and overseas, but beyond the age of 30 or so the population is relatively stable. An indication of the poverty of the area is the fact that six of the men in the sample examined in September-October 1957, then aged 45—64, claimed no occupation save begging. All in all, Nicotera seems to be reasonably typical of the rural far south of Italy, a backwards area of the depressed Mezzogiorno. As elsewhere in many parts of Italy, the people live in a crowded village and walk out daily to work in their small fields as far as several kilometers away.

There were eight physicians in or near Nicotera in 1957 but the nearest modern diagnostic and treatment facilities are in a small hospital some 20 kilometers inland at Vibo Valentia. The headquarters for the survey examinations was a rented two-storey house in the center of Nicotera.

The Area of Crevalcore

The large agricultural village of Crevalcore is in the fertile valley of the Po River, roughly equidistant from Modena and Bologna but north of the main highway between those cities. This is in the relatively prosperous area called "Emilia la grassa" (Emilia the fat land) because of its abundant farm produce and traditionally rich diet. Politically, Crevalcore is Communist-controlled; the consensus of opinion seemed to be that the local government is honest, efficient and tolerant. Wheat and other grains, fruit and livestock dominate agriculture and there is no manufacturing industry. The climate is hot in summer and relatively damp and cold in winter.

Crevalcore, like the other villages in this flat countryside, could never have been militarily defensible, so there was no fortress development and it is relatively spread out over the countryside. The population beyond the age of 30 or so is fairly stable, but besides the usual emigration of youth, there is some movement at older ages to jobs in industry in nearby Bologna and elsewhere in Italy.

There is a small but relatively complete hospital in Crevalcore and this was used as the headquarters for the survey examinations.

The Area of Montegiorgio

Montegiorgio is a farming village in the rolling hills of the Province of Marche 35 kilometers inland, by way of a secondary road, from the small town of Fermo on the Adriatic coast. The village itself is on the top of a hill but the families of the commune are spread out over several kilometers. This was the land to which the Sabines fled from the famous rape but the population was early amalgamated with the advancing Roman Empire, and Ancona, now as then, the largest city of the region, was the springboard for the invasion by Diocletian of Illyria (Yugoslavia).

Agriculture is the only industry in Montegiorgio; the small farms produce a good yield of produce but at a high cost of labor. The climate is temperate but relatively cold in winter, and there is generally abundant water from the nearby mountains. The people are largely self-sufficient for everyday needs from their own farms, or the farms they operate as share-croppers, but the cash income is low. There is a steady migration from all of Marche to urban centers and it is said that a quarter of a million "Marchigiani" are in Rome. However, the men aged 40 or more are generally stable in their residences in or near the village.

Montegiorgio has a small hospital with a friendly chief physician and staff but the headquarters for the survey examinations was in a commodious suite of rooms in the town hall, recently rebuilt and enlarged after an earthquake.

Sample Coverage

The general method of establishing the rosters has been described in the preceding Section A, 12, and details of the method were given there for Nicotera, as an example. Though theoretically everyone in Italy is officially registered and every adult must have a valid identity card, the local registries are not always up to date or free from clerical error. It is not uncommon for a man to move away from his legal residence but to have his name carried on the local voter registry for years thereafter. However, the correction of errors and establishment of a true roster is much easier in villages such as Nicotera, Crevalcore and Montegiorgio, where everyone knows everyone else, than in urban areas where people are less stable and are easily lost in the moving crowd. Since there is practically no immigration into these villages, the discovery of newcomers is not troublesome.

The aim was to examine all the men aged 40—59 (45—64 in Nicotera) in these villages. The high degree of success in this aim is indicated by the fact that the examinations covered 97.0, 98.5 and 99.0 per cent of the men in the corrected rosters of Nicotera, Crevalcore and Montegiorgio, respectively. However, by the time the men were actually examined a few of them were aged 60 and in some other cases the ages stated in the rosters were found to be incorrect when identity cards were compared. Since the present analysis concerns only men aged 40—59 at the time of examination, the numbers for whom data given here are smaller than the total number of men examined.

Age Distribution

The age distributions of the men in these Italian villages show some peculiarities. At Nicotera the men aged 45—49, 50—54 and 55—59 represented 48.9, 26.2, and 24.9 per cent of all men aged 45—59. The large relative excess of men aged 45—49 (in 1957) is striking. At least part of the explanation is that their cohort, born in the years 1908 through 1912, was too young to have suffered the heavy attrition from mortality in World War I or from migration in the difficult postwar period through the mid-twenties that affected the men born in the period 1893—1907, i.e. the men in the age groups 50—54 and 55—59.

Both Crevalcore and Montegiorgio show a different set of peculiarities in age distribution — a great shortage of men aged 40—44 and a less marked shortage of men aged 55—59. At Crevalcore the percentages of all men aged

40—59 who were aged 40—44, 45—49, 50—54 and 55—59 were, respectively 17.5, 30.5, 29.7 and 22.3. The corresponding percentages at Montegiorgio were 17.2, 34.4, 30.3 and 18.1. Men aged 40—44 in 1960 were born in 1916—1920, a period of a very low birth rate in Italy, as in many other countries, caused by World War I. This cohort was also the first to be called to the army when World War II began and therefore was the one most affected by mortality and by reluctance to return to the restrictions of village life after the war.

The deficiency of men aged 55—59 in Crevalcore and Montegiorgio, that is to say of men born in the years 1900—1904, may have several explanations. Their birth dates are included in the period when emigration from Italy of young men and young families was at its height. Perhaps more important, this was a cohort much affected by the great postwar migration to the cities and away from Italy in the nineteen-twenties.

Age, Physical Activity and Occupation

Table C2. 1 gives the distribution of the men of Nicotera, Crevalcore and Montegiorgio, by 5-year age groups, into three classes of habitual physical activity. In all areas the majority of these middle-aged men were engaged in heavy physical work, mostly as small-scale farmers. Except in Crevalcore, there was a tendency for the men to withdraw from the heaviest labor in their late fifties but even at ages 55—59 more than half of the men in all areas were in Activity Class 3.

The occupations of all of the men were ascertained but for the present purposes it seemed desirable only to differentiate between the higher socio-economic group of professional and businessmen, the men in agricultural occupations, and all others. These groupings are given in Table C2. 2. The dominance of farming is clear, as well as the fact that relatively few men in these villages could be put in the higher socio-economic class, even when this was extended to include the salesmen (Code nos. 14 and 15). Actually, most of the few men who might be classed as salesmen in these areas were also semi-independent businessmen. By and large, "upper socio-economic class" in these villages is only a relative term. No really rich men live in these villages and the teachers, who are relatively upper class, have lower incomes than many of the men in these areas who are rated in a lower social class.

Distribution of the Measured Variables

Table C2. 3 gives the median values, by age, for height, relative body weight, Σ skinfolds as a measure of body fatness, systolic and diastolic blood pressure, and cholesterol concentration in the blood serum. Table C2. 3 also gives these medians expressed as percentages of the averages of the medians for all 18 population samples in these cooperative studies.

The men of Nicotera were the shortest, thinnest men and had the lowest relative weights. The men of Crevalcore were the tallest, fattest and relatively heaviest. The contrast is greatest in regard to body fatness. The thickness of the true skin is about 1.5 mm. so about 3 mm. of the skinfold thickness is not fat and about 6 mm. of the Σ skinfolds should be subtracted to get a measure of actual fat. Accordingly, the relative fat measure is about 7 mm. for Nicotera, 9 for Montegiorgio and 16 for Crevalcore. In other words, the men of Crevalcore tend to be more than twice as fat as the men of Nicotera.

There are similar differences between the areas in regard to blood

TABLE C2.1

Physical activity of men in rural Italy classed by age and habitual physical activity ("ACT.," 1 = sedentary and light, 2 = moderate, 3 = heavy work). N = total men. Table entries are percentages of all men of given age in the area.

AGE	NICOTERA, N = 570			CREVALCORE, N = 992			MONTEGIORGIO, N = 719		
	ACT. 1	ACT. 2	ACT. 3	ACT. 1	ACT. 2	ACT. 3	ACT. 1	ACT. 2	ACT. 3
40-44	--	--	--	13.7	21.7	64.6	4.1	26.8	69.1
45-49	20.4	13.9	65.7	11.6	20.8	67.6	4.0	23.9	72.1
50-54	20.3	13.0	66.7	9.6	18.1	72.3	9.7	20.7	69.6
55-59	34.2	9.4	56.4	13.1	15.4	71.5	9.1	40.9	50.0
40-59	23.7	12.6	63.7	11.7	19.0	69.3	6.7	26.6	66.7

TABLE C2.2

Occupation of men in rural Italy classed: Codes 1-15 (business, professional, business owners and government officials), Codes 66-69, 71-75 (farming, agriculture and forestry), and all others. Table entries are percentages of all men in the area.

OCCUPATION	NICOTERA	CREVALCORE	MONTEGIORGIO
Codes 1-15	11.3	6.9	8.5
" 66-69, 71-75	50.0	44.1	68.2
All Other	38.7	49.0	23.3

TABLE C2.3

Medians for Italian men, classed by age, and these values as percentages of the averages of the medians for all 18 samples of men.

AREA	VARIABLE	MEDIAN VALUES				MEDIAN, % OF AVERAGE			
		40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
NICOTERA	Height (cm.)	--	162	161	160	--	95.7	95.5	95.3
"	Rel. Wt. (%)	--	94	89	91	--	97.7	93.5	96.7
"	Σ Skinfolds	--	13	13	14	--	63.7	62.8	70.4
"	Syst. B.P.	--	125	127	136	--	94.0	92.7	96.7
"	Diast. B.P.	--	75	75	78	--	92.1	89.9	92.5
"	Serum Chol.	--	184	174	166	--	88.8	83.3	80.3
CREVALCORE	Height (cm.)	169	168	168	167	99.5	99.4	99.8	99.6
"	Rel. Wt. (%)	105	103	102	101	107.0	107.1	107.1	107.3
"	Σ Skinfolds	23	21	22	22	108.5	102.9	106.3	110.6
"	Syst. B.P.	136	142	147	157	103.8	106.8	107.3	111.7
"	Diast. B.P.	84	87	88	90	103.7	106.9	105.5	106.8
"	Serum Chol.	194	194	198	204	94.0	93.6	94.8	98.7
MONTEGIORGIO	Height (cm.)	165	165	163	162	97.2	97.6	96.9	96.6
"	Rel. Wt. (%)	99	98	94	94	100.9	93.6	98.7	99.9
"	Σ Skinfolds	15	16	14	14	70.8	78.4	67.6	70.4
"	Syst. B.P.	128	134	137	142	97.7	100.8	100.0	101.0
"	Diast. B.P.	78	80	81	83	96.3	98.3	97.1	98.5
"	Serum Chol.	192	200	199	198	93.0	96.5	95.3	95.8

pressure — Crevalcore higher than Montegiorgio which, in turn, is higher than Nicotera. It does not seem, however, that in these samples there is simply a linear relationship between median blood pressure and median relative weight or body fatness. Montegiorgio and Nicotera do not really differ much in relative weight or Σ skinfolds but the difference in blood pressure is significant.

Serum cholesterol tends to be lower in Nicotera, especially at the older ages, than in either of the other villages, but the cholesterol values are not high in any of these samples.

Compared with the averages of all men in these cooperative studies, the men of Crevalcore tend to be relatively heavy, fat and characterized by high blood pressures, the men of Nicotera are light, thin, and have low blood pressures, and the men of Montegiorgio are intermediate.

Full details of the distributions of these variables in these villages are given in the Appendix. Cumulative frequency distributions, with a probability scale for the ordinate, are given in Figures C2.1, C2.2 and C2.3. Because no or only trivial trends with age over the range 40—59 were shown for height, Σ skinfolds and serum cholesterol, ages 40—59 were combined for these variables. The other variables showed clear age trends so in Figs. C2. 1, C2. 2 and C2. 3 a distinction is made between ages 40—49 (heavy line) and 50—59 (light line).

Departure from a straight line of the cumulative distributions in Figs. C2. 1, C2. 2 and C2. 3 indicates deviation from a normal probability distribution. As in other samples in the present series of cooperative studies, non-normality is most marked for Σ skinfolds but, except for height, it is evident to at least some degree for the other variables. Transformations to make closer approximations to normality can be found for these other variables but these do not have general validity; e.g. a transformation that does nicely for systolic blood pressure at ages 40—49 does less well at ages 50—59; Σ skinfolds requires a different transformation for Crevalcore than for Montegiorgio. These facts argue strongly for the use of statistical methods in the analysis of *these data that do not assume normal* distributions.

Physical Activity, Occupation and the Measured Variables

Relationships between these measured variables and physical activity and occupational status may be examined with the data in Tables C2. 4—C2. 7, inclusive. In Nicotera, Crevalcore and Montegiorgio, relatively few men were sedentary (Activity Class 1) or in the upper socio-economic class of occupations (Code nos. 1—13, professional, managerial and business-owner classes). And in this latter socio-economic class almost none of the men were engaged *in* heavy physical activity (Class 3).

In Crevalcore, when occupation is ignored, the men in Activity Class 1 (sedentary) were, compared with the other men, more prone to be overweight, to elevated blood pressure and much more prone to obesity; they did not differ significantly in the tendency to hypercholesterolemia. Because larger numbers are concerned, a more reliable analysis can be made by comparing men of Activity Class 2 with those in Class 3. The most active men (Class 3) compared with those in Class 2, tend to be less prone to excess body fat, slightly less prone to overweight but were not significantly different in regard to blood pressure or serum cholesterol. On the other hand, when physical activity is ignored, the men in Occupational Classes 1—13 in Creval-

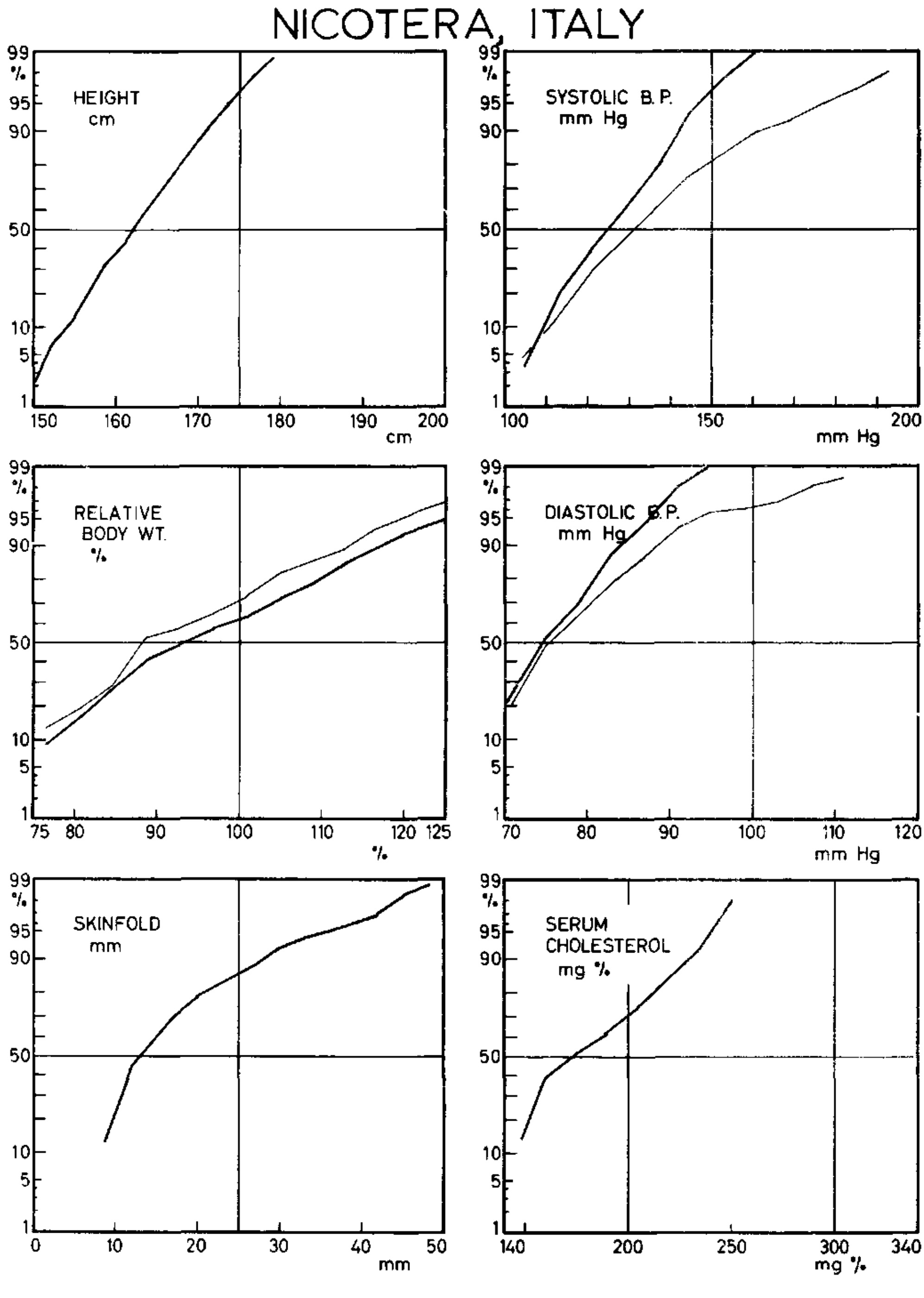

NICOTERA, ITALY
HEIGHT
cm
SYSTOLIC B.P.
mm Hg
RELATIVE
BODY WT.
%
DIASTOLIC B.P.
mm Hg
SKINFOLD
mm
SERUM
CHOLESTEROL
mg %
99
%
95
90
50
10
5
1
150
160
170
180
190
200
cm
100
150
200
mm Hg
75
80
90
100
110
120
125
%
70
80
90
100
110
120
mm Hg
0
10
20
30
40
50
mm
140
200
250
300
340
mg %

Figure C2. 1

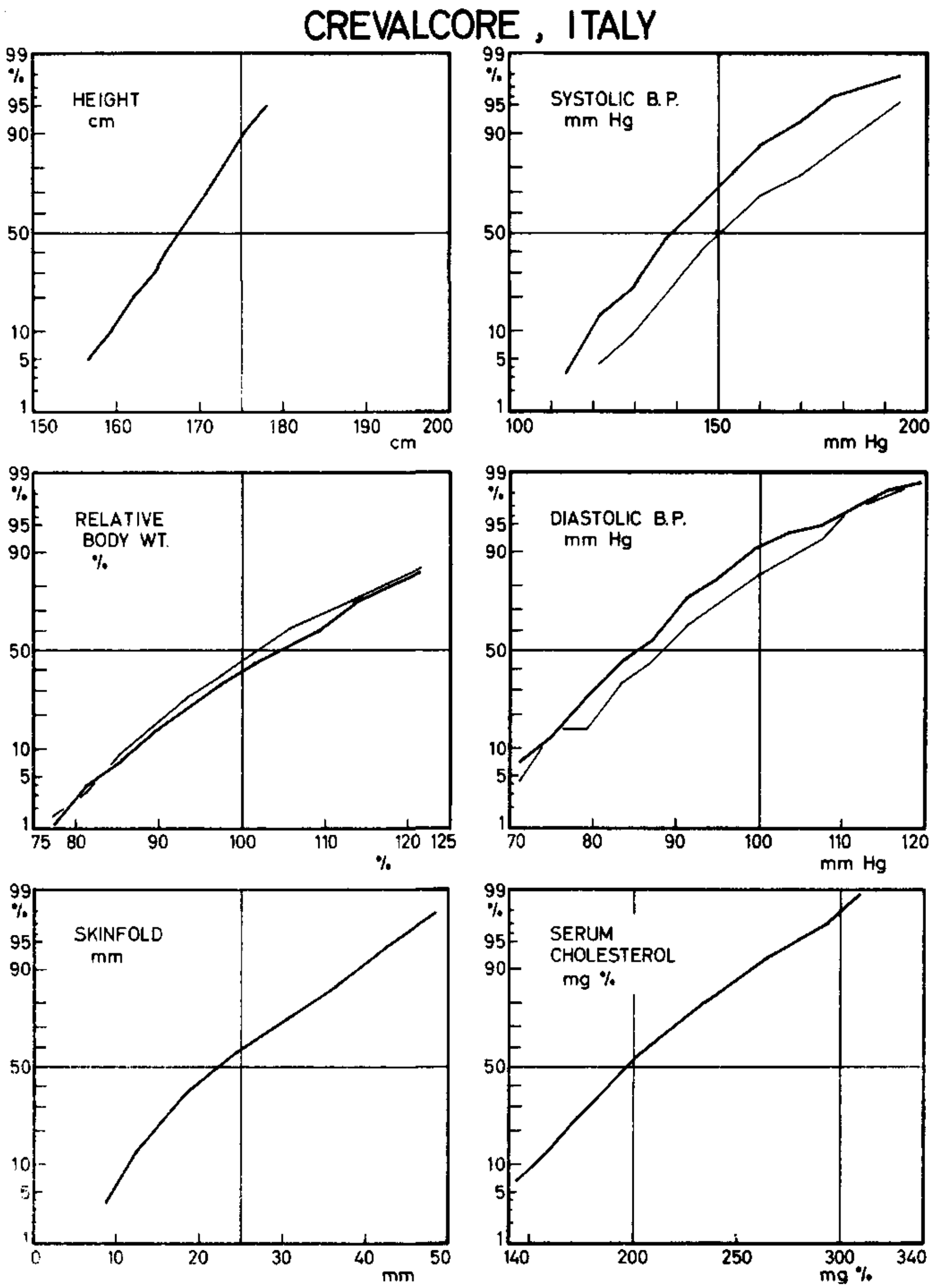

CREVALCORE , ITALY
HEIGHT
cm
SYSTOLIC B.P.
mm Hg
RELATIVE
BODY WT.
%
DIASTOLIC B.P.
mm Hg
SKINFOLD
mm
SERUM
CHOLESTEROL
mg %
cm
mm Hg
%
mm Hg
mm
mg %

Figure C2. 2

MONTEGIORGIO , ITALY

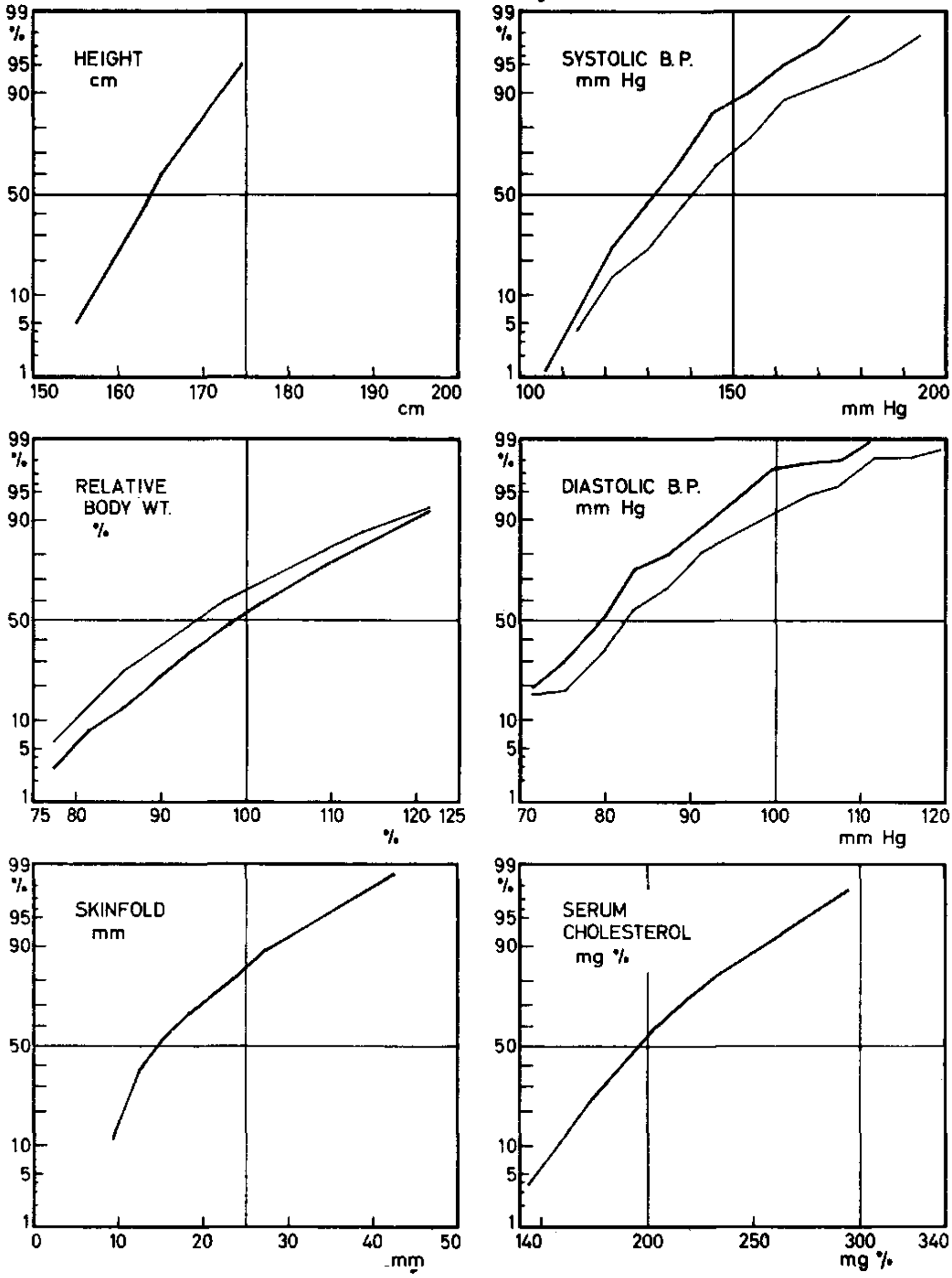


Figure C2. 3

TABLE C2.4

Occupation and physical activity versus measured variables in Crevalcore and Montegiorgio. Numbers of men with "Low" and with "High" values of the variables indicated. "Low" and "High" are the bottom 30 and the top 30 per cent, respectively, of the distributions of all men of the same age in the same sample.

CREVALCORE

OCCUPATION	PHYSICAL ACTIVITY	RELATIVE WT.		Σ SKINFOLDS		SYSTOLIC B.P.		DIASTOLIC B.P.		CHOLESTEROL	
		Low	High	Low	High	Low	High	Low	High	Low	High
1-13	Class 1	2	5	1	6	2	4	2	4	2	2
"	" 2	7	20	4	25	14	10	11	15	12	19
"	" 3	0	2	0	3	1	2	0	2	2	1
"	All Classes	9	27	5	34	17	16	13	21	16	22
14-94	Class 1	27	32	17	38	27	36	20	32	23	27
"	" 2	40	48	30	45	42	36	38	38	41	43
"	" 3	208	181	238	170	196	196	215	195	199	186
"	All Classes	275	261	285	253	265	268	273	265	263	256
1-94	Class 1	29	37	18	44	29	40	22	36	25	29
"	" 2	47	68	34	70	43	46	49	53	53	62
"	" 3	208	183	238	173	197	198	215	197	201	187

MONTEGIORGIO

OCCUPATION	PHYSICAL ACTIVITY	RELATIVE WT.		Σ SKINFOLDS		SYSTOLIC B.P.		DIASTOLIC B.P.		CHOLESTEROL	
		Low	High	Low	High	Low	High	Low	High	Low	High
1-13	Class 1	3	4	2	5	1	3	3	3	1	3
"	" 2	9	26	7	26	12	22	8	11	7	24
"	" 3	0	0	0	0	0	0	0	0	0	0
"	All Classes	12	30	9	31	13	25	11	14	8	27
14-94	Class 1	10	8	7	10	5	8	5	7	8	10
"	" 2	33	60	26	61	33	55	38	55	31	52
"	" 3	154	115	172	110	163	125	158	125	163	120
"	All Classes	197	183	205	181	201	188	201	187	202	182
1-94	Class 1	13	12	9	15	6	11	8	10	9	13
"	" 2	42	86	33	87	45	77	46	66	38	76
"	" 3	154	115	172	110	163	125	158	125	163	120

TABLE C2.5

Activity 1 vs. Activity 2. Excess frequency of high values (deciles 8-10) of the variables observed among men of Activity 1, expressed as % of expectation from total numbers of men in Activities 1 plus 2. Also, chi-square values for the differences between observed and expected distributions.

OCCUPATION	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Nicotera										
1-94	20.8	8.97	25.7	14.80	17.1	3.27	-6.7	0.45	1.4	0
1-13	5.1	0.51	3.9	0.43	10.6	1.79	6.0	0.35	-9.1	0
14-94	36.1	6.85	42.9	8.56	18.9	0.87	-23.1	1.91	0	0
Crevalcore										
1-94	16.4	1.50	13.4	1.47	33.3	6.75	16.1	1.49	-7.1	0.21
1-13	11.1	0	9.1	0	53.8	0.50	14.3	0	-42.9	0.53
14-94	1.6	0	18.8	2.51	27.2	4.54	16.4	1.42	-2.5	0
Montegiorgio										
1-94	-20.0	0.86	-5.1	0.01	-19.1	0.63	-24.8	1.12	-7.8	0.05
1-13	-4.8	0	13.6	0.01	-14.3	0	-11.8	0	-26.8	0.21
14-94	-25.2	0.89	-11.5	0.12	-20.8	0.48	-29.3	1.09	0	0

TABLE C2.6

Activity 2 vs. Activity 3. Occupations 14-94 only. Excess frequency, as in Table C2.5, of high values among men of Activity 2.

SAMPLE	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Nicotera	22.0	0.59	25.0	0.85	0.6	0	65.6	9.71	36.4	0.06
Crevalcore	31.1	5.40	27.2	3.71	-4.8	0.07	0	0	70.6	19.34
Montegiorgio	48.6	16.01	56.8	21.42	35.5	8.63	35.5	8.63	32.7	6.92

TABLE C2.7

Occupation 1-13 vs. 14-94. Excess frequency, as in Table C2.5, of high values among men in Occupations 1-13, expressed as % of expectation from total numbers of men in Occupations 1-13 + 14-94.

ACTIVITY	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Nicotera										
1+2	11.5	0.90	26.5	6.35	10.1	0.35	0	0	35.1	0.48
1	-3.1	0.04	4.5	0.19	4.3	0.04	13.9	0.91	21.2	0.04
2	15.4	0	53.8	0.50	-54.6	0.34	-46.0	0.76	150.0	0.05
Crevalcore										
1+2	6.4	0.11	22.5	2.33	-24.7	1.68	- 1.0	0	1.9	0
1	16.3	0.02	17.6	0.07	-13.0	0	- 4.8	0	-37.5	0.25
2	5.3	0.03	29.5	3.13	-19.4	0.54	4.9	0.01	6.7	0.06
Montegiorgio										
1+2	22.4	2.39	27.0	3.55	12.6	0.52	10.6	0.32	26.8	2.79
1	48.1	0.46	47.1	0.80	20.0	0	30.4	0.03	0	0
2	19.3	1.52	16.6	1.13	11.1	0.33	7.7	0.11	30.4	3.15

Probabilities, p, associated with chi-square values: 2.71, p = 0.10; 3.84, p = 0.05; 5.41, p = 0.02; 6.64, p = 0.01; 10.83, p = 0.001.

core were much more prone than the other men to overweight and obesity but were not significantly different in the other variables.

In Montegiorgio, when Occupational Class is ignored, the few men in Activity Class 1 did not differ significantly from the rest of the men in regard to any of the five variables. However, the men in Activity Class 2 were much more prone to high values in all five variables than the men in Activity Class 3. In the reverse analysis, when physical activity is ignored, the men in Occupational Classes 1—13 in Montegiorgio tended to be more often in the "high" category of all of the variables and this tendency is statistically significant for all variables except diastolic blood pressure.

Because of the correlation between physical activity and occupation in these samples, more meaningful results require comparison of physical activity classes within given Occupational Classes and *vice versa*. In order to provide larger numbers for this comparison it is useful to combine the Crevalcore and Montegiorgio samples and this seems justifiable because in these respects there are no significant differences between these samples. But even if the Crevalcore and Montegiorgio samples are combined, Occupational Classes 1—13 contain too few men in either Activity 1 or Activity 3 so these categories are not covered in the following analysis.

Within Activity 2 in the combined Crevalcore and Montegiorgio samples, the men in the higher socio-economic group differ from the rest of the men significantly in regard to body fatness (Σ skinfolds). Fifty-one of these men were in the top 30 per cent of the skinfolds distribution compared with the chance expectation of 43.5 men (chi-square = 5.28 and p = 0.03). In relative body weight these men tend to be more often overweight also but the difference is of doubtful significance (chi-square = 3.60, p = 0.06). There are no significant differences in the other variables.

Within Occupations 14—94 in the combined Crevalcore-Montegiorgio material, there is no significant difference between Activity Classes 1 and 2 in regard to the distribution of any of the variables. Comparing Class 1 with Class 3 fails to show a significant difference in regard to relative weight, systolic blood pressure or serum cholesterol but there are significant differences in obesity and diastolic blood pressure (chi-square = 17.03 and = 4.55, respectively, with p less than 0.001 and p = 0.03).

Finally, in this combined material in Occupations 14—94, the men in Activity Class 2 are more often in the high category for all variables than the men in Activity Class 3 and the difference is significant except for systolic blood pressure where chi-square = 2.81 and p = 0.09. The probability values are less than p = 0.001 for relative weight (chi-square = 11.63) and Σ skinfolds (chi-square = 34.49); for diastolic blood pressure chi-square = 3.90 (p = 0.05) and for serum cholesterol chi-square = 6.14 (p = less than 0.02).

The general picture from the Crevalcore-Montegiorgio material is that the distribution of the measured variables is related to both activity and to occupational status so that if only one of these characteristics is considered alone its effect on the measured variables is much over-estimated.

The clearest association involving physical activity independently from socio-economic status concerns body fatness and it is reasonable to suggest that this is a cause-and-effect relationship. The greater the habitual physical activity, the less body fat though not necessarily the less relative body weight. The men who do the heaviest work obviously tend to have a low fat mass but a high muscle mass. It seems also that the men in Activity Class 3 tend to have lower values for blood pressure and serum cholesterol.

The group of Occupations 14—94 is far from being homogeneous in socio-economic status; it includes very poor men as well as men who are, relatively, moderately rich; it includes men of the lowest social class as well as men of much higher social standing. The result, then, is that this analysis may substantially under-estimate the effect of socio-economic status on the distribution of these variables.

Smoking Habits

Cigar and pipe smoking is negligible in Italy, particularly in rural areas, and cigarette smoking is discouraged by the absence of advertising (by law) and high price. Both in Crevalcore and Montegiorgio one-fourth of the men had never smoked and at the time of the examinations non-smokers represented 37 per cent of the men in Crevalcore and 41 per cent in Montegiorgio. Men who regularly smoked 20 or more cigarettes a day amounted to 17.8 per cent of men aged 40—59 at Crevalcore and only 9.6 per cent at Montegiorgio. Heavy cigarette smoking was even less common in Nicotera but the records, made in 1957, are not fully comparable. Smoking habit data are given in Tables C2.8, C2.9.

As in other samples in this cooperative study, the non-smokers at Crevalcore and Montegiorgio tended to be more often overweight and obese than the smokers. Among 362 non-smokers at Crevalcore, 64 per cent were above and 36 per cent below the median relative body weight for all men aged 40—59 at Crevalcore; at Montegiorgio 61 per cent of the non-smokers were above the median relative weight. The discrepancy in body fatness was equally striking. At Crevalcore 63 per cent of the non-smokers were in the above-median class for Σ skinfolds; the corresponding figure for Montegiorgio was 65 per cent.

Non-smokers in Crevalcore and Montegiorgio also tended to be in the above-median classes for blood pressure and serum cholesterol but this tendency was less marked than in regard to relative weight and Σ skinfolds. The largest trend in these variables was for diastolic blood pressure at Crevalcore where there were 215 non-smokers in the above-median class compared with an expected number of 183.8; the difference has extremely high statistical significance.

The tendency to higher serum cholesterol values among all non-smokers than among all smokers is not statistically significant in either village. Curiously, both in Crevalcore and in Montegiorgio the men who had once smoked but had quit tended to have higher serum cholesterol values than light smokers (1—9 cigarettes per day). For the median cutting point, the difference is significant at the level of $p = 0.02$ (chi-square $= 6.09$).

Electrocardiographic Findings

Tables C2.10—C2.13, inclusive, summarize the electrocardiographic findings in Crevalcore and Montegiorgio. Classified by the Minnesota Code, the frequency of reportable items in the record taken in rest rises with age in both areas and in each age the prevalence of abnormality (rate per 1000 men) tends to be slightly higher in Crevalcore than in Montegiorgio. The most common abnormalities in both areas are left axis deviation (Code II, 1), high amplitude R waves, left type (Code III, 1), sinus tachycardia (Code VIII, 7) and small degrees of T wave negativity (Code V, 3).

TABLE C2.8

Cigarette smoking habits of men of Italy. Percentage of men who never smoked, who had stopped, who smoked 1-9, 10-19, 20 or more cigarettes daily at the time of their examination.

SAMPLE	AGE	NEVER	QUIT	1-9	10-19	20 OR MORE
Nicotera	45-49	18.1	9.7	40.1	22.9	9.2
"	50-54	24.6	9.8	33.7	26.2	5.7
"	55-59	21.7	16.5	35.7	18.3	7.8
"	45-59	20.7	11.4	37.3	22.6	8.0
Crevalcore	40-44	28.1	14.6	14.6	16.5	26.2
"	45-49	23.0	10.5	18.0	29.8	18.7
"	50-54	24.3	12.7	19.2	29.1	14.7
"	55-59	27.0	12.6	20.9	26.0	13.5
"	40-59	25.1	12.3	18.5	26.5	17.6
Montegiorgio	40-44	22.8	13.8	27.6	24.4	11.4
"	45-49	28.0	15.4	27.1	20.2	9.3
"	50-54	24.7	14.4	27.4	23.7	9.8
"	55-59	26.9	18.5	29.2	17.7	7.7
"	40-59	25.9	15.4	27.7	21.5	9.5

TABLE C2.9

Smoking. Number of men in Italy below (LOW) and above (HIGH) the age specific medians, for age and area, of measured variables, classed according to smoking habits. HEAVY = 20 or more, OTHER = 1-19 cigarettes daily.

VARIABLE	SAMPLE	NON-SMOKERS		HEAVY		OTHER	
		LOW	HIGH	LOW	HIGH	LOW	HIGH
Relative Weight	Crevalcore	130	232	96	77	261	179
"	Montegiorgio	115	178	39	29	203	148
ΣSkinfolds	Crevalcore	137	233	96	78	260	183
"	Montegiorgio	113	210	43	25	202	149
Systolic B. P.	Crevalcore	163	205	86	87	241	196
"	Montegiorgio	143	151	34	34	180	172
Diastolic B. P.	Crevalcore	153	215	96	77	239	197
"	Montegiorgio	142	152	31	37	186	166
Serum Cholesterol	Crevalcore	177	185	71	98	231	198
"	Montegiorgio	136	153	38	28	180	171

TABLE C2.10

CREVALCORE, ITALY

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (174)	45-49 (303)	50-54 (295)	55-59 (221)
Total with reportable ECG Items	I - IX		64 (367.8)	126 (415.8)	131 (444.1)	117 (529.4)
Q Waves	I	1	0	0	3 (10.2)	2 (9.0)
		2	3 (17.2)	1 (3.3)	2 (6.8)	2 (9.0)
		3	5 (28.7)	7 (23.1)	3 (10.2)	7 (31.7)
Axis Deviation	II					
Left		1	5 (28.7)	11 (36.3)	11 (37.3)	14 (63.3)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	9 (51.7)	13 (42.9)	15 (50.8)	18 (81.4)
Right type		2	0	3 (9.9)	0	2 (9.0)
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	4 (13.2)	5 (16.9)	6 (27.1)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	1 (5.7)	6 (19.8)	5 (16.9)	3 (13.6)
No S-T-J plus segment downward		3	0	0	2 (6.8)	0
S-T - J 1 mm. or more, upward segment		4	0	2 (6.6)	5 (16.9)	1 (4.5)
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	2 (9.0)
- 1 mm. to -5 mm.		2	1 (5.7)	5 (16.5)	5 (16.9)	4 (18.1)
0 ± 1.mm.		3	8 (46.0)	7 (23.1)	11 (37.3)	12 (54.3)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	1 (5.7)	2 (6.6)	0	0
Accelerated Conduction		4	2 (11.5)	1 (3.3)	1 (3.4)	0
Ventricular Blocks	VII					
Left Bundle		1	0	1 (3.3)	0	2 (9.0)
Right Bundle		2	1 (5.7)	7 (23.1)	2 (6.8)	1 (4.5)
Incomplete Right Bundle		3	0	4 (13.2)	4 (13.6)	3 (13.6)
Intraventricular Block		4	0	0	0	0
Arrhythmias	VIII					
Premature Beats		1	1 (5.7)	0	3 (10.2)	0
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	3 (9.9)	0	3 (13.6)
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	1 (3.4)	1 (4.5)
Sinus tachycardia		7	7 (40.2)	13 (42.9)	13 (44.1)	10 (45.2)
Sinus bradycardia		8	0	7 (23.1)	2 (6.8)	4 (18.1)
Technically poor records	IX	8	0	2 (6.6)	0	1 (4.5)

ECG FINDING

TABLE C2.11

CREVALCORE, ITALY

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

		AGE GROUP (Number of Men)			
ECG FINDING	ECG Code	40-44 (172)	45-49 (297)	50-54 (289)	55-59 (211)
Exercise tests not made or	X 1				
incomplete	X 2	2 (11.5)	6 (19.8)	6 (20.3)	10 (45.2)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	3 (17.4)	1 (3.4)	1 (3.5)	2 (9.5)
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	2 (11.6)	3 (10.1)	1 (3.5)	6 (28.4)
No S-T-J plus segment downward	3	0	0	0	1 (4.7)
S-T - J 1 mm. or more, upward					
segment	4	2 (11.6)	5 (16.8)	5 (17.3)	4 (19.0)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	1 (3.4)	0	1 (4.7)
0 ± 1 mm.	3	2 (11.6)	2 (6.7)	2 (6.9)	7 (33.2)
Arrhythmias post-exercise	XV				
(none at rest)	1	2 (11.6)	8 (26.9)	4 (13.8)	7 (33 2)
Technically poor post-exercise					
records	XI 8	3 (17.4)	6 (20.2)	5 (17.3)	3 (14.2)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

At Rest					
Large Q Waves	I 1	0	0	3 (10.2)	2 (9.0)
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	0	1 (3.3)	1 (3.4)	1 (4.5)
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	0
Other Negative T as sole	V 2, 3				
anomaly	only	4 (23.0)	4 (13.2)	6 (20.3)	4 (18.1)
S-T Depression as sole	IV 1-4				
anomaly	only	0	1 (3.3)	0	0
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	0	5 (16.5)	4 (13.6)	4 (18.1)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	1 (5.7)	8 (26.4)	2 (6.8)	3 (13.6)
Arrhythmias	VIII 2-6	0	3 (9.9)	1 (3.4)	4 (18.1)
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	4 (23.3)	7 (23.6)	0	5 (23.7)
Negative T as sole	XII 1-3				
anomaly	only	0	2 (6.7)	1 (3.5)	0
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	0
Arrhythmias	XV 1				
as sole anomaly	only	2 (11.6)	5 (16.8)	2 (6.9)	3 (14.2)

TABLE C2.12

MONTEGIORGIO, ITALY

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (123)	45-49 (247)	50-54 (217)	55-59 (130)
Total with reportable ECG Items	I - IX		42 (341.5)	99 (400.8)	96 (442.4)	61 (469.2)
Q Waves	I	1	0	1 (4.0)	2 (9.2)	1 (7.7)
		2	1 (8.1)	0	3 (13.8)	2 (15.4)
		3	0	3 (12.1)	0	2 (15.4)
Axis Deviation	II					
Left		1	3 (24.4)	13 (52.6)	16 (73.7)	12 (92.3)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	6 (48.8)	3 (12.1)	12 (55.3)	3 (23.1)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	1 (8.1)	1 (4.0)	2 (9.2)	1 (7.7)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	1 (8.1)	1 (4.0)	2 (9.2)	2 (15.4)
No S-T-J plus segment downward		3	0	1 (4.0)	0	1 (7.7)
S-T - J 1 mm. or more, upward segment		4	0	1 (4.0)	1 (4.6)	3 (23.1)
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	1 (8.1)	1 (4.0)	0	0
- 1 mm. to -5 mm.		2	1 (8.1)	1 (4.0)	4 (18.4)	0
0 ± 1 mm.		3	1 (8.1)	7 (28.3)	7 (32.3)	4 (30.8)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	1 (8.1)	3 (12.1)	1 (4.6)	0
Accelerated Conduction		4	0	0	0	1 (7.7)
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	1 (7.7)
Right Bundle		2	0	1 (4.0)	2 (9.2)	0
Incomplete Right Bundle		3	1 (8.1)	5 (20.2)	1 (4.6)	4 (30.8)
Intraventricular Block		4	0	0	1 (4.6)	0
Arrhythmias	VIII					
Premature Beats		1	1 (8.1)	0	5 (23.0)	1 (7.7)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	1 (4.6)	1 (7.7)
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	1 (8.1)	1 (4.0)	1 (4.6)	0
Sinus tachycardia		7	4 (32.5)	9 (36.4)	3 (13.8)	4 (30.8)
Sinus bradycardia		8	2 (16.3)	5 (20.2)	5 (23.0)	4 (30.8)
Technically poor records	IX	8	1 (8.1)	1 (4.0)	0	1 (7.7)

TABLE C2.13

MONTEGIORGIO, ITALY

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (122)	45-49 (241)	50-54 (211)	55-59 (126)
Exercise tests not made or	X 1				
incomplete	X 2	1 (8.1)	6 (24.3)	6 (27.6)	4 (30.8)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz. or downward segment	1	1 (8.2)	2 (8.3)	1 (4.7)	1 (7.9)
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	2 (16.4)	4 (16.6)	4 (19.0)	2 (15.9)
No S-T-J plus segment downward	3	0	0	1 (4.7)	0
S-T - J 1 mm. or more, upward segment	4	5 (41.0)	4 (16.6)	7 (33.2)	2 (15.9)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	0	0
0 ± 1 mm.	3	1 (8.2)	4 (16.6)	3 (14.2)	1 (7.9)
Arrhythmias post-exercise	XV				
(none at rest)	1	2 (16.4)	2 (8.3)	5 (23.7)	5 (39.7)
Technically poor post-exercise records	XI 8	2 (16.4)	6 (24.9)	5 (23.7)	4 (31.7)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

ECG FINDING	ECG Code	40-44	45-49	50-54	55-59
At Rest					
Large Q Waves	I 1	0	1 (4.0)	2 (9.2)	1 (7.7)
Lesser Q Waves	I 2,3 +				
with Negative T Waves	V 1,2	1 (8.1)	0	0	0
Deeply Negative T as sole anomaly	V 1 only	0	0	0	0
Other Negative T as sole anomaly	V 2,3 only	0	1 (4.0)	2 (9.2)	0
S-T Depression as sole anomaly	IV 1-4 only	0	1 (4.0)	0	3 (23.1)
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	1 (8.1)	0	2 (9.2)	0
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1,2,4	0	1 (4.0)	3 (13.8)	1 (7.7)
Arrhythmias	VIII 2-6	1 (8.1)	1 (4.0)	2 (9.2)	1 (7.7)
Post-exercise					
S-T Depression as sole anomaly	XI 1-4 only	5 (41.0)	7 (29.0)	5 (23.7)	3 (23.8)
Negative T as sole anomaly	XII 1-3 only	0	3 (12.4)	0	0
Ventricular Conduction Defect as sole anomaly	XIV 1,2,4 only	0	0	0	0
Arrhythmias as sole anomaly	XV 1 only	2 (16.4)	0	2 (9.5)	3 (23.8)

Electrocardiograms were recorded after the standard exercise test in 700 out of 717 men at Montegiorgio and in 969 out of 993 men at Crevalcore. At Montegiorgio, the exercise test yielded 18 cases of S-T depression (Code XI, 1, 2, 3) where none had been present at rest, thus more than doubling the frequency of this abnormality. At Crevalcore, the exercise added 20 additional S-T depressions to the 32 cases where this abnormality had been present in rest. The exercise test was less effective in producing new T wave negativity. For Code XII, 1, 2, exercise produced no new cases at Montegiorgio and only 2 at Crevalcore; in rest this abnormality was found in 8 men at Montegiorgio and in 17 men at Crevalcore.

The rarity of certain ECG abnormalities is notable in this material — — in a total of 1710 men aged 40—59 there were no cases of complete A-V block, only 4 cases of left bundle branch block, only 8 cases of auricular fibrillation or flutter. If we take major Q waves (Code I, 1) as the most definite evidence of previous infarction, it is interesting that only 9 cases were found, or a rate of 5.3 per thousand men aged 40—59.

The Minnesota Code for the ECG was not available until several years after the Nicotera survey. Further, the ECG records from Nicotera may not be entirely comparable with the ECG records from the other samples because of some questions about technique and equipment. However, the following may be noted. Two farmers aged 55 and 57 and one hairdresser aged 46 had records indicating old infarction (Minnesota Code I, 1). Isolated S-T depression of 0.5 mm. or more in rest was observed in 9 men (3 aged 45—49, 2 aged 50—54, 4 aged 54—59). Isolated flat or negative T wave in rest was observed in 5 men (2 aged 45—49, 2 aged 50—54, one aged 56). S-T depression associated with T wave abnormality or auricular fibrillation was noted in 3 men in rest (ages 45, 47, 54) and 4 men post-exercise (ages 49, 52, 55, 59) one of whom was diabetic. There were no cases of bundle branch block.

Angina pectoris was diagnosed in only one man at Nicotera, an obese landowner aged 57 whose ECG was normal. Three hypertensive men (B.P. 160/95 or more) showed ECG evidence of left ventricular hypertrophy; their ages were 54, 56 and 58. At Nicotera there were five men with rheumatic heart disease (4 aged 45—49, one aged 55) and three with pulmonary heart disease (ages 49, 56 and 59). In general, then, it seems that the prevalence of coronary heart disease at Nicotera was low.

Prevalence of Hypertension

The prevalence of hypertension, by two different criteria, of diastolic blood pressure, in these Italian villages is summarized in Table C2.14. Among men of the same age, at Crevalcore hypertension was about twice as common as at Montegiorgio and some five times more common than at Nicotera. These differences are statistically highly significant. For example, even the smallest difference, that between Montegiorgio and Nicotera with 100 mm. in diastole as the criterion, proves to have a value of $p < 0.02$.

In comparison with the average prevalence of hypertension in all 18 samples in these cooperative studies, Nicotera is extremely low, Montegiorgio is definitely low, and Crevalcore is higher than the average. All of these differences between Montegiorgio and Nicotera and the rest of the 17 samples are statistically highly significant. The difference between Crevalcore and the rest of the populations is not significant

TABLE C2.14

Prevalence of diastolic hypertension (95 or more, 100 or more mm Hg, fifth phase) among men classed by age. Percentage of men in rural Italy who are hypertensive, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm
Nicotera	--	--	1.3	0.9	4.9	3.3	6.0	4.3
Crevalcore	16.5	8.5	20.5	10.3	25.9	15.5	28.5	17.1
Montegiorgio	5.7	2.4	8.9	2.8	14.7	8.3	15.3	8.4
Mean, 18 samples	13.6	7.9	15.6	8.9	20.9	13.5	21.5	13.8

with 100 mm. in diastole as the criterion (p = about 0.12) but with 95 mm. as the criterion the difference is highly significant (p = about 0.005).

Prevalence of Overweight

Table C2.15 shows the percentage of men, classed by age, who were overweight by either of two criteria — 110 per cent or more or 120 per cent or more of the average weight for height and age as given in the Appendix. By either criterion, overweight was much more common in Crevalcore than in either Nicotera or Montegiorgio. The difference between Nicotera and Montegiorgio in this respect is small.

Compared with all 17 other samples of men, Nicotera differs little; Montegiorgio tends to have rather more cases of overweight than expected; in Crevalcore the frequency of overweight is about double the expectation.

Hypertension versus Other Variables

The distributions of the hypertensive men according to decile classes of relative body weight, Σ skinfolds and serum cholesterol concentration are shown in Figures C2.4, C2.5 and C2.6.

In all areas the prevalence rate of hypertension rises markedly, though not uniformly, with increasing values for these other variables; absence of a trend would be indicated by random variations about a horizontal straight line. At Montegiorgio the upward trend of prevalence with increasing relative weight and with Σ skinfolds seems to be definitely curvilinear. This is scarcely indicated at Crevalcore except, perhaps, in the sharp rise in prevalence from the ninth to the tenth decile in relative body weight.

The trend toward increasing prevalence of hypertension with increasing serum cholesterol values seems to be more or less linear in both areas. The relationship of hypertension frequency to serum cholesterol is statistically highly significant and the same is true for the relationships to relative weight and Σ skinfolds.

These relationships are particularly striking if the prevalence of hypertension in the upper 30 per cent (deciles 8, 9, 10) of the distributions is expressed as percentage of the prevalence among men in the bottom 30 per cent (deciles 1, 2, 3) of the distributions. For Crevalcore and Montegiorgio combined, the percentage is 251 per cent for relative weight, 229 per cent for Σ skinfolds, 186 per cent for serum cholesterol.

The relative rarity at Nicotera of hypertension, as here defined, and the small numbers on whom serum cholesterol was measured, makes the corresponding analysis less certain for that sample. However, 11 out of a total of 16 "hypertensives" were in the top 3 deciles of relative body weight, none in the bottom 3 deciles; and 10 out of the 16 were in the top 3 deciles of Σ skinfolds and only one in the bottom 30 per cent of the Σ skinfolds distribution. There were only 2 cases of hypertension among the 68 men aged 45—59 on whom cholesterol values were obtained; they were both in the eighth decile of the cholesterol distribution of the 68 Nicotera men.

Overweight versus Other Variables

If 110 per cent of "standard" average body weight for given height and age is taken as the criterion for overweight, among men aged 40—59, at Crevalcore 34 per cent and at Montegiorgio 20 per cent would be classed as overweight. The difference is statistically highly

TABLE C2.15

Prevalence of overweight (110 or more and 120 or more per cent of "standard" average for height and age). Percentage of men in rural Italy, classed by age, who are overweight, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	110%	120%	110%	120%	110%	120%	110%	120%
Nicotera	--	--	21.7	9.1	12.2	5.7	17.1	4.3
Crevalcore	42.9	20.9	34.7	16.2	30.1	12.6	33.3	19.1
Montegiorgio	22.0	6.5	24.8	11.8	16.6	6.5	18.5	10.8
Mean, 18 samples	20.9	8.4	19.4	6.9	18.1	6.7	16.8	7.3

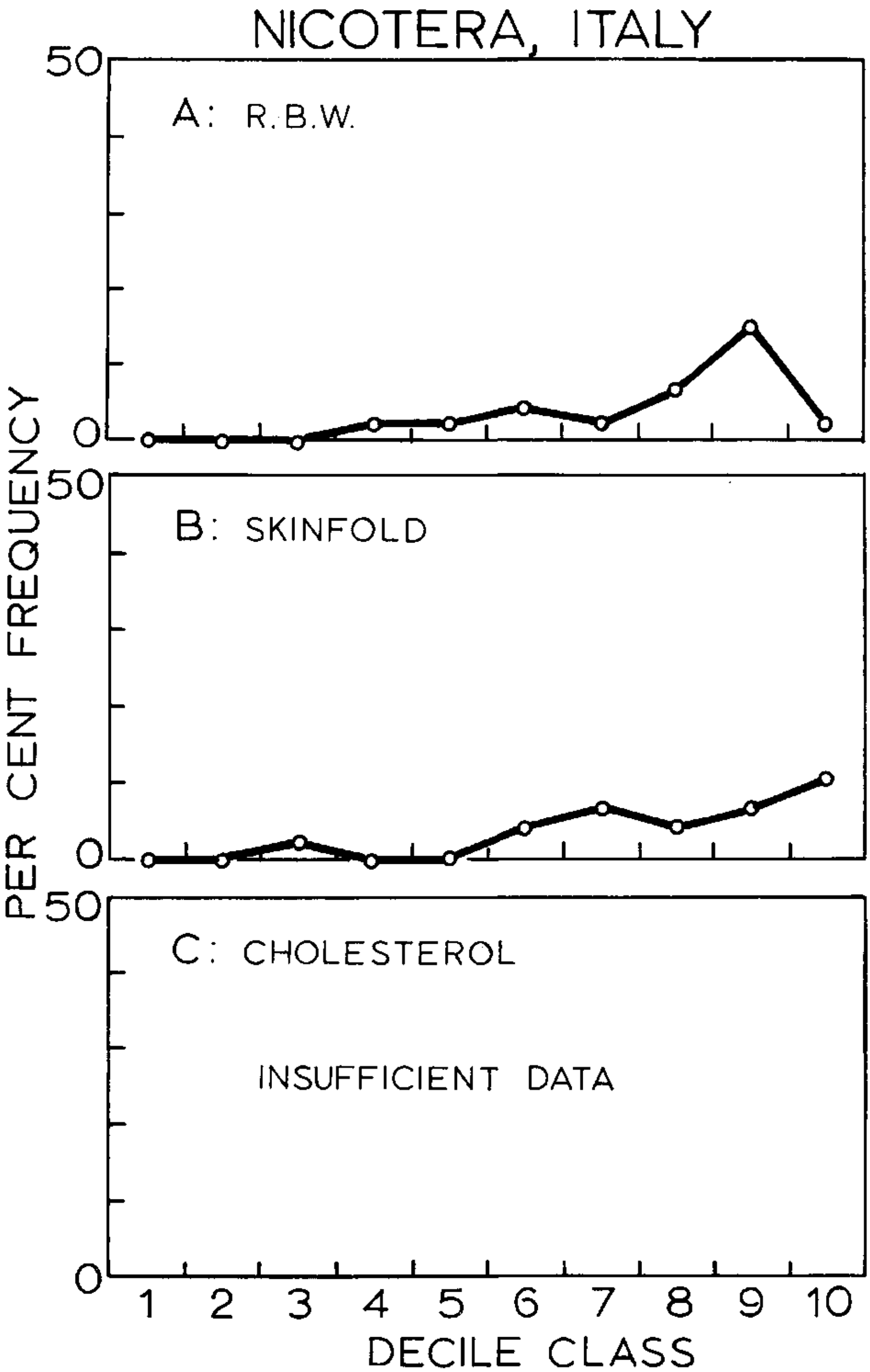

NICOTERA, ITALY
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
INSUFFICIENT DATA
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C2. 4

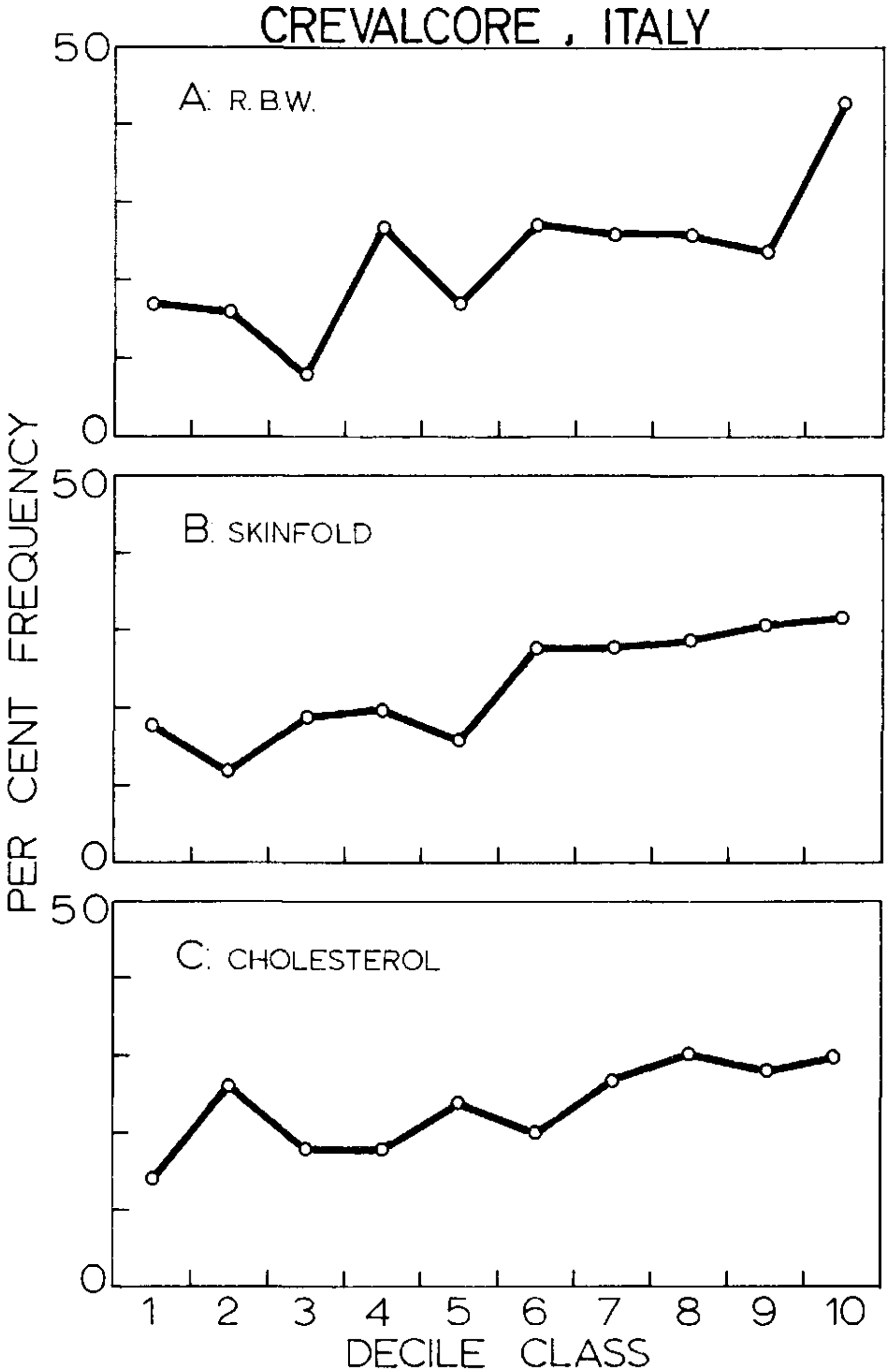

CREVALCORE , ITALY
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C2. 5

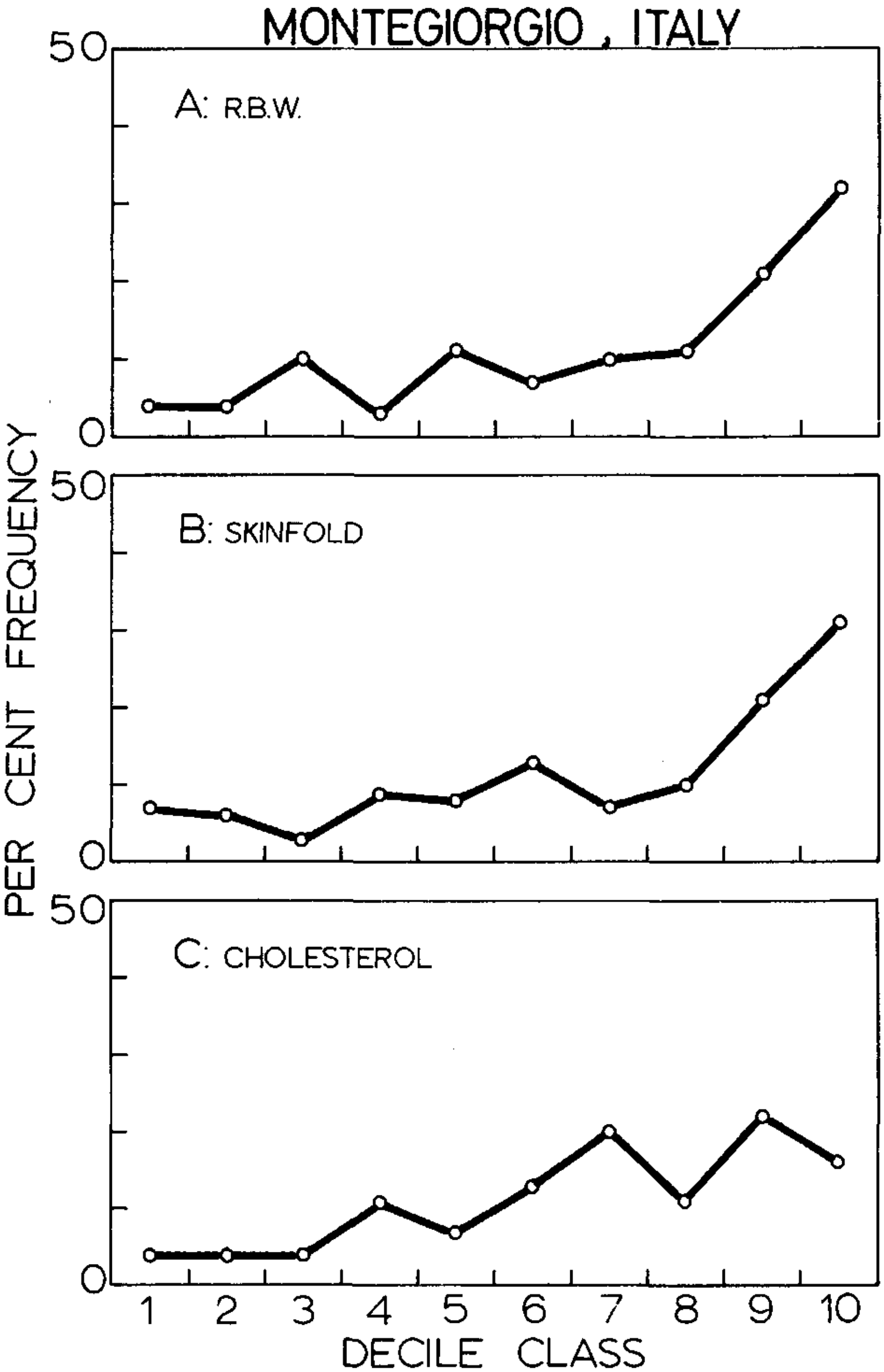

MONTEGIORGIO , ITALY
50
0
A: R.B.W.
50
0
B: SKINFOLD
50
0
C: CHOLESTEROL
PER CENT FREQUENCY
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C2.6

significant. The distribution of these overweight men by decile classes of serum cholesterol, diastolic blood pressure and systolic blood pressure are shown in Figures C2.7, C2.8 and C2.9. In both areas there is a marked tendency for prevalence of overweight to rise with increasing levels of these other variables and in all cases this is of high statistical significance. In Crevalcore the trend lines do not depart significantly from a straight line; in Montegiorgio there is a distinct suggestion of curvilinearity.

As in the case of hypertension, it is interesting to compare the prevalence of overweight among the men in the top and the bottom 30 per cent classes of distribution of the other variables. For serum cholesterol, the prevalence of overweight in the top 30 per cent is 185 per cent of that in the bottom 30 per cent; the corresponding figures for systolic and diastolic blood pressures are, respectively, 205 and 182 per cent.

Among 470 Nicotera men aged 45—49, 85 men, or 18 per cent, were classed as overweight by the present criterion. The difference from the figure for Montegiorgio is not significant. The distribution of these overweight men into the decile classes of blood pressure is shown in Figure C2.7. Forty-one of these overweight men were in the top 30 per cent and only eight in the bottom 30 per cent of the systolic blood pressure distribution. The corresponding figures for diastolic blood pressure are 42 men in the top and six men in the bottom 30 per cent. Cholesterol data were available on only 13 overweight men; eight of them were in the top and one in the bottom 30 per cent of the cholesterol distribution.

Prevalence of Obesity and of Hypercholesterolemia

Section H, below, presents a system for classifying men aged 40—59 into grades of body fatness and of hypercholesterolemia based on the distributions of Σ skinfolds and of serum cholesterol concentration observed in seven samples of men in areas of favorable mortality from all causes and prevalence of coronary heart disease. For each of the two variables cutting points were found which include the top 5, 10, 15 and 20 per cents of the reference population. Accordingly, Grade 1 obesity is assigned to men whose Σ skinfolds value exceeds 37 mm., Grade 2 covers the range 32—37, Grade 3 covers 29—31, and Grade 4 covers 26—28 mm. Grade 1 may be considered to be "extreme". The grades of hypercholesterolemia were assigned to serum cholesterol values on a similar basis.

With these criteria, the prevalence of any degree of obesity proves to be 16, 39, and 16 per cent for men at Nicotera, Crevalcore and Montegiorgio, respectively. These figures emphasize the marked contrast between Crevalcore on the one hand and Nicotera and Montegiorgio on the other. Further, it is clear that obesity is much more common in Crevalcore than the general prevalence in areas of favorable mortality and prevalence of coronary heart disease. In Crevalcore 39 per cent of the men are obese but for all areas used as the base, only 18 per cent are obese; for extreme obesity the corresponding figures are 13 and 5 per cent.

The prevalence of hypercholesterolemia of any degree was 22, 21, and 12

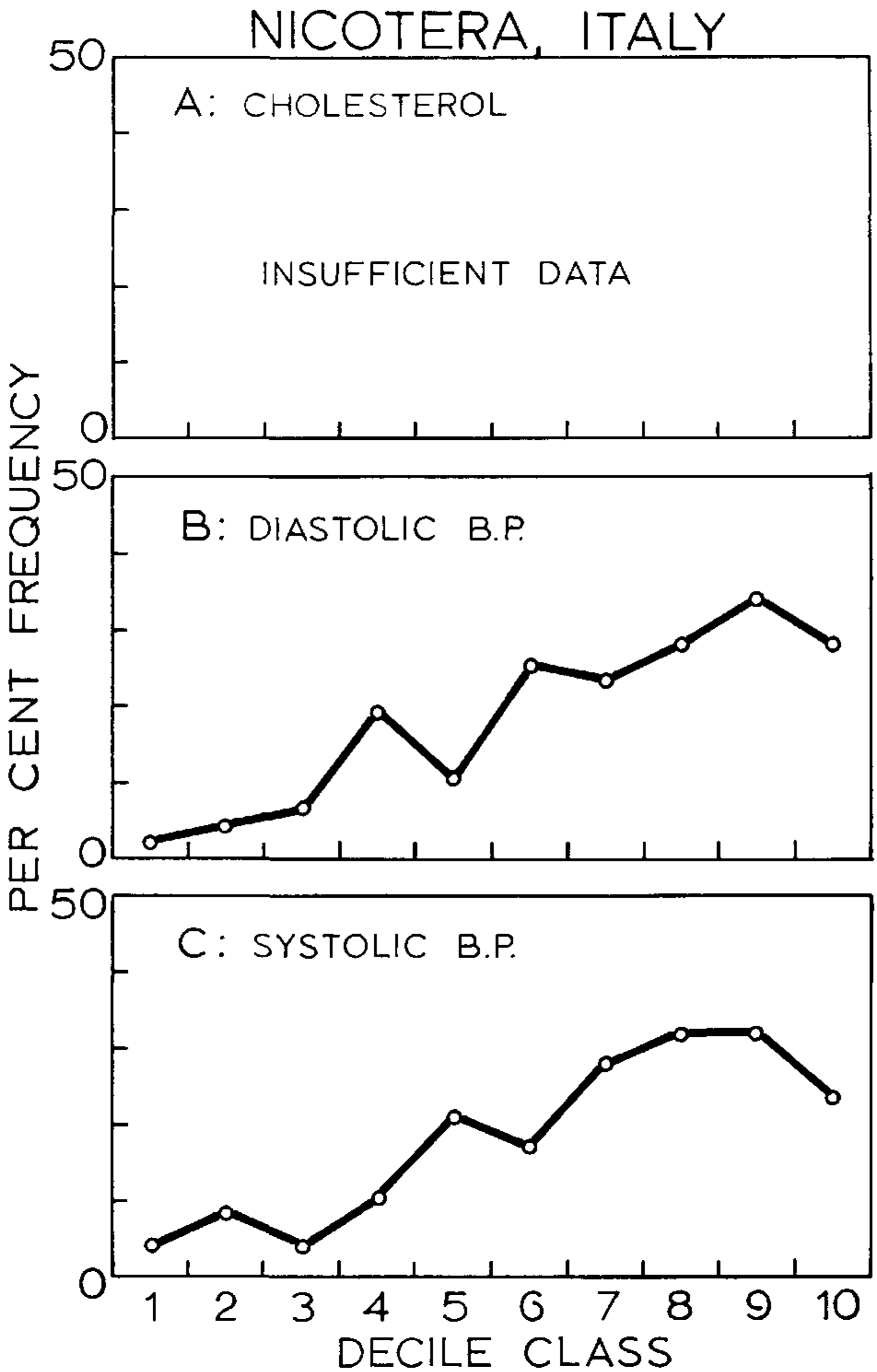

NICOTERA, ITALY
A: CHOLESTEROL
INSUFFICIENT DATA
B: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C2. 7

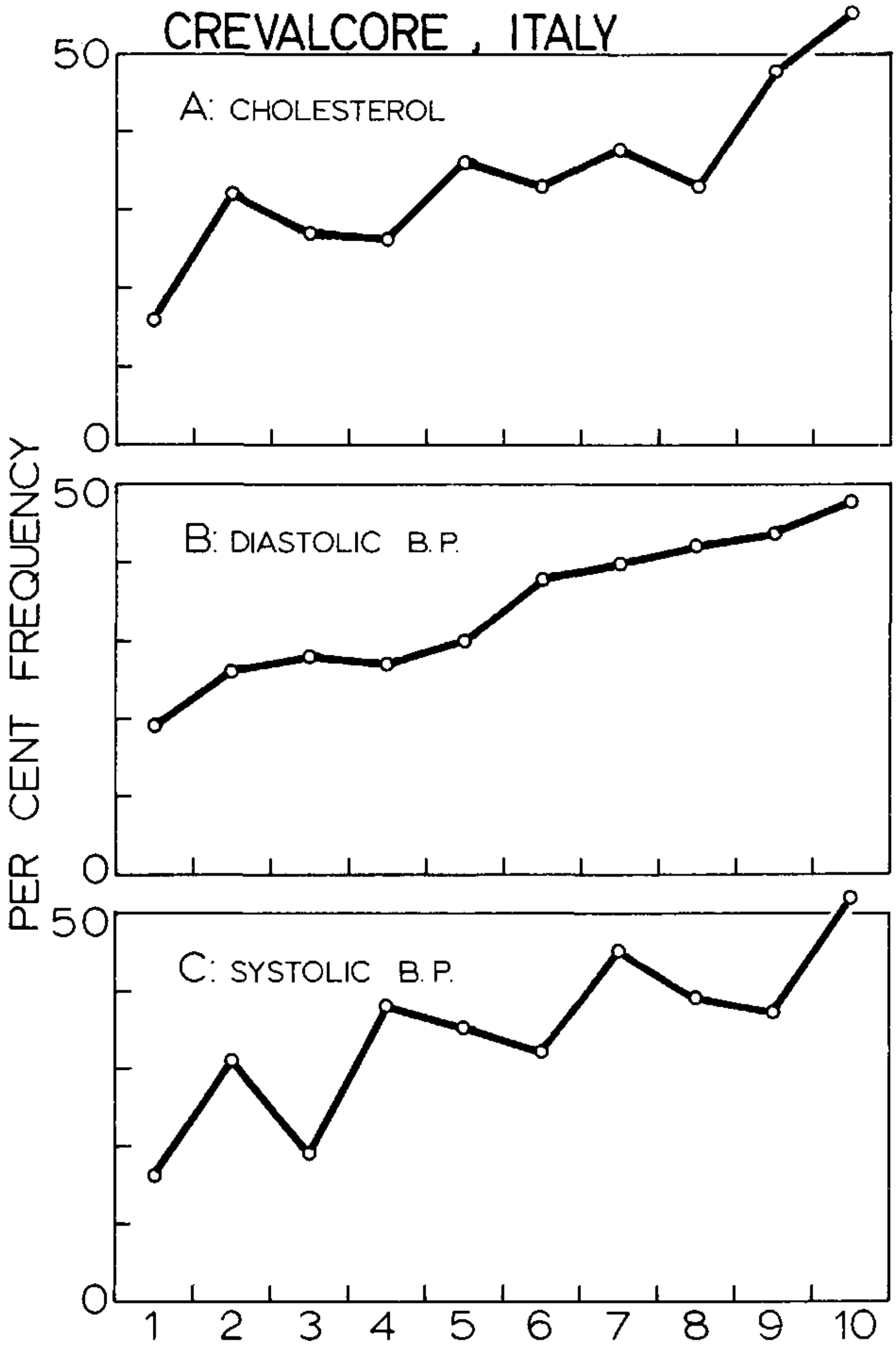
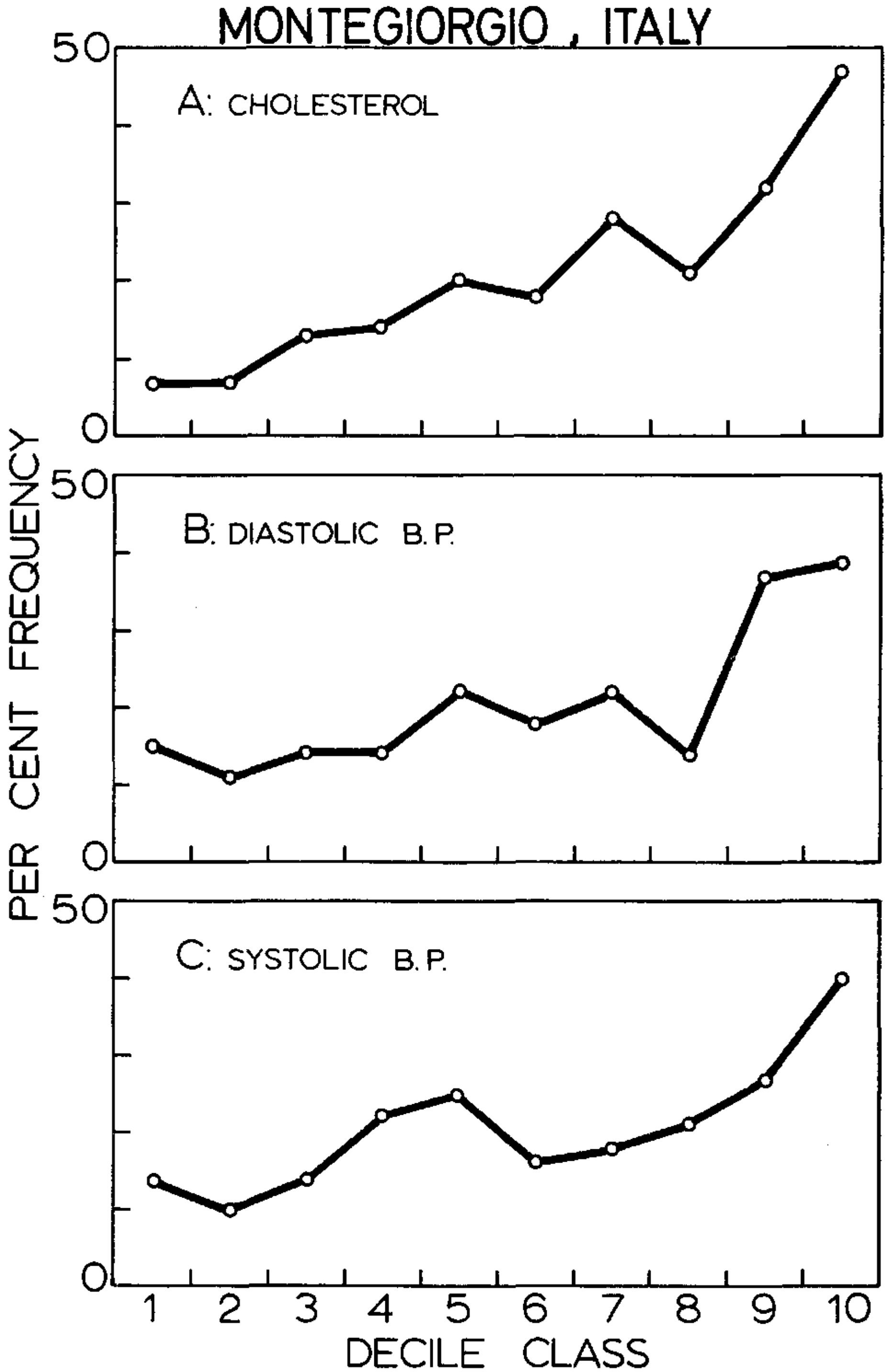

CREVALCORE , ITALY
PER CENT FREQUENCY
50
0
A: CHOLESTEROL
B: DIASTOLIC B. P.
C: SYSTOLIC B. P.
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C2. 8



MONTEGIORGIO: Prevalence of OVERWEIGHT vs. A-cholesterol, B-diastolic, C-systolic blood pressure

10

Figure C2. 9

per cent at Crevalcore, Montegiorgio and Nicotera, respectively; the corresponding figures for extreme (Grade 1) hypercholesterolemia are 6,6, and zero per cent.

Summary

Over 98 per cent of all men aged 40—59 were examined in three rural areas of Italy centered on the villages of Nicotera (near the "toe" of Italy), Crevalcore (in the lower Po valley), and Montegiorgio (in the hills near the Adriatic Sea in the Province of Marche). In all three areas most of the men were engaged in small-scale farming and there was no other significant industry. Correspondingly, about two thirds of the men, including the oldest group (55—59), habitually did heavy physical work and there were few sedentary men.

The men of Nicotera tended to be the shortest and thinnest and to be least often hypertensive, the men of Crevalcore being at the opposite extreme in these variables. Serum cholesterol concentration tended to be relatively low in all areas but especially so in Nicotera. Within each area the least active men tended to be the fattest and to have higher blood pressures and serum cholesterol values. But it is shown that these relationships are confounded with socio-economic status. If either physical activity or socio-economic status is considered alone, its apparent effect on the measured variables is much over-estimated.

Most of the middle-aged men in these villages smoke cigarettes but relatively few smoke 20 or more cigarettes daily. The non-smokers, both those who never smoked and those who had stopped, were more often overweight and obese than the smokers. They also tended to higher blood pressure and serum cholesterol values but this was less marked than their trend to relative obesity.

Twelve-lead electrocardiograms in rest and after a standard exercise test showed relatively few abnormalities in any of the three areas. By any criterion the prevalence of heart disease was low.

Hypertension was frequent in Crevalcore and fairly common in Montegiorgio. With the criterion of 95 mm. or more in diastole (fifth phase) in rest, 23 per cent of the men of Crevalcore were hypertensive; the corresponding figure for Montegiorgio being 11 per cent. Hypertension was uncommon in Nicotera.

In all areas the prevalence of hypertension was directly, but curvilinearly, related to relative body weight and body fatness; there was a less marked apparently linear relationship between serum cholesterol and hypertension. Overweight was common in Crevalcore and rare in Nicotera.

Acknowledgments

Among the large number of people who made this program possible, first thanks are due to the professional staff who helped so much in the field: Drs. Ratko Buzina (Zagreb), Henry Blackburn (Minneapolis), L. A. Cioffi (Naples), Domenico Cotrone (Rome), Louise Dalderup (Amsterdam), Bruno Imbimbo (Naples), Aubrey Kagan (Geneva, then of London), Mario Mancini (Naples), Ivan Mohaček (Zagreb), and Sven Punsar (Helsinki). Some aspects of the work were aided by Drs. J. Carlotti (Paris), Martti J. Karvonen (Helsinki), Prof. Noboru Kimura (Kurume, Japan), Mrs. Margaret H. Keys (Minneapolis), Drs. Arrigo Poppi (Verona), Traian Sofonea (Trieste), and Paul Dudley White (Boston).

We are grateful for the excellent cooperation given by the officials and physicians in the villages of Nicotera, Crevalcore and Montegiorgio. Prof. Gino Bergami gave encouragement and made available the facilities of the Istituto di Fisiologia of the University of Naples which served as the "home base" for the field work in Italy.

C3. RURAL MEN IN DALMATIA AND SLAVONIA, YUGOSLAVIA

by Ratko Buzina (Zagreb), Ancel Keys (Minneapolis), Ivan Mohaček (Zagreb), Árpád Hahn (Zagreb), Josef Brozek (Lehigh, Pennsylvania), and Henry Blackburn (Minneapolis).

Interesting contrasts between villages in Dalmatia and in Slavonia, Yugoslavia, in regard to the diet and serum cholesterol concentration, and reputed differences between those regions in the frequency of heart disease, emerged from surveys conducted by several of the present collaborators (Brozek 1955; Brozek *et al.*, 1957). These facts, plus the experience of excellent cooperation in these areas, led to the organization of a more systematic study on a larger scale.

Two regions in Dalmatia and in Slavonia were selected on the basis of previous experience and exploratory talks with officials and influential people in the areas of interest. Rosters of all men aged 40—59 were established and checked and the work of examination was carried out in the fall of 1958. In Dalmatia 727 out of 742 men in the roster were examined in full (98.0 per cent) and the coverage was also good in Slavonia; 749 out of 815 men (91.9 per cent) were examined; most of those missed were not refusals but were men who were temporarily at work away from their villages. The methods and criteria, improved from those developed in the exploratory studies in 1957 in Nicotera and Crete, were those that subsequently formed the common protocol of the surveys in Finland and elsewhere and are reported, in part, in the present publication.

Dalmatia

Dalmatia was invaded and long ruled by the Romans who, however, did not settle there in large numbers. The original Illyrian population was displaced by or absorbed into the Slavic population who migrated into the region about fourteen hundred years ago.

The area of study comprises a series of villages in a coastal strip of rather barren mountainside along the Adriatic stretching south some 60 kilometers from the port town of Makarska. The population is Croatian with here and there notable influences from neighboring Italy. Though the region was long ruled by Austria, there is little evidence of Germanic or Teutonic influence.

Small-scale hand farming provides a livelihood for most of the population with fishing a poor second in importance. The land is poor and in the absence of any other industry the economic level is low. Tourist traffic on the Dalmatian coast is increasingly important in the past few years but as yet has had little impact on the villages of the present study. The climate is generally mild and temperate. Local produce includes grapes, wine, figs, olives, a variety of other fruits, and small plots of land devoted to cereals. Olive oil has been an important part of the local diet. There is a health center and small hospital at Makarska.

Slavonia

The area of study in Slavonia is centered in the large village of Dalj, near the Drava River in a broad plain close to the Hungarian frontier of Yugoslavia. There is bus and local train communication with the nearby regional capital of Osijek which has high schools, technical training schools and a general hospital. The population is almost entirely Slav, about two-thirds Serbs and one-third Croats.

This is an agricultural region of flat fertile land, well suited to mechanized farming, and modern methods are slowly replacing primitive methods of agriculture. There is no other industry. Economically, the population may be somewhat better off than that of Dalmatia, but the full potential of the region has not yet been developed. The climate is mid-continental, with hot dry summers and severe winters with heavy snows.

Distribution by Physical Activity and Occupation

Table C3.1 shows the distribution of the men in Dalmatia and Slavonia. In both areas the majority of the men do hard physical work (Grade 3) and there is no tendency for the percentage of men in the high activity class to decline with age over the ages 40—60; there is actually some trend in the opposite direction. In Dalmatia only 7.9 per cent of the men 40—59 are sedentary or engaged only in light work. This class of physical activity has a larger representation in Slavonia but still amounts only to 17.2 per cent.

Table C3.2 summarizes the occupational distribution of these men. Only 5.3 per cent in Dalmatia and 8.6 in Slavonia are in the professional, managerial and official class and more than half in both areas are simple farmers. In Dalmatia 13.3 per cent are fishermen but they also do some farming.

Distribution by Six Measured Variables

Table C3.3 gives the medians, and those medians expressed as percentages of the averages of the medians for all men in the 18 samples in the present cooperative studies, of height, relative body weight (as percentage of the "standard" average for height and age), body fatness (Σ skinfolds over the triceps muscle and over the tip of the scapula), systolic and diastolic (5th phase) blood pressure, and serum cholesterol concentration. Cumulative frequency distributions of these variables are shown in Figures C3.1 and C3.2. Details of the distributions are tabulated in the Appendix.

The Dalmatians average about 5 cm. taller than the Slavonians and in both samples, as in other samples over these ages, the youngest men are the tallest. In relative body weight the men are similar in both samples and are definitely lighter for their height and age than the general average of the men studied. In both areas the men are decidedly thin, with all median values being close to 15 mm. for Σ skinfolds. Allowing for true skin thickness, this means that the average thickness of the

TABLE C3. 1

Physical activity, men in Dalmatia and Slavonia classed by age and physical activity ("ACT.," 1 = sedentary and light, 2 = moderate, 3 = heavy work). N = total men. Table entries are percentages of all men of given age in the area.

AGE	DALMATIA, N = 671			SLAVONIA, N = 699		
	ACT. 1	ACT. 2	ACT. 3	ACT. 1	ACT. 2	ACT. 3
40-44	10.6	16.5	72.9	21.6	14.7	63.7
45-49	8.7	15.3	76.0	21.4	8.3	70.3
50-54	6.2	8.1	85.7	11.1	9.1	79.8
55-59	7.8	10.4	81.8	17.1	7.4	75.5
40-59	7.9	11.8	80.3	17.2	9.2	73.6

TABLE C3. 2

Occupation of men in Dalmatia and Slavonia classed: Codes 1-15 (business, professional, government officials), Codes 66-69, 71-75 (farming, agriculture, forestry), and all others. Table entries are percentages of all men in the area.

OCCUPATION	DALMATIA	SLAVONIA
Codes 1-15	5.3	8.6
" 66-69, 71-75	61.4	57.1
All Other	33.3	34.3

TABLE C3. 3

Medians for men, classed by age, in Dalmatia and in Slavonia and these values as percentages of the average of the medians for all 18 samples of men.

AREA	VARIABLE	MEDIAN VALUES				MEDIAN, % OF AVERAGE			
		40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
DALMATIA	Height (cm.)	175	173	173	172	103.1	102.3	102.8	102.6
"	Rel. Wt. (%)	94	93	90	88	95.8	96.7	94.5	93.5
"	Σ Skinfolds	15	15	14	13	70.8	73.5	67.6	65.3
"	Syst. B.P.	136	135	137	135	103.8	101.5	100.0	96.0
"	Diast. B.P.	85	80	82	82	104.9	98.3	98.3	97.3
"	Serum Chol.	182	185	186	188	88.2	89.2	89.0	91.0
SLAVONIA	Height (cm.)	170	168	166	168	100.1	99.4	98.6	100.2
"	Rel. Wt. (%)	95	94	88	91	96.8	97.7	92.4	96.7
"	Σ Skinfolds	15	15	13	14	70.8	73.5	62.8	70.4
"	Syst. B.P.	130	130	131	140	99.2	97.7	95.6	99.6
"	Diast. B.P.	79	80	80	84	97.5	98.3	95.9	99.6
"	Serum Chol.	196	197	200	194	95.0	95.0	95.7	93.9

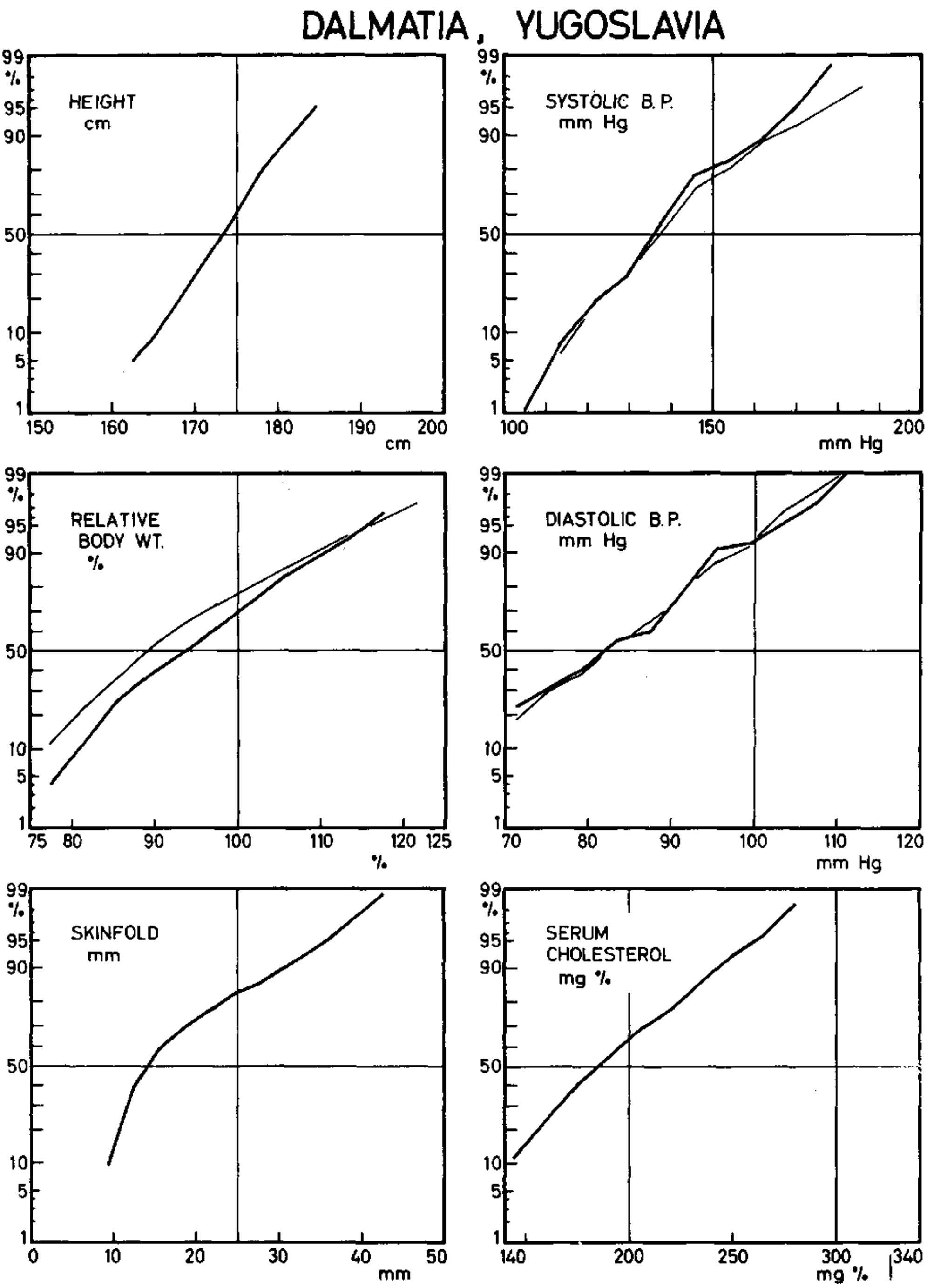

DALMATIA, YUGOSLAVIA
HEIGHT
cm
SYSTOLIC B.P.
mm Hg
RELATIVE
BODY WT.
%
DIASTOLIC B.P.
mm Hg
SKINFOLD
mm
SERUM
CHOLESTEROL
mg %
99
%
95
90
50
10
5
1
150 160 170 180 190 200
cm
100 150 200
mm Hg
75 80 90 100 110 120 125
%
70 80 90 100 110 120
mm Hg
0 10 20 30 40 50
mm
140 200 250 300 340
mg %

Figure C3. 1

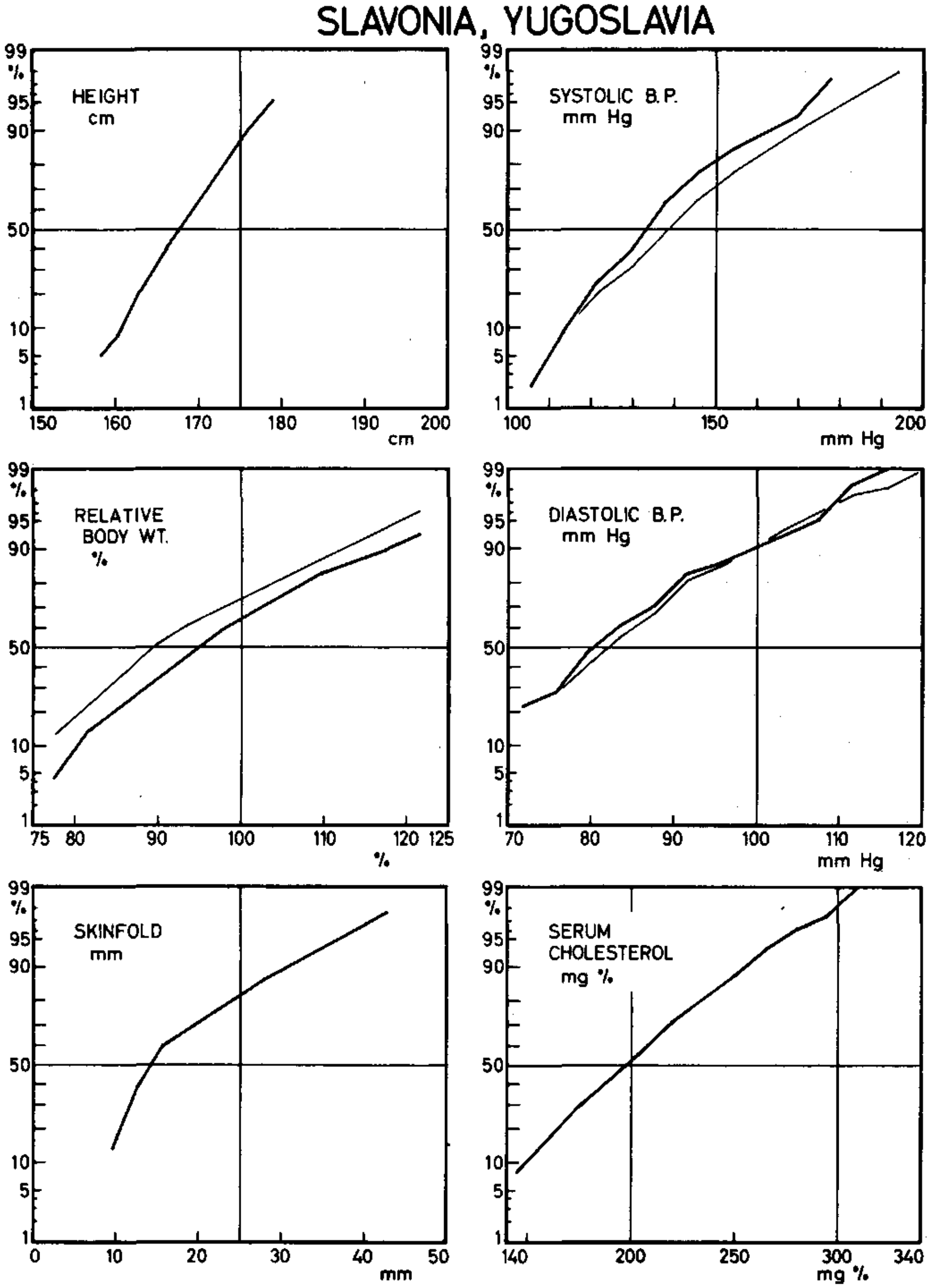

SLAVONIA, YUGOSLAVIA
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT. %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C3. 2

subcutaneous fat is only about 2 to 3 mm.

The Dalmatians are remarkable in regard to blood pressure in that they show no rise with age in either systole or diastole over most of the distribution; the median values are actually lower at ages 55—59 than at 40—44. The ninth decile cutting points for systolic pressure in the Dalmatian men is 160 at ages 40—44, 165 at ages 55—59; the corresponding values for diastolic pressure are 95 and 99 mm. The Slavonians are little different in blood pressure except that they show more age trend, the medians being lower than in Dalmatia at ages 40—44 but higher at ages 55—59.

The serum cholesterol values are decidedly low according to findings in the United States and northern Europe and they are clearly lower in Dalmatia than in Slavonia, the medians for corresponding ages differing by about 12 mg. cholesterol per 100 ml. of serum.

Physical Activity and Socio-Economic Status

In these population samples men with low physical activity tend to be more often relatively overweight, obese and to have high blood pressure and relative hypercholesterolemia than their more active counterparts. For example, in the combined material for Dalmatia and Slavonia, chance expectation would place equal numbers of men in Activity Classes 1 + 2 in the upper and in the lower 30 per cent categories of all men of equal age in the same area (deciles 8—10 and 1—3, respectively). But the data for men in these lower activity classes show 129 men in the upper 30 per cent group of relative weight and only 62 in the lower 30 per cent group. Corresponding figures for Σ skinfolds are 138 and 48 men, for systolic blood pressure 89 and 74 men, for diastolic blood pressure 95 and 82, and for serum cholesterol 93 and 63 men.

But attention to socio-economic status, ignoring physical activity, shows even more striking departures from random chance. Among the men in the upper socio-economic class (Occupations 1—13), 61 were in the decile classes 8—10 for relative weight and only 10 men in decile classes 1—3. Corresponding figures for Σ skinfolds are 67 and 13 men, for systolic blood pressure 36 and 26, for diastolic blood pressure 37 and 26, and for serum cholesterol 33 and 17 men.

Obviously, the interpretation of these data is complicated because of the high correlation (inverse) between physical activity and socio-economic status. Almost no men of higher socio-economic status engage in physical activity (Class 3) in these populations; relatively few men in the lower socio-economic class are sedentary. Attempts at more detailed analysis are shown in Tables C3.4, C3.5, and C3.6. The general question of physical activity versus socio-economic status in regard to obesity, high blood pressure, etc., is discussed in more detail in Section D, below.

Smoking Habits

Next to the sample in Velika Krsna, also in Yugoslavia, the men in Dalmatia and Slavonia tended to smoke less than the men in any of the other samples in these studies. Table C3.7 shows the distribution of cigarette smoking habits by age. It should be noted that pipe and cigar smoking is rare in these areas. In both areas the percentage of men who had never smoked tends to fall with age while the percentage of stopped smokers has the opposite tendency so that the percentage of non-smokers is fairly constant at all ages. In general, the men of Dalmatia smoke

TABLE C3.4

Activity 1 vs. Activity 2. Excess frequency of high values (deciles 8-10) of the variables observed among men of Activity 1, expressed as % of expectation from total numbers of men in Activities 1 plus 2. Also, chi-square values for the differences between observed and expected distributions.

OCCUPATION	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Dalmatia										
1-94	79.7	16.02	57.9	15.20	18.6	0.54	30.4	1.72	12.0	0.18
1-13	11.1	1.30	11.8	6.14	16.5	0.90	16.5	0.90	-4.4	0
14-94	100.0	1.70	66.7	1.44	-20.0	0	25.0	0.01	20.0	0
Slavonia										
1-94	19.5	7.44	18.8	7.28	-6.8	0.24	-6.3	0.26	-10.7	1.14
1-13	10.4	1.46	1.0	0	-1.5	0	-1.5	0	-2.4	0
14-94	21.4	1.20	17.6	0.70	-34.8	1.69	-13.8	0.23	0.7	0

TABLE C3.5

Activity 2 vs. Activity 3. Occupations 14-94 only. Excess frequency, as in Table C3.4, of high values among men of Activity 2.

SAMPLE	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Dalmatia	23.1	1.66	48.1	6.06	24.4	1.52	15.0	0.49	19.4	0.91
Slavonia	54.8	6.17	55.8	6.35	15.4	0.46	33.3	2.65	54.8	7.08

TABLE C3.6

Occupation 1-13 vs. 14-94. Excess frequency, as in Table C3.4, of high values among men in Occupations 1-13, expressed as % of expectation from total numbers of men in Occupations 1-13 + 14-94.

ACTIVITY	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Dalmatia										
1+2	70.4	13.29	38.1	6.82	12.0	0.12	13.8	0.26	16.3	0.46
1	5.0	0.14	3.3	0.05	10.1	0.27	2.6	0	0	0
2	60.0	0.61	-14.3	0	-35.5	0.20	40.0	0.05	37.9	0.22
Slavonia										
1+2	24.2	5.01	31.1	9.06	13.5	0.51	1.0	0	-23.8	2.79
1	7.6	0.91	11.4	2.57	19.8	2.13	4.2	0.02	-16.7	1.62
2	0	0.19	25.0	0	42.9	0	25.0	0	11.1	0

Probabilities, p, associated with chi-square values: 2.71, p = 0.10; 3.84, p = 0.05; 5.41, p = 0.02; 6.64, p = 0.01; 10.83, p = 0.001.

TABLE C3.7

Cigarette smoking habits of men of Dalmatia and Slavonia. Percentage of men who never smoked, who had stopped, who smoked 1-9, 10-19, 20 or more cigarettes daily at the time of their examination.

SAMPLE	AGE	NEVER	QUIT	1-9	10-19	20 OR MORE
Dalmatia	40-44	39.4	7.1	7.1	30.9	15.5
"	45-49	33.3	8.9	7.2	27.8	22.8
"	50-54	26.3	11.0	8.1	32.1	22.5
"	55-59	26.9	16.8	6.3	23.7	26.3
"	40-59	30.0	11.6	7.2	28.4	22.8
Slavonia	40-44	31.3	10.8	9.8	26.5	21.6
"	45-49	30.4	13.8	8.8	31.0	16.0
"	50-54	20.2	13.1	10.1	35.9	20.7
"	55-59	26.5	14.0	8.8	32.6	18.1
"	40-59	26.4	13.2	9.3	32.3	18.8

a little more than do the Slavonians. Among those who do smoke, the number of cigarettes smoked daily shows little age trend.

Table C3.8 considers the association of smoking habits with other characteristics of these men. In both areas the non-smokers tend to be above the median for all men of their age in their sample in relative weight, body fatness and blood pressure and these trends are statistically highly significant. On the other hand, the heavy smokers, who regularly smoke 20 or more cigarettes daily, show the opposite tendencies, though only the Slavonian heavy smokers are significantly distinguished in this respect.

In Dalmatia the serum cholesterol level shows little relationship to smoking habits but in Slavonia the non-smokers are unduly represented in the above-median serum cholesterol class while the heavy smokers are significantly more apt to be below the median. "Other" smokers in Slavonia, who smoke regularly but fewer than 20 cigarettes a day, tend to be below the cholesterol median.

Electrocardiographic Findings

The electrocardiographic findings in rest and immediately after the standard exercise test are summarized in Tables C3.9, C3.10, C3.11 and C3.12. ECG abnormalities of any kind are remarkably uncommon in Dalmatia — in rest not a single case of definite old infarction (Code I, 1), only 7 cases of S-T depression, 3 of significant T wave inversion, no A-V blocks (partial or complete), only one left bundle branch block, only 3 men (all 55—59) with auricular fibrillation or flutter, 9 cases of sinus tachycardia, in a total of 669 men aged 40—59, 60 per cent of them over 50 years of age. The exercise test added little more evidence of abnormality — 4 cases of ischemic S-T depression and 5 cases of arrhythmia where the records had shown none in rest.

The Slavonian men showed more pathology but their records were still better than the usual expectation from other population samples. There were 3 men with definite old myocardial infarction, 10 of significant S-T depression and 12 of T wave inversion, 2 left bundle branch blocks and 2 cases of atrial fibrillation or flutter. However, there were 79 cases of high amplitude R waves (left type), and 27 men with significant sinus tachycardia in rest. The exercise test was more productive of ECG changes in Slavonia than in Dalmatia, with three times as many cases of ischemic S-T depression where the records were normal in rest.

Prevalence of Hypertension

Table C3.13 shows the prevalence of hypertension by age, using two different criteria of diastolic blood pressure. In general, hypertension is more common in Slavonia than in Dalmatia, especially among the oldest men (ages 55—59). Compared with all samples of men in these studies, the Slavonians are in the middle of the distribution for hypertension whereas the Dalmatians are somewhat less prone to high blood pressure.

Figures C3.3 and C3.4 show the distribution of the hypertensive men (diastolic pressure 95 mm. or more) of Dalmatia and Slavonia in decile classes of relative body weight, of the sum of the skinfolds, and of serum cholesterol concentration. In each case there is a striking curvilinear relationship, hypertension being practically unrelated to these other variables except at the upper ends of their distributions. For relative body weight and Σ skinfolds the men in the top 20 per cent of the

TABLE C3.8

Smoking. Number of men in Yugoslavia below (LOW) and above (HIGH) the age-specific medians, for age and area, of measured variables, classed according to smoking habits. HEAVY = 20 or more, OTHER = 1-19 cigarettes daily.

VARIABLE	SAMPLE	NON-SMOKERS		HEAVY		OTHER	
		LOW	HIGH	LOW	HIGH	LOW	HIGH
Relative Weight	Dalmatia	112	162	87	64	133	103
" "	Slavonia	78	198	87	44	181	106
Σ Skinfolds	Dalmatia	107	167	80	70	134	102
" "	Slavonia	82	194	87	44	177	110
Systolic B.P.	Dalmatia	122	153	79	72	129	106
" "	Slavonia	118	158	72	59	156	131
Diastolic B.P.	Dalmatia	122	154	84	67	125	116
" "	Slavonia	118	158	75	56	153	134
Serum Cholesterol	Dalmatia	137	137	82	68	111	121
" "	Slavonia	110	157	155	124	75	55

TABLE C3.9

DALMATIA, YUGOSLAVIA

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

		AGE GROUP (Number of Men)			
ECG FINDING	ECG Code	40-44 (84)	45-49 (184)	50-54 (211)	55-59 (190)
Total with reportable ECG Items	I - IX	26 (309.5)	50 (271.7)	50 (237.0)	41 (215.8)
Q Waves	I 1	0	0	0	0
	2	1 (11.9)	2 (10.9)	3 (14.2)	2 (10.5)
	3	1 (11.9)	4 (21.7)	0	1 (5.3)
Axis Deviation	II				
Left	1	1 (11.9)	10 (54.3)	2 (9.5)	10 (52.6)
Right	2	0	1 (5.4)	0	0
High Amplitude R Waves	III				
Left type	1	3 (35.7)	6 (32.8)	8 (37.9)	2 (10.5)
Right type	2	0	2 (10.9)	1 (4.7)	0
S-T Depression (rest)	IV				
S-T - J 1 mm. or more, horiz. or downward segment	1	0	0	0	1 (5.3)
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	0	0	1 (4.7)	1 (5.3)
No S-T-J plus segment downward	3	1 (11.9)	1 (5.4)	1 (4.7)	1 (5.3)
S-T - J 1 mm. or more, upward segment	4	0	0	0	0
T-Wave Negativity (rest)	V				
- 5 mm. or more	1	0	0	0	0
- 1 mm. to -5 mm.	2	0	1 (5.4)	1 (4.7)	1 (5.3)
0 ± 1.mm.	3	1 (11.9)	1 (5.4)	1 (4.7)	3 (15.8)
A-V Conduction Defect	VI				
Complete Block	1	0	0	0	0
Partial Block	2	0	0	0	0
P-R over 0.21 second	3	0	0	0	0
Accelerated Conduction	4	0	0	1 (4.7)	2 (10.5)
Ventricular Blocks	VII				
Left Bundle	1	0	0	0	1 (5.3)
Right Bundle	2	1 (11.9)	2 (10.9)	1 (4.7)	1 (5.3)
Incomplete Right Bundle	3	3 (35.7)	3 (16.3)	4 (19.0)	2 (10.5)
Intraventricular Block	4	0	0	1 (4.7)	0
Arrhythmias	VIII				
Premature Beats	1	2 (23.8)	0	0	4 (21.1)
Ventricular tachycardia	2	0	0	0	0
Atrial fibrillation, flutter	3	0	0	0	3 (15.8)
Supra-vent. tachycardia	4	0	0	0	0
Ventricular rhythm	5	0	0	0	0
A-V nodal rhythm	6	0	1 (5.4)	0	0
Sinus tachycardia	7	1 (11.9)	3 (16.3)	4 (19.0)	1 (5.2)
Sinus bradycardia	8	0	1 (5.4)	0	0
Technically poor records	IX 8	0	0	0	0

TABLE C3.10

DALMATIA, YUGOSLAVIA

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

		AGE GROUP (Number of Men)			
ECG FINDING	ECG Code	40-44 (83)	45-49 (179)	50-54 (209)	55-59 (187)
Exercise tests not made or incomplete	X 1 X 2	1 (12.0)	5 (27.9)	2 (9.6)	3 (16.0)
S-T Depression post-exercise (none at rest)	XI				
S-T - J 1 mm. or more, horiz. or downward segment	1	0	0	0	1 (5.3)
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	0	1 (5.6)	1 (4.8)	0
No S-T-J plus segment downward	3	0	1 (5.6)	0	0
S-T - J 1 mm. or more, upward segment	4	0	2 (11.2)	1 (4.8)	1 (5.3)
T Wave Negativity post-exercise (none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	0	0
0 ± 1 mm.	3	0	0	2 (9.6)	2 (10.7)
Arrhythmias post-exercise (none at rest)	XV 1	0	1 (5.6)	1 (4.8)	3 (16.0)
Technically poor post-exercise records	XI 8	0	1 (5.6)	0	1 (5.3)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

At Rest					
Large Q Waves	I 1	0	0	0	0
Lesser Q Waves with Negative T Waves	I 2, 3 + V 1, 2	0	1 (5.5)	0	0
Deeply Negative T as sole anomaly	V 1 only	0	0	0	0
Other Negative T as sole anomaly	V 2, 3 only	1 (11.8)	1	2 (9.5)	1 (5.3)
S-T Depression as sole anomaly	IV 1-4 only	1 (11.8)	1 (5.5)	2 (9.5)	1 (5.3)
High Amplitude R with S-T Depression	III 1 + IV 1-4	0	1 (5.5)	0	0
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	1 (11.8)	2 (10.9)	2 (9.5)	2 (10.5)
Arrhythmias	VIII 2-6	0	1 (5.5)	0	3 (15.8)
Post-exercise					
S-T Depression as sole anomaly	XI 1-4 only	0	1 (5.6)	2 (9.6)	2 (10.7)
Negative T as sole anomaly	XII 1-3 only	0	0	1 (4.8)	1 (5.3)
Ventricular Conduction Defect as sole anomaly	XIV 1, 2, 4 only	0	0	0	0
Arrhythmias as sole anomaly	XV 1 only	0	1 (5.6)	1 (4.8)	2 (10.7)

TABLE C3.11

SLAVONIA, YUGOSLAVIA

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (102)	45-49 (180)	50-54 (196)	55-59 (216)
Total with reportable ECG Items	I - IX		30 (294.1)	60 (333.3)	75 (382.7)	84 (388.9)
Q Waves	I	1	0	2 (11.1)	1 (5.1)	0
		2	0	2 (11.1)	1 (5.1)	3 (13.9)
		3	0	2 (11.1)	1 (5.1)	1 (4.6)
Axis Deviation	II					
Left		1	3 (29.4)	8 (44.4)	9 (45.9)	20 (92.6)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	14 (137.3)	15 (83.3)	23 (117.3)	27 (125.0)
Right type		2	0	0	1 (5.1)	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	0	0	1 (4.6)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	0	2 (11.1)	2 (10.2)	2 (9.3)
No S-T-J plus segment downward		3	0	2 (11.1)	0	1 (4.6)
S-T - J 1 mm. or more, upward segment		4	0	1 (5.6)	0	1 (4.6)
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	1 (5.1)	0
- 1 mm. to -5 mm.		2	0	3 (16.7)	3 (15.3)	5 (23.1)
0 ± 1 mm.		3	1 (9.8)	8 (44.4)	7 (35.7)	10 (46.3)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	0	1 (5.6)	0	0
Accelerated Conduction		4	0	0	1 (5.1)	1 (4.6)
Ventricular Blocks	VII					
Left Bundle		1	0	0	1 (5.1)	1 (4.6)
Right Bundle		2	0	1 (5.6)	0	2 (9.3)
Incomplete Right Bundle		3	0	3 (16.7)	0	1 (4.6)
Intraventricular Block		4	0	0	0	1 (4.6)
Arrhythmias	VIII					
Premature Beats		1	0	0	0	5 (23.1)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	1 (5.1)	1 (4.6)
Supra-vent. tachycardia		4	0	0	0	1 (4.6)
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	0	0
Sinus tachycardia		7	3 (29.4)	9 (50.0)	8 (40.8)	7 (32.4)
Sinus bradycardia		8	0	0	0	0
Technically poor records	IX	8	0	0	1 (5.1)	0

TABLE C3.12

SLAVONIA, YUGOSLAVIA

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (101)	45-49 (175)	50-54 (189)	55-59 (204)
Exercise tests not made or incomplete	X 1 X 2	1 (9.8)	5 (27.8)	7 (35.7)	12 (55.6)
S-T Depression post-exercise (none at rest)	XI				
S-T - J 1 mm. or more, horiz. or downward segment	1	0	3 (17.1)	1 (5.3)	1 (4.9)
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	0	2 (11.4)	2 (10.6)	3 (14.7)
No S-T-J plus segment downward	3	0	0	0	0
S-T - J 1 mm. or more, upward segment	4	1 (9.9)	1 (5.7)	0	2 (9.8)
T Wave Negativity post-exercise (none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	0	2 (9.8)
0 ± 1 mm.	3	0	3 (17.1)	1 (5.3)	0
Arrhythmias post-exercise	XV				
(none at rest)	1	0	0	1 (5.3)	4 (19.6)
Technically poor post-exercise records	XI 8	1 (9.9)	0	2 (10.6)	1 (4.9)

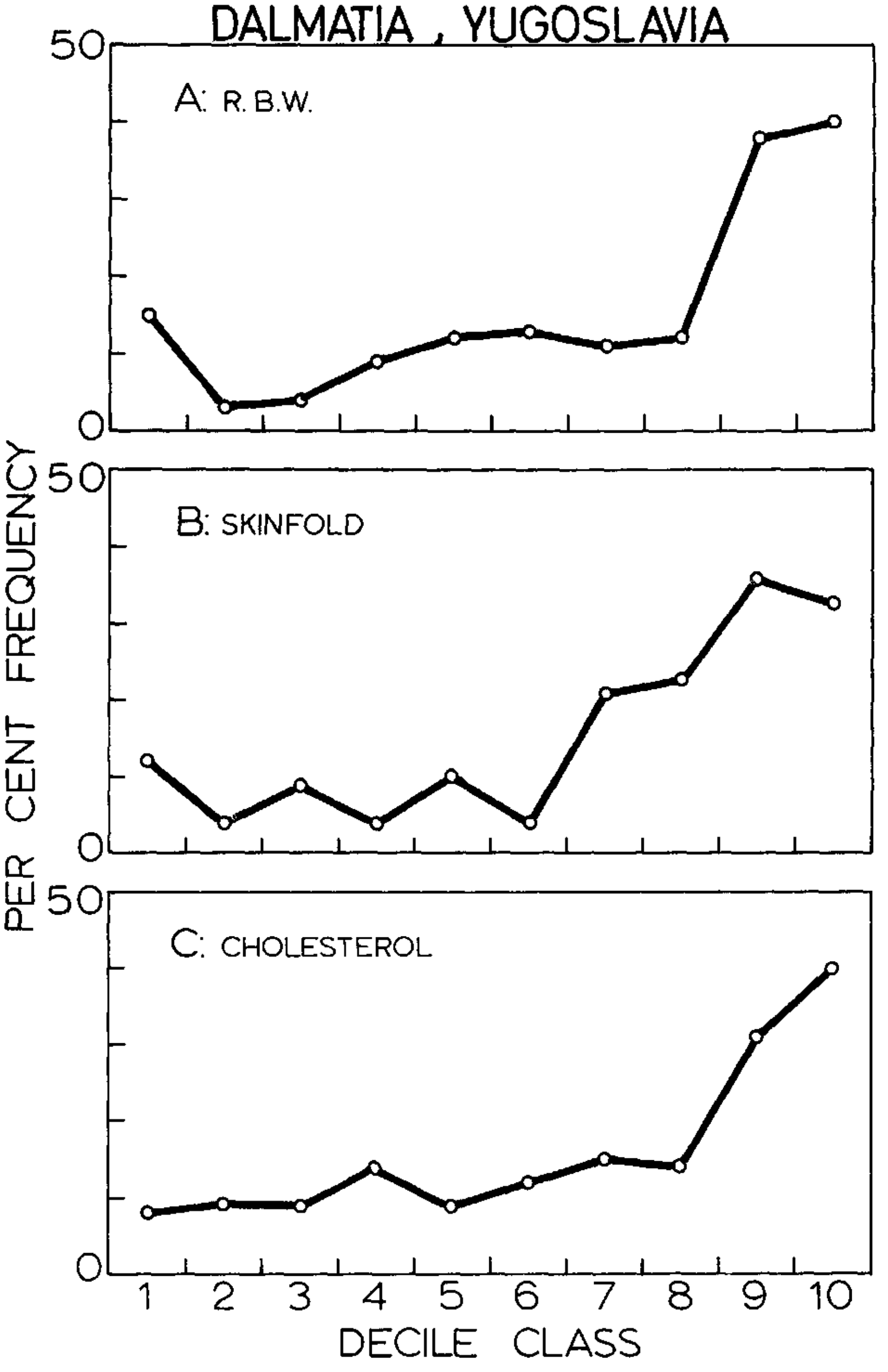
FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

ECG FINDING	ECG Code	40-44	45-49	50-54	55-59
At Rest					
Large Q Waves	I 1	0	2 (11.1)	1 (5.1)	0
Lesser Q Waves with Negative T Waves	I 2, 3 + V 1, 2	0	0	0	0
Deeply Negative T as sole anomaly	V 1 only	0	0	0	0
Other Negative T as sole anomaly	V 2, 3 only	0	3 (16.7)	2 (10.2)	4 (18.5)
S-T Depression as sole anomaly	IV 1-4 only	0	2 (11.1)	0	0
High Amplitude R with S-T Depression	III 1 + IV 1-4	0	2 (11.1)	2 (10.2)	1 (4.6)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	0	1 (5.6)	1 (5.1)	4 (18.5)
Arrhythmias	VIII 2-6	0	0	1 (5.1)	2 (9.3)
Post-exercise					
S-T Depression as sole anomaly	XI 1-4 only	0	3 (17.1)	0	4 (19.6)
Negative T as sole anomaly	XII 1-3 only	0	3 (17.1)	1 (5.3)	1 (4.9)
Ventricular Conduction Defect as sole anomaly	XIV 1, 2, 4 only	0	0	0	0
Arrhythmias as sole anomaly	XV 1 only	0	0	1 (5.3)	1 (4.9)

TABLE C3.13

Prevalence of diastolic hypertension (95 or more, 100 or more mm Hg, fifth phase) among men classed by age. Percentage of men in Dalmatia and Slavonia who are hypertensive, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm
Dalmatia	13.2	7.2	14.8	8.7	18.0	7.6	16.1	9.3
Slavonia	13.7	8.8	17.1	11.0	11.2	8.1	22.1	12.4
Mean, 18 samples	13.6	7.9	15.6	8.9	20.9	13.5	21.5	13.8



DALMATIA , YUGOSLAVIA
A: R. B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C3. 3

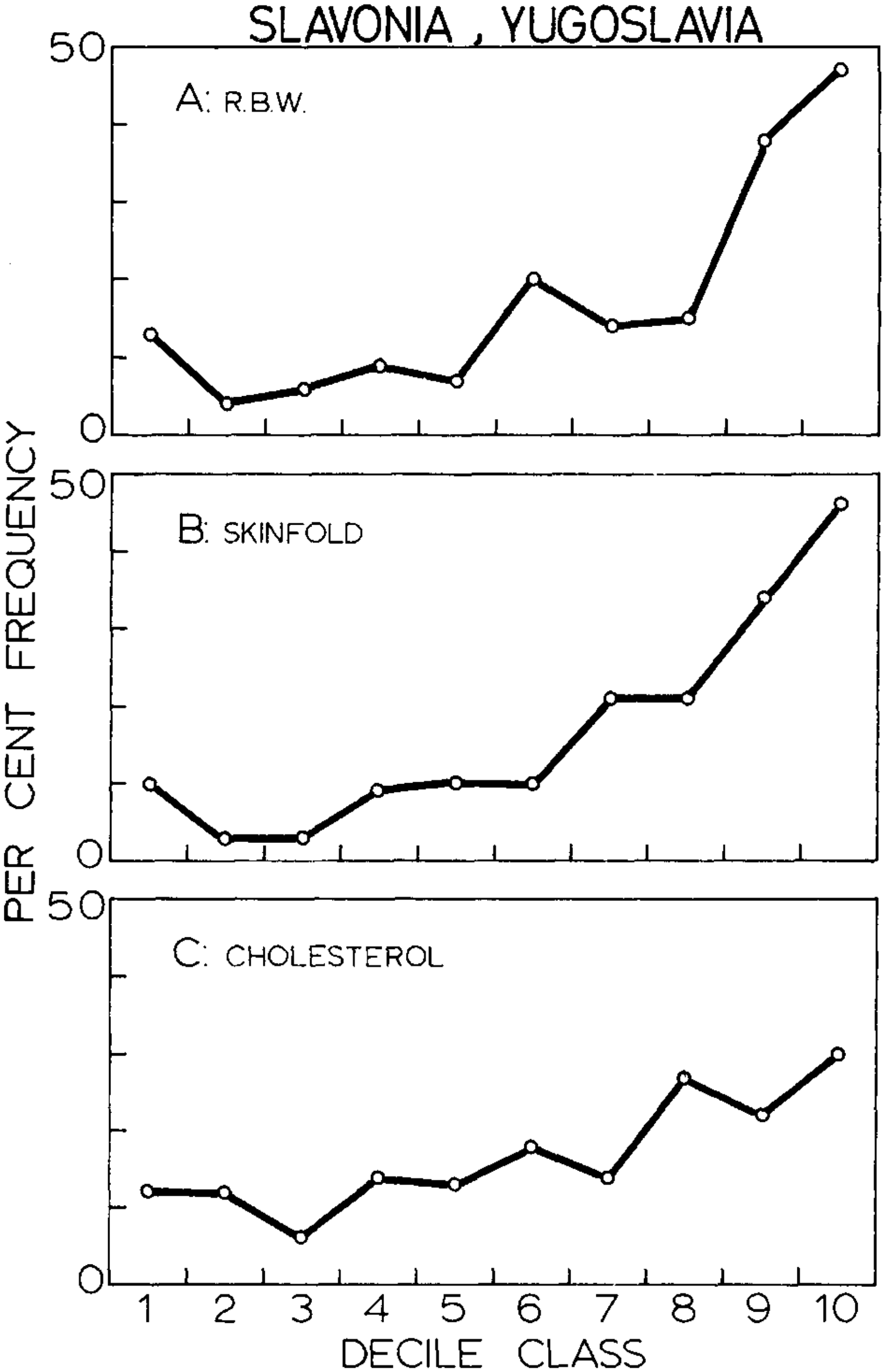

SLAVONIA , YUGOSLAVIA
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C3. 4

distributions are far more apt to be hypertensive than the men in the remainder of the distributions. For serum cholesterol the situation is similar, though not quite so dramatic in Slavonia.

The general picture, then, is that the prevalence of hypertension is unrelated to body weight at all values below relative weight of about 110 per cent, to Σ skinfolds at all values below about 20 mm., and to serum cholesterol below about 240 mg. per 100 ml.

Prevalence of Overweight

The prevalence of overweight, defined as relative body weight of 110 per cent and 120 per cent of the standard values for given height and age in the Appendix, is summarized in Table C3.14. Overweight is not common in Dalmatia and is only moderately frequent in Slavonia. With 110 per cent of the standard as the criterion, 10 per cent of the Dalmatians and 14 per cent of the Slavonians are overweight; the corresponding figures for U.S. railroad switchmen and for men in Crevalcore, Italy, are 37 and 34 per cent, respectively.

Figures C3.5 and C3.6 show the distribution of the overweight (110 per cent of standard) men in decile classes of serum cholesterol, diastolic and systolic blood pressure. The prevalence of overweight increases with increasing values of these other variables. The relationship is very marked, and curvilinear, with blood pressure, less striking but still highly significant, with serum cholesterol. For example, men with systolic blood pressure less than 130 mm. are rarely overweight; more than 20 per cent of men with systolic pressure of the order of 160 or more are overweight. Men with serum cholesterol values of 180 mg. per 100 ml., or less, are seldom overweight; at cholesterol values of the order of 250, about a fourth of the men are overweight.

Summary

Data are presented on 1476 men aged 40—59, comprising 94.8 per cent of all men of those ages in two rural areas of Dalmatia and Slavonia, Yugoslavia. In both areas most of the men were small-scale farmers. Only 12.6 per cent of these men were sedentary or engaged in light physical activity; 76.7 per cent of them habitually did heavy physical work.

The men in Dalmatia averaged about 5 cm. taller than the men in Slavonia; in both areas height tended to decrease slightly with age. In body fatness the men in both areas were similarly thin. The two areas were similar in the distribution of blood pressure but hypertension was somewhat less common in Dalmatia than in Slavonia. In Dalmatia there was almost no age trend in blood pressure over the range 40 through 50 years. Serum cholesterol concentration was relatively low in both areas but more so in Dalmatia.

Relatively high body weight, obesity, high blood pressure and high serum cholesterol were more common among the less active men in the upper socio-economic class than among the more active men in the lower class.

About 40 per cent of the men in both areas were non-smokers and only about 20 per cent of them smoked 20 or more cigarettes daily. Compared with the smokers, the non-smokers tended to be more often overweight, obese and to have high blood pressure. High serum cholesterol values tended to be less common among the men who smoked

TABLE C3.14

Prevalence of overweight (110 or more and 120 or more per cent of "standard" average for height and age). Percentage of men in Dalmatia and Slavonia, classed by age, who are overweight, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	110%	120%	110%	120%	110%	120%	110%	120%
Dalmatia	9.4	2.4	10.4	2.2	8.1	2.8	11.6	4.2
Slavonia	14.7	6.9	19.2	10.4	12.7	6.1	11.6	3.7
Mean, 18 samples	20.9	8.4	19.4	6.9	18.1	6.7	16.8	7.3

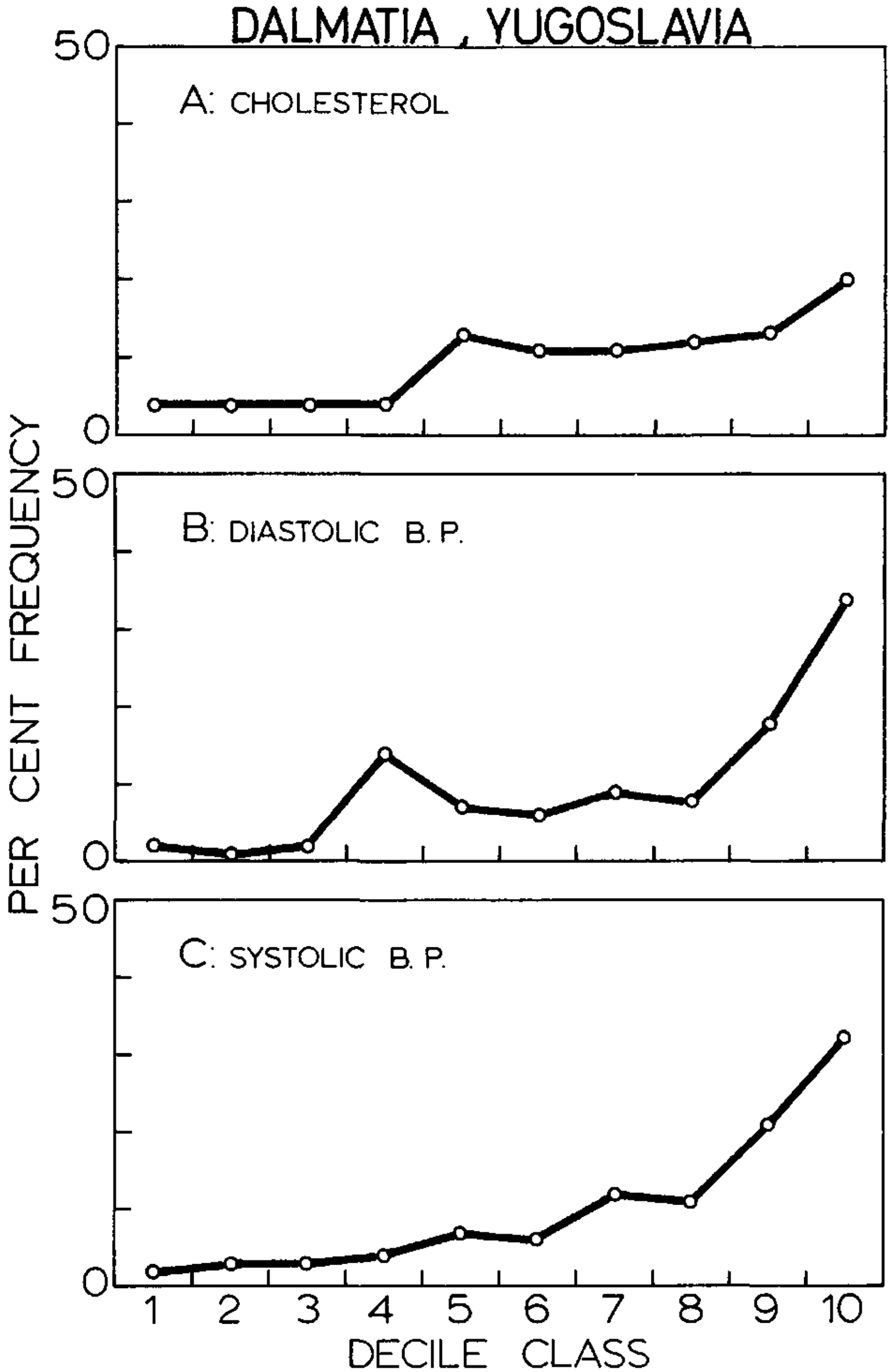
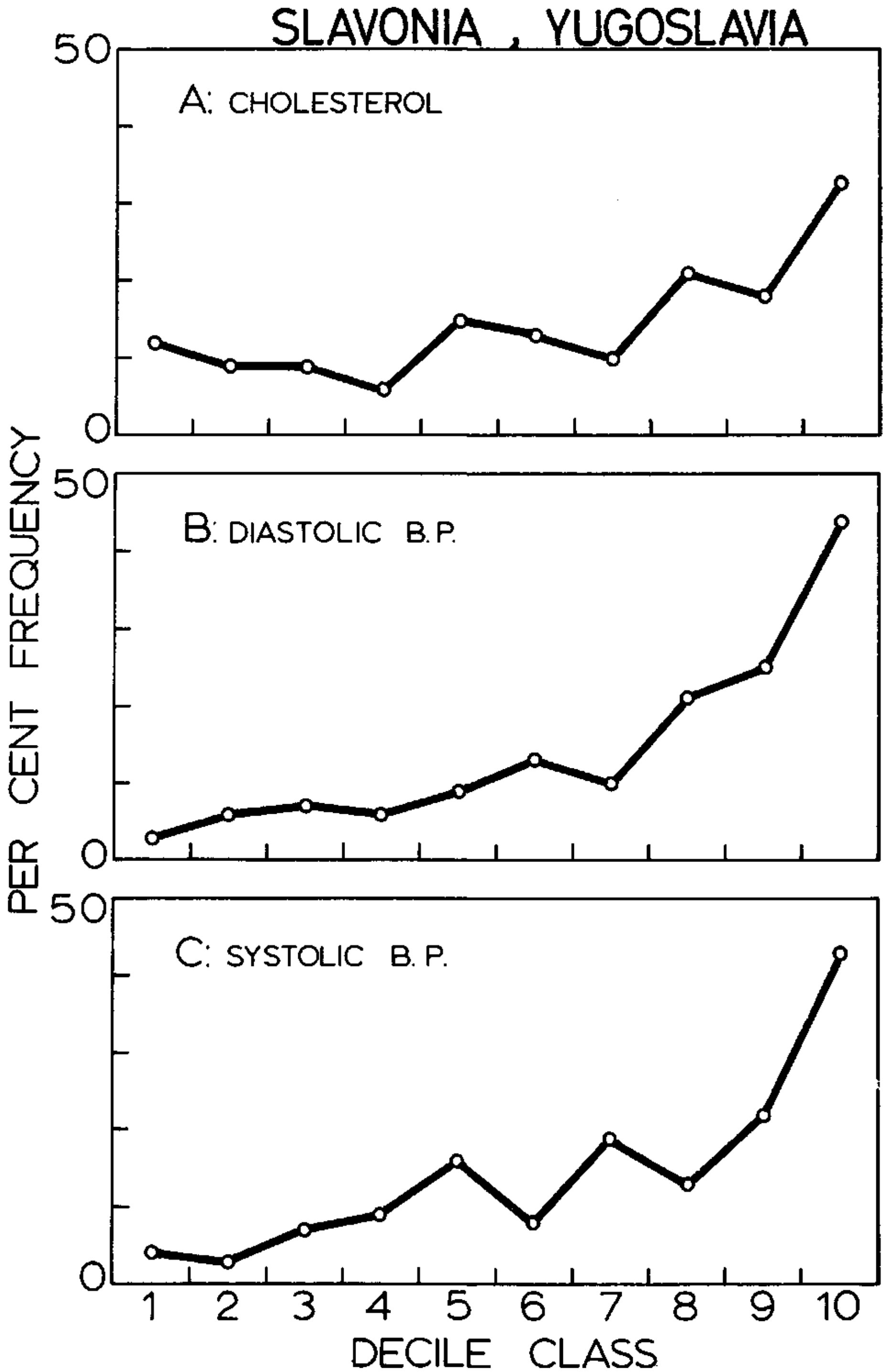

DALMATIA , YUGOSLAVIA
A: CHOLESTEROL
B: DIASTOLIC B. P.
C: SYSTOLIC B. P.
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C3. 5



SLAVONIA: Prevalence of OVERWEIGHT vs. A-cholesterol, B-diastolic, C-systolic blood pressure

Figure C3. 6

20 or more cigarettes daily than among the other smokers or the non-smokers.

Significant electrocardiographic abnormalities in rest or after standard exercise were rare in Dalmatia and not frequent in Slavonia.

The prevalence of hypertension showed a marked curvilinear relationship to relative body weight, body fatness and serum cholesterol, resulting in no association except at the upper ends of the distributions of those variables.

Acknowledgments

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C4. MEN IN RURAL EAST AND WEST FINLAND

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Introduction

Finland is of great interest in regard to the epidemiology of coronary heart disease because of the reported very high incidence and mortality of the disease, especially in East Finland (Karelia). Interest is enhanced by the fact that Finland is a country where relatively few people are obese or sedentary, the majority of the population live quietly in the rural countryside, and medical standards are high.

The mortality rate ascribed to coronary heart disease in Finland has long been the highest in Europe and the most recent data indicate that among men aged 40—59 the Finns now have the highest death rate in the world from this cause, 372.4 deaths per 100,000 in 1961; the comparable figure for the United States in 1961 is 365.2. This is not surprising; in 1956 and 1959 our personal surveys of patients in several parts of Finland as well as in Helsinki everywhere gave the same picture of extraordinary prevalence of the disease, verified by electrocardiographic and other evidence of myocardial infarction. The coronary patients generally occupied over 30 per cent of all medical beds for adult patients in the general hospitals.

In 1956 medical and dietary surveys were made of substantially all reportedly healthy middle-aged men in two series of villages in the area of Finnish Karelia (East Finland) centered on the town of Joensuu. Some of the data have been reported (Roine *et al.*, 1958; Keys *et al.*, 1958b; Karvonen *et al.*, 1959). The very high intake of butterfat is noteworthy.

In 1959 the same general areas, with some changes in the geographical limits, were covered in the systematic studies reported in part here. But in 1959 the attempt was made to examine *all* men, then aged 40—59, who were permanent residents of the selected areas. The final rosters of eligible men, prepared from the excellent official registries, were checked and the result was 823 men in East Finland and 887 in West Finland who were invited for the examinations. 99.3 and 97.0 per cent of those men, respectively, were examined in detail in September-October, 1959.

Methods and criteria were the same as used with the samples of men in other countries reported here and comparability was assured by adding experienced professional personnel from the U.S.A., Yugoslavia, and Sweden to the Finnish team.

East Finland (Karelia)

Karelia is the land of the epic Kalevala of Finland and, in spite of the proximity to Russia, the population is entirely Finnish with no trace of any Slav element. There is an appreciable number of adherents to the Greek Orthodox faith but these people too are purely Finnish in race, language and outlook. After the last war with the U.S.S.R., a large area of the most prosperous part of Karelia was taken over by the U.S.S.R. and the Finnish population there, as a body, elected to move across the new border so as to remain in Finland. Most of these refugees were settled in other parts of Finland remote from Karelia and the study population is mainly made up of men from families that have not moved for generations.

The headquarters of the study area is the small village of Ilomantsi, very close to the Russian border and about 90 kilometers from the town of Joensuu in which there is a large modern hospital, an airport and railroad. The population is sparse and a relatively large geographical area was included in order to provide the requisite number of subjects. In general, the population lives on small farms or clearings in the forest and the men work at logging for the paper pulp industry during the long winters. The economic level is low compared to the rest of Finland but the population tends to remain stable in this sub-arctic land. At the time of the study communication with the rest of Finland was by rather poor road to Joensuu; currently a railroad is under construction to Ilomantsi.

The age distributions of the population studied in 1959 reflected some differential loss of the younger men in the two wars with the U.S.S.R. There were fewer men aged 40—44 than in the age group 45—49 (207 vs. 238 men).

West Finland

A series of small villages and individual farms in the southwest of Finland, not far inland from the city of Turku, comprises the West Finland area. There is no other industry besides agriculture in the actual area of study but the nearby port city of Turku is industrial and maritime as well as being a commercial center and the seat of a university and medical school. The dominant Finnish element of the population is hardly diluted by the long rule of Sweden. Some of the population, dispossessed as a result of World War II from what is now Soviet Karelia, were settled in this West Finland area in the late 1940's but these people are now well integrated and in general the population is stable.

The climate is sub-arctic but somewhat less severe than that of Karelia and the farms are more productive, especially of small grains and potatoes. As in East Finland dairying is prominent and much butter, milk and cheese is locally consumed, though perhaps the per-capita consumption is less than in Karelia.

The age structure of the populations of men examined in 1959 reflects the heavy losses of younger men in the two wars against U.S.S.R. Successive 5-year age groups from 40—59 years provided 19.6, 26.0, 28.6 and 25.8 per cent of the total.

Distribution by Physical Activity and Occupation

Table C4.1 gives the distribution, by age, of the Finnish men classed according to physical activity. For all ages combined, 71.1 per cent of the East Finns and 77.2 per cent of the men in the West were in the heavy (Grade 3) Activity Class. The high intensity of

TABLE C4.1

Physical activity, men in East and in West Finland classed by age and habitual physical activity ("ACT.," 1 = sedentary and light, 2 = moderate, 3 = heavy work). N = total men. Table entries are percentages of all men of given age in the area.

AGE	E. FINLAND, N = 816			W. FINLAND, N = 860		
	ACT. 1	ACT. 2	ACT. 3	ACT. 1	ACT. 2	ACT. 3
40-44	9.1	22.0	68.9	8.9	14.8	76.3
45-49	11.3	15.1	73.6	7.1	12.9	79.9
50-54	11.2	14.2	74.6	11.4	14.3	74.3
55-59	14.6	19.3	66.1	8.1	13.5	78.4
40-59	11.4	17.5	71.1	9.0	13.8	77.2

physical work that characterized many of these men led to an original classification in four grades, Grade 4 being "extreme", but this latter group was combined with those in Grade 3 because of difficulty in deciding where some men belonged and because in none of the other 16 samples studied in other countries was there a sizeable number of men who could be put in Grade 4 with security.

Over all ages 40—59 only 11.4 per cent of men in the East and 9.0 per cent in the West could be classed as being sedentary or doing only light work. In East Finland, but not in the West, the percentage of men in Activity Class 1 rose with age but the trend is not marked. In neither area was there any tendency for the percentage of Activity Class 3 men to change with age. In general, there are no significant differences between the two areas in regard to physical activity.

Table C4.2 summarizes the distributions in regard to general type of occupation. In East Finland there were a few more men in the business, professional and officials categories but in both areas these men are a very small minority. In both areas almost 70 per cent of the men are small-scale farmers and woodsmen, usually devoting the winters to logging and working on their own farms during the rest of the year.

Distributions of Six Measured Variables

Table C4.3 gives the median values, and those medians expressed as percentage of the averages of the medians for all men in these cooperative studies, for height, relative body weight, body fatness (Σ skinfolds), systolic and diastolic (5th phase) blood pressure, and serum cholesterol concentration. Details of the distributions of these variables are given in the Appendix. Figures C4.1 and C4.2 show the cumulative frequency distributions of these variables. Because height, Σ skinfolds and serum cholesterol show little or no age trend over the range 40—59 years in this material, all ages 40—59 are combined in the graphs on these variables. For relative body weight, systolic and diastolic blood pressure the heavy line is for ages 40—49, the light line for ages 50—59.

In both areas of Finland, height and serum cholesterol show substantially normal distributions as does diastolic blood pressure in East Finland (Karelia) but not in the west. The relative body weight distributions are not far from normal in both areas. Σ skinfolds are grossly non-normal in distribution in Finland as in other areas.

The men in West Finland consistently tend to be taller, relatively heavier, fatter (but still very lean) than their agecounterparts in the East. On the other hand, the East Finns tend to have higher blood pressure and higher serum cholesterol values. Except for Σ skinfolds, these differences are all so obviously significant that detailed probability estimates are unnecessary.

When these Finns are compared with the average of all 18 samples, the men in the East are slightly below and those in the West slightly above average height. In relative weight, the East Finns are significantly underweight while the men in the West tend, if anything, to be a little heavier for their height and age than the general average. Both groups, but especially the East Finns, are much thinner than the average of all men.

In blood pressure, the East Finns clearly tend to have higher pressures both in systole and in diastole than the general average of the 18 samples. The West Finns tend to slightly higher systolic and lower diastolic blood pressures than the general average.

TABLE C4.2

Occupation of men in East and in West Finland classed: Codes 1-15 (business, professional, business owners and government officials), Codes 66-69, 71-75 (farming, agriculture and forestry), and all others. Table entries are percentages of all men in the area.

OCCUPATION	E. FINLAND	W. FINLAND
Codes 1-15	8.3	4.6
" 66-69, 71-75	68.7	69.5
All Other	23.0	25.9

TABLE C4.3

Medians for men, classed by age, in East and in West Finland and these values expressed as percentages of the averages of the medians for all 18 samples of men.

AREA	VARIABLE	MEDIAN VALUES				MEDIAN, % OF AVERAGE			
		40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
E. FINLAND	Height (cm.)	168	168	168	167	98.9	99.3	99.8	99.6
"	Rel. Wt. (%)	94	94	93	90	95.8	97.7	97.7	95.6
"	Σ Skinfolds	13	15	14	14	61.3	73.5	67.6	70.4
"	Syst. B.P.	141	140	149	153	107.6	105.3	108.8	108.8
"	Diast. B.P.	87	88	90	90	107.4	108.1	107.9	106.8
"	Serum Chol.	265	272	262	259	128.4	131.2	125.4	125.4
W. FINLAND	Height (cm.)	173	171	172	170	101.9	101.1	102.2	101.4
"	Rel. Wt. (%)	98	96	97	95	99.9	99.8	101.9	101.0
"	Σ Skinfolds	16	16	16	16	75.5	78.4	77.3	80.4
"	Syst. B.P.	133	135	139	143	101.5	101.5	101.5	101.7
"	Diast. B.P.	80	80	82	82	98.8	98.3	98.3	97.3
"	Serum Chol.	248	255	257	251	120.2	123.0	123.0	121.5

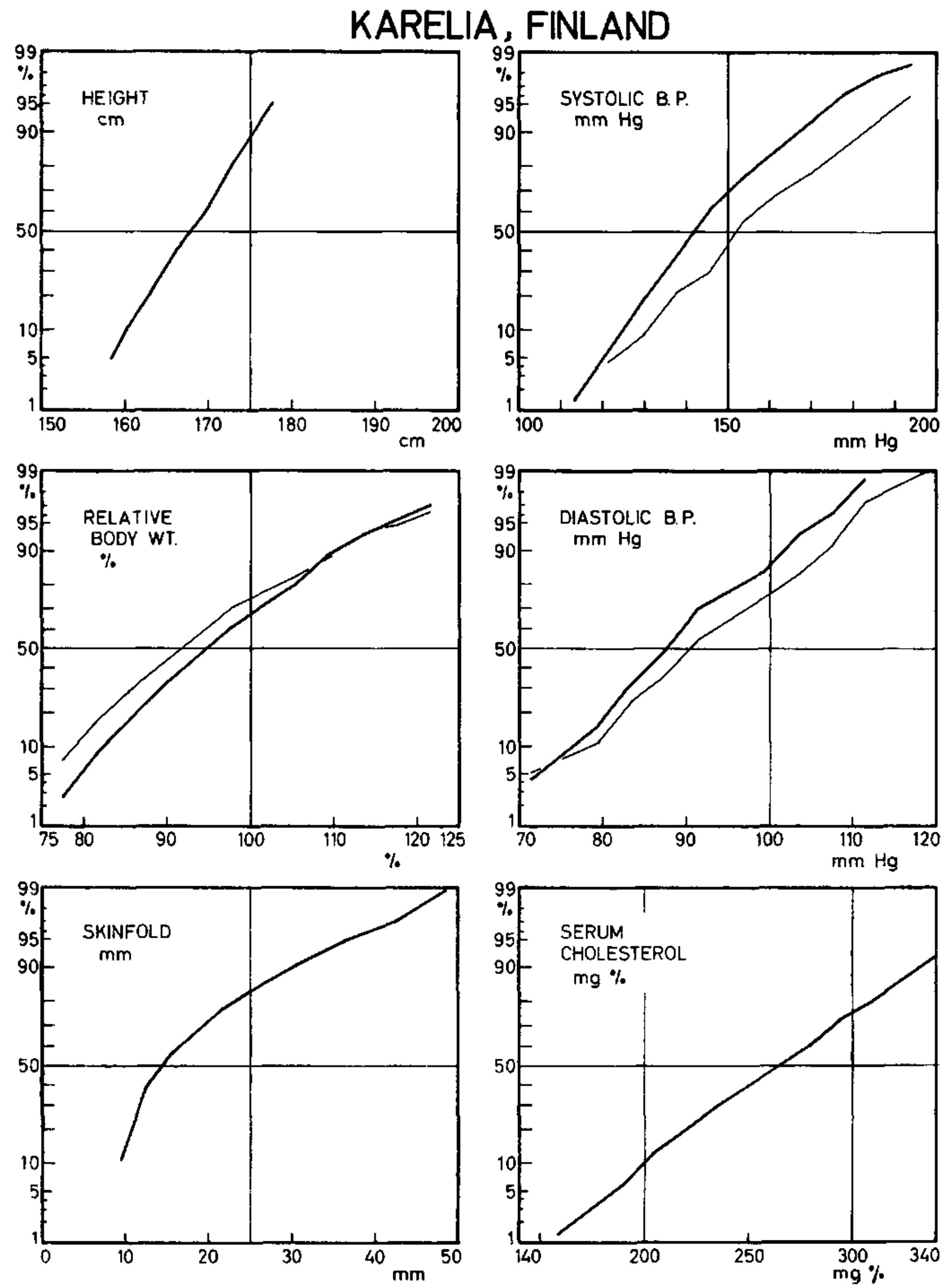
KARELIA, FINLAND
HEIGHT
cm
SYSTOLIC B.P.
mm Hg
RELATIVE
BODY WT.
%
DIASTOLIC B.P.
mm Hg
SKINFOLD
mm
SERUM
CHOLESTEROL
mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C4. 1

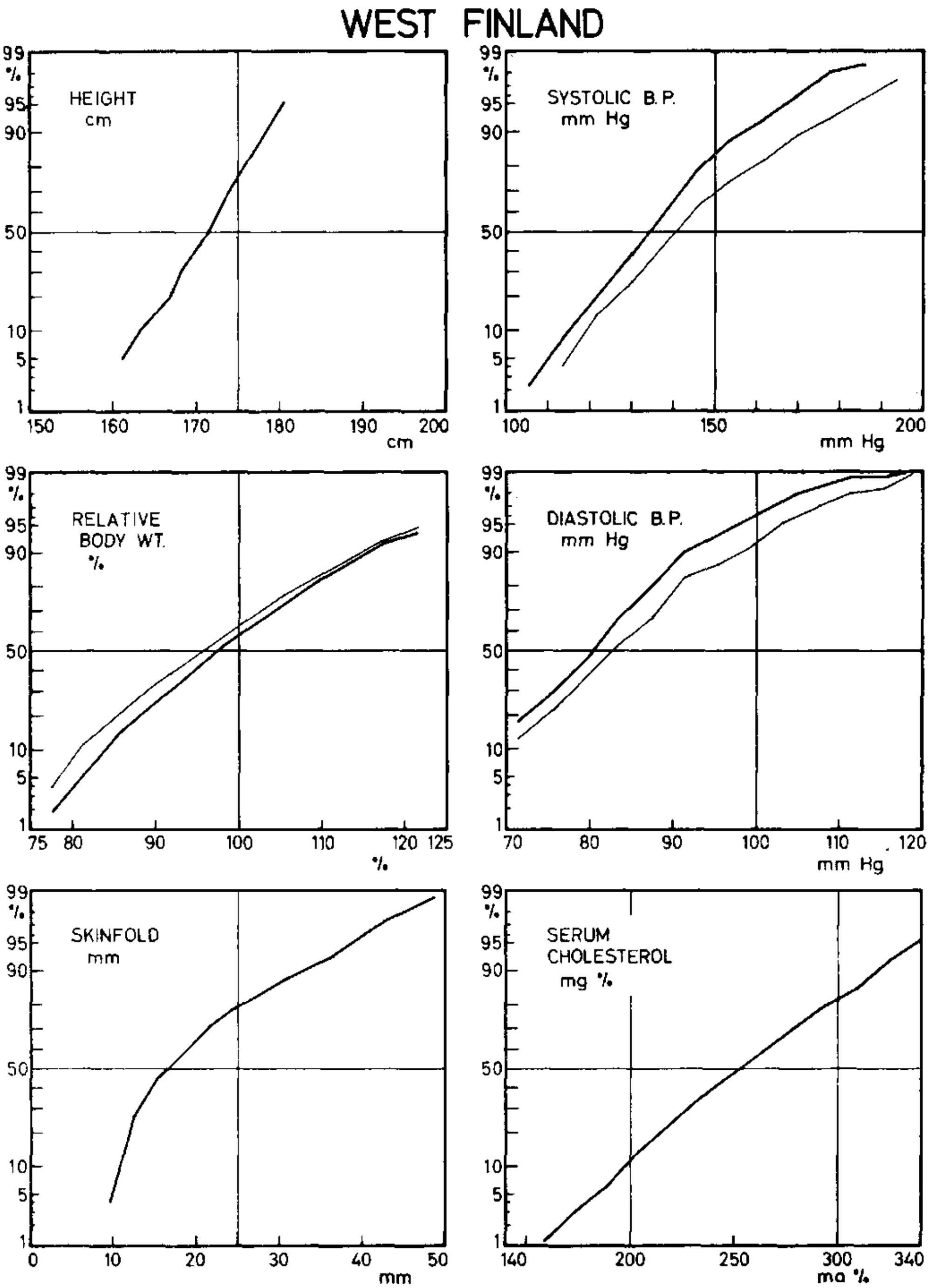
WEST FINLAND
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT. %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C4. 2

Physical Activity and Socio-Economic Status

In both East and West Finland the relative frequency of overweight and of obesity decreases as physical activity increases. With decile classes 8—10 of relative body weight representing overweight, chance distribution would result in an expectation of about 24, 43, and 155 "overweight" men in Eeast Finland in Activity Classes 1, 2, and 3, respectively; the observed numbers are 36, 55, and 131 men, respectively. The corresponding numbers for "overfat" (deciles 8—10 in Σ skinfolds) in East Finland are 26, 44, and 161 men in Activity Classes 1, 2, and 3; the observed numbers are 45, 58, and 128 men, respectively. Similar relationships were found in West Finland. Frequency of relatively high blood pressure or serum cholesterol values was not significantly related to physical activity in either area.

When physical activity is ignored and comparison is made between men in the upper socio-economic class (Occupations 1—13) with those in the lower class (Occupations 14—92, 94), similar significant differences are found in the frequency of overweight and of obesity, the men in the upper socio-economic class being more often overweight and fat.

Obviously, the analysis is complicated by the high correlation (inverse) between physical activity and socio-economic status. Tables C4.4, C4.5, and C4.6 summarize some findings when both physical activity and occupation are considered simultaneously.

Within broad socio-economic classes there are no significant differences in the distributions of overweight or obese men between Activity Classes 1 and 2, but there are highly significant differences between Activity Classes 2 and 3 within the lower socio-economic class of men (Table C4.5). Higher diastolic blood pressures are also overly represented in Activity Class 2 as compared with Activity Class 3 in West but not in East Finland.

Comparisons between upper and lower socio-economic classes in regard to the frequency of high values of these variables are made in Table C4.6. In general, overweight and obesity are overly represented in the upper socio-economic class, even when physical activity is relatively constant.

Smoking Habits

Smoking has long been common in Finland except during the years 1939—45 when war severely restricted the importation of tobacco. At the time of the examinations reported here (1959) 68.5 per cent of the East and 57.2 per cent of the West Finns studied were cigarette smokers. Among these rural men there are also a few pipe smokers; cigars are occasionally smoked on festive occasions.

In East Finland an appreciable number of the smokers use the "Russian type" of cigarette, with a hollow paper mouthpiece and containing only a relatively small amount of tobacco; this type is rarely used in West Finland in recent years, and this difference should be noted in comparing the intensity of smoking in the two areas.

In East Finland 31.4 per cent of all the men smoked 20 or more cigarettes daily and so could be considered to be "heavy" smokers in our classification: in West Finland only 14.8 per cent of the men are in this category. Though these values are not completely comparable because of the difference in cigarette types, it seems clear that the men in Karelia more often tend to smoke and to smoke heavily than the men in the study area of West Finland.

The associations of differences in smoking habits with differences in other characteristics are examined in Table

TABLE C4.4

Activity 1 vs. Activity 2. Excess frequency of high values (deciles 8-10) of the variables observed among men of Activity 1, expressed as % of expectation from total numbers of men in Activities 1 plus 2. Also, chi-square values for the differences between observed and expected distributions.

OCCUPATION	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
East Finland										
1-94	9.8	0.68	17.5	3.47	10.5	0.23	11.1	0.41	-6.4	0.10
1-13	-9.1	0.43	7.9	0.62	17.6	0.19	-4.3	0	1.1	0
14-94	19.5	1.04	12.4	0.39	14.3	0.19	28.0	1.53	0.8	0
West Finland										
1-94	16.9	1.62	31.1	6.89	-22.2	1.34	-10.0	0.27	9.1	0.13
1-13	-4.2	0.03	0.5	0	-24.0	2.07	-6.6	0.03	1.0	0
14-94	14.0	0.24	28.2	1.51	-26.8	0.65	-19.2	0.40	5.3	0

TABLE C4.5

Activity 2 vs. Activity 3. Occupations 14-94 only. Excess frequency, as in Table C4.4, of high values among men of Activity 2.

SAMPLE	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
East Finland	51.1	8.32	71.9	16.44	-9.1	0.22	7.1	0.11	11.1	0.38
West Finland	51.2	9.88	47.2	8.55	11.5	0.44	37.2	5.55	-7.9	0.18

TABLE C4.6

Occupation 1-13 vs. 14-94. Excess frequency, as in Table C4.4, of high values among men in Occupations 1-13, expressed as % of expectation from total numbers of men in Occupations 1-13 + 14-94.

ACTIVITY	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
East Finland										
1+2	31.5	7.35	35.3	12.61	-19.8	0.91	-10.9	0.31	-14.6	0.63
1	9.0	0.20	24.4	5.16	-14.9	0.23	-23.7	1.32	-11.8	0.13
2	51.1	7.81	37.9	4.45	-30.6	0.70	0	0	-16.7	0.25
West Finland										
1+2	36.6	4.52	52.0	10.56	12.1	0.11	9.4	0.08	26.2	0.86
1	12.7	0.54	21.2	3.04	9.4	0	13.6	0.16	13.6	0.16
2	66.7	1.98	76.5	2.44	78.6	2.13	25.0	0.05	30.4	0.03

Probabilities, p, associated with chi-square values: 2.71, p = 0.10; 3.84, p = 0.05; 5.41, p = 0.02; 6.64, p = 0.01; 10.83, p = 0.001.

C4.7 which gives the numbers of men classed by smoking habits and distributed as below or above the age-specific medians for all men in the designated sample. In both samples the tendency of the non-smokers to be more often relatively heavier and fatter than the rest of these Finns is very pronounced while the heavy smokers have a marked but less striking tendency in the opposite direction.

The non-smokers in both areas also differ in tending to have higher blood pressure and this is clear in both systole and diastole. Again, the heavy smokers as well as "other" smokers show the opposite tendency. Serum cholesterol concentration tends to be somewhat low in the non-smokers while both heavy and "other" smokers consistently tend to the opposite distribution.

Except for serum cholesterol, all of these differences between non-smokers and either heavy or "other" smokers are statistically significant. The difference in serum cholesterol concentration is not statistically significant when heavy or "other" or all smokers are compared with non-smokers. When heavy smokers are compared with "other" smokers, no significant differences are found.

Electrocardiographic Findings

Tables C4.8, C4.9, C4.10, and C4.11 summarize the electrocardiographic findings, both in rest and after the final exercise test. Thirteen men showed clear evidence of old myocardial infarction but there is no difference between the two areas of Finland in this small number, the age-corrected rates being 8.6 and 7.4 per 1 000 men for East and West Finland, respectively. There were no cases of complete heart block and only 5 cases of left bundle branch block (2 in East, 3 in West Finland). High amplitude R waves (left type Code III, 1) and sinus bradycardia, (Code VIII, 8) were fairly common in both areas but the samples did not differ significantly in the prevalence of either of these findings.

The post-exercise ECGs in Finland showed fewer major new abnormalities than the average of all samples studied. This may reflect the high degree of physical training noted as being almost the rule in the Finnish men.

Prevalence of Hypertension versus Other Variables

By any ordinary criterion of blood pressure, the prevalence of hypertension in East Finland was much greater than in West Finland. Table C4.12 gives the prevalence, with two criteria of diastolic blood pressures. With either criteria, the difference is statistically highly significant and is consistent at all ages. The prevalence of hypertension was significantly more common in East Finland and less common in West Finland than among men in all 18 samples in these cooperative studies.

The distributions of the hypertensive Finns (95 mm. or more in the 5th phase of diastole) into age- and area-specific decile classes of relative body weight, Σ skinfolds and serum cholesterol concentration are shown in Figures C4.3 and C4.4. Note that in these graphs absence of a relationship would be represented by points randomly distributed about a horizontal straight line. In East Finland the frequency of hypertension tends to rise at the upper end of the distributions of relative body weight but this tendency is much more evident in West Finland where the top 10 per cent (decile 10) of the men in relative weight are about four times more prone to be hypertensive than the men in the first eight decile classes. A somewhat similar but less marked relationship is shown between hypertension prevalence and body fatness and again the picture is

TABLE C4.7

Smoking. Number of men in Finland below (LOW) and above (HIGH) the age-specific medians, for age and area, of measured variables, classed according to smoking habits. HEAVY = 20 or more, OTHER = 1-19 cigarettes daily.

VARIABLE	SAMPLE	NON-SMOKERS		HEAVY		OTHER	
		LOW	HIGH	LOW	HIGH	LOW	HIGH
Relative Weight	E. Finland	94	160	133	117	176	117
" "	W. "	115	241	72	52	230	124
Σ Skinfolds	E. Finland	82	175	147	109	179	123
" "	W. "	119	246	81	46	226	137
Systolic B.P.	E. Finland	116	137	136	117	153	149
" "	W. "	159	206	69	58	200	163
Diastolic B.P.	E. Finland	106	147	146	117	162	139
" "	W. "	145	220	73	54	209	154
Serum Cholesterol	E. Finland	138	119	123	133	147	154
" "	W. "	191	173	59	68	177	185

TABLE C4.8

KARELIA, FINLAND

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (207)	45-49 (238)	50-54 (197)	55-59 (172)
Total with reportable ECG Items	I - IX		92 (444.4)	117 (491.6)	107 (543.1)	105 (610.5)
Q Waves	I	1	1 (4.8)	2 (8.4)	1 (5.1)	3 (17.4)
		2	2 (9.7)	1 (4.2)	2 (10.2)	2 (11.6)
		3	0	1 (4.2)	0	3 (17.4)
Axis Deviation	II					
Left		1	4 (19.3)	6 (25.2)	10 (50.8)	4 (23.3)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	33 (159.4)	38 (159.7)	40 (203.0)	35 (203.5)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	2 (8.4)	2 (10.2)	5 (29.1)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	2 (9.7)	3 (12.6)	3 (15.2)	6 (34.9)
No S-T-J plus segment downward		3	0	0	0	4 (23.3)
S-T - J 1 mm. or more, upward segment		4	0	0	0	0
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	1 (4.2)	0	2 (11.6)
- 1 mm. to -5 mm.		2	1 (4.8)	6 (25.2)	3 (15.2)	14 (81.4)
0 ± 1 mm.		3	7 (33.8)	15 (63.0)	9 (45.7)	12 (69.8)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	11 (53.1)	9 (37.8)	4 (20.3)	5 (29.1)
Accelerated Conduction		4	0	0	0	1 (5.8)
Ventricular Blocks	VII					
Left Bundle		1	0	1 (4.2)	0	1 (5.8)
Right Bundle		2	1 (4.8)	0	2 (10.2)	0
Incomplete Right Bundle		3	6 (29.0)	3 (12.6)	8 (40.6)	2 (11.6)
Intraventricular Block		4	0	0	0	0
Arrhythmias	VIII					
Premature Beats		1	0	3 (12.6)	4 (20.3)	3 (17.4)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	1 (4.2)	0	1 (5.8)
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	1 (4.8)	1 (4.2)	1 (5.1)	2 (11.6)
Sinus tachycardia		7	3 (14.5)	5 (21.0)	5 (25.4)	3 (17.4)
Sinus bradycardia		8	9 (43.5)	14 (58.8)	7 (35.5)	10 (58.1)
Technically poor records	IX	8	0	0	0	0

TABLE C4.9

KARELIA, FINLAND

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (201)	45-49 (220)	50-54 (170)	55-59 (138)
Exercise tests not made or	X 1				
incomplete	X 2	6 (29.0)	18 (75.6)	27 (137.1)	34 (197.7)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	0	0	0	1 (7.2)
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	1 (5.0)	3 (13.6)	2 (11.8)	0
No S-T-J plus segment downward	3	0	0	0	0
S-T - J 1 mm. or more, upward					
segment	4	3 (14.9)	1 (4.5)	3 (17.6)	5 (36.2)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	0	0
0 ± 1 mm.	3	0	1 (4.5)	3 (17.6)	1 (7.2)
Arrhythmias post-exercise	XV				
(none at rest)	1	0	2 (9.1)	2 (11.8)	5 (36.2)
Technically poor post-exercise					
records	XI 8	1 (5.0)	1 (4.5)	1 (5.9)	0

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

		40-44	45-49	50-54	55-59
At Rest					
Large Q Waves	I 1	1 (4.8)	2 (8.4)	1 (5.1)	3 (17.4)
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	1 (4.8)	1 (4.2)	0	2 (11.6)
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	0
Other Negative T as sole	V 2, 3				
anomaly	only	3 (14.5)	10 (42.0)	4 (20.3)	8 (46.5)
S-T Depression as sole	IV 1-4				
anomaly	only	0	0	1 (5.1)	1 (5.8)
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	2 (9.7)	2 (8.4)	2 (10.2)	6 (34.9)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	1 (4.8)	1 (4.2)	2 (10.2)	1 (5.8)
Arrhythmias	VIII 2-6	1 (4.8)	2 (8.4)	1 (5.1)	3 (17.4)
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	2 (10.0)	2 (9.1)	2 (11.8)	3 (21.7)
Negative T as sole	XII 1-3				
anomaly	only	0	0	0	0
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	0
Arrhythmias	XV 1				
as sole anomaly	only	0	1 (4.5)	1 (5.9)	1 (7.2)

TABLE C4.10

WEST FINLAND

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (168)	45-49 (223)	50-54 (245)	55-59 (221)
Total with reportable ECG Items	I - IX		77 (458.3)	96 (430.5)	118 (481.6)	119 (538.5)
Q Waves	I	1	2 (11.9)	0	1 (4.1)	3 (13.6)
		2	1 (6.0)	2 (9.0)	1 (4.1)	0
		3	0	2 (9.0)	1 (4.1)	2 (9.0)
Axis Deviation	II					
Left		1	7 (41.7)	6 (26.9)	15 (61.2)	11 (49.8)
Right		2	1 (6.0)	0	0	0
High Amplitude R Waves	III					
Left type		1	27 (160.7)	28 (125.6)	44 (179.6)	40 (181.0)
Right type		2	0	1 (4.5)	2 (8.2)	1 (4.5)
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	2 (11.9)	0	2 (8.2)	1 (4.5)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	2 (11.9)	0	5 (20.4)	3 (13.6)
No S-T-J plus segment downward		3	1 (6.0)	0	2 (8.2)	1 (4.5)
S-T - J 1 mm. or more, upward segment		4	0	0	0	1 (4.5)
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	1 (4.1)	0
- 1 mm. to -5 mm.		2	5 (29.7)	0	4 (16.3)	3 (13.6)
0 ± 1.mm.		3	7 (41.7)	8 (35.9)	7 (28.6)	17 (76.9)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	2 (9.0)	0	0
P-R over 0.21 second		3	1 (6.0)	6 (26.9)	12 (49.0)	4 (18.1)
Accelerated Conduction		4	0	0	1 (4.1)	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	1 (4.1)	2 (9.0)
Right Bundle		2	3 (17.9)	2 (9.0)	3 (12.2)	1 (4.5)
Incomplete Right Bundle		3	2 (11.9)	2 (9.0)	7 (28.6)	6 (27.1)
Intraventricular Block		4	0	0	0	0
Arrhythmias	VIII					
Premature Beats		1	2 (11.9)	2 (9.0)	2 (8.2)	5 (22.6)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	1 (4.5)	1 (4.1)	2 (9.0)
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	2 (9.0)	0	1 (4.5)
Sinus tachycardia		7	4 (23.8)	1 (4.5)	2 (8.2)	3 (13.6)
Sinus bradycardia		8	7 (41.7)	6 (26.9)	8 (32.7)	10 (45.2)
Technically poor records	IX	8	0	0	0	0

TABLE C4.11

WEST FINLAND

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (164)	45-49 (216)	50-54 (226)	55-59 (203)
Exercise tests not made or incomplete	X 1 X 2	4 (23.8)	7 (31.4)	19 (77.6)	18 (81.4)
S-T Depression post-exercise (none at rest)	XI				
S-T - J 1 mm. or more, horiz. or downward segment	1	1 (6.1)	0	1 (4.4)	0
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	1 (6.1)	6 (27.8)	2 (8.8)	2 (9.9)
No S-T-J plus segment downward	3	0	1 (4.6)	0	2 (9.9)
S-T - J 1 mm. or more, upward segment	4	0	2 (9.3)	7 (31.0)	4 (19.7)
T Wave Negativity post-exercise (none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	1 (6.1)	0	0	1 (4.9)
0 ± 1 mm.	3	2 (12.2)	5 (23.1)	5 (22.1)	4 (19.7)
Arrhythmias post-exercise (none at rest)	XV 1	3 (18.3)	8 (37.0)	9 (39.8)	7 (34.5)
Technically poor post-exercise records	XI 8	4 (24.4)	3 (13.9)	3 (13.3)	5 (24.6)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

At Rest					
Large Q Waves	I 1	2 (11.9)	0	1 (4.1)	3 (13.6)
Lesser Q Waves with Negative T Waves	I 2, 3 + V 1, 2	0	0	0	0
Deeply Negative T as sole anomaly	V 1 only	0	0	0	0
Other Negative T as sole anomaly	V 2, 3 only	5 (29.8)	4 (17.9)	3 (12.2)	9 (40.7)
S-T Depression as sole anomaly	IV 1-4 only	0	0	1 (4.1)	0
High Amplitude R with S-T Depression	III 1 + IV 1-4	4 (23.8)	0	5 (20.4)	1 (4.5)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	3 (17.9)	2 (9.0)	4 (16.3)	3 (13.6)
Arrhythmias	VIII 2-6	0	3 (13.5)	1 (4.1)	3 (13.6)
Post-exercise					
S-T Depression as sole anomaly	XI 1-4 only	1 (6.1)	4 (18.5)	5 (22.1)	2 (9.9)
Negative T as sole anomaly	XII 1-3 only	0	3 (13.9)	4 (17.7)	1 (4.9)
Ventricular Conduction Defect as sole anomaly	XIV 1, 2, 4 only	0	0	0	0
Arrhythmias as sole anomaly	XV 1 only	1 (6.1)	4 (18.5)	5 (22.1)	3 (14.8)

TABLE C4.12

Prevalence of diastolic hypertension (95 or more, 100 or more mm Hg, fifth phase) among men classed by age. Percentage of men in East and West Finland who are hypertensive, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm
East Finland	21.8	13.1	27.2	17.4	35.5	23.8	38.2	25.3
West Finland	8.3	4.2	5.8	3.6	14.7	10.2	13.5	7.2
Mean, 18 samples	13.6	7.9	15.6	8.9	20.9	13.5	21.5	13.8

TABLE C4.13

Prevalence of overweight (110 or more and 120 or more per cent of "standard" average for height and age). Percentage of men in East and West Finland, classed by age, who are overweight, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	110%	120%	110%	120%	110%	120%	110%	120%
East Finland	10.7	3.9	10.9	3.5	13.9	3.6	10.1	4.8
West Finland	15.9	8.5	19.9	6.0	18.5	7.1	13.8	5.0
Mean, 18 samples	20.9	8.4	19.4	6.9	18.1	6.7	16.8	7.3

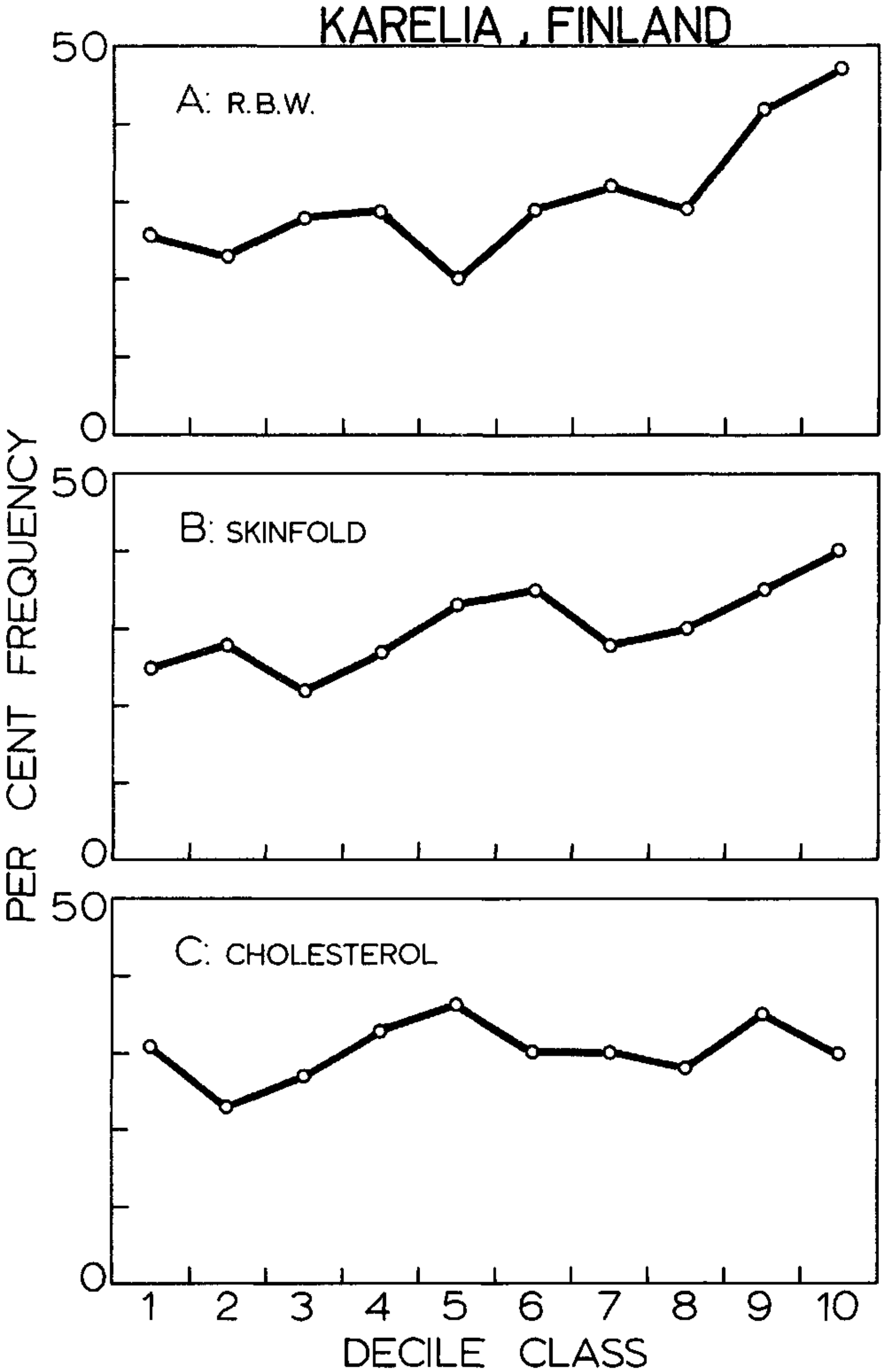
KARELIA , FINLAND
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
50
0
50
0
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C4. 3

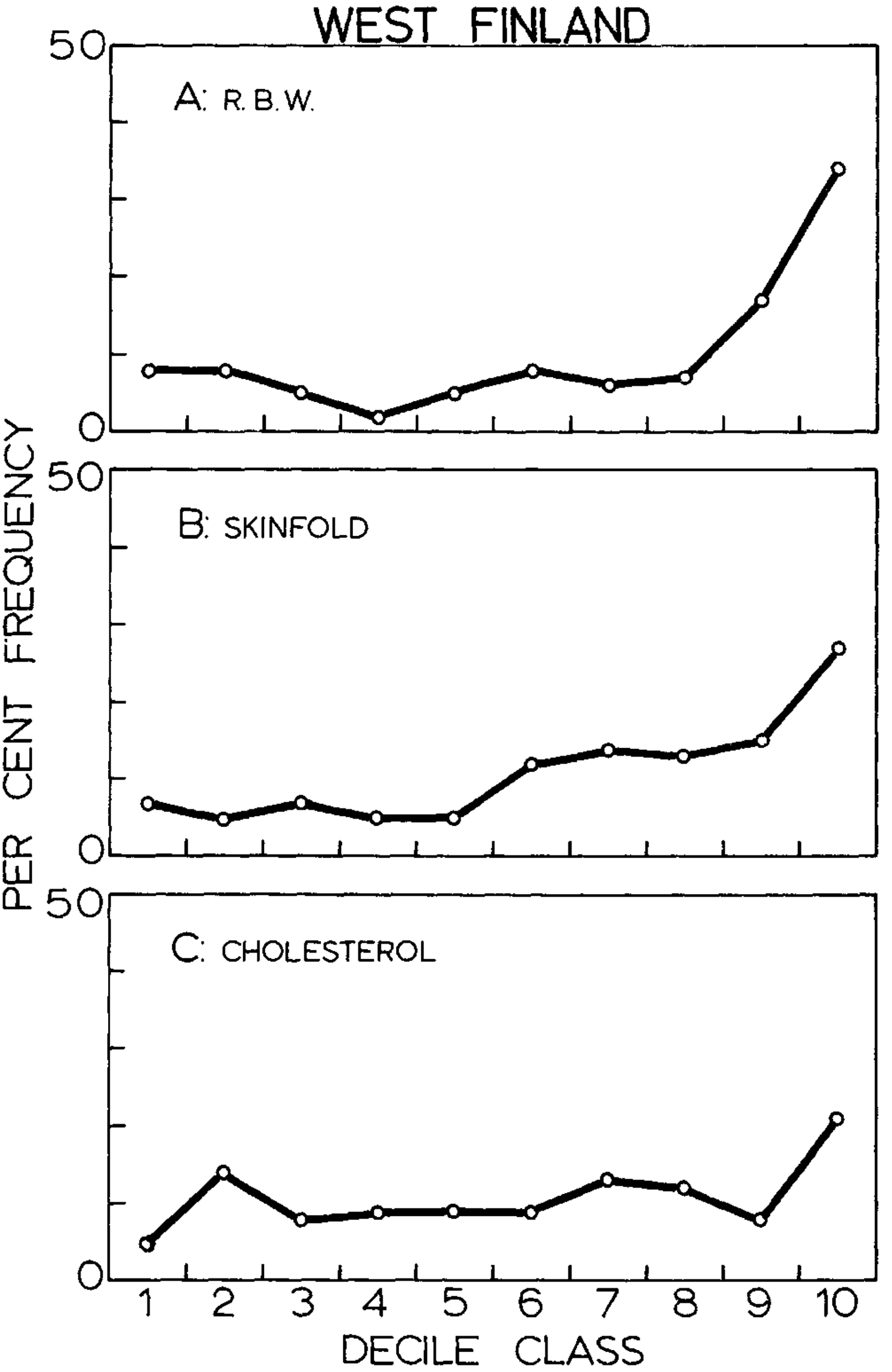
WEST FINLAND
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
50
0
50
0
50
0
PER CENT FREQUENCY
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C4. 4

more marked in West than in East Finland. In neither area, considered alone, is the prevalence of hypertension significantly related to the serum cholesterol level, except, perhaps, for the indication in West Finland that the men with the highest cholesterol values (decile 10) are more prone to hypertension than the men with the lowest values for cholesterol (decile 1). In West Finland out of 85 men in cholesterol decile class 10, there were 18 cases of hypertension but the first decile class only 4 out of 85 men were hypertensive; the difference has very high significance (chi-square=22.98). If East and West Finland are combined the prevalence of hypertension is clearly related to the serum cholesterol level but this merely reflects the fact that both hypertension and hypercholesterolemia are more frequent in East than in West Finland.

Prevalence of Overweight versus Other Variables

Table C4.13 shows the prevalence of overweight by two criteria of relative body weight. Overweight, defined as body weight 110 per cent or more above the U.S. Medico-Actuarial average for height and age, is more common in West than in East Finland, the prevalence rates being 17 and 11 per cent, respectively. The difference, 54.5 per cent more frequent overweight in West than in East Finland, is highly significant (chi-square = 10.91, p = 0.001).

The West Finns tend to be a little less often overweight than the men in all 18 samples but the difference is insignificant. The East Finns, however, are much less often overweight and the difference from the total population of men is highly significant.

The distributions of the overweight Finns (110 or more per cent of the "standard" average for height and age) into age- and area-specific decile classes of the distributions, for all Finns, of blood pressure and serum cholesterol are shown in Figures C4.5 and C4.6. Overweight prevalence is not related to serum cholesterol level in East Finland but in West Finland there is a trend for overweight prevalence to increase with rising serum cholesterol level. Comparing the men in the below-vs. above median cholesterol values, the numbers of overweight men are 58 and 86 respectively, and the non-overweights number 336 and 338; chi-square = 6.098 and p = less than 0.02.

In both areas the frequency of overweight rises with both systolic and diastolic blood pressure and the trend is highly significant.

Summary

In two rural areas of East and of West Finland 98 per cent of all men aged 40—59 (N = 1677) were examined. Three fourths of these men were engaged in heavy physical work on small farms and in logging; only 10 per cent were sedentary or engaged only in light physical activity.

These men tended to be thin and to have very high serum cholesterol values, especially in East Finland. The less active men, and those in the higher socio-economic class, tended to have the highest relative body weights and Σ skinfolds. Neither blood pressure nor serum cholesterol tended to be related to physical activity or socio-economic status.

Most of these men smoked cigarettes. The non-smokers included unduly large proportions of the relatively heavy, obese men, and men with high blood pressure.

Both areas tended to have a relatively high frequency of electrocardiographic abnormalities; this was most pronounced in East Finland.

The prevalence of hypertension tended to increase with increasing relative

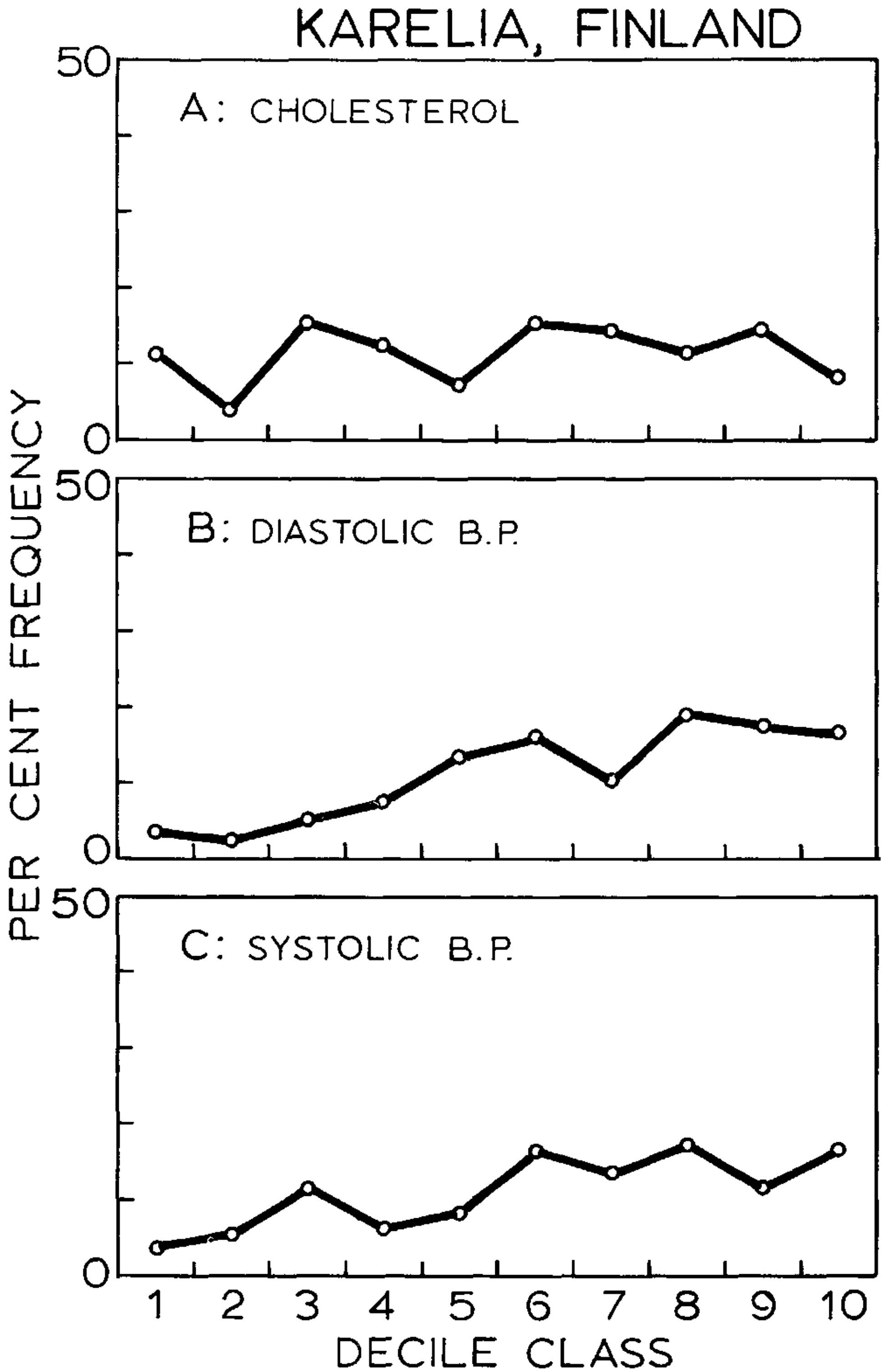
KARELIA, FINLAND
A: CHOLESTEROL
B: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C4. 5

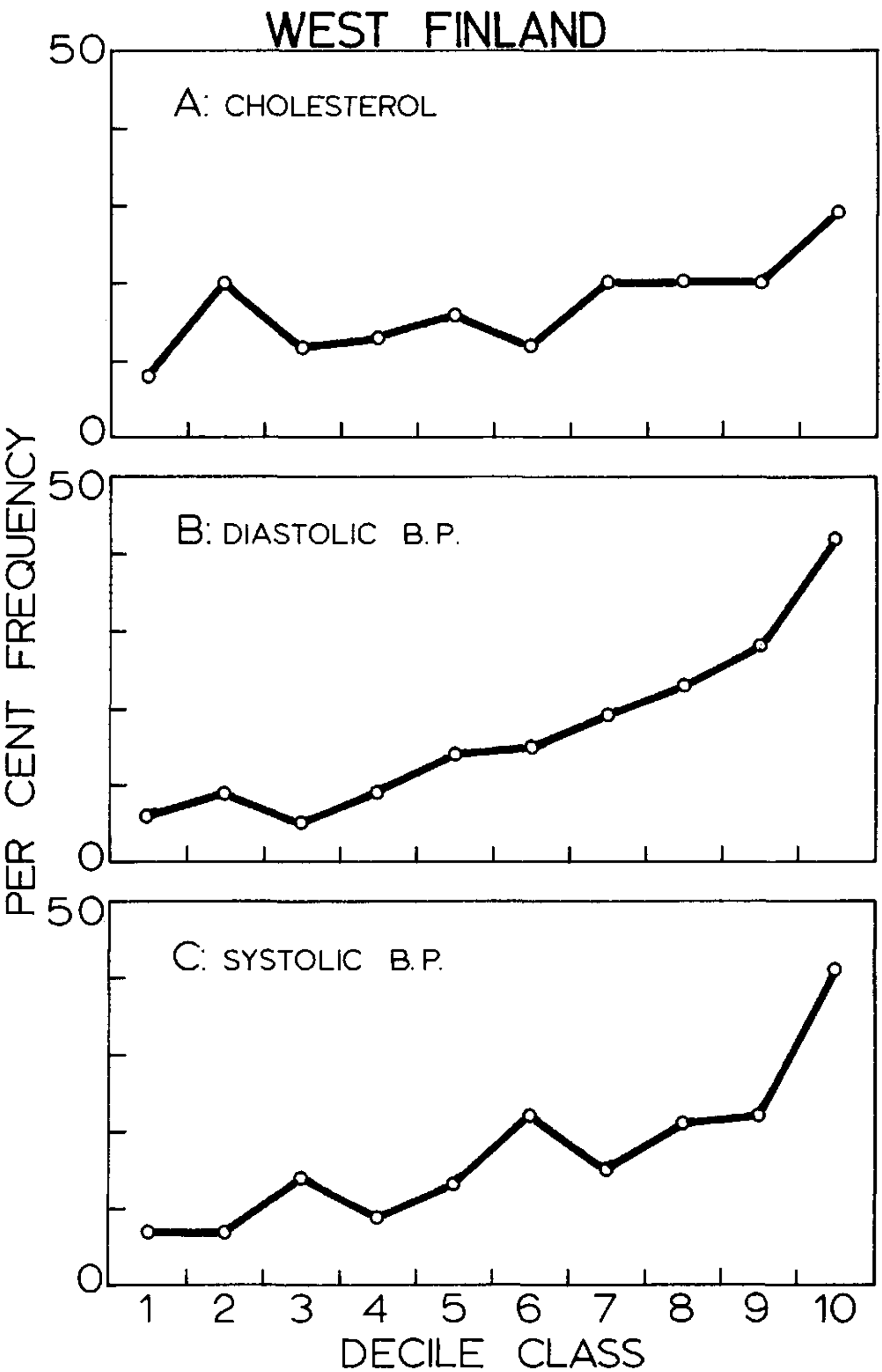
WEST FINLAND
A: CHOLESTEROL
B: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
50
0
50
0
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C4. 6

body weight and Σ skinfolds, especially in West Finland. The prevalence of hypertension appeared to be unrelated to serum cholesterol concentration in either area.

Overweight was uncommon in East Finland, somewhat more common in West Finland. In both areas, but especially in West Finland, the prevalence of overweight rose with increasing blood pressure. In West Finland, but not in East Finland, the prevalence of overweight rose with increasing serum cholesterol concentration.

Acknowledgments

The research team in 1959 in East and West Finland included Drs. Gunnar Blomqvist (Stockholm), Veikko Kallio (Turku), Martti J. Karvonen, Esko Orma, Sven Punsar (all of Helsinki), Pentti Rautaharju (Halifax), Juha Takkunen, Mr. A. O. Heinonen and Nurse, Mrs. Anja Valve (all of Helsinki). Drs. Ratko Buzina (Zagreb), Louisa M. Dalderup (Amsterdam), Ian T. T. Higgins (then Cardiff, now of Pittsburgh) and Elisabeth Marler contributed their experience at the beginning phase of the study.

Establishing the roster of men and securing their participation was the responsibility of two Health Nurses, Mrs. Impi Lavikainen in the East and Mrs. Kirsti Kuisma in the West.

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Prof. Leo Noro, Director of the Institute of Occupational Health, placed staff members and facilities of the Institute at the disposal of the study.

The participation of Finland in the collaborative investigation was largely due to the stimulus of Prof. Pauli Soisalo, then President of the Board of the Finnish Heart Association.

C5. THE TOWN OF ZUTPHEN, THE NETHERLANDS

by F. S. P. van Buchem and L. M. Dalderup.

Introduction

Zutphen has long been a small commercial town, a center of commerce and traffic of a farming district in the eastern part of the Netherlands. The climate is typical of the lowlands near the North Sea, that is to say it is temperate and moist. In modern times manufacturing has become increasingly important, with a particularly strong development after the second world war. Today there are, among others, factories producing machinery, ready-made clothing, and for processing iron and leather, printing and book-binding establishments, rag grading and packing plants. Besides light industry and the activities of a retail market center, Zutphen is notable as a center for secondary and technical education for a large district. The two hospitals of the town have a full staff of specialists, including three specialists in internal medicine. The population numbers about 25,000.

Zutphen was chosen as a center for epidemiological research on atherosclerosis because it is a town of suitable size with a very stable population who had shown willingness to cooperate in an earlier somewhat similar medical survey. The population registry of Zutphen on January 1, 1960, contained about 2,300 men then aged 40 through 59 years. Because only about 1,000 men of those ages could be included in the study, 4 out of every 9 names were randomly selected from the alphabetical registry. Seventy per cent of these men responded favorably to a written invitation and the remaining 30 per cent were personally visited in the attempt to recruit them.

In the summer of 1960 a total of 907 men were examined, representing 83.4 per cent of those invited. When the studies were repeated in 1961 and 1962 another 10 invitees came in, bringing the total to 917 men and 84.3 per cent coverage in the full examination. The cooperation of the local physicians made it possible to obtain information about the state of health of all but 7 of the men who were unwilling to cooperate.

The examinations in 1960 were carried out by a team, headed by a professor of internal medicine, which included 3 internists, 2 general practitioners, an ophthalmologist, who were assisted by technicians and nurses.

In addition to the standard items in the protocol common to all of the areas in this cooperative study, the work at Zutphen in 1960 included detailed ophthalmological examination and fluoroscopy of the chest. These latter items will be considered in separate reports.

The present statistical analysis concerns 878 men whose records were complete for most items and who were 40 through 59 years of age at the time of the examinations in 1960.

Age, Physical Activity and Occupation

Table C5.1 gives the distribution of men, by age, into the three classes of habitual physical activity. In regard to age, there is a notable deficit of men aged 40—44 in the sample, presumably reflecting losses to the Zutphen population of the younger men related to World War II and its aftermath of migration. The men aged 40—44 in 1960 were aged 25—29 at the end of the war in 1945. Except for the U.S.A., a relative deficiency of men in this youngest age class was noted in all of the other samples in this cooperative study.

Few of the middle-aged men in Zutphen are engaged in heavy work but there is no evidence for a withdrawal from heavy manual labor with advancing age; the *highest* percentage of men in heavy work is in the oldest age group. The occupational distribution of the Zutphen men is given in Table C5.2. It is notable that a third of the sample are professional men or are engaged in business or clerical jobs. The occupational data indicate that a high proportion of the middle-aged men in Zutphen are in "white collar" jobs or in jobs involving a considerable degree of skill. Agricultural pursuits of one kind or another, which once occupied a substantial proportion of men in Zutphen, was represented in 1960 by only 2.5 per cent of the men in the sample. Both in regard to physical activity and occupation the distribution of the men in Zutphen is greatly different from all the other general population samples in this cooperative study; the other samples being dominated by heavy physical activity and by farmers.

Distribution of the Measured Variables

Table C5.3 gives the median values of the men, classed by age, for relative body weight, the sum of the skinfolds, blood pressure and serum cholesterol. Table C5.3 also gives these medians as percentages of the average medians for the men in all 18 samples in this cooperative study. The cumulative frequency distributions of these variables are shown in Figure C5.1. Details of the distributions are given in the Appendix.

In this Zutphen material there was no significant age trend in height, skinfold thickness or serum cholesterol so all ages, 40—59, were combined to provide the cumulative frequency distributions of these variables in Figure C5.1. Relative body weight and both systolic and diastolic blood pressure showed significant age trends. For these three variables the heavy line is for ages 40—49, the light line is for ages 50—59. In Figure C5.1 the ordinate is on a probability scale. The deviation of the cumulative frequencies from a straight line is obvious for blood pressure at ages 50—59 but serum cholesterol and Σ skinfolds also depart somewhat from a normal, Gaussian distribution.

The men of Zutphen are relatively tall, being exceeded in height only slightly by the U.S. railway executives who are the tallest group among the 18 samples. Though they tend to have slightly higher relative body weights than the men in most of the other samples, they are not so much inclined to overweight as the men in Crevalcore and Rome, Italy, or any of the U.S. samples. Their position in regard to body fatness is similar to that for rela-

TABLE C5.1

Zutphen men in 1960, classed by age and physical activity (1 = sedentary, 2 = moderately active, 3 = very active).

AGE	TOTAL MEN	% IN ACTIVITY 1	2	3
40-44	181	24.3	66.9	8.8
45-49	237	17.8	74.2	8.1
50-54	235	24.3	64.7	11.1
55-59	225	30.7	52.4	16.9
All ages	878	24.1	64.6	11.3

TABLE C5.2

Zutphen men, 1960, classed by occupation.

OCCUPATION	CODE	%	OCCUPATION	CODE	%
Professional	1-10	5.3	Building trades	54-61	11.0
Business, etc.	11-15	17.5	Metal work	62-65	8.5
Foreman	16-22	4.7	Agriculture	66-69, 71-75	2.5
Clerical	23-26	10.5	Factory work	78-80	5.5
Protection	27-30	3.0	Services	81-87	2.6
Food Handlers	31-39	5.8	General labor	88, 89	3.4
Skilled light crafts	40-44	5.2	Miscellaneous	90-94	7.3
Transportation	45-53	6.3	Not working	95-98	0.8

TABLE C5.3

Medians for Zutphen men, classed by age, and these values as percentages of the averages of the medians for all 18 samples of men.

VARIABLE	MEDIAN VALUES				MEDIAN, % OF AVERAGE			
	40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
Height (cm.)	175	175	174	172	103.1	103.5	103.4	102.6
Relative Wt. (%)	99	97	97	97	100.9	100.8	101.9	103.1
Σ Skinfolds (mm.)	24	23	24	22	113.2	112.5	115.9	110.6
Systolic B.P. (mm. Hg)	140	140	140	145	106.9	105.3	102.2	103.1
Diastolic B.P. "	90	90	90	88	111.1	110.6	107.9	104.4
Serum Chol. (mg. %)	233	235	227	226	112.9	113.4	108.7	109.4

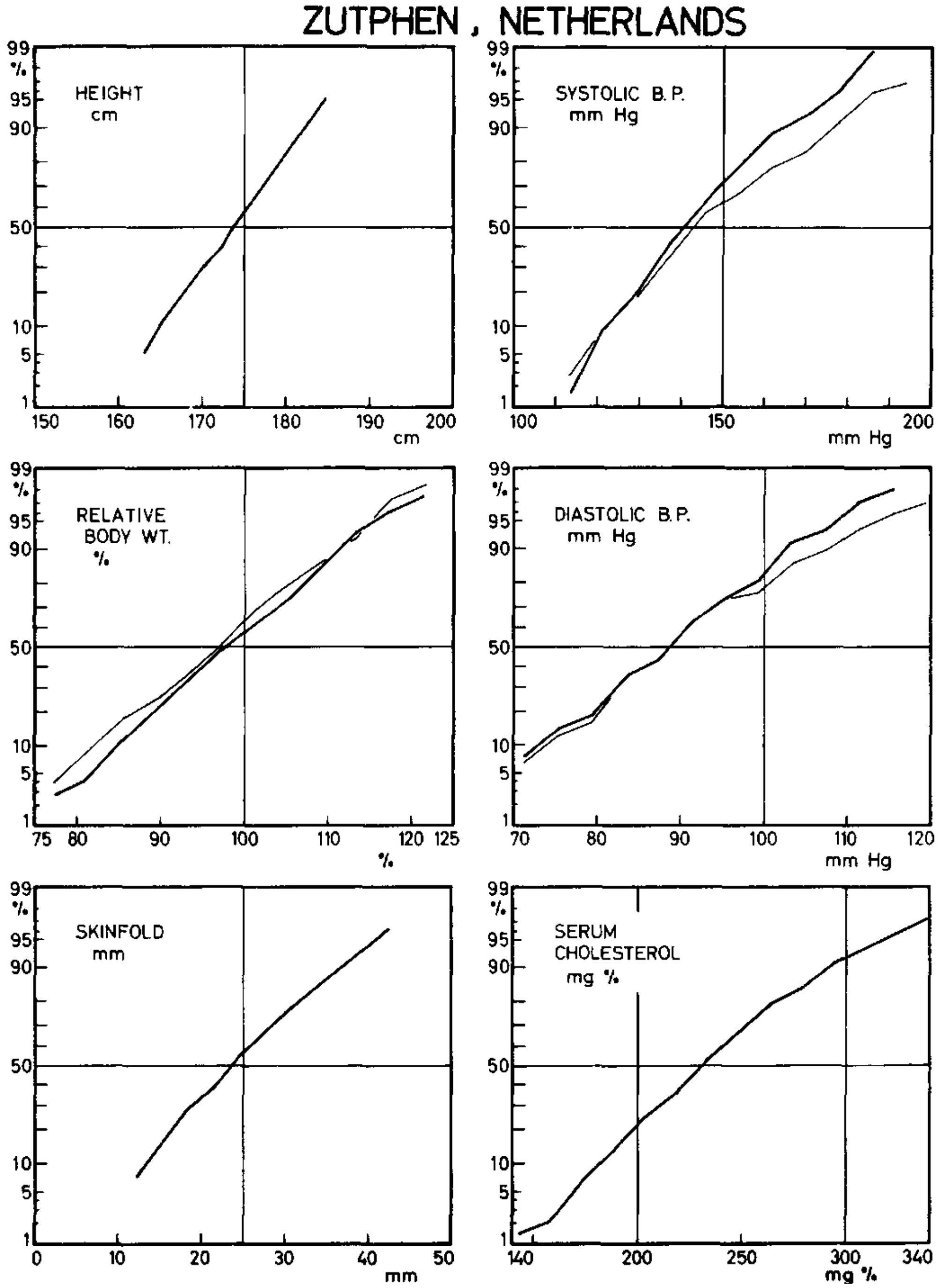
ZUTPHEN , NETHERLANDS
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT. %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C5. 1

tive body weight; all of the U.S. samples tend to be much fatter and the Rome railway employees are slightly fatter than the men of Zutphen.

In general, the men of Zutphen tend to have somewhat higher blood pressures than the men in any of the other areas except in Karelia (East Finland). Finally, the serum cholesterol concentration tends to be relatively high in these men but not as high as in the U.S. railway employees and far lower than in the men in Finland. In a broad classification of the 18 population samples, the men of Zutphen would be grouped with the men in Finland and in the U.S.A. in the high serum cholesterol category.

Smoking Habits

In regard to smoking habits, the men of Zutphen differ from the men in all of the other 17 samples in this cooperative study in that many of them smoke pipes and cigars; these are infrequently used in the other populations. Still, three-quarters (74.7 per cent) of these men of Zutphen smoke cigarettes, though only a few (10.6 per cent) could be classed as heavy cigarette smokers, i.e., men who regularly smoke 20 or more cigarettes daily. Only 7.6 per cent of the Zutphen men never smoked cigarettes. Table C5.4 gives the data.

As in most of the other samples, it was observed that the non-cigarette smokers tended to be relatively heavier and fatter than the cigarette smokers. Though the non-cigarette smokers represented only 25.3 per cent of the sample, they accounted for 35.1 per cent of the men in the top 20 per cent for relative body weight and 37.6 per cent of the top 20 per cent in the sum of the skinfolds. There was no significant difference between the cigarette smokers and the non-cigarette smokers in their distribution in regard to blood pressure or serum cholesterol. Data are summarized in Table C5.5.

The heaviest cigarette smokers were not notable in regard to blood pressure or serum cholesterol but, curiously, they too, like the non-cigarette smokers, tended to overweight and obesity. Though only representing 10.7 per cent of all the men, they accounted for 16.1 and 15.0 per cent of the top 20 per cent of all men in relative weight and sum of skinfolds, respectively. These figures indicate excesses of 51.9 and 41.5 per cent, respectively, of cases of overweight and of obesity among the heavy cigarette smokers.

Electrocardiographic Findings

The electrocardiographic data from recordings at rest are summarized in Table C5.6 which gives numbers of cases and rates per 1 000 men of findings of abnormalities in terms of the classification in the Minnesota Code (Blackburn *et al.*, 1960). As expected, the prevalence of ECG abnormality increased with age in substantially all items. An interesting exception is the prevalence of sinus tachycardia in rest which steadily decreased with age.

The most common single abnormalities in rest were left axis deviation (Code II, 1), tall R waves (Code III, 1), flat or slightly negative T wave (Code V, 3), and sinus tachycardia (Code VIII, 7), with all-ages prevalences of 39.9, 43.3, 36.5 and 53.6 cases per thousand, respectively. Q wave abnormality was relatively frequent. The most definite sign of previous myocardial infarction, Code I, 1, was shown by 8 men (9.1 per thousand); for men 55—59 the rate of this finding was 22.2 per thousand.

The post-exercise ECG, recorded for 97.7 per cent of the men, provided a moderate yield of additional abnormalities, particularly of S-T depression

TABLE C5.4

Cigarette smoking habits of men of Zutphen. Percentage of men who never smoked, who had stopped, who smoked 1-9, 10-19, 20 or more cigarettes daily at the time of their examination.

SAMPLE	AGE	NEVER	QUIT	1-9	10-19	20 OR MORE
Zutphen	40-44	6.1	11.2	27.4	39.7	15.6
"	45-49	6.4	11.5	32.5	36.8	12.8
"	50-54	6.4	24.3	30.6	31.9	6.8
"	55-59	11.3	22.6	30.8	26.7	8.6
"	40-59	7.6	17.7	30.5	33.5	10.7

TABLE C5.5

Smoking. Number of men in Zutphen, Netherlands below (LOW) and above (HIGH) the age-specific medians, for age and area, of measured variables, classed according to smoking habits. HEAVY = 20 or more, OTHER = 1-19 cigarettes daily.

VARIABLE	SAMPLE	NON-SMOKERS		HEAVY		OTHER	
		LOW	HIGH	LOW	HIGH	LOW	HIGH
Relative Weight	Zutphen	98	122	43	49	294	262
Σ Skinfolds	"	86	134	44	49	303	253
Systolic B.P.	"	105	115	44	49	284	271
Diastolic B.P.	"	93	127	44	48	298	257
Serum Cholesterol	"	110	103	34	57	268	253

TABLE C5.6

ZUTPHEN, NETHERLANDS

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (180)	45-49 (237)	50-54 (235)	55-59 (225)
Total with reportable ECG Items	I - IX		76 (422.2)	109 (459.9)	106 (451.1)	106 (471.1)
Q Waves	I	1	0	0	3 (12.8)	5 (22.2)
		2	3 (16.7)	3 (12.7)	2 (8.5)	6 (26.7)
		3	3 (16.7)	1 (4.2)	2 (8.5)	5 (22.2)
Axis Deviation	II					
Left		1	3 (16.7)	11 (46.4)	7 (29.8)	14 (62.2)
Right		2	1 (5.6)	0	0	1 (4.4)
High Amplitude R Waves	III					
Left type		1	6 (33.3)	10 (42.2)	9 (38.3)	13 (57.8)
Right type		2	0	0	0	1 (4.4)
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	0	4 (17.0)	6 (26.7)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	0	4 (16.9)	2 (8.5)	3 (13.3)
No S-T-J plus segment downward		3	1 (5.6)	2 (8.4)	4 (17.0)	2 (8.9)
S-T - J 1 mm. or more, upward segment		4	2 (11.1)	2 (8.4)	1 (4.3)	1 (4.4)
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	1 (4.4)
- 1 mm. to -5 mm.		2	0	0	9 (38.3)	6 (26.7)
0 ± 1 mm.		3	5 (27.8)	5 (21.1)	8 (34.0)	14 (62.2)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	2 (11.1)	2 (8.4)	4 (17.0)	5 (22.2)
Accelerated Conduction		4	0	0	0	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	3 (13.3)
Right Bundle		2	2 (11.1)	2 (8.4)	2 (8.5)	3 (13.3)
Incomplete Right Bundle		3	2 (11.1)	1 (4.2)	3 (12.8)	4 (17.8)
Intraventricular Block		4	5 (27.8)	2 (8.4)	0	2 (8.9)
Arrhythmias	VIII					
Premature Beats		1	0	2 (8.4)	1 (4.3)	3 (13.3)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	1 (4.2)	2 (8.5)	2 (8.9)
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	0	0
Sinus tachycardia		7	14 (77.8)	13 (54.9)	11 (46.8)	9 (40.0)
Sinus bradycardia		8	1 (5.6)	2 (8.4)	2 (8.5)	3 (13.3)
Technically poor records	IX	8	0	1 (4.2)	3 (12.8)	0

where none was present in rest. The data are given in Table C5.7. In rest, 34 cases of S-T depression were observed; 44 more cases were noted post-exercise and in 13 of these the response was that often called "ischemic" (Code IV, 1, 2, 3). Arrhythmias were observed post-exercise in 13 men who had not shown arrhythmias in rest.

Table C5.7 also shows the prevalence of certain ECG findings, including combinations, that are commonly considered to be of clinical import. The only combination of ECG abnormalities that adds materially to the prevalence of clinical import is tall R wave plus S-T depression; there were 8 cases of this combination.

Prevalence of Hypertension

Table C5.8 shows the prevalence in Zutphen of hypertension specified according to four different criteria. By any criterion the men of Zutphen have a high prevalence of elevated blood pressure. Among the 18 population samples in the present cooperative study, only the men of Karelia (East Finland) match the men of Zutphen in this respect. With the relatively conservative criterion of diastolic blood pressure of 100 or more mm. Hg, about one-fifth of the men of Zutphen have hypertension. With the lowest cut-off for hypertension, 140 or more mm. Hg in systole, more than half of the Zutphen men are hypertensive.

The prevalence of hypertension in Zutphen is strongly related to relative body weight and to body fatness (Σ skinfolds) as indicated in Table C5.9. Among men above the median for their age of either relative weight or fatness the prevalence of hypertension, defined as diastolic blood pressure of 95 or more mm. Hg, is more than twice that among men below the median. The men in the top 20 per cent of the distribution of either relative weight or fatness are about 5 times more prone to hypertension than the men in the bottom 20 per cent of the distribution of these variables.

Though there is a slight indication that hypertension increases with increasing serum cholesterol, this trend is not statistically significant for the comparison above vs. below median cholesterol (chi-square = 1.63) nor for the comparison of the men in the top vs. those in the bottom 20 per cent of the cholesterol distribution (chi-square = 3.09).

Prevalence of Overweight

Overweight is subject to definition, of course, but most investigators would agree that a relative body weight of 10 per cent or more above the average weight for height and age as given in the Medico-Actuarial Tables of 1912 (see Appendix) is definitely overweight. For a man aged 50 with height = 170 cm., for example, a relative weight of 110 per cent on that basis would mean a body weight of 77.7 kg.

Among the Zutphen men, 13 per cent had relative body weights of 110 per cent or more. What were other characteristics of these overweight men? Above it was noted that the prevalence of hypertension was strongly related to relative body weight. The reverse analysis is summarized in Table C5.10.

In the Zutphen sample the prevalence of overweight is strongly related both to arterial blood pressure and to serum cholesterol concentration. The relationship is most marked with diastolic blood pressure. Overweight is three times as common among men with above-median than among men with below-median diastolic blood pressure; in the top 20 per cent of the diastolic B. P. distribution the prevalence of overweight is seven times that in the bottom 20 per cent.

TABLE C5.7

ZUTPHEN, NETHERLANDS

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (179)	45-49 (234)	50-54 (223)	55-59 (212)
Exercise tests not made or	X 1				
incomplete	X 2	1 (5.6)	3 (12.7)	12 (51.1)	13 (57.8)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	1 (5.6)	0	2 (9.0)	5 (23.6)
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	0	1 (4.3)	1 (4.5)	1 (4.7)
No S-T-J plus segment downward	3	1 (5.6)	1 (4.3)	0	0
S-T - J 1 mm. or more, upward					
segment	4	6 (33.5)	9 (38.5)	7 (31.4)	9 (42.5)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	1 (5.6)	2 (8.5)	1 (4.5)	4 (18.9)
0 ± 1 mm.	3	4 (22.3)	4 (17.1)	3 (13.5)	6 (28.3)
Arrhythmias post-exercise	XV				
(none at rest)	1	1 (5.6)	4 (17.1)	4 (17.9)	4 (18.9)
Technically poor post-exercise					
records	XI 8	6 (33.5)	9 (38.5)	15 (67.3)	9 (42.5)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

ECG FINDING	ECG Code	40-44 (179)	45-49 (234)	50-54 (223)	55-59 (212)
At Rest					
Large Q Waves	I 1	0	0	3 (12.8)	5 (22.2)
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	0	0	0	0
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	0
Other Negative T as sole	V 2, 3				
anomaly	only	1 (5.6)	1 (4.2)	3 (12.8)	0
S-T Depression as sole	IV 1-4				
anomaly	only	1 (5.6)	0	0	1 (4.4)
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	1 (5.6)	1 (4.2)	2 (8.5)	4 (17.8)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	7 (38.9)	4 (16.9)	2 (8.5)	8 (35.6)
Arrhythmias	VIII 2-6	0	1 (4.2)	2 (8.5)	2 (8.9)
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	4 (22.3)	5 (21.4)	3 (13.5)	9 (42.5)
Negative T as sole	XII 1-3				
anomaly	only	0	1 (4.3)	1 (4.5)	4 (18.9)
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	0
Arrhythmias	XV 1				
as sole anomaly	only	1 (5.6)	3 (12.8)	2 (9.0)	1 (4.7)

TABLE C5.8

Percentage of Zutphen men classed as hypertensive by blood pressure criteria: systolic B.P. 140 or more and 160 or more; diastolic B.P. 95 or more and 100 or more mm. Hg.

AGE	SYSTOLIC		DIASTOLIC	
	140	160	95	100
40-44	54.1	13.8	29.4	19.4
45-49	54.0	19.8	29.1	17.7
50-54	56.2	24.9	30.9	23.2
55-59	63.1	27.6	31.6	22.7

TABLE C5.9

Prevalence (%) of high diastolic B.P. (95 or more mm. Hg) among Zutphen men classed below and above the median and in the bottom and top 20% of all men of same age for the variables indicated.

VARIABLE	BOTTOM 20%	BELOW Median	ABOVE Median	TOP 20%
Relative weight	11.5	19.2	41.4	50.5
Σ Skinfolds	11.5	18.0	42.6	53.0
Serum cholesterol	28.0	29.0	33.2	37.5

TABLE C5.10

Prevalence (%) of overweight (110% or more) among Zutphen men classed below and above the median and in the bottom and top 20% of all men of same age for the variables indicated.

VARIABLE	BOTTOM 20%	BELOW Median	ABOVE Median	TOP 20%
Systolic B.P.	8.0	9.2	18.0	26.0
Diastolic B.P.	4.0	6.2	20.6	28.0
Serum cholesterol	10.0	8.8	17.6	18.5

The prevalence of overweight is about twice as high in the above-median systolic B. P. men as in the below-median men and a similar relationship holds for serum cholesterol. In the comparison of the top vs. the bottom 20 per cent classes of the distributions, however, systolic B. P. may be more important than serum cholesterol. All of these differences are statistically highly significant with $p = 0.01$ or less.

Relationships Concerning Occupation and Physical Activity

As noted above, the men in Zutphen were classed into three levels of habitual physical activity as well as by occupation. The occupations may be grouped into two broad socio-economic classes — Code nos. 1—13 (professional, managerial and business owners), and Code nos. 14—94 (all other occupations). The data are suitable for examination of the question as to whether the men so classed differ in their tendency to have high values of the measured variables of relative weight, body fatness (Σ skinfolds), arterial blood pressure and serum cholesterol concentration. For these purposes "low" and "high" values are defined as the bottom and top 30 per cents of the distribution of the values of all Zutphen men in the same age quinquennium.

The basic data are set forth in Table C5.11. The bottom 3 lines in Table C5.11 concern physical activity, ignoring occupational status. In general, men with the lowest physical activity (Class 1) tend to be more often overweight, over-fat, and to have higher blood pressure and serum cholesterol values than the other men. The moderately active men (Class 2) tend to show the opposite tendency but to a less marked degree. The men with the highest physical activity (Class 3) are most often lean and characterized by low serum cholesterol values but they are not remarkable in regard to relative body weight or blood pressure.

On the other hand, when physical activity is ignored, there is an even more striking distinction between men in occupational classes 1—13 and those in all other occupations. The men in the upper socio-economic class are much more often relatively overweight and obese, prone to high blood pressure and to have high serum cholesterol values than the rest of the population. It should be noted that the men in occupations 1—13 are generally characterized by low physical activity; among a total of 155 men in those occupations, 45.8 per cent were in Activity Class 1 and only six could be classed as being very active (Class 3).

The question then arises as to what extent the measured characteristics associated with occupation can be ascribed to physical activity and, on the other hand, the extent to which socio-economic status may be responsible for the differences associated with physical activity. Tables C5.12, C5.13, and C5.14 concern these questions. It appears that most of the association of low physical activity with high values of these variables is accounted for by socio-economic status. Some, but certainly not all, of the association of high socio-economic status with high values of these variables is, in turn, accounted for by physical activity.

It will be generally agreed that high values of the variables considered here are associated with an increased tendency to develop coronary heart disease. On this basis, the men at Zutphen who are most at risk are those in the upper socio-economic class whose habitual physical activity is low. On the other hand, the men in the lower socio-economic group who are most active physically would not appear to represent a remarkably low risk group com-

TABLE C5.11

Occupation and physical activity versus measured variables in Zutphen. Numbers of men with "Low" and "High" values of the variables. "Low" and "High" are the bottom and the top 30 per cents, respectively, of the distributions of all men of the same age.

OCCUPATION	PHYSICAL ACTIVITY	RELATIVE WT.		Σ SKINFOLDS		SYSTOLIC B.P.		DIASTOLIC B.P.		CHOLESTEROL	
		Low	High	Low	High	Low	High	Low	High	Low	High
1-13	Class 1	9	37	9	38	14	23	13	30	12	28
"	" 2	15	31	14	33	28	23	22	25	17	38
"	" 3	0	4	1	0	1	4	0	2	2	2
"	All Classes	24	72	24	71	43	50	35	57	31	68
14-94	Class 1	32	39	31	54	41	49	40	43	38	44
"	" 2	168	125	168	115	144	130	158	144	140	108
"	" 3	32	27	38	17	30	31	27	28	39	25
"	All Classes	232	191	237	186	215	210	225	215	217	177
1-94	Class 1	41	76	40	92	55	72	53	73	50	72
"	" 2	183	156	182	148	172	153	180	169	157	146
"	" 3	32	31	40	17	31	35	27	30	41	27

TABLE C5.12

Activity 1 vs. Activity 2. Excess frequency of high values (deciles 8-10) of the variables observed among men of Activity 1, expressed as % of expectation from total numbers of men in Activities 1 plus 2. Also, chi-square values for the differences between observed and expected distributions.

OCCUPATION	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Zutphen										
1-94	22.8	5.84	41.3	21.41	20.0	4.26	17.3	3.24	24.8	6.94
1-13	14.9	1.97	13.1	1.61	5.5	0.06	15.8	1.49	-10.8	0.92
14-94	10.2	0.47	44.8	12.47	26.9	4.57	10.5	0.58	29.4	4.64

TABLE C5.13

Activity 2 vs. Activity 3. Occupations 14-94 only. Excess frequency, as in Table C5.12, of high values among men of Activity 2.

REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
-2.3	0.38	4.2	1.26	-3.7	1.29	-1.4	0.12	-2.5	0.39

TABLE C5.14

Occupations 1-13 vs. 14-94. Excess frequency, as in Table C5.12, of high values among men in Occupations 1-13, expressed as % of expectation from total numbers of men in Occupations 1-13 + 14-94.

ACTIVITY	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Zutphen										
1+2	49.1	18.74	47.9	19.23	3.4	0.04	20.9	3.18	46.7	16.82
1	39.1	8.98	18.0	2.43	-9.1	3.04	19.5	1.83	8.9	0.31
2	40.9	5.28	15.4	10.01	6.0	0.05	10.6	0.26	74.3	18.40

Probabilities, p, associated with chi-square values: 2.71, p = 0.10; 3.84, p = 0.05; 5.41, p = 0.02; 6.64, p = 0.01; 10.83, p = 0.001.

pared to the other men in those samples. They have a somewhat reduced tendency to hypercholesterolemia but they are not remarkable in either relative body weight or in blood pressure. Their chief distinguishing feature is the fact that they are often overweight but not overfat.

Prevalence of Hypertension

Table C5.15 shows the prevalence of diastolic hypertension, judged by two criteria, among men classed by age at Zutphen. In general, hypertension was common at Zutphen and more prevalent there than in the average of all the samples of men in these studies. It is interesting, however, that there is no age trend over the years 40—59 in the frequency of hypertension at Zutphen.

Thirty per cent of all men aged 40—59 at Zutphen would be classed as hypertensive in 95 mm. in diastole (fifth phase) is the criterion. Figure C5.2 shows the distribution of these hypertensive men into the decile classes of relative body weight, Σ skinfolds, and serum cholesterol. If the prevalence of hypertension were unrelated to these other variables, in each case the trend would be random about a horizontal straight line on the graph, i. e. only chance would cause different numbers of men to fall into the different decile classes.

At Zutphen the prevalence of hypertension rises sharply with both relative weight and Σ skinfolds; substantially, the relationship to decile class is an upward-sloping straight line. The fattest men (decile 10 in Σ skinfolds) have almost 10 times the prevalence of hypertension of the thinnest men (decile 1); the actual numbers are 49 of 88 and 5 of 88 men, respectively.

With serum cholesterol a relationship is much less marked and regular. However, if the men in the top 30 per cent (deciles 8, 9, 10) of the cholesterol distribution are compared with all the other Zutphen men, they prove to have a 19.4 per cent excess of cases of hypertension; this is significant, with chi-square = 5.64 and p = less than 0.02.

Prevalence of Overweight

Table C5.16 shows the prevalence of overweight, by two relative weight criteria, among the men of Zutphen classed by age. In general, overweight is not very common and it is less frequent at Zutphen than in the average of all samples of men in these studies. At Zutphen the frequency of overweight tends to diminish slightly with age from 40 through 59 years.

If 110 per cent or more relative body weight is taken as a definition of overweight, 13 per cent of all the Zutphen men aged 40—59 are overweight. The distributions of those overweight in decile classes of serum cholesterol, diastolic blood pressure, and systolic blood pressure are shown in Figure C5.3.

With increasing blood pressure, either systolic or diastolic, the prevalence of overweight increases but the relationship tends to be curvilinear, especially with systolic blood pressure. The top systolic blood pressure class differs sharply from the rest of the distribution; in that class 35.6 per cent of the men are overweight and if that class is omitted from the analysis almost no statistically significant relationship remains between overweight and systolic blood pressure.

The trend of prevalence of overweight with increasing serum cholesterol is irregular. However, there is high statistical significance when the top (deciles 8—10) and bottom (deciles 1—3) of the cholesterol distribution are compared. In the top 30 per cent of the cholesterol distribution 46 out of 247 men are overweight compared with 23

TABLE C5.15

Prevalence of diastolic hypertension (95 or more, 100 or more mm Hg, fifth phase) among men classed by age. Percentage of men at Zutphen who are hypertensive, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	95mm	100mm	95mm	100mm	95mm	100mm	95mm	100mm
Zutphen	29.4	19.4	29.1	17.7	30.9	23.2	31.6	22.7
Mean, 18 samples	13.6	7.9	15.6	8.9	20.9	13.5	21.5	13.8

TABLE C5.16

Prevalence of overweight (110 or more and 120 or more per cent of "standard" average for height and age). Percentage of men at Zutphen, classed by age, who are overweight, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	110%	120%	110%	120%	110%	120%	110%	120%
Zutphen	14.9	3.3	13.5	3.8	13.7	1.7	11.6	2.7
Mean, 18 samples	20.9	8.4	19.4	6.9	18.1	6.7	16.8	7.3

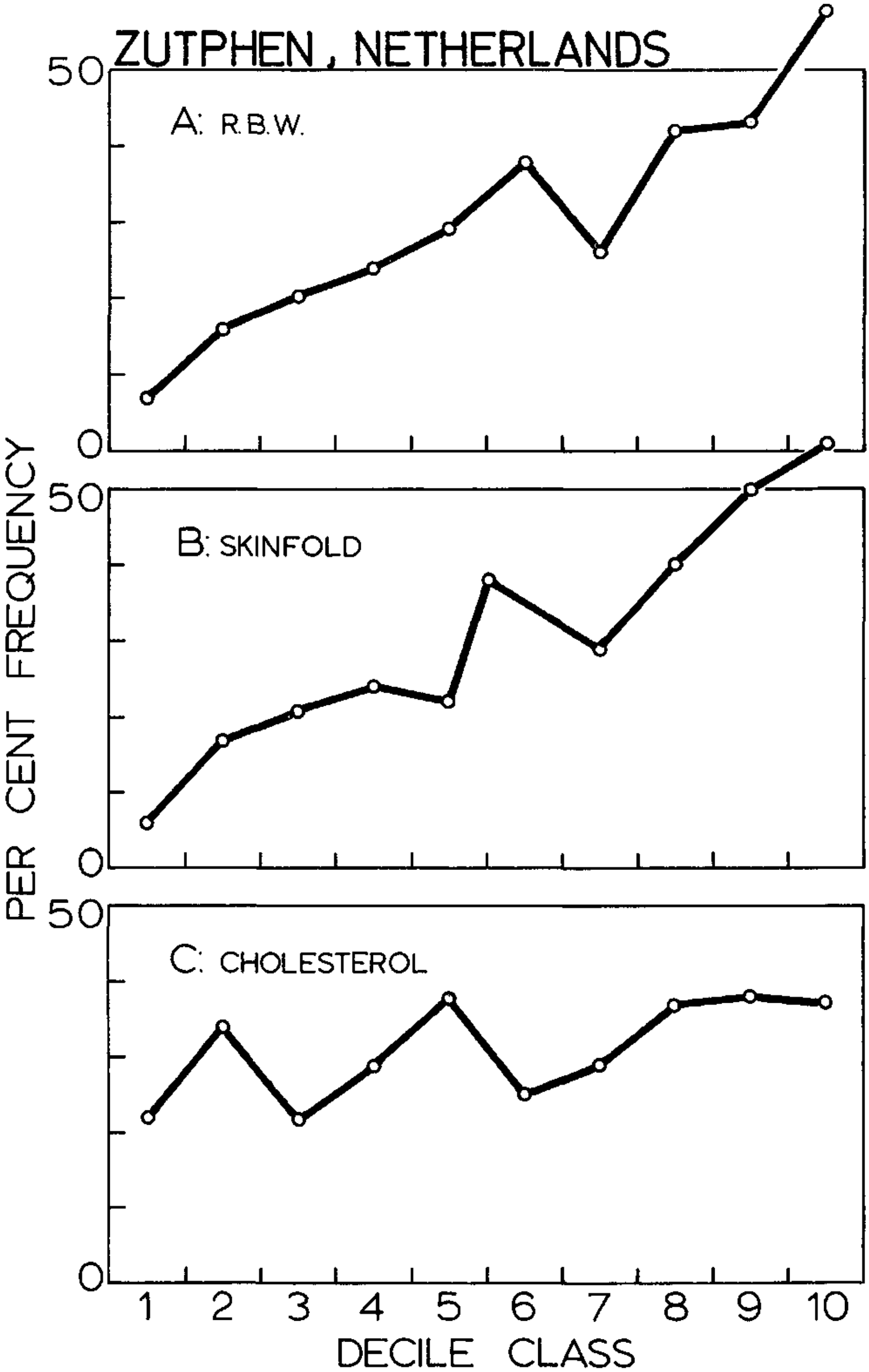
ZUTPHEN , NETHERLANDS
50
0
A: R.B.W.
50
0
B: SKINFOLD
50
0
C: CHOLESTEROL
PER CENT FREQUENCY
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C5. 2

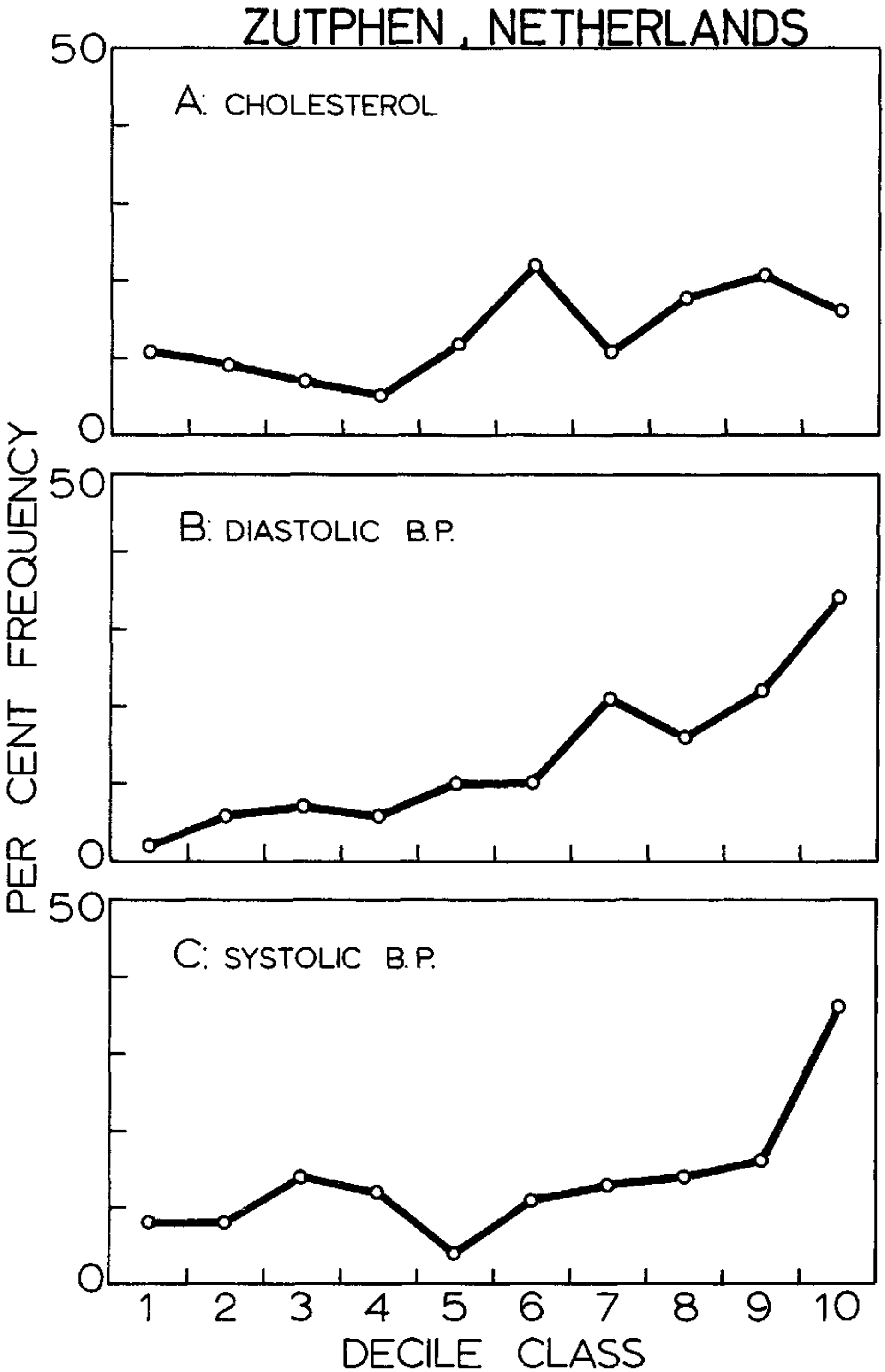
ZUTPHEN, NETHERLANDS
A: CHOLESTEROL
B: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C5. 3

out of 250 men in the bottom 30 per cent of the distribution; chi-square = 8.60 and p = about 0.005.

Summary

In the commercial town of Zutphen, in the eastern part of the Netherlands, a statistical sample of four out of nine men aged 40—59 was drawn and 84.3 per cent of these men (N = 917) were examined. Only 11.3 per cent of these men were engaged in heavy physical activity; 24.1 per cent were sedentary or did only light work.

In general, compared with other samples in these studies, the men of Zutphen were somewhat above the average in relative body weight, Σ skinfolds, blood pressure and serum cholesterol. Most of them were cigarette smokers but only 10.7 per cent smoked 20 or more cigarettes daily. The non-smokers tended to be more often overweight and obese, and to have higher blood pressures than the smokers. Electrocardiographic abnormalities, in rest and after exercise, were not very common but tended to be somewhat more prevalent than in the rural populations studied in Italy, Greece, Yugoslavia and Japan.

Hypertension was common by any criteria and was especially prevalent among men in the upper part of the distributions of relative weight, Σ skinfolds and serum cholesterol concentration. Similarly, overweight was unduly common among men in the upper part of the distributions of blood pressure and serum cholesterol.

High values for relative weight, Σ skinfolds, blood pressure and serum cholesterol were more common among sedentary than among more active men and among men in the higher socio-economic class than in the lower class.

Acknowledgments

The professional staff in the survey at Zutphen in 1960, directed by Prof. F. S. P. van Buchem, included Doctors M. J. Bosma, L. M. Dalderup, R. Hamburger, J. W. M. Th. van den Heuvel-Aghina, E. E. J. Marler, and M. A. Zorn, G. Pol (Chemist), and assistants W. Buchel, A. H. Thomassen-Gijsbers and B. Schillemans-Visser.

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C6. RURAL POPULATIONS IN CRETE AND CORFU, GREECE

by Christ Aravanis, A. S. Dontas, D. Lekos and Ancel Keys

Introduction

An early decision in the plans for the present series of studies was to include at least one sample of men whose habitual diet is high in fat but low in saturated fatty acids. Populations eating large amounts of olives and olive oil would meet these specifications and among many such populations at the eastern end of the Mediterranean Sea the island of Crete is a classical example. In the vicinity of Iraklion (Heraklion, the ancient Candia) the olive tree has been a major source of food for at least five thousand years; great pottery jars and vats for the storage of olive oil are numerous in the ruins of the palace of Minos and other remnants of the Minoan civilization.

Crete also had the advantage of being the subject of an intensive study shortly after World War II, sponsored by the Rockefeller Foundation, which provided much information about health conditions, diet, etc. (Albaugh, 1953). That study documented the fact of the continued prominence of olives and especially olive oil and small consumption of meats and dairy products in a simple but reasonably abundant diet. Cardiovascular diseases appeared to be relatively uncommon from the rather superficial information on morbidity and mortality collected by the Rockefeller group.

The later decision to include a study on the island of Corfu was based on information that the diet there is similar to that in Crete but that the attitudes and social psychology there are much more European in contrast with the Cretans whose psychology is more Oriental. Our preliminary survey of middle-aged men in eleven villages in Crete in 1957 had shown a remarkable rarity of coronary heart disease and the question was raised as to whether in part this was related to the fatalistic philosophy and preservation of the old, unhurried ways characteristic of rural Crete. In short, comparison of Crete and Corfu offered the prospect of comparing two populations of Greek farmers eating much the same diet and practicing the same kind of handlabor agriculture but perhaps differing in "tension".

Crete

The mountainous island of Crete with an area of 3,600 square kilometers and a population today of 550,000, is a land of small farmers with a very long history. The island gave birth to the Minoan Civilization some 5,000 years ago but beginning with the incursion of the Dorians, early in Greek history, from what now is Greece proper, it has seldom been free from invasions and protracted foreign rule—notably by the Romans, Venetians and Turks. Finally, in 1913 Crete again became an integral part of Greece. Though there is no separatist sentiment, even today the population tends to consider itself Cretan as well as Greek. Hundreds of years of Turkish rule left its mark so that the culture of Crete is relatively less Western and modern than that of other parts of Greece.

The climate is warm-temperate, rain is rather scanty and the land is dry a good deal of the year in many parts of the island. Basically, the only industry is agriculture and this is concentrated on a few crops, chiefly table grapes, olives and olive oil, white currants, nuts and pulses. Table grapes for export are a major cash crop in the study area. The olive has been of key importance in the diet since Minoan times and there is reason to believe that the local diet has changed little for many centuries.

The area under study on Crete consists of a series of villages, inhabited by small farmers, centered at Kastelli, about 30 km. east and inland from the port city of Iraklion. In modern times many young men tend to leave these villages seeking opportunity in Iraklion, Athens, or overseas; they seldom return. Aside from such migration and a little movement between villages, the population of these villages is very stable, poor in money and many amenities of modern life but relatively content. As in the rest of Crete, the Greek Orthodox religion prevails.

Corfu

The verdant island of Corfu, with an area of 589 square kilometers, lies just off the Greek mainland in the Ionian Sea. Homer, in the Odyssey, called it Pheakon. Corfu was a part of Greece as early as the 8th century B. C. but was dominated by the Romans from 300 B. C. to 400 A. D., then by Byzantium until 1200, by Venice from 1386 to 1797, by France and Russia from 1797 to 1814, and by England from 1815 to 1864 when it finally came back to Greek rule.

The climate is warm-temperate and humid, with a long rainy season, contrasting with the more arid climate of much of Greece. Except for some trade as a tourist center (and winter home of royal families in the 19th and early 20th centuries), the industry of the island is purely agricultural, the main produce being olives and olive oil, grapes, pulses and fruits.

Sociologically, Corfu is much more "European" than is Crete though both are wholly Greek and the Greek Orthodox Church is dominant. Among rural areas in Greece, Crete is perhaps the least Western in outlook and manner, while Corfu is one of the most occidental and European.

The area under study on Corfu comprises a series of farming villages in the northeastern part of the island. As elsewhere in Greek villages, there has been some outward migration of young men but otherwise the population is stable.

As indicated in Section A, a survey was made in 1957 on the island of Crete in which the attempt was to examine substantially all of the men, then aged 45—65, in a selected series of villages. The protocol and methods were similar to those employed in the study in the fall of 1960 here reported. For the 1960 study the general area was the same but the age range was changed to cover men aged 40—59, inclusive, at the time of the examinations and for the sake of efficiency the geographical boundaries were changed and reduced so as to concentrate on six villages instead of covering twelve as in 1957. Accordingly, a considerable number of men examined in 1957 were re-examined in 1960 in Crete.

Both in Crete and Corfu the initial rosters, compiled from official local records, proved to contain many inaccuracies — they listed some men who had long since moved to other parts of Greece or had emigrated abroad, a few who had died. A few men who had permanently moved into the study villages were not in the offical lists of our villages but were considered to be properly included in our study population. Finally, some clerical errors in name or date of birth were corrected to provide the final roster.

In both areas the cooperation was excellent and the result was that the examinations covered 686 out of 703 men in the roster in Crete (97.6 per cent), and 529 out of 555 men in the roster in Corfu (95.3 per cent). The data reported here cover slightly smaller numbers because some items of examination were inadvertently missed in occasional men and some blood samples were spoiled in the analysis. Further, when the statistical analysis was made, check of birth dates showed that a few men were out of the age range at the actual time of their examinations and their data are not included here.

Age, Physical Activity and Occupation

Table C6.1 gives the classifications of the men of Crete and Corfu by age and habitual physical activity. In both areas there is a relative shortage of men aged 40—44 and in Corfu this shortage is also marked for men aged 45—49. Roughly, there is a relative shortage of something like 60 men in the age class 40—44 in Crete, i.e. over a fourth of that cohort; in Corfu about the same proportion of men aged 40—49 who might be expected to be in the roster are no longer there.

In large part this age structure must reflect losses in World War II and emigration thereafter. The men aged 40—44 in 1960 and 1961 were those called first to defend Greece from the Italian and then from the German invasions; at the start of these aggressions they were aged 19—23 (Corfu) or 20—24 (Crete). At the end of the war, the survivors of those cohorts were aged 24—28 (Crete) or 25—29 (Corfu). During the war few of these young men had any possibility of marrying and establishing their own households in their native villages, many of them had seen something outside of those villages; they were no longer rooted in the local soil and were prone to seek opportunity in the cities or to emigrate.

In Crete over 60 per cent of the men were habitually engaged in heavy physical work and less than 7 per cent were sedentary or did only light work. Corfu stands in sharp contrast, with less than a third of the men in Class 3 activity and an equal number in Class 1. The principal reason for this difference is the fact that the villages in the Corfu study are in close proximity to the port city of Corfu with many tourist establishments and holiday homes while the Crete villages are much more isolated.

Table C6.2 shows the occupational distribution of the subjects in Crete and Corfu. Three-fourths of the Cretans and over half of the men of Corfu are farmers. More men are engaged in business and clerical work in the Corfu villages than in Crete but even in Corfu less than 9 per cent of the men are so occupied.

Distribution of Measured Variables

Table C6.3 gives the median values of the men, classed by age, for relative body weight, the sum of the skinfolds,

TABLE C6.1

Men of Crete (1960) and Corfu (1961) classed by age (at time of examination) and habitual physical activity (1 = sedentary and light, 2 = moderate, 3 = very active).

AGE	CRETE TOTAL MEN	CRETE % in ACTIVITY: 1	2	3	CORFU TOTAL MEN	CORFU % in ACTIVITY: 1	2	3
40-44	160	9.4	26.3	64.3	120	34.2	32.5	33.3
45-49	202	5.4	33.7	60.9	114	25.4	43.0	31.6
50-54	175	7.4	33.0	59.6	169	32.0	34.9	33.1
55-59	148	5.4	30.4	64.2	126	34.1	39.7	26.2
All Ages	685	6.9	31.0	62.1	529	31.6	37.2	31.2

TABLE C6.2

Men of Crete (1960) and Corfu (1961) classed by occupation.

OCCUPATION	CODE	CRETE %	CORFU %	OCCUPATION	CODE	CRETE %	CORFU %
Professional	1-10	3.8	2.3	Metal work	62-65	1.7	2.1
Business, etc.	11-15	1.3	6.3	Agriculture	66-69, 71-75	74.7	54.7
Foremen	16-22	0	1.1	Fishermen	70	0	2.4
Clerical	23-26	1.3	2.4	Factory work	78-80	0.6	1.1
Protection	27-30	1.2	1.4	Services	81-87	0.3	1.5
Food Handlers	31-39	4.7	3.0	General labor	88, 89	0.3	2.3
Skilled light craft	40-44	2.2	2.0	Miscellaneous	90-94	1.3	1.9
Transportation	45-53	2.0	4.6	Not working	95-98	1.9	3.9
Building trades	54-61	2.6	6.9				

TABLE C6.3

Medians for the men of Crete and Corfu, classed by age, and those values expressed as percentage of the average of the medians for all 18 samples of men.

ITEM	CRETE 40-44	CRETE 45-49	CRETE 50-54	CRETE 55-59	CORFU 40-44	CORFU 45-49	CORFU 50-54	CORFU 55-59
Height, cm.	166	166	166	165	167	166	166	164
" % of average	97.8	98.2	98.6	98.4	98.3	98.2	98.6	97.8
Relative Weight	94	91	92	88	94	93	92	90
" % of average	95.8	94.6	96.6	93.5	95.8	96.7	96.6	95.6
Σ Skinfolds, mm.	14	14	15	14	16	15	14	14
" % of average	66.0	68.6	72.5	70.4	75.5	73.5	67.6	70.4
Systolic B.P., mm.	131	132	135	138	130	130	134	135
" % of average	100.0	99.2	98.5	98.2	99.2	97.7	97.8	96.0
Diastolic B.P., mm.	80	80	81	83	81	80	81	81
" % of average	98.8	98.3	97.1	98.5	100.0	98.3	97.1	96.1
Serum Chol. mg.%	198	199	210	208	193	203	202	194
" % of average	95.9	96.0	100.5	100.7	93.5	97.9	96.7	93.9

blood pressure, and serum cholesterol: this table also shows these values expressed as percentages of the average medians for the men in all 18 samples in this cooperative study. The cumulative frequency distributions of these variables are shown in Figures C6.1, C6.2. As elsewhere, height is normally distributed and the skinfold thickness departs most notably from a normal distribution. Details of the distributions are given in the Appendix.

On the average, the men of Crete and Corfu are almost identical in height and are similar in relative body weight and body fatness (sum of skinfolds), though the men of Crete tend to be a trifle thinner and less heavy than the Corfu men. Compared with the average of all 18 samples, these Greeks are somewhat short, relatively underweight, and decidedly thin. If allowance is made for the true skin included in the skinfold measurement, the average thickness of the subcutaneous fat over the triceps muscle and over the tip of the scapula is barely 5 mm.; the corresponding value for the average of the men in all samples is over 7 mm., i.e. almost half again as much subcutaneous fat.

The men of Crete and Corfu do not differ importantly in arterial blood pressure and both in systole and diastole their blood pressure tends to be very slightly less than the average for all the men in this cooperative study. In regard to serum cholesterol concentration, there is a significant tendency for values to be lower in Corfu than in Crete but the difference is trifling, only 6 mg. per 100 ml. in the middle of the distribution. The median cholesterol values of these Greeks are about 3 per cent less than the average of all 18 samples of men.

Age trends of these variables are not large over the ages 40—59 in these men. For skinfold thickness and serum cholesterol age trends are small and inconsistent so all ages 40—59 were grouped for the cumulative frequency distributions shown in Figures C6.1, C6.2. In Crete the cholesterol median is 10.5 mg. per 100 ml. higher at ages 50—59 than at ages 40—49 but the difference is statistically not significant (chi-square = 2.64). As expected, systolic blood pressure tends to rise with age but the average yearly increment is only 0.5 mm. Hg in Crete and 0.3 in Corfu. Diastolic blood pressure shows even less age trend, more in Corfu and only an average rise of 0.2 mm. per year in Crete.

Activity and Socio-Economic Status

In Crete and Corfu alike the frequency of relatively high values for the measured variables tended to be related to the habitual physical activity and to the socio-economic status of the men. For both areas combined, 17.1 per cent of all men were sedentary or engaged only in light activity (Class 1) while 48.8 per cent did heavy physical work (Class 3). If physical activity were unrelated to the measured variables the expectation would be that similar percentages of all men with high relative weight, Σ skinfolds, blood pressure and serum cholesterol would be found in these activity classes.

If "high" values of the variables are taken to be the top 30 per cent of the distributions, the percentage of all men with such high values who were found in Activity Class 1 proved to be, not 17.1, but 26.6 for relative body weight, 29.3 for Σ skinfolds, 21.8 for systolic blood pressure, 23.1 for diastolic blood pressure and 22.9 for serum cholesterol. Similarly, in Activity Class 3, instead of the expected value of 48.8 per cent, the finding was 34.1 for relative weight, 29.3 for Σ skinfolds, 39.8 for systolic B. P., 39.8 for diastolic B. P., and 39.0 for cholesterol. In effect, the excess of relatively overweight men was 55.6 per cent among men in Activity Class 1 and

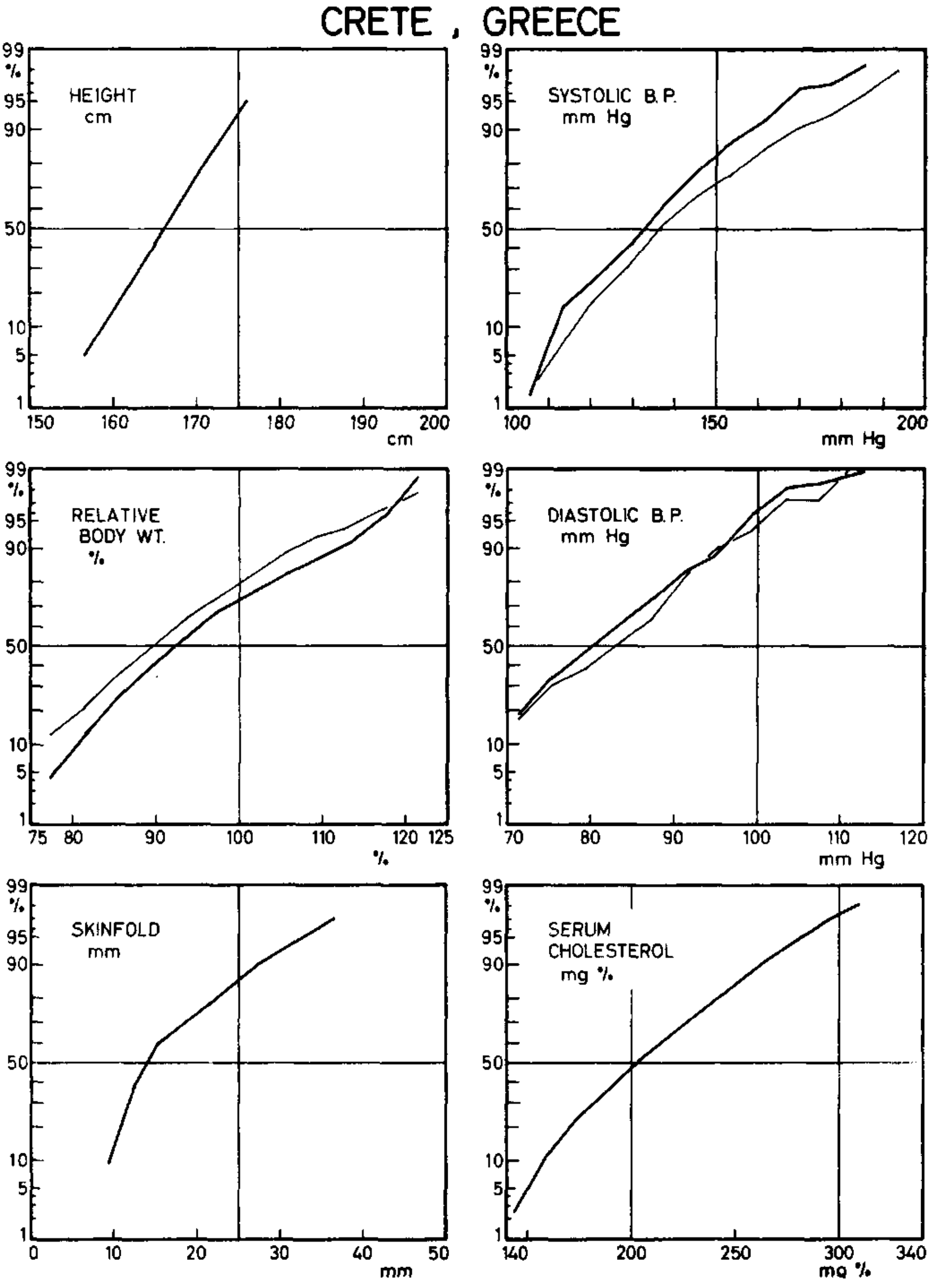
CRETE , GREECE
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT. %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C6. 1

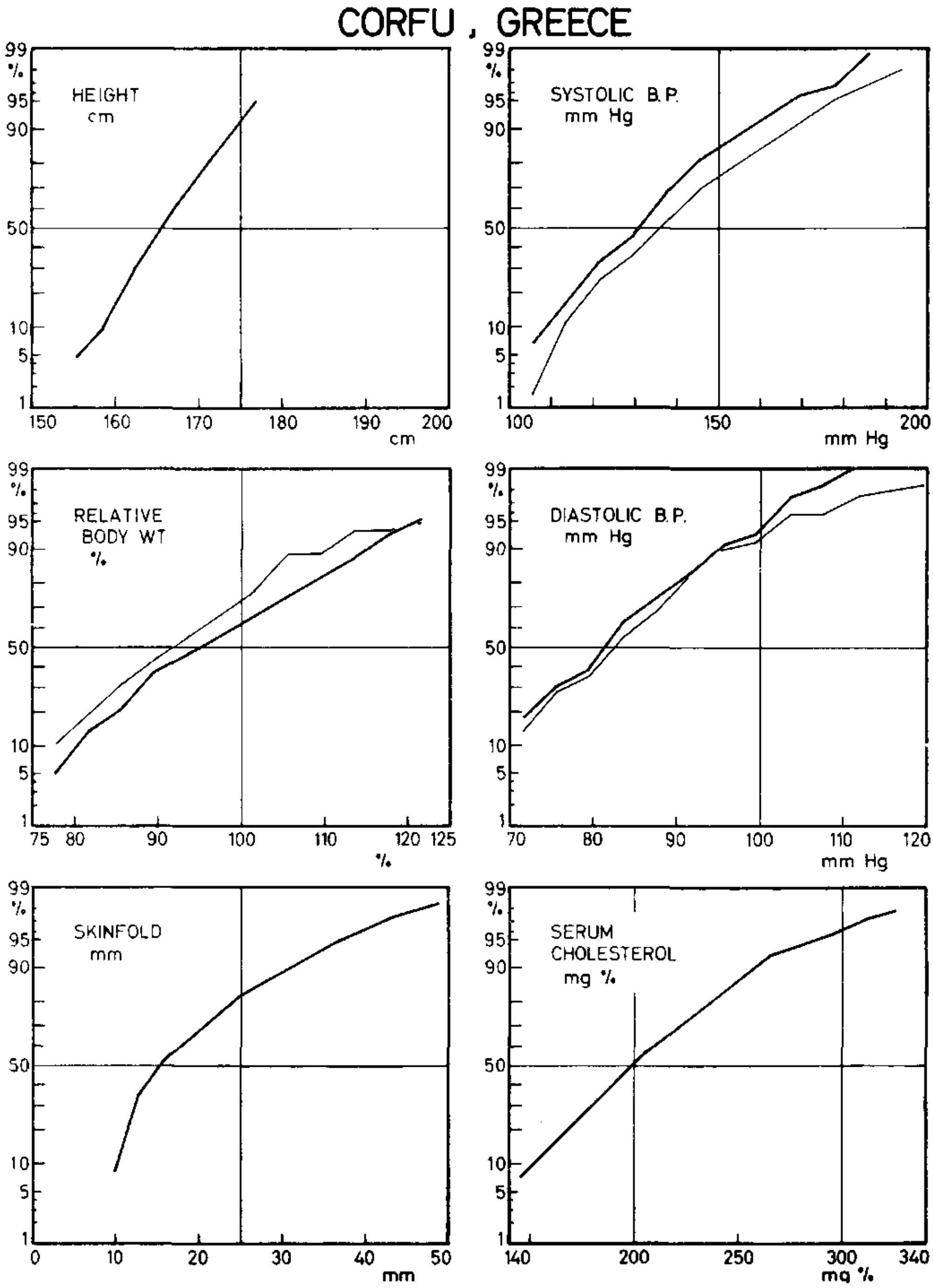
CORFU , GREECE
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C6. 2

in this activity class excesses for relative obesity were 71.3 per cent, for systolic blood pressure 27.5 per cent, for diastolic blood pressure 35.0 per cent, and for serum cholesterol 28.7 per cent.

The corresponding analysis for socio-economic status is hampered by the fact that very few men in these populations can be safely classed as being in a higher socio-economic class than the rest of the men. Only 61 men in Corfu and Crete were in Occupations 1—13, so this upper socio-economic class represents only 4.9 per cent of the samples. But in this class are found 11.6 per cent of all "overweight" men (deciles 8—10 in relative body weight), 12.4 per cent of "obese" men (deciles 8—10 in Σ skinfolds), 7.3 and 8.3 per cent, respectively, of all men with higher systolic and diastolic blood pressures (deciles 8—10) and 6.5 per cent of all men with higher cholesterol values (deciles 8—10).

Physical activity and socio-economic status are so closely correlated (inversely) in this material that they cannot be sharply separated in further analysis. Tables C6.4, C6.5, and C6.6 summarize attempts in this direction. Within the higher socio-economic class (Occupations 1—13), only Activity Classes 1 and 2 can be compared because Class 3 is not represented. Table C6.4 shows that within this higher socio-economic class the only significant difference between Activity Classes 1 and 2 is in relative weight on the island of Crete. Failure to find other differences may reflect the small number of men involved as well as the relatively small difference in physical activity concerned.

Occupation Classes 14—94 include large numbers of men in both Activity Classes 2 and 3 and a substantial number (N = 169) in Class 1. But it is a gross over-simplification to consider all men in Occupations 14—94 to be uniform in socio-economic status. So the differences, within Occupations 14—94, between men in the three Activity Classes indicated in Tables C6.4 and C6.5 cannot all be ascribed to physical activity.

The comparisons between men in different Occupation Classes shown in Table C6.6 on the other hand give minimal estimates of differences related to socio-economic status. The net result of consideration of all these data is to conclude that both physical activity and socio-economic status are important influences but their relative effects cannot be accurately estimated.

Smoking Habits

For centuries Greece has been a large producer of tobacco, almost all being of the "Turkish" type, and the majority of men everywhere are regular cigarette smokers. In Crete the water pipe or hookah is occasionally seen but this old Turkish custom of smoking has almost entirely disappeared. The distribution of smoking habits, by age, is given in Table C6.7.

Almost a fourth of these Greeks never smoked cigarettes and at the time of the examinations 42.8 per cent of the Cretans and 36.5 per cent of the men of Corfu were non-smokers. The smokers in Crete tended to smoke more heavily than the smokers of Corfu and this difference is statistically highly significant. The difference between the percentages of heavy smokers (20 or more cigarettes daily) in Crete and Corfu has a chi-square value of 9.55 and $p =$ less than 0.01.

The relationships between smoking habits and other characteristics of the men of Crete and Corfu, examined in detail in Section F, below, are summarized in Table C6.8. Here it may be noted that, as elsewhere, the non-smokers in these samples tend to be relatively heavier and fatter than the smokers.

TABLE C6.4

Activity 1 vs. Activity 2. Excess frequency of high values (deciles 8-10) of the variables observed among men of Activity 1, expressed as % of expectation from total numbers of men in Activities 1 plus 2. Also, chi-square values for the differences between observed and expected distributions.

OCCUPATION	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Corfu										
1-94	22.1	7.17	28.6	13.03	12.1	1.90	16.5	3.48	9.7	1.15
1-13	-8.0	0.85	-1.9	0	0.7	0	-0.9	0	17.6	1.25
14-94	21.1	4.67	27.7	8.88	9.0	0.73	15.9	2.45	7.2	0.45
Crete										
1-94	75.7	15.40	74.7	18.53	19.4	0.61	54.4	6.60	49.3	5.21
1-13	23.2	4.56	15.6	2.11	23.1	0.51	2.0	0	28.2	1.42
14-94	45.2	1.46	71.4	9.21	25.0	0.33	83.3	5.68	61.3	3.01

TABLE C6.5

Activity 2 vs. Activity 3. Occupations 14-94 only. Excess frequency, as in Table C6.4, of high values among men of Activity 2.

SAMPLE	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Corfu	21.6	6.24	29.7	11.16	11.3	2.05	8.1	0.91	13.3	2.97
Crete	30.3	8.96	47.1	21.40	27.5	8.06	18.4	3.27	21.3	4.55

TABLE C6.6

Occupation 1-13 vs. 14-94. Excess frequency, as in Table C6.4, of high values among men in Occupations 1-13, expressed as % of expectation from total numbers of men in Occupations 1-13 + 14-94.

ACTIVITY	REL. WT.		Σ SKINFOLDS		SYST. B.P.		DIAST. B.P.		CHOLESTEROL	
	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2	Excess	Chi^2
Corfu										
1+2	100.0	13.85	91.9	12.61	63.0	4.88	46.1	2.29	13.6	0.09
1	50.0	3.94	46.8	4.12	46.1	2.68	23.6	0.53	22.0	0.37
2	263.6	7.35	172.7	2.50	66.7	0.11	81.8	0.20	0	0.59
Crete										
1+2	76.5	14.17	66.7	14.20	-8.4	0.05	36.4	2.62	10.2	0.09
1	24.1	4.36	11.1	1.02	-4.8	0	-9.9	0.16	-5.7	0
2	40.0	0.75	56.2	2.71	-31.0	0.49	45.5	1.20	-21.6	0.11

Probabilities, p, associated with chi-square values: 2.71, p = 0.10; 3.84, p = 0.05; 5.41, p = 0.02; 6.64, p = 0.01; 10.83, p = 0.001.

TABLE C6.7

Cigarette smoking habits of men of Crete and Corfu. Percentage of men who never smoked, who had stopped, who smoked 1-9, 10-19, 20 or more cigarettes daily at the time of their examination.

SAMPLE	AGE	NEVER	QUIT	1-9	10-19	20 OR MORE
Crete	40-44	20.0	18.1	8.1	21.3	32.5
"	45-49	26.7	17.3	9.9	15.3	30.8
"	50-54	24.4	19.3	11.9	15.3	29.1
"	55-59	23.0	21.6	10.8	17.6	27.0
"	40-59	23.8	19.0	10.2	17.2	29.8
Corfu	40-44	26.7	7.5	12.5	32.5	20.8
"	45-49	27.1	13.2	20.2	19.3	20.2
"	50-54	21.3	12.4	11.2	33.2	21.9
"	55-59	24.6	14.3	11.1	26.2	23.8
"	40-59	24.6	11.9	13.4	28.4	21.7

TABLE C6.8

Smoking. Number of men in Greece below (LOW) and above (HIGH) the age-specific medians, for age and area, of measured variables, classed according to smoking habits. HEAVY = 20 or more, OTHER = 1-19 cigarettes daily.

VARIABLE	SAMPLE	NON-SMOKERS		HEAVY		OTHER	
		LOW	HIGH	LOW	HIGH	LOW	HIGH
Relative Weight	Crete	113	167	118	83	106	77
"	Corfu	66	126	75	40	123	98
Σ Skinfolds	Crete	105	188	129	75	109	79
"	Corfu	59	134	72	43	133	88
Systolic B. P.	Crete	131	157	115	88	92	95
"	Corfu	80	113	63	52	121	100
Diastolic B. P.	Crete	129	159	118	85	91	96
"	Corfu	70	113	68	47	126	95
Serum Cholesterol	Crete	136	147	95	96	96	82
"	Corfu	89	99	61	54	110	108

The "moderate" cigarette smokers (10 to 19 cigarettes daily) are least often overweight or obese.

Focussing on the men above the median values for their age and residence, among the non-smokers in Crete 63 per cent were above the median relative body weight and 64 per cent were above the median value of the sum of the skinfolds. The corresponding figures for Corfu for non-smokers are 66 per cent above the relative weight median, 69 per cent above the median sum of skinfolds.

The Greek non-smokers showed similar but less remarkable trends to have higher blood pressure than the smokers. For diastolic blood pressure, for example, 55 per cent of the non-smokers in Crete and 64 per cent of them in Corfu were above the median for their age and residence. In both areas the non-smokers also tended to have somewhat higher values for serum cholesterol than the smokers but the trend is not statistically significant in either area when the distribution about the median is analyzed.

Electrocardiographic Findings

Tables C6.9, C6.10, C6.11, and C6.12 summarize the electrocardiographic (ECG) findings, classified according to the Minnesota Code, in Crete and Corfu. In both samples, but particularly in Crete, the ECG findings are notable for the relatively small number of abnormalities.

In Crete only one man showed a definite pattern of previous infarction (Code I, 1); in Corfu three men were in this category. If both samples are combined, the rate of prevalence of this finding is only 3.3 per thousand men. A striking feature of the ECG records in Crete is the high frequency of sinus bradycardia, more than 10 per cent of the men showing this peculiarity. The prevalence of very slow heart rates in Crete accounts for the relatively high frequency of long P-R intervals; the latter are not rate-corrected in this material.

In Crete the post-exercise records increased the number of ischemic S-T depressions. Thirteen men showed depressions (Code IV, 1, 2 or 3) in rest; among men who showed no such abnormalities in rest, twelve showed them in the post-exercise record. The exercise test provoked no significant negative T waves (Code XII, 1, 2).

Significant ECG abnormalities were more numerous in Corfu than in Crete — three vs. one Q wave (Code I, 1); 22 S-T depressions (Code IV, 1—3) vs. 13; eleven negative T waves (Code V, 1, 2) vs. four; two atrial fibrillations vs. none. On the other hand, left axis deviation (Code II, 1) was more common in Crete than in Corfu. In Corfu, the exercise test added 14 cases of ischemic S-T depression and one case of negative T wave.

Prevalence of Hypertension and Overweight

Over the age range 40—59 the prevalence of hypertension shows no consistent age trend in Corfu and in Crete the prevalence actually tends to fall from age 40—44 to 55—59. The data for diastolic hypertension are summarized in Table C6.13.

In general, there is no significant difference between the two areas in the prevalence of hypertension. Compared with the men in all 18 samples in these cooperative studies, the prevalence of hypertension in Crete and Corfu is similar at ages 40—49 but at ages 50—59 these Greeks are less prone to hypertension and this difference is statistically highly significant. At these older ages only about half as many of these Greeks

TABLE C6.9

CRETE, GREECE

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (158)	45-49 (202)	50-54 (176)	55-59 (147)
Total with reportable ECG Items	I - IX		64 (405.1)	94 (465.3)	81 (460.2)	84 (571.4)
Q Waves	I	1	0	0	1 (5.7)	0
		2	1 (6.3)	0	1 (5.7)	0
		3	1 (6.3)	2 (9.9)	2 (11.4)	1 (6.8)
Axis Deviation	II					
Left		1	2 (12.7)	9 (44.6)	13 (73.9)	8 (54.4)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	11 (69.6)	6 (29.7)	7 (39.8)	11 (74.8)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	0	2 (11.4)	0
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	3 (19.0)	2 (9.9)	2 (11.4)	3 (20.4)
No S-T-J plus segment downward		3	1 (6.3)	0	0	0
S-T - J 1 mm. or more, upward segment		4	0	0	1 (5.7)	0
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	0
- 1 mm. to -5 mm.		2	1 (6.3)	1 (5.0)	1 (5.7)	1 (6.8)
0 ± 1 mm.		3	4 (25.3)	5 (24.8)	3 (17.0)	1 (6.8)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	6 (38.0)	3 (14.9)	5 (28.4)	9 (61.2)
Accelerated Conduction		4	1 (6.3)	0	0	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	0
Right Bundle		2	1 (6.3)	1 (5.0)	0	3 (20.4)
Incomplete Right Bundle		3	3 (19.0)	3 (14.9)	2 (11.4)	3 (20.4)
Intraventricular Block		4	0	0	0	0
Arrhythmias	VIII					
Premature Beats		1	1 (6.3)	3 (14.9)	3 (17.0)	1 (6.8)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	0	0
Supra-vent. tachycardia		4	0	0	0	1 (6.8)
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	1 (5.0)	1 (5.7)	1 (6.8)
Sinus tachycardia		7	3 (19.0)	2 (9.9)	3 (17.0)	1 (6.8)
Sinus bradycardia		8	14 (88.6)	27 (133.7)	19 (108.0)	19 (129.3)
Technically poor records	IX	8	0	0	1 (5.7)	0

TABLE C6.10

CRETE, GREECE

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (156)	45-49 (200)	50-54 (174)	55-59 (146)
Exercise tests not made or	X 1				
incomplete	X 2	2 (12.7)	2 (9.9)	2 (11.4)	1 (6.8)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	0	2 (10.0)	1 (5.7)	0
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	1 (6.4)	3 (15.0)	3 (17.2)	1 (6.8)
No S-T-J plus segment downward	3	0	0	1 (5.7)	0
S-T - J 1 mm. or more, upward					
segment	4	7 (44.9)	12 (60.0)	4 (23.0)	5 (34.2)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	0	0
0 ± 1 mm.	3	2 (12.8)	2 (10.0)	2 (11.5)	2 (13.7)
Arrhythmias post-exercise	XV				
(none at rest)	1	1 (6.4)	2 (10.0)	3 (17.2)	2 (13.7)
Technically poor post-exercise					
records	XI 8	6 (38.5)	7 (35.0)	11 (63.2)	6 (41.1)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

		40-44	45-49	50-54	55-59
At Rest					
Large Q Waves	I 1	0	0	1 (5.7)	0
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	0	0	0	0
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	0
Other Negative T as sole	V 2, 3				
anomaly	only	1 (6.3)	2 (9.9)	1 (5.7)	1 (6.8)
S-T Depression as sole	IV 1-4				
anomaly	only	0	1 (5.0)	3 (17.0)	0
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	2 (12.7)	0	0	0
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	1 (6.3)	1 (5.0)	0	3 (20.4)
Arrhythmias	VIII 2-6	0	1 (5.0)	1 (5.7)	2 (13.6)
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	6 (38.5)	8 (40.0)	6 (34.5)	3 (20.5)
Negative T as sole	XII 1-3				
anomaly	only	1 (6.4)	1 (5.0)	1 (5.7)	1 (6.8)
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	0
Arrhythmias	XV 1				
as sole anomaly	only	1 (6.4)	0	1 (5.7)	2 (13.7)

TABLE C6.11

CORFU, GREECE

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (120)	45-49 (114)	50-54 (169)	55-59 (126)
Total with reportable ECG Items	I - IX		24 (200.0)	30 (263.2)	44 (260.4)	36 (285.7)
Q Waves	I	1	0	0	1 (5.9)	2 (15.9)
		2	0	0	2 (11.8)	2 (15.9)
		3	2 (16.7)	3 (26.3)	4 (23.7)	1 (7.9)
Axis Deviation	II					
Left		1	1 (8.3)	0	4 (23.7)	5 (39.7)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	5 (41.7)	10 (87.7)	11 (65.0)	14 (111.1)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	1 (8.8)	3 (17.8)	3 (23.8)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	4 (33.3)	3 (26.3)	4 (23.7)	1 (7.9)
No S-T-J plus segment downward		3	1 (8.3)	0	0	2 (15.9)
S-T - J 1 mm. or more, upward segment		4	0	0	0	0
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	2 (15.9)
- 1 mm. to -5 mm.		2	1 (8.3)	1 (8.8)	4 (23.7)	3 (23.8)
0 ± 1 mm.		3	3 (25.0)	1 (8.8)	5 (29.6)	3 (23.8)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	1 (8.3)	0	1 (5.9)	0
P-R over 0.21 second		3	0	1 (8.8)	1 (5.9)	0
Accelerated Conduction		4	0	1 (8.8)	0	0
Ventricular Blocks	VII					
Left Bundle		1	1 (8.3)	0	1 (5.9)	0
Right Bundle		2	1 (8.3)	1 (8.8)	3 (17.8)	3 (23.8)
Incomplete Right Bundle		3	2 (16.7)	2 (17.5)	5 (29.6)	0
Intraventricular Block		4	0	0	1 (5.9)	0
Arrhythmias	VIII					
Premature Beats		1	3 (25.0)	2 (17.5)	3 (17.8)	1 (7.9)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	2 (11.8)	0
Supra-vent. tachycardia		4	0	0	0	1 (7.9)
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	0	0
Sinus tachycardia		7	4 (33.3)	3 (26.3)	2 (11.8)	1 (7.9)
Sinus bradycardia		8	1 (8.3)	1 (8.8)	2 (11.8)	1 (7.9)
Technically poor records	IX	8	1 (8.3)	1 (8.8)	1 (5.9)	0

TABLE C6.12

CORFU, GREECE

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(*Rate per 1,000 men in parentheses*)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (119)	45-49 (112)	50-54 (164)	55-59 (118)
Exercise tests not made or	X 1				
incomplete	X 2	1 (8.3)	2 (17.5)	5 (29.6)	8 (63.5)
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	0	0	2 (12.2)	1 (8.5)
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	0	2 (17.9)	4 (24.4)	5 (42.4)
No S-T-J plus segment downward	3	0	0	0	0
S-T - J 1 mm. or more, upward					
segment	4	2 (16.8)	4 (35.7)	5 (30.5)	5 (42.4)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	1 (6.1)	0
0 ± 1 mm.	3	0	0	0	0
Arrhythmias post-exercise	XV				
(none at rest)	1	2 (16.8)	1 (9.0)	0	1 (8.5)
Technically poor post-exercise					
records	XI 8	3 (25.2)	3 (26.8)	11 (67.1)	7 (59.3)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

ECG FINDING	ECG Code	40-44	45-49	50-54	55-59
At Rest					
Large Q Waves	I 1	0	0	1 (5.9)	2 (15.9)
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	0	0	0	0
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	1 (7.9)
Other Negative T as sole	V 2, 3				
anomaly	only	0	0	2 (11.8)	1 (7.9)
S-T Depression as sole	IV 1-4				
anomaly	only	2 (16.7)	2 (17.5)	1 (5.9)	1 (7.9)
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	1 (8.3)	2 (17.5)	0	2 (15.9)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	2 (16.7)	1 (8.8)	5 (29.6)	3 (23.8)
Arrhythmias	VIII 2-6	0	0	2 (11.8)	1 (7.9)
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	2 (16.8)	2 (17.9)	5 (30.5)	4 (33.9)
Negative T as sole	XII 1-3				
anomaly	only	0	0	0	0
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	0
Arrhythmias	XV 1				
as sole anomaly	only	2 (16.8)	1 (8.9)	0	0

TABLE C6.13

Prevalence of diastolic hypertension (95 or more, 100 or more mm Hg, fifth phase) among men classed by age. Percentage of men in Crete and Corfu who are hypertensive, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm
Crete	13.9	5.7	13.4	5.0	11.0	6.4	9.6	5.5
Corfu	8.3	5.8	14.9	8.8	13.0	7.7	11.1	6.3
Mean, 18 samples	13.6	7.9	15.6	8.9	20.9	13.5	21.5	13.8

TABLE C6.14

Prevalence of overweight (110 or more and 120 or more per cent of "standard" average for height and age). Percentage of men in Crete and Corfu, classed by age, who are overweight, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	110%	120%	110%	120%	110%	120%	110%	120%
Crete	13.1	2.5	10.9	3.0	10.8	4.5	4.1	1.4
Corfu	13.3	7.5	20.7	4.4	10.7	6.0	11.9	6.3
Mean, 18 samples	20.9	8.4	19.4	6.9	18.1	6.7	16.8	7.3

are hypertensive as would be expected from the data on all 18 samples.

The percentages of men who are overweight are given in Table C6.14. The men of Crete are less often grossly overweight (20 per cent or more above the "standard" average for height and age) than the men of Corfu but in both areas the prevalence of overweight tends to be less than among all men in the 18 samples in these cooperative studies.

Prevalence of Obesity and Hypercholesterolemia

Using the classification criteria developed in Section H, below, 13 per cent of the men of Crete have some degree of obesity but only 2 per cent were classed as Grade 1 (extremely obese). The corresponding figures for Corfu are 16 and 4 per cent.

The prevalence of any degree of hypercholesterolemia, using the criteria in Section H, is 27 per cent in Crete, 24 per cent in Corfu. Grade 1 hypercholesterolemia characterized 7 per cent of the men in Crete, 6 per cent of the men of Corfu. Though these frequencies are substantial, they are considerably lower than the average of all men in the 18 samples in the present studies.

Hypertension versus Other Variables

If hypertension is judged to be present when the diastolic blood pressure is 95 mm. or more, 12 per cent of the men aged 40—59 were hypertensive in both Crete and Corfu. The distributions of these hypertensive men into decile classes of relative body weight, Σ skinfolds and serum cholesterol are shown in Figures C6.3 and C6.4 In both areas, and for all three variables, the prevalence of hypertension rises with increasing levels of these other variables, most strikingly in the upper part of the distributions of relative body weight and Σ skinfolds; for these two variables there is a marked trend to curvilinearity.

More detailed inspection of Figures C6.3 and C6.4, and the data on which they are based, shows that there is no significant tendency for the prevalence of hypertension to rise with either relative weight or Σ skinfolds over the first six or seven decile classes; all of the significant relationship is contributed by the top three or four decile classes.

The picture of hypertension distribution as related to serum cholesterol in this Greek material at first glance seems to be less dramatic than in the relative weight and Σ skinfold data but it is still highly significant. Hypertension is more than twice as prevalent (2.2 times) among the men in the top 30 than in the bottom 30 per cent of the cholesterol distribution in Crete. In Corfu the discrepancy is even more remarkable; in the top 3 decile classes of cholesterol, 29 out of 158 men were hypertensive; in the bottom 3 deciles only 11 out of 158 men were so classed; the relative frequency of hypertension in Corfu is 2.6 times higher in the upper than it is in the lower 30 per cent of the cholesterol distribution.

Overweight versus Other Variables

Among men aged 40—59 the prevalence of overweight was 3 per cent in Crete and 6 per cent in Corfu, if a relative body weight of 120 per cent of the U.S. averages in the Medico-Actuarial Investigations is taken as the criterion. The difference between the areas, though small, is significant (chi-square = 6.40, p = less than 0.02).

The distributions of these overweight men into decile classes of serum cholesterol, diastolic and systolic blood pressures are shown in Figures C6.5 and

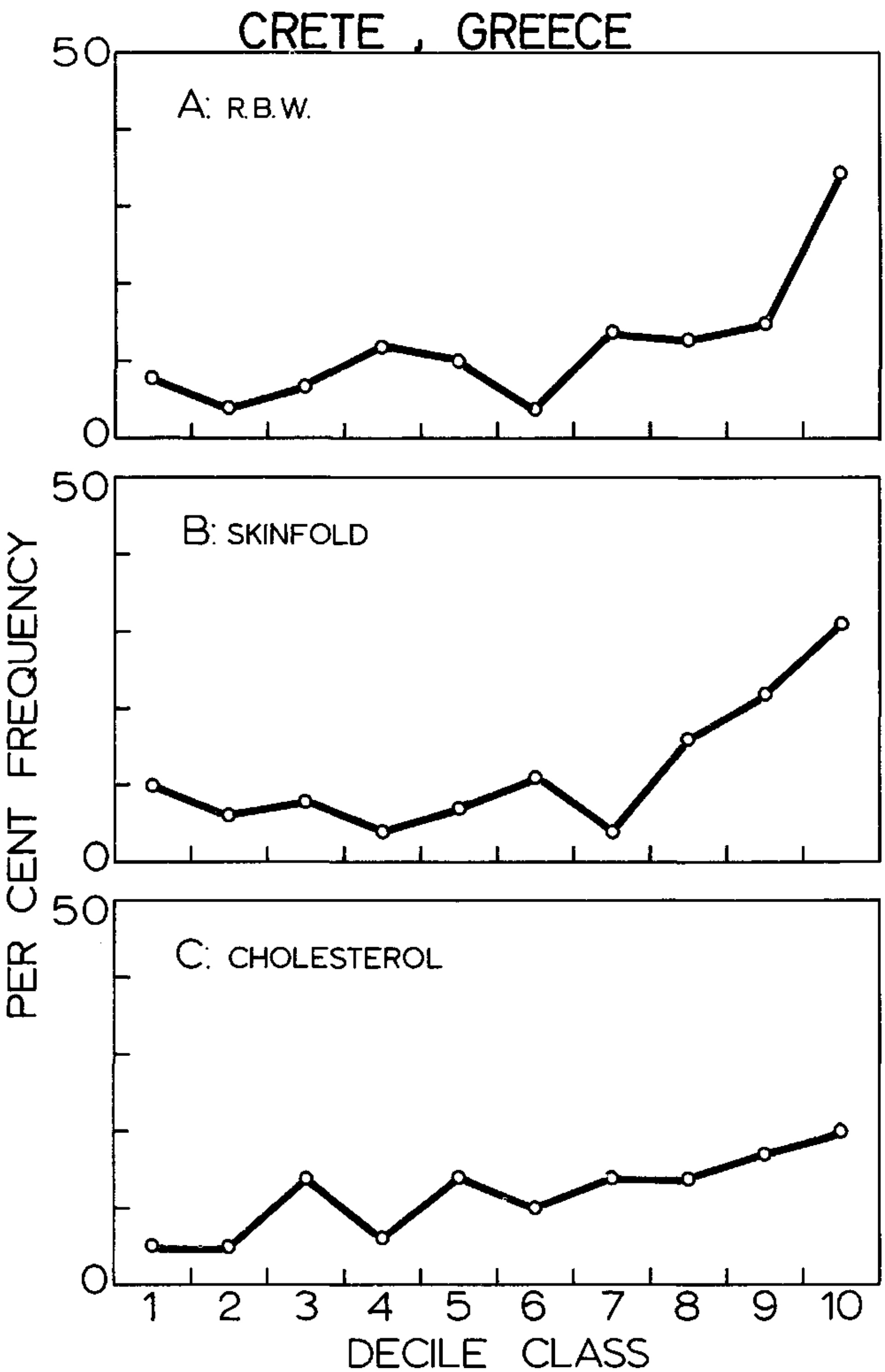
CRETE , GREECE
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C6. 3

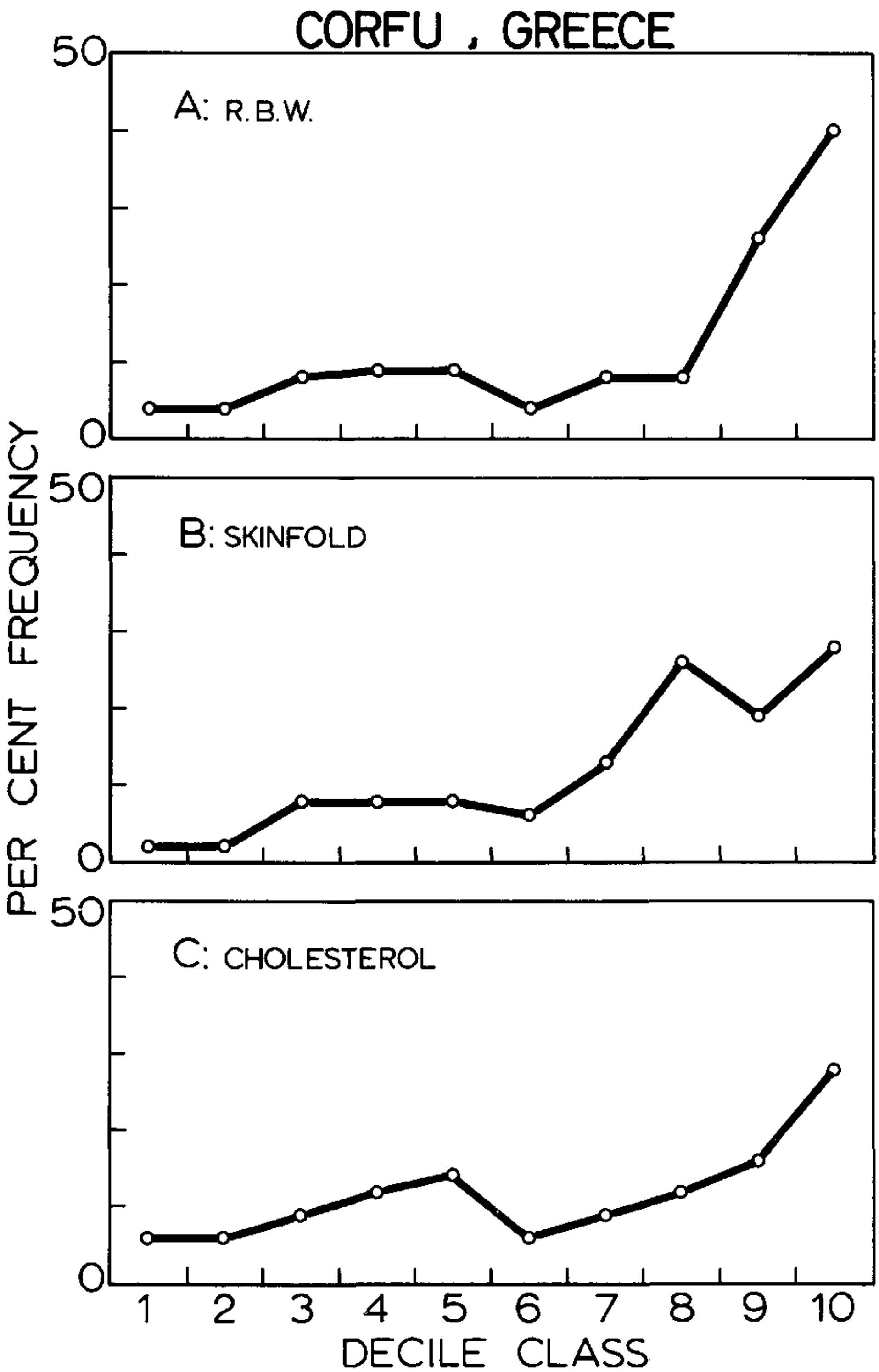
CORFU , GREECE
PER CENT FREQUENCY
50
0
A: R.B.W.
50
0
B: SKINFOLD
50
0
C: CHOLESTEROL
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C6. 4

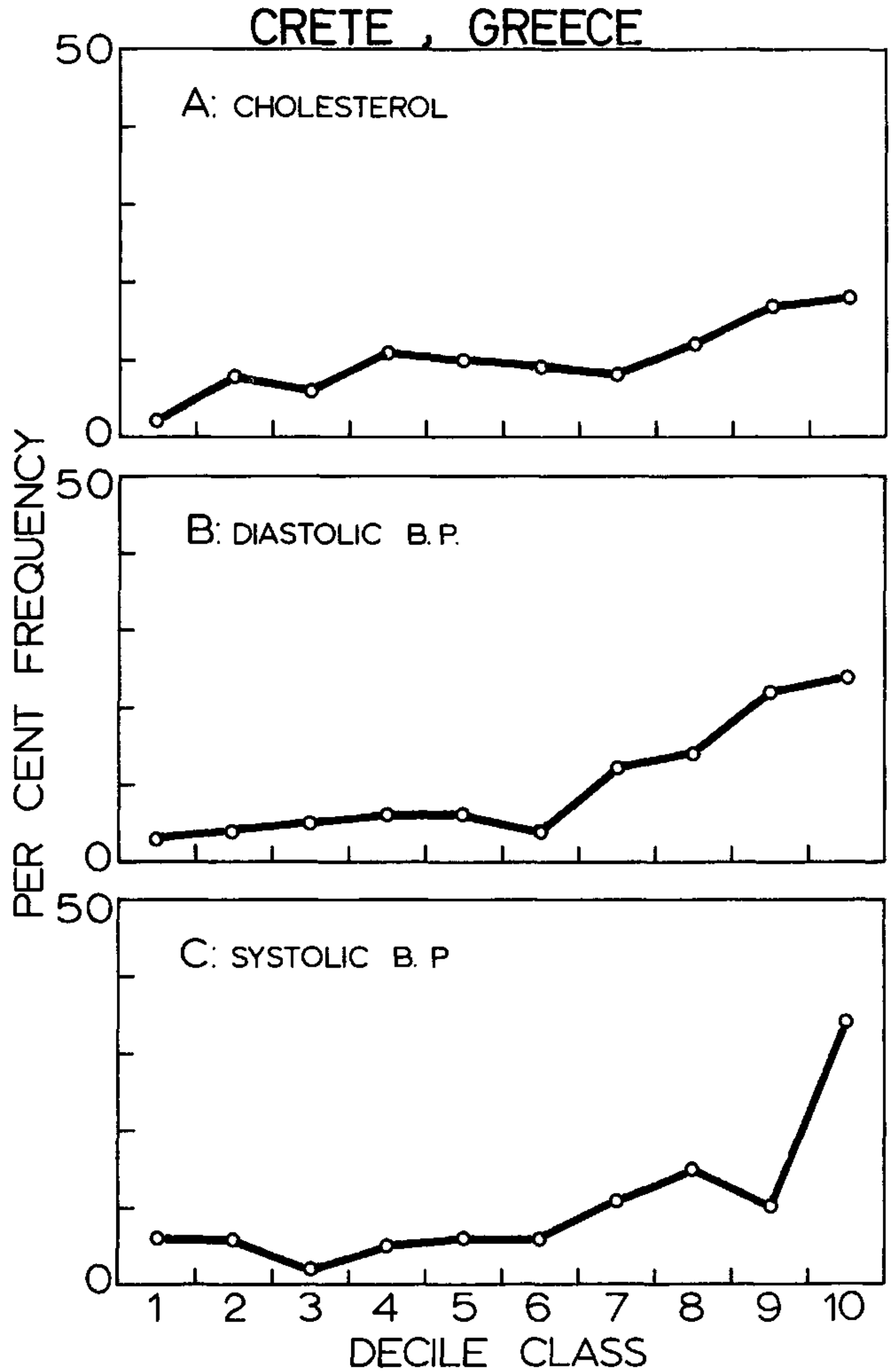
CRETE , GREECE
50
A: CHOLESTEROL
0
50
B: DIASTOLIC B. P.
0
50
C: SYSTOLIC B. P
0
PER CENT FREQUENCY
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C6. 5

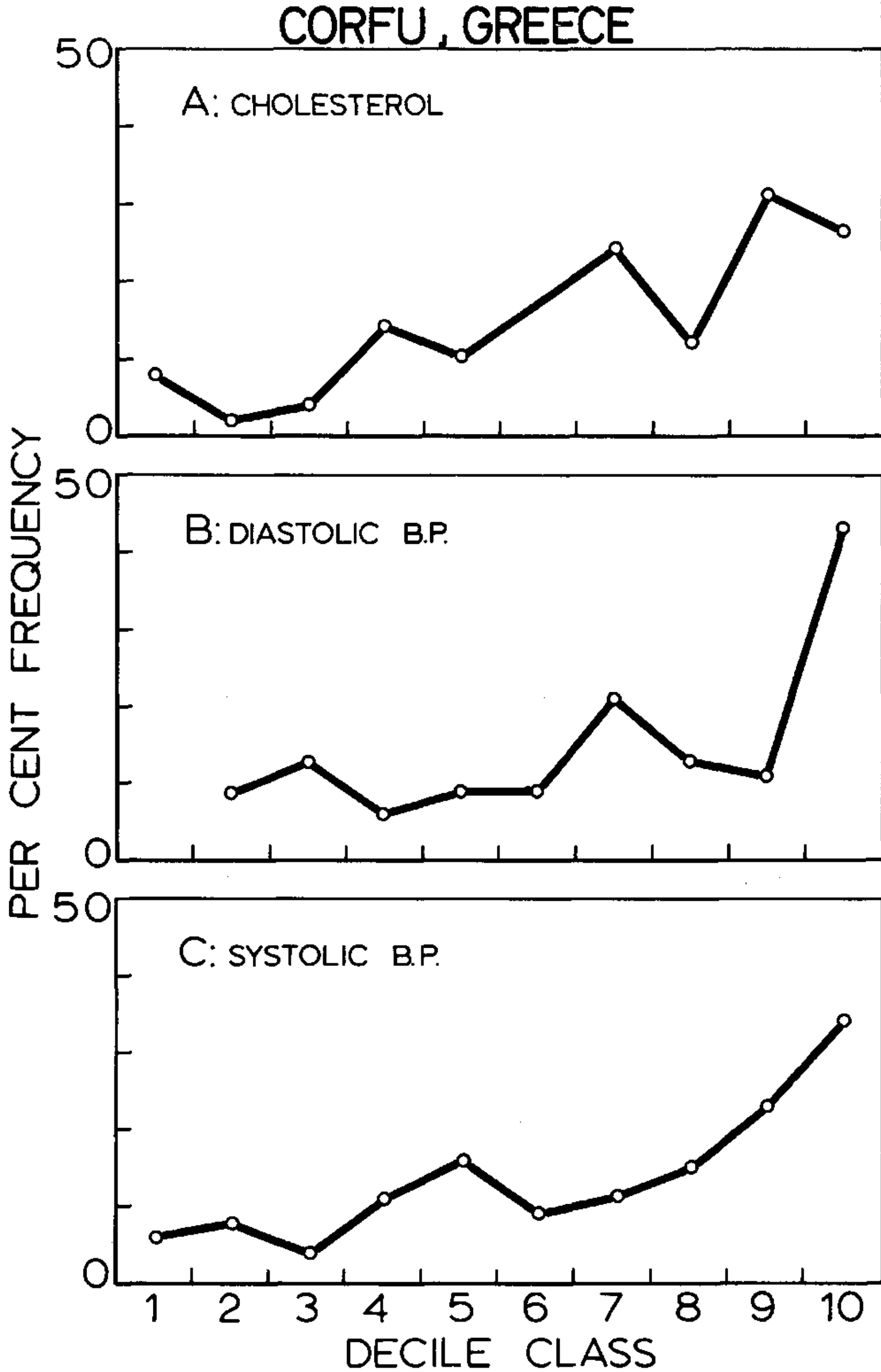
CORFU, GREECE
A: CHOLESTEROL
B: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C6. 6

C6.6. In both areas the prevalence of overweight is markedly related to each of these other variables and in several cases, at least, the relationship appears to be curvilinear, with most of the trend being dependent on the top decile classes.

Among 65 overweight men in Crete, 31 were in the top and 10 in the bottom 30 per cent of the cholesterol distribution; the corresponding numbers among 70 overweight men in Corfu are 36 and 7 men. For diastolic blood pressure the discrepancies are similar; in Crete, 40 men were in the top and eight in the bottom 30 per cent of the diastolic blood pressure distribution; in Corfu the corresponding figures are 36 in the top, 12 in the bottom.

Summary

In two rural areas of Greece, on the Islands of Crete and Corfu, 96.6 per cent of all men aged 40—59 (N = 1215) were examined. Over 60 per cent of the men of Crete were engaged in heavy physical work and only 6.9 per cent were sedentary or engaged in only light activity. The corresponding percentages for Corfu were 31.2 per cent heavy activity, 31.6 sedentary or only light work.

In both areas the men tended to be decidedly thinner and somewhat lower in relative body weight than the average men in the other samples in these studies. In both areas the men in the higher socio-economic classes or who were characterized by low physical activity tended to be over-represented in the upper ends of the distributions of relative body weight, Σ skinfolds, blood pressure and serum cholesterol.

In both areas most of the men smoked cigarettes. The non-smokers were much more often relatively overweight and fat than the smokers and also tended to have higher blood pressures and serum cholesterol values.

Significant electrocardiographic abnormalities were uncommon in both areas and were especially rare in Crete. Post-exercise records increased the number of abnormalities but the total prevalence of indications of myocardial ischemia was still low.

Hypertension was less common in these Greek samples than the average for all samples in these studies and the prevalence was similar in Crete and Corfu. In both areas hypertension prevalence rose sharply with increasing relative body weight and Σ skinfolds in the upper part of the distributions of these variables. The prevalence of hypertension was also directly related to serum cholesterol level.

Overweight was uncommon in these samples; in Crete large degrees of overweight were especially rare. The prevalence of overweight tended to be directly related to blood pressure and to serum cholesterol concentration.

Acknowledgments

The research teams in Crete in 1960 and in Corfu in 1961, included Drs. Christ Aravanis, C. Chlouverakis, A. S. Dontas, D. Lekos, A. Papadopoulus, E. Staphylakis, G. Stamatoyannopoulos, C. Vasilikos and A. Vlachopoulos. Valuable counsel as well as other aid was provided by Prof. George Michaelides and Dr. D. Papapanagiutou.

In Crete, Dr. G. Hadgakis, Health Commissioner for Heraklion, and George Arnaoutakis were most helpful. The work in Crete in 1960 was made easier by the 1957 survey in which help was provided by Drs. Jacques Carlotti, Flaminio Fidanza, Martti J. Karvonen, Ancel Keys, Noboru Kimura and Paul Dudley White, and Mrs. Margaret Haney Keys.

In Corfu, important aid was given by Dr. D. Avramidis, Health Commissioner.

C7. A FARMING AND A FISHING VILLAGE IN JAPAN — TANUSHIMARU AND USHIBUKA

by Noboru Kimura (Kurume)

Introduction

Because of much evidence that coronary heart disease is relatively uncommon in Japan, though not among Americanized Japanese in the United States, it was considered important to conduct systematic studies in that country. It was planned to include several villages in Kyushu, the southern island of Japan in the general program of cooperative work begun in 1957 at Nicotera in Italy but limitation of funds prevented the use of international teams and other arrangements used elsewhere to guarantee complete comparability. However, local efforts enabled similar surveys to be carried out in the spring of 1958 in a typical farming village, Tanushimaru, and in the summer of 1960 in a fishing village, Ushibuka. These villages afford contrasts both in the type of occupation and in the diet.

Tanushimaru

This farming village in the northern part of Kyushu is entirely devoted to highly productive small-scale farming of rice, wheat, fruits, vegetables and arboriculture, the produce being sold in the nearby markets of the city of Fukuoka and the town of Kurume. Though the general population is rather poor and there is a high degree of socio-economic homogeneity, those farmers who most intensively cultivate every meter of land as tree nurseries are relatively wealthy. The climate is humid and warm-temperate, but snow falls occasionally in winter. The population tends to be stable in residence though, as elsewhere in rural areas, migration of young people to the cities is substantial.

Ushibuka

Ushibuka is a fishing village on a small island offshore from Ariake Bay of Kyushu. Most of the men are engaged in the heavy work of fishing in small boats which go out daily, or for several days, at a time. In bad weather work is concentrated on building and repairing boats and nets. Some farming serves purely local needs and there is no other industry. The produce of the sea, together with rice and vegetables, dominates the diet; large amounts of fish are eaten daily. The population is rather isolated because of the island location and tends to exhibit the insular character of people in homogeneous settlements in remote places; Ushibuka is seven hours by boat from the big city of Fukuoka. The climate is warm-temperate, similar to that of Tanushimaru but less cold in winter and generally less humid.

Sample Coverage

Every Japanese adult must have an identification card and good local registries are maintained of births, deaths, residents and voters, so establishment of a reliable roster of all men aged 40—59 in a given locality is easy. Some clerical errors in age and name are readily corrected by examination of identity cards. In the villages, excellent cooperation in medical surveys was obtained in exploratory studies in 1956 (Keys *et al.*, 1958 a) and this experience was repeated in the studies reported here.

All men aged 40—59 in the prescribed areas were invited for the examinations. The extraordinary response of 99.6 per cent at Ushibuka and 100 per cent at Tanushimaru was obtained. However, some errors in age were discovered at the time of the examinations and a considerable number of out-of-age volunteers also showed up. Only data on men 40—59 at the time of examination are reported here (509 at Tanushimaru, 500 at Ushibuka).

The age distributions of the men in these Japanese villages reflect the losses of younger men during World War II. In both Tanushimaru and Ushibuka, the age class 40—44 contained the fewest men in any of the 5-year age classes studied (22.1 per cent in Tanushimaru, 22.9 in Ushibuka); the largest representation in both villages was in the age class 50—54 (26.4 per cent in Tanushimaru, 27.6 in Ushibuka).

Distribution of Six Measured Variables

Table C7.1 gives the median values of the Japanese men, classed by age, for relative body weight (as percentage of the "standard" averages for given height and age tabulated in the Appendix), the sum of the skinfolds (over the triceps muscle and the tip of the scapula), systolic and diastolic (5th phase) blood pressure, and serum cholesterol concentration. Figures C7.1 and C7.2 show the cumulative frequency distributions (probability scale) of these variables. Full details of the distributions are given in the Appendix.

The farmers at Tanushimaru tend to be nearly 2 cm. taller than the fishermen at Ushibuka and in both samples the men are shorter, by about 8 to 9 cm. on the average, than the average of all men in the 18 samples in the present study. Except at ages 55—59, where the men in the two villages are the same, the relative body weight of the fishermen of Ushibuka is slightly greater than that of the farmers in Tanushimaru. In both areas the men tend to be much lighter for their height and age than the average for all 18 samples.

Body fatness was not measured at Ushibuka but the men at Tanushimaru tended to be very lean and this did not change with age. Compared with all 18 samples, the sum of the skinfolds averaged only a trifle over 70 per cent of the average of all 18 samples but this does not fully indicate the real difference in fatness. Since about 1.5 mm. of the skin plus subcutaneous fat layer is true skin, about 6 mm. of the sum of the skinfolds is not fat. And since Σ skinfolds includes four layers of skin plus fat, the average thickness of subcutaneous fat at the sites of measurement was only a trifle over 2 mm. in these Japanese men, whereas the average for all 18 samples was nearly twice that figure. Compared with the fattest men in these studies, the U.S. railroad employees, the difference is impressive indeed — 2 vs. 6.5 mm. of subcutaneous fat; the average subcutaneous fat thickness of these Japanese is less than a

TABLE C7.1

Median values for Japanese men, classed by age, and these values expressed as percentage of the average of the medians for all 18 samples of men.

SAMPLE and VARIABLE	MEDIAN VALUES 40-44	45-49	50-54	55-59	MEDIAN as % of AVERAGE 40-44	45-49	50-54	55-59
TANUSHIMARU								
(no. of men)	(112)	(117)	(137)	(143)	(112)	(117)	(137)	(143)
Height, cm.	162	161	159	160	95.4	95.2	94.5	95.4
Relative Wt.,	89	86	84	84	90.7	89.4	88.2	89.3
Σ Skinfolds, mm.	15	15	14	15	70.8	73.5	67.6	75.4
Systolic B.P., mm. Hg	120	128	132	138	91.6	96.2	95.7	98.2
Diastolic " " "	68	70	72	78	84.0	86.0	86.3	92.5
Serum Cholesterol, mg.%	167	165	178	168	80.9	79.6	85.2	81.3
USHIBUKA								
(no. of men)	(115)	(128)	(139)	(118)	(115)	(128)	(139)	(118)
Height, cm.	160	160	158	159	94.2	94.6	93.9	94.8
Relative Wt.,	91	89	87	84	92.8	92.5	91.4	89.3
Σ Skinfolds, mm.	--	--	--	--	--	--	--	--
Systolic B.P., mm. Hg	126	128	135	140	96.2	96.2	98.5	99.6
Diastolic " " "	75	76	80	80	92.6	93.4	95.9	94.9
Serum Cholesterol, mg.%	142	143	137	144	68.8	69.0	65.6	69.7

TABLE C7.2

Cigarette smoking habits of men, classed by age, in Tanushimaru and Ushibuka. Percentage of men who had never smoked, men who had quit smoking, and heavy smokers (20 or more cigarettes daily).

AGE	TANUSHIMARU Never	Quit	Heavy	USHIBUKA Never	Quit	Heavy
40-44	15.6	12.8	40.4	15.8	8.8	42.9
45-49	14.8	12.2	49.5	10.9	4.7	49.6
50-54	13.8	13.8	44.7	13.1	8.8	35.7
55-59	20.1	13.7	39.6	20.3	6.8	31.2
40-59	16.2	13.2	43.4	14.9	7.2	37.7

TABLE C7.3

Number men below (LO) and above (HI) age-specific medians for all Japanese, Tanushimaru left, Ushibuka right-hand. Heavy = 20 or more, Other = 1-19 cigarettees per day.

	Non-Smoker		Heavy		Other		Non-Smoker		Heavy		Other	
	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI
Rel. Wt.	77	83	108	106	69	64	38	62	84	92	106	73
Σ Skinf.	70	83	108	106	71	61	--	--	--	--	--	--
Syst. B.P.	86	75	100	164	86	66	38	72	99	86	110	89
Diast. B.P.	79	82	102	112	73	61	43	33	92	93	112	87
Serum Chol	78	77	115	94	53	74	57	52	93	91	96	103

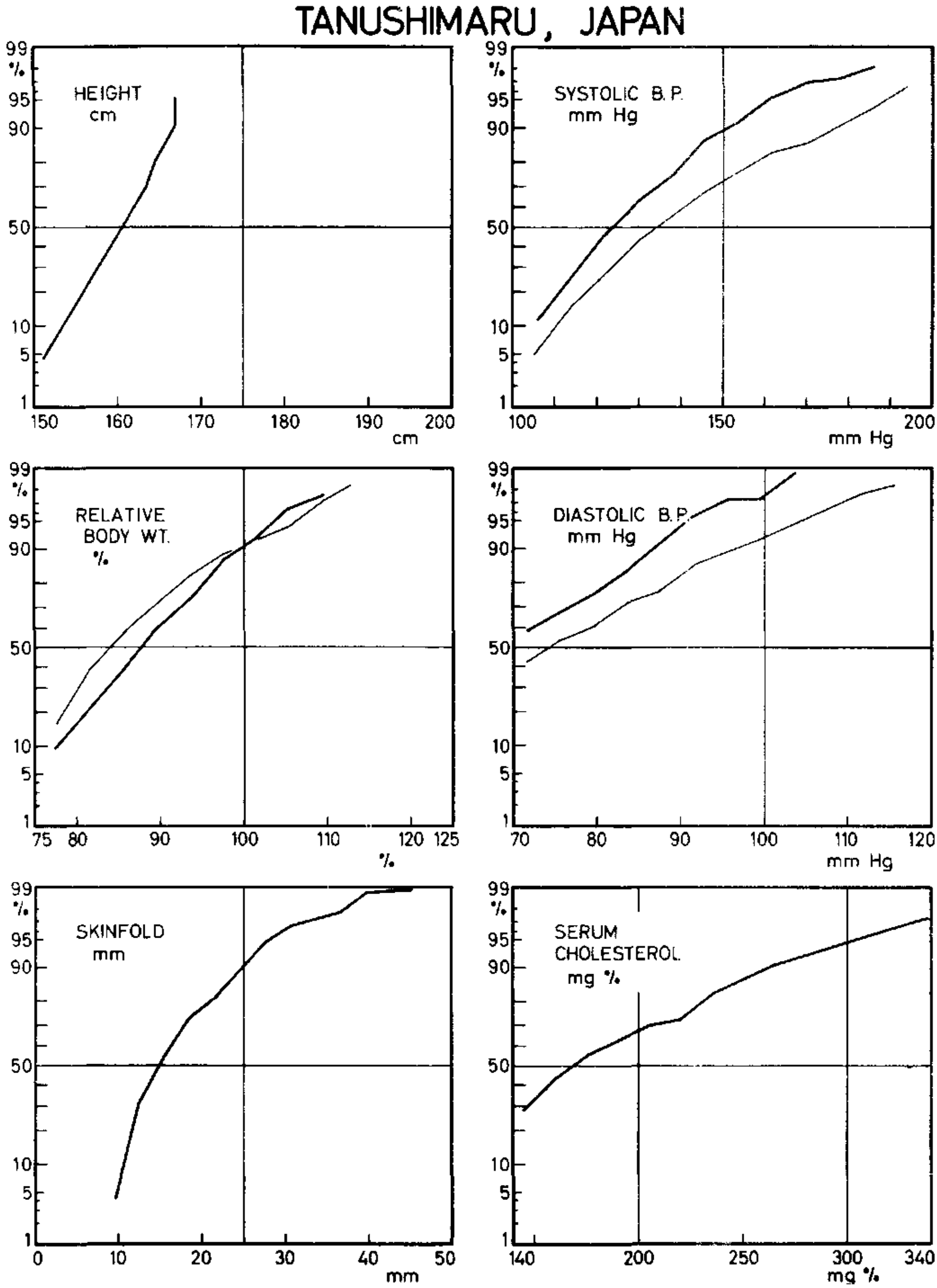
TANUSHIMARU, JAPAN
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT. %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C7. 1

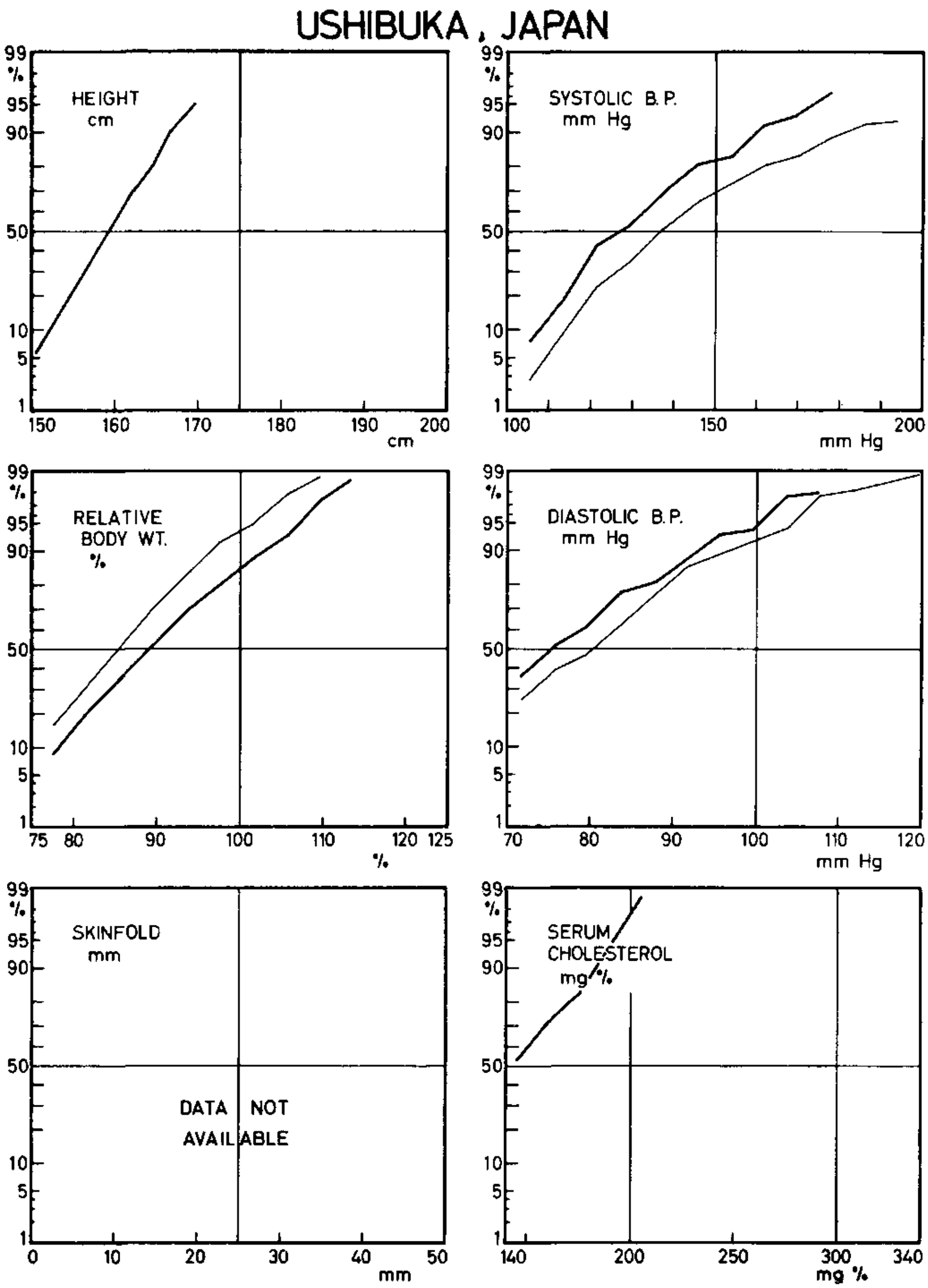
USHIBUKA, JAPAN
HEIGHT
cm
SYSTOLIC B.P.
mm Hg
RELATIVE
BODY WT.
%
DIASTOLIC B.P.
mm Hg
SKINFOLD
mm
DATA NOT
AVAILABLE
SERUM
CHOLESTEROL
mg %
mg %

Figure C7.2

third that of the Americans studied.

Both in systole and in diastole, the blood pressure tended to be appreciably higher at Ushibuka than at Tanushimaru; many members of the same research team worked in both villages so this difference is unlikely to be due to differences between observers. Serum cholesterol concentration, though low in both areas, was some 18 per cent (i. e., more than 25 mg. per 100 ml., on the average) higher in Tanushimaru than in Ushibuka. Compared with the average of all 18 samples, the serum cholesterol values were very low in both places and in this respect were approached only by the men in Velika Krsna, Yugoslavia, whose cholesterol values were a little lower than those of the Japanese fishermen and higher than those of the Japanese farmers.

Smoking Habits

Heavy cigarette smoking has been the rule for men in Japan for many years. In the present series of studies the Japanese proved to be the heaviest smokers of any of the groups studied; at Tanushimaru 43.4 per cent of the men smoke 20 or more cigarettes daily and at Ushibuka 37.7 per cent are in that category. Table C7.2 summarizes the smoking data.

In contrast with most other samples, in Japan there was no trend for the percentage of quit smokers to rise with age. The percentage of men who never smoked was highest in the oldest age class and this is statistically significant but the percentage of never smoking is not age-related at other ages. As in other samples, the percentage of heavy smokers tends to fall with age.

The men in these two villages differ significantly in the percentages of non-smokers versus smokers, Tanushimaru having more non-smokers (chi-square $= 6.486$, $p =$ less than 0.02). This is primarily because there are more quit smokers in Tanushimaru. On the other hand, the percentage of heavy smokers is higher in Tanushimaru than in Ushibuka but the difference is not quite significant (chi-square $=3.526$, $p =$ about 0.06).

Table C7.3 examines the question of associations between smoking habits and the measured variables. The Tanushimaru men differ from men in most of the other samples studied in that differences in smoking habits are not significantly associated with differences in relative body weight or body fatness. In Ushibuka the non-smokers, as elsewhere, more often tended to be overweight; for the distribution above and below the median relative body weight, chi-square $= 6.899$ and $p =$ less than 0.01.

In Ushibuka, but not in Tanushimaru, non-smokers were overly represented in the above-median class of systolic blood pressure. For systolic pressure, 72 of the non-smokers were above the median but only 55 would be expected from chance; the difference is highly significant (chi-square $= 12.776$ and $p =$ less than 0.001).

In Ushibuka smoking habits were unrelated to serum cholesterol but in Tanushimaru the heavy smokers tended to have lower values than the rest of the men. However, when calculation is made with the median cholesterol value as cutting point the difference is not quite significant (chi-square $=$ 3.199).

Electrocardiographic Findings

ECG data from Tanushimaru are presented in Tables C7.4 and C7.5 and from Ushibuka in Tables C7.6 and C7.7. The original records were not available for replicate and adjudicated readings in the central laboratory but were coded by Dr. H. Toshima in Ja-

TABLE C7.4

TANUSHIMARU, JAPAN

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (112)	45-49 (117)	50-54 (135)	55-59 (140)
Total with reportable ECG Items	I - IX		39 (348.2)	39 (333.3)	48 (355.6)	54 (385.7)
Q Waves	I	1	2 (17.9)	1 (8.5)	0	0
		2	2 (17.9)	1 (8.5)	1 (7.4)	4 (28.6)
		3	0	0	0	0
Axis Deviation	II					
Left		1	1 (8.9)	0	2 (14.8)	1 (7.1)
Right		2	0	0	1 (7.4)	0
High Amplitude R Waves	III					
Left type		1	9 (80.4)	10 (85.5)	7 (51.9)	12 (85.7)
Right type		2	1 (8.9)	0	1 (7.4)	1 (7.1)
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1 + 4	2 (17.9)	2 (17.1)	2 (14.8)	3 (21.4)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	4 (35.7)	5 (42.7)	10 (74.1)	15 (107.1)
No S-T-J plus segment downward		3	6 (53.6)	3 (25.6)	9 (66.7)	7 (50.0)
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	1 (8.9)	0	0	0
- 1 mm. to -5 mm.		2	0	0	0	2 (14.3)
0 ± 1.mm.		3	3 (26.8)	0	7 (51.9)	7 (50.0)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	1 (7.4)	0
P-R over 0.21 second		3	0	3 (25.6)	4 (29.6)	2 (14.3)
Accelerated Conduction		4	1 (8.9)	1 (8.5)	0	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	0
Right Bundle		2	0	0	2 (14.8)	2 (14.3)
Incomplete Right Bundle		3	1 (8.9)	1 (8.5)	0	0
Intraventricular Block		4	0	0	0	0
Arrhythmias	VIII					
Premature Beats		1	0	0	0	0
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	1 (7.4)	5 (35.7)
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	1 (8.5)	0	0
Sinus tachycardia		7	1 (8.9)	0	0	1 (7.1)
Sinus bradycardia		8	11 (98.2)	13 (111.1)	14 (103.7)	9 (64.3)
Technically poor records	IX	8	0	0	0	0

TABLE C7.5

TANUSHIMARU, JAPAN

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

		AGE GROUP (Number of Men)			
ECG FINDING	ECG Code	40-44 (107)	45-49 (109)	50-54 (127)	55-59 (127)
Exercise tests not made or incomplete	X 1 X 2	5 (44.6)	8 (68.4)	8 (59.3)	13 (92.9)
S-T Depression post-exercise (none at rest)	XI				
S-T - J 1 mm. or more, horiz. or downward segment	1+4	0	0	1 (7.9)	0
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	2 (18.7)	3 (27.5)	3 (23.6)	5 (39.4)
No S-T-J plus segment downward	3	3 (28.0)	0	2 (15.7)	3 (23.6)
T Wave Negativity post-exercise (none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	0	0
0 ± 1 mm.	3	0	0	0	1 (7.9)
Arrhythmias post-exercise (none at rest)	XV 1	0	0	1 (7.9)	1 (7.9)
Technically poor post-exercise records	XI 8	0	0	1 (7.9)	0

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

		40-44	45-49	50-54	55-59
At Rest					
Large Q Waves	I 1	2 (17.9)	1 (8.5)	0	0
Lesser Q Waves with Negative T Waves	I 2, 3 + V 1, 2	0	0	0	0
Deeply Negative T as sole anomaly	V 1 only	0	0	0	0
Other Negative T as sole anomaly	V 2, 3 only	0	0	2 (14.8)	2 (14.3)
S-T Depression as sole anomaly	IV 1-4 only	6 (53.6)	8 (68.4)	12 (88.9)	12 (85.7)
High Amplitude R with S-T Depression	III 1 + IV 1-4	1 (8.9)	1 (8.5)	3 (22.2)	5 (35.7)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	0	0	2 (14.8)	2 (14.3)
Arrhythmias	VIII 2-6	0	1 (8.5)	1 (7.4)	5 (35.7)
Post-exercise					
S-T Depression as sole anomaly	XI 1-4 only	4 (37.4)	1 (9.2)	3 (23.6)	3 (23.6)
Negative T as sole anomaly	XII 1-3 only	0	0	0	0
Ventricular Conduction Defect as sole anomaly	XIV 1, 2, 4 only	0	0	0	0
Arrhythmias as sole anomaly	XV 1 only	0	0	1 (7.9)	0

TABLE C7.6

USHIBUKA, JAPAN

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (112)	45-49 (122)	50-54 (136)	55-59 (114)
Total with reportable ECG Items	I - IX		31 (276.8)	46 (377.0)	46 (338.2)	37 (324.6)
Q Waves	I	1	0	0	1 (7.4)	1 (8.8)
		2	0	0	0	1 (8.8)
		3	0	0	0	0
Axis Deviation	II					
Left		1	1 (8.9)	0	1 (7.4)	1 (8.8)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	20 (178.6)	14 (114.8)	18 (132.4)	19 (166.7)
Right type		2	1 (8.9)	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1+4	1 (8.9)	3 (24.6)	1 (7.4)	0
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	1 (8.9)	7 (57.4)	6 (44.1)	5 (43.9)
No S-T-J plus segment downward		3	1 (8.9)	6 (49.2)	11 (80.9)	6 (52.6)
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	1 (7.4)	0
- 1 mm. to -5 mm.		2	1 (8.9)	0	3 (22.1)	0
0 ± 1 mm.		3	0	4 (32.8)	1 (7.4)	3 (26.3)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	1 (8.9)	0	2 (14.7)	1 (8.8)
P-R over 0.21 second		3	3 (26.8)	5 (41.0)	1 (7.4)	1 (8.8)
Accelerated Conduction		4	0	0	0	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	0
Right Bundle		2	2 (17.9)	3 (24.6)	0	1 (8.8)
Incomplete Right Bundle		3	0	1 (8.2)	0	0
Intraventricular Block		4	0	0	0	0
Arrhythmias	VIII					
Premature Beats		1	0	0	1 (7.4)	1 (8.8)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	0	0
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	0	0
Sinus tachycardia		7	1 (8.9)	0	0	0
Sinus bradycardia		8	5 (44.6)	8 (65.6)	5 (36.8)	3 (26.3)
Technically poor records	IX	8	0	0	0	1 (8.8)

TABLE C7.7

USHIBUKA, JAPAN

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (92)	45-49 (102)	50-54 (117)	55-59 (98)
Exercise tests not made or incomplete	X 1 X 2	20 (178.6)	20 (163.9)	20 (147.1)	16 (140.4)
S-T Depression post-exercise (none at rest)	XI				
S-T - J 1 mm. or more, horiz. or downward segment	1+4	0	0	0	1 (10.2)
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	0	2 (19.6)	3 (25.6)	4 (40.8)
No S-T-J plus segment downward	3	3 (32.6)	4 (39.2)	5 (42.7)	5 (51.0)
T Wave Negativity post-exercise (none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	0	0
0 ± 1 mm.	3	0	0	0	0
Arrhythmias post-exercise (none at rest)	XV 1	0	0	1 (8.5)	0
Technically poor post-exercise records	XI 8	0	0	0	0

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

ECG FINDING	ECG Code	40-44	45-49	50-54	55-59
At Rest					
Large Q Waves	I 1	0	0	1 (7.4)	1 (8.8)
Lesser Q Waves with Negative T Waves	I 2, 3 + V 1, 2	0	0	0	0
Deeply Negative T as sole anomaly	V 1 only	0	0	0	0
Other Negative T as sole anomaly	V 2, 3 only	0	1 (8.2)	0	1 (8.8)
S-T Depression as sole anomaly	IV 1-4 only	1 (8.9)	12 (98.4)	12 (88.2)	7 (61.4)
High Amplitude R with S-T Depression	III 1 + IV 1-4	1 (8.9)	2 (16.4)	2 (14.7)	2 (17.5)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	2 (17.9)	3 (24.6)	0	1 (8.8)
Arrhythmias	VIII 2-6	0	0	0	0
Post-exercise					
S-T Depression as sole anomaly	XI 1-4 only	2 (21.7)	4 (39.2)	4 (34.2)	8 (81.6)
Negative T as sole anomaly	XII 1-3 only	0	0	0	0
Ventricular Conduction Defect as sole anomaly	XIV 1, 2, 4 only	0	0	0	0
Arrhythmias as sole anomaly	XV 1 only	0	0	1 (8.5)	0

pan and there may be systematic reading differences. The Japanese ECG data are therefore considered with these reservations.

At Tanushimaru three large Q waves (I, 1) were seen; curiously they were among men in the younger decade of age. Axis deviation (II 1, 2) was uncommon except that there was one case, extremely rare, of marked right axis deviation (over 120°). Left and right type of high amplitude R waves are comparatively common, and the rates for resting S-T segment depression alone or in combinations are quite high. The modified version of the S-T segment depression code in the Minnesota classification (see Appendix), in which "ischemic" sagging depression is separated from categories IV, 1 and XI, 1, was not employed in these readings. Prolonged P-R interval was unusually common, but must be viewed in the light of the finding that ten per cent of the Tanushimaru population had resting heart rates less than 50 beats per minute.

Post-exercise ECG records were obtained from 93.2 per cent of the men at Tanushimaru, the exclusions being made for the following reasons: 1) the resting ECG showed ST-T abnormality or ventricular conduction disturbance, 2) there was difficulty in walking, 3) blindness, 4) the examination was done in hospital or at home, not at the field station. The "yield" of additional ECG abnormalities from the post-exercise record was low at Tanushimaru.

At Ushibuka large Q waves (I, 1) were rare and axis deviation was relatively uncommon. Left type high amplitude R waves were recorded in 15 per cent of the men aged 40—59 years. It is not known whether this is primarily due to a systematic peculiarity of reading or to the degree to which the finding is associated with lean body build or elevated blood pressure. However, the finding is twice as common in Ushibuka as in Tanushimaru where the ECG coder was the same individual.

There was an unusually high prevalence of resting S-T depression (10 per cent in Codes IV, 1—3) probably related to the same factors as in Tanushimaru. The coincidence of frequent prolonged A-V conduction and sinus bradycardia was found in Ushibuka as in Tanushimaru. Other arrhythmias were rare.

Post-exercise ECG records were obtained from 84.5 per cent of the men of Ushibuka, the reasons for exclusion being the same as at Tanushimaru. Again, as at Tanushimaru, the number of new ECG abnormalities from the exercise test was not large.

The infrequency of conduction defects, heart blocks and arrhythmias is notable in the records from Tanushimaru and Ushibuka. There were no cases of complete block, intraventricular block, left bundle branch block; in rest, there were only two cases of frequent extra-systoles, six of atrial fibrillation or flutter and two of sinus tachycardia.

Hypertension Prevalence and Other Variables

By any criterion, hypertension is somewhat less prevalent in the Japanese villages than in the other areas studied. The data for two criteria of diastolic blood pressure are summarized in Table C7.8. With either criterion, hypertension was decidedly less prevalent in these villages than the average of the other population samples in these studies. At ages 40—54, but not at ages 55—59, hypertension is more common at Ushibuka than at Tanushimaru. For the total age range 40—59 years, hypertension is significantly more prevalent at Ushibuka than at Tanushimaru if 95 mm. or more in diastole is the cri-

TABLE C7.8

Prevalence of diastolic hypertension (95 or more, 100 or more mm Hg, fifth phase) among men classed by age. Percentage of men at Tanushimaru and Ushibuka who are hypertensive, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm
Tanushimaru	1.8	1.8	3.4	3.4	7.3	6.6	15.4	10.5
Ushibuka	7.0	3.5	13.3	8.6	12.9	8.6	12.7	7.6
Mean, 18 samples	13.6	7.9	15.6	8.9	20.9	13.5	21.5	13.8

TABLE C7.9

Prevalence of overweight (110 or more and 120 or more per cent of "standard" average for height and age). Percentage of men at Tanushimaru and Ushibuka, classed by age, who are overweight, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	110%	120%	110%	120%	110%	120%	110%	120%
Tanushimaru	1.8	0	2.6	1.7	4.4	0.7	1.4	0.7
Ushibuka	4.7	0.9	2.6	0	1.6	0.8	0.9	0
Mean, 18 samples	20.9	8.4	19.4	6.9	18.1	6.7	16.8	7.3

terion (chi-square = 4.394, p = less than 0.04); with 100 mm. or more as the criterion, the two villages are not significantly different.

The distributions of the hypertensive men, defined as diastolic pressure of 95 mm. or more, into decile classes of relative body weight, Σ skinfolds, and serum cholesterol concentration are shown in Figures C7.3 and C7.4. At Ushibuka, as in other samples reported here, the prevalence of hypertension rises with increasing relative body weight. Among the men in deciles 9, 10 (i.e. the 20 per cent for relative weight) 18.7 per cent are hypertensive as compared with only 5.6 per cent among men in deciles 1, 2. But Tanushimaru is remarkable in that there is no tendency for hypertension prevalence to vary with relative weight.

On the other hand, at Tanushimaru the prevalence of hypertension seems to be related to body fatness, at least in the upper part of the Σ skinfolds distribution. Compared with the lower 80 per cent (deciles 1—8) of the distribution of Σ skinfolds, the men in the top 20 per cent of Σ skinfolds have 2.72 times the prevalence rate of hypertension and the difference is highly significant (chi-square = 7.527, p = less than 0.01). Σ skinfolds data are not available for Ushibuka.

At Tanushimaru there is no significant relationship between hypertension and serum cholesterol level but at Ushibuka there is an irregular tendency for the prevalence of hypertension to be greater among the men with the relatively higher serum cholesterol values. Comparing the men above the cholesterol median with those below the median, at Ushibuka the respective prevalence figures are 33 cases among 246 men, or 13.4 per cent, and 24 cases among 247 men, or 9.7 per cent. This difference at the median cutting point does not reach statistical significance but when the men in the top 20 per cent of serum cholesterol are compared with the rest of the men, their prevalence of hypertension proves to be significantly higher (chi-square = 4.012, p = less than 0.05).

Prevalence of Overweight and Other Variables

Data on the prevalence of overweight are given in Table C7.9. Both in Tanushimaru and Ushibuka only 2.4 per cent of the men aged 40—59 would qualify as overweight when this is defined as 110 or more per cent of the "standard" average body weight for height and age; with the more commonly used cutting point of 120 or more per cent, almost none of these men would be classed as overweight. The distributions of the few overweight men (110 or more per cent of "standard" average) in these samples into decile classes of serum cholesterol and blood pressure are shown in Figures C7.5 and C7.6. In both villages and for all three variables there is some tendency for the prevalence of overweight to increase as the values of the other variables increase, but statistical analysis is needed to evaluate this.

The small numbers of overweight men hamper such analysis, but comparison can be made of the men over the median with those below the median for these variables. Since in these respects the distributions are not significantly different in the two samples, it is reasonable to combine the data represented in Figures C7.5 and C7.6.

For Tanushimaru and Ushibuka combined, the above-median men in cholesterol have an overweight prevalence of 3.72 per cent; the figure for the below-median men is 1.66 per cent but chi-square is only 3.05 and p = about 0.08. Diastolic blood pressure, however, proves to be significant in the above- and below-median compari-

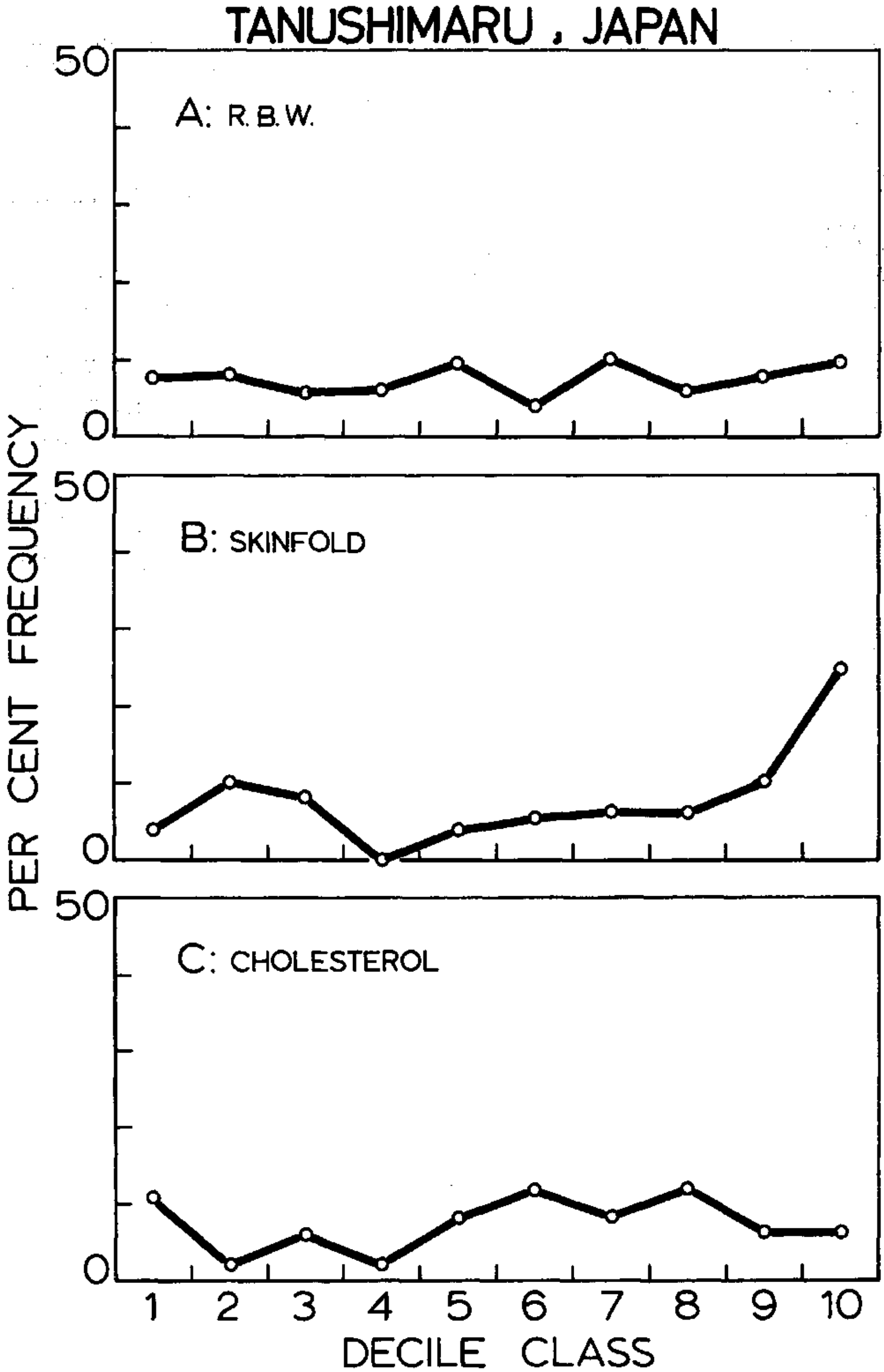
TANUSHIMARU , JAPAN
A: R. B. W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C7. 3

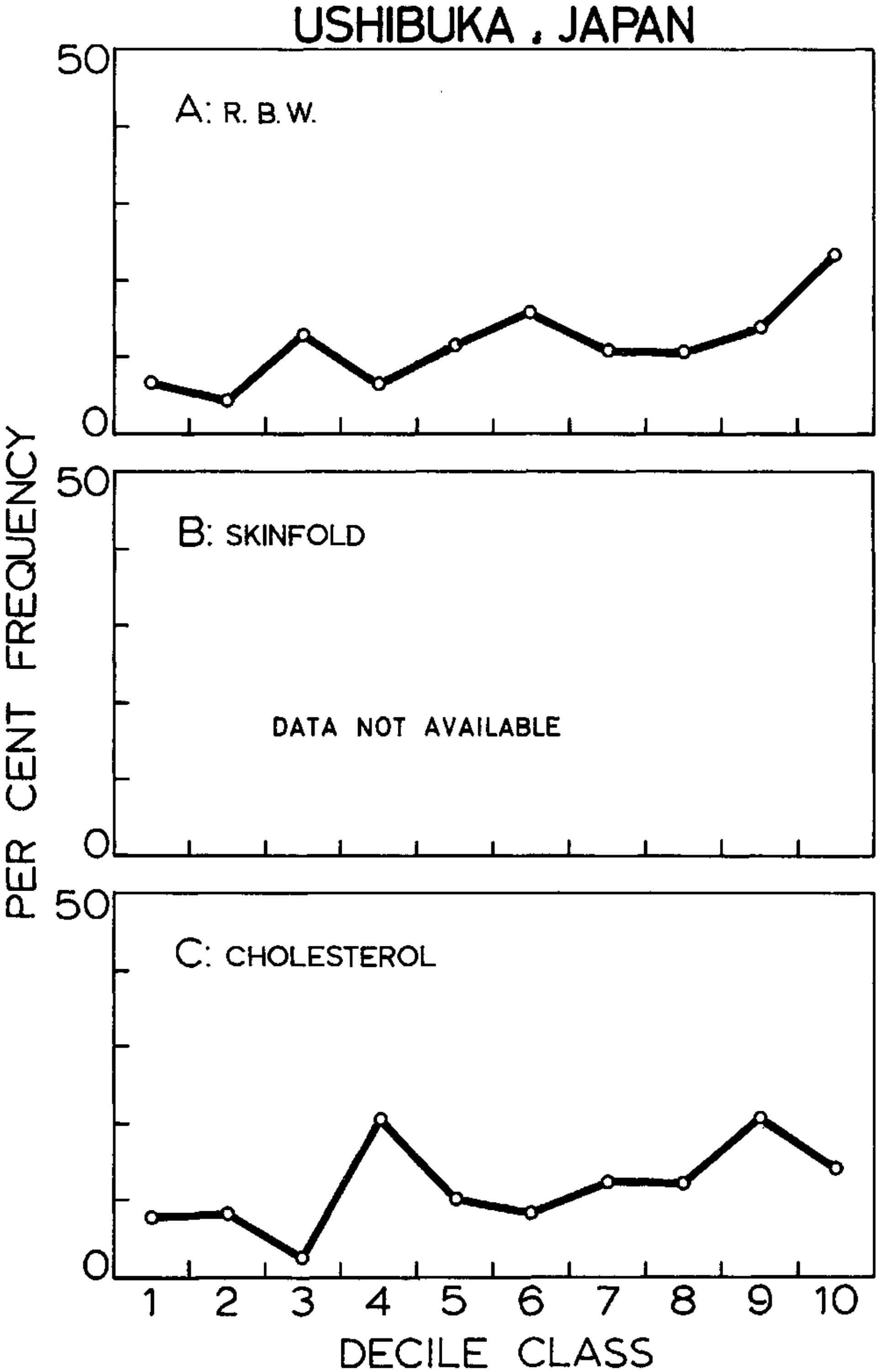
USHIBUKA, JAPAN
A: R. B. W.
B: SKINFOLD
DATA NOT AVAILABLE
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
50
0
50
0
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C7.4

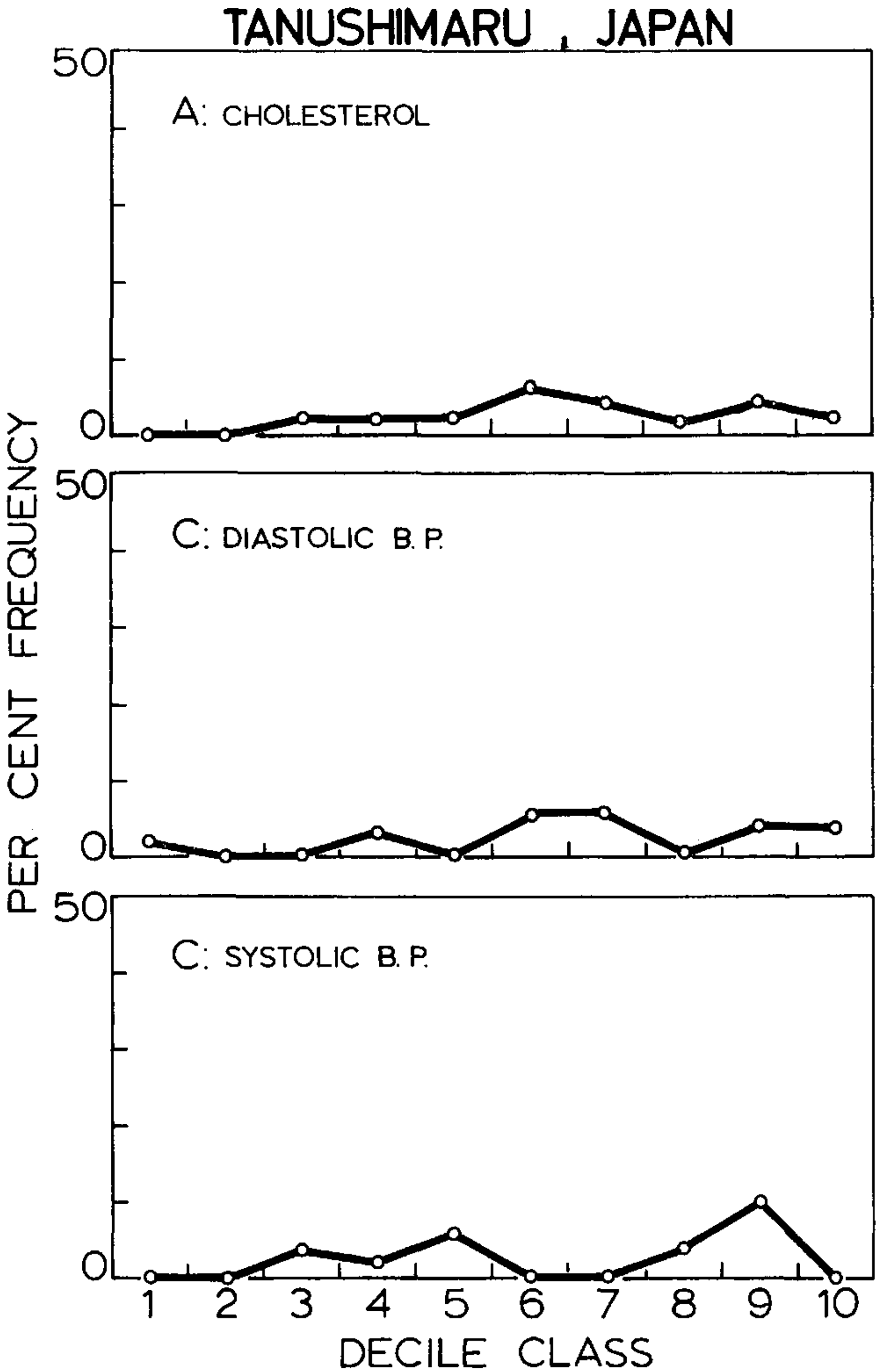
TANUSHIMARU , JAPAN
A: CHOLESTEROL
C: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C7. 5

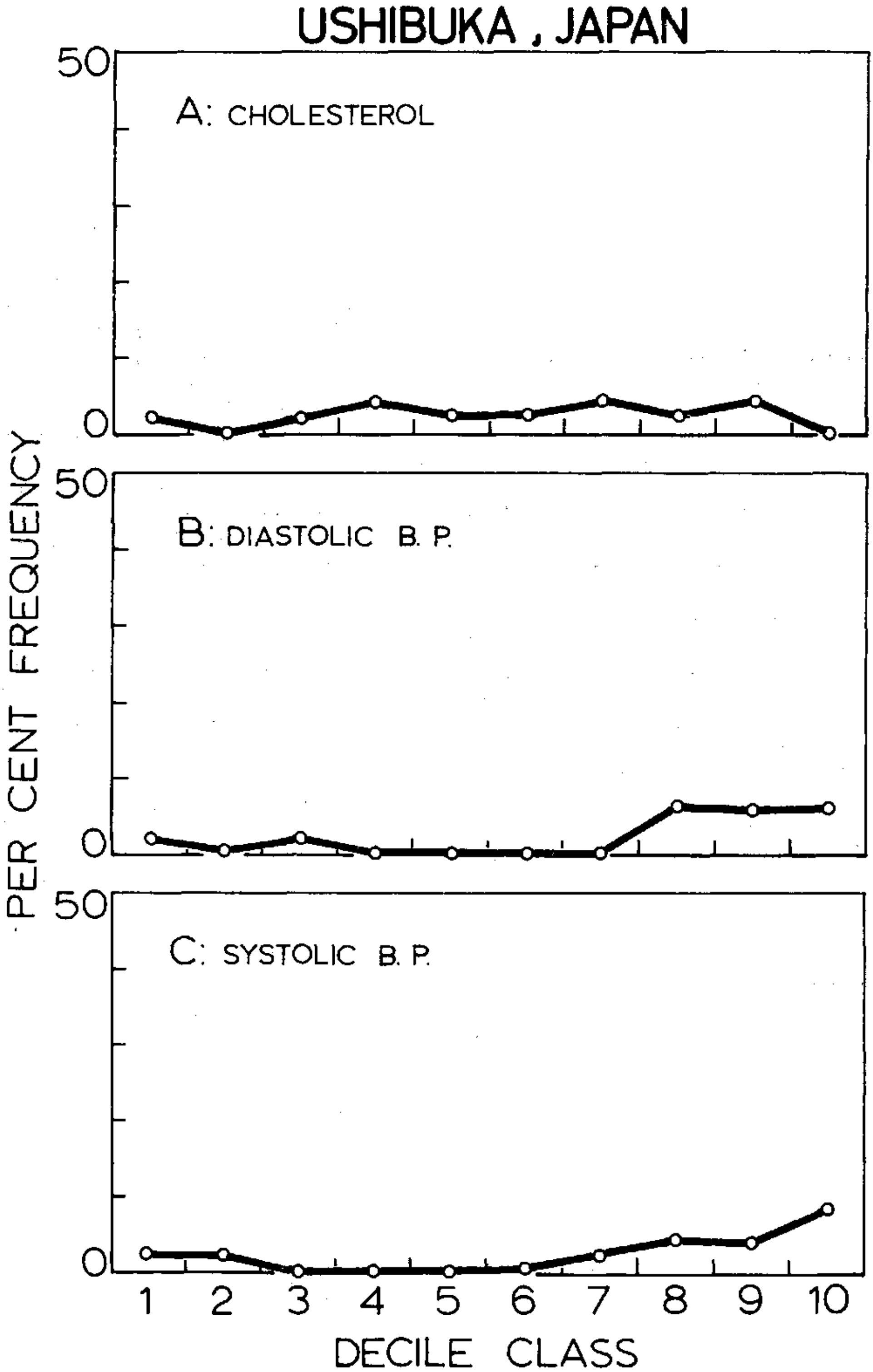
USHIBUKA , JAPAN
A: CHOLESTEROL
B: DIASTOLIC B. P.
C: SYSTOLIC B. P.
PER CENT FREQUENCY
50
0
50
0
50
0
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C7. 6

son. Among 505 men below the median diastolic blood pressure for their age and village, only 5 were overweight compared with 19 among 504 above-median men; chi-square = 7.254 and p = less than 0.01. Similarly for systolic pressure, among 505 men below the median, there were 5 overweight men while among the 504 above-median men there were 19 cases of overweight.

Prevalence of Obesity and Hypercholesterolemia

Classification systems for obesity (in terms of Σ skinfolds) and hypercholesterolemia are presented in Section H, below. Though these criteria, based on the distributions of measurements in the "healthiest" areas in the 18 population samples studied, are rigorous, only 8 per cent of the Tanushimaru men would be classed in any grade of obesity and only 2 per cent would be classed as Grade 1 obesity. In serum cholesterol concentration the Tanushimaru men are less remarkable, 9 per cent were Grade 1 and 19 per cent Grade 4 hypercholesterolemia. In Ushibuka only one per cent of the men were Grade 4 hypercholesterolemia and no men were classed in higher grades.

Summary

In the farming village Tanushimaru and the fishing village Ushibuka, in southern Japan (Kyushu), 99.8 per cent of all men aged 40—59 were examined (N = 1013). Compared with the men in the other samples in these studies these men were shorter, much lighter, thinner, had very low serum cholesterol values and tended to have lower blood pressures, especially in diastole. Compared with the fishermen of Ushibuka the farmers of Tanushimaru were similar in height and in relative body weight, tended to have slightly lower blood pressures and significantly higher serum cholesterol values.

Over 70 per cent of the men of Tanushimaru and almost 80 per cent of the men of Ushibuka smoked cigarettes. The frequency of heavy smoking (20 or more cigarettes daily) was higher in these Japanese villages than in any of the other samples of men of this age studied. Non-smokers at Ushibuka, but not at Tanushimaru, included an unduly high proportion of relatively overweight men and men with relatively high systolic blood pressure. In neither area was there an unexpected frequency of relatively high serum cholesterol values among the non-smokers. At Tanushimaru, but not at Ushibuka, heavy smokers included fewer men than expected with relatively high serum cholesterol values.

Significant electrocardiographic abnormalities were similar and relatively uncommon in both Tanushimaru and Ushibuka. Sinus tachycardia in rest was unusually frequent in both villages.

The prevalence of hypertension in these villages was decidedly less than the average for the other samples of men in these studies. At Ushibuka, but not at Tanushimaru, the prevalence of hypertension rose with increasing relative body weight. At Tanushimaru, the men with the highest Σ skinfolds most often tended to have hypertension. Obesity was rare in these samples.

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The professional staff on the team at Tanushimaru in 1958 and at Ushibuka in 1960 comprised Drs. Ichiro Furukawa, Hironori Toshima, Shoji Nishimoto, Yushio Nawata, Akira Seki, Fuminobu Mori, Shigeru Soejima, Shunichi Kodama, Shigeo Nakakura, Akio Fukumoto, Kazumasa Kitamura, Wataru Murakami, Osamu Tokura, Hiroshi Kameo, Masamichi Akasu, Kazuhiko Sasaki, Taizo Endo, Koki Matsutake, Ikuro Goto, Yoshie Ohya, Hiroto Mashiba, Hiroshi Okamuru, Tsuyoshi Murakami, Takeshi Sasaki, Yasuhiko Nabeshima, Eisaburo Yamagata, Mikitoshi Horamatsu and Tadashi Koga.

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C8. RAILROAD EMPLOYEES IN ROME

by H. L. Taylor, Mario Monti, Vittorio Puddu, Alessandro Menotti and Ancel Keys

In many countries employees of the railroads do rather similar work, tend to be stable in their occupations and are covered by systems of disability, retirement and record-keeping that make them especially suitable for epidemiological studies on cardiovascular diseases. The example of the studies on railroad employees in the United States (see Section C1, above), led to the organization of a similar study on employees of the State Railways of Italy with concentration, in regard to detailed medical examinations, on certain occupational categories of male employees in Rome.

The examinations were made in the summer of 1962. The methods were identical and professional personnel (Drs. H. L. Taylor and H. Blackburn) engaged in the work in the U.S.A. participated in the work in Rome. The eligible roster consisted of permanently employed men aged 40—59 who were in the selected job categories. Actually, many men on the list were not invited because of known conflicts in the operating schedules. Among about 1 000 men aged 40—59 in the four selected occupations who were invited, 806 were examined. Some of those who did not respond were unable to do so because of local difficulties in getting to the examination headquarters in the Stazione Termini during the scheduled period so the effective response rate of those who really had an opportunity to respond was better than 80 per cent.

In contrast to the United States, all railroads in Italy are completely electrified and there are various other differences in technical operations and traditional working arrangements so it is not possible to equate job categories in the two countries. Four occupations were covered in Rome: 1) clerks, including station masters (capi stazione), 2) switchmen, 3) electricians, and 4) maintenance of way men. The distribution of men in the Rome sample, by age and occupation, is given in Table C8.1.

The work of railroad clerks in Italy is generally similar to that in the United States but the study in Rome concentrated on station masters, a subcategory of clerks. These men report arrivals and departures of all trains and are on the platforms at the moment of arrival and departure. More of the Italian clerks worked in small stations along the line than the clerks sampled in the United States. By design, the latter were confined to railroad centers where both clerks and switchmen are employed.

There are some differences in the work of the switchmen in the two

TABLE C8.1

Numbers of Rome railway men classed by age, occupation and location.

OCCUPATION	IN ROME PROPER				OUTSIDE ROME PROPER			
	40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
Clerks	16	19	15	10	29	33	28	15
Switchmen	17	35	27	10	21	20	23	9
Electricians	35	23	46	24	18	22	24	11
Maintenance of Way Men	15	16	18	7	13	46	48	38
All Men	83	93	106	51	111	121	123	73

TABLE C8.2

Rome railway men. Medians and the median values expressed as percentage of the averages of the medians for all 18 samples of men.

VARIABLE	MEDIAN VALUES				MEDIAN as % of AVERAGE			
	40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
Height, cm.	166	166	165	164	97.8	98.2	98.0	97.8
Relative Weight, %	108	108	106	108	110.1	112.3	111.3	114.8
Σ Skinfolds, mm.	26	27	25	26	122.6	132.4	120.8	130.7
Systolic B.P., mm. Hg	135	138	138	142	103.1	103.8	100.7	101.0
Diastolic B.P., mm. HG	86	89	89	90	106.2	109.3	106.7	106.8
Serum Chol., mg.%	207	206	209	204	100.3	99.4	100.0	98.7

countries. In Italy the switching crews are smaller and more tailored in number to the needs of the immediate job.

The railroad electricians in Italy have various tasks in the maintenance of the electrical system. Up to the age of 45 or so they do a considerable amount of work on the overhead lines which involves climbing poles. The electricians aged 50 and over work mainly on the ground. As a result the younger electricians are probably more active than the switchmen but the older men are not.

The men who maintain the road bed in Italy do a good deal of heavy work and observation of them at work gives the impression that their work is heavier than that of their counterparts in the United States.

The Rome sample of men represents an area centered on the city proper, the equivalent of a division in the American railroad system, which extends to include the division points of Cassino, 140 km., Formia, 180 km. to the south, Grossetto, 180 km. to the north and Sulmona, 100 km. to the southeast. Though the job responsibilities are similar throughout the area, living conditions and some of the working conditions in Rome itself differ from those outside of the capitol. Table C8.1 distinguishes between Rome proper and the rest of the area in regard to age and occupation distribution.

Distribution of Six Measured Variables

Table C8.2 gives the median values of height, relative body weight, the sum of the skinfolds (over the triceps muscle and over the tip of the scapula), systolic and diastolic (fifth phase) blood pressure and serum cholesterol concentration for all men in the Rome sample classed by age. The table also expresses these values as percentages of the averages of the medians of all men of corresponding age in the 18 samples in this cooperative study.

These Romans show no age trend in relative weight, Σ skinfolds, or serum cholesterol. Height tends to decrease and blood pressure to rise with age; these trends are similar to those found in other samples.

Compared with the average of all samples, the Rome railway men tend to be slightly shorter, decidedly heavier at equal height and age, and very much fatter; they tend to have somewhat higher blood pressures, especially in diastole; they correspond closely to the general average in serum cholesterol concentration. The outstanding feature of these Romans is their tendency toward obesity as indicated by Σ skinfolds. Note that the true skin represents about 6 mm. of the sum of the skinfolds so the median (all ages) actual subcutaneous fat thickness of these Romans is about 5.0 mm. at these sites; the corresponding figure for all 18 samples is about 3.6 mm., so in this respect these Romans are nearly 40 per cent fatter than the general average of men studied. They are, in fact, fatter than the men in any of the other samples expect the U.S. railroad employees.

Compared with the other samples of men in Italy, the Rome railway men are a little taller than the men in Montegiorgio, some 4 cm. taller than the men in Nicotera but several cm. shorter than the men in Crevalcore. They have considerably greater relative body weights and they are much fatter than the men in the other Italian samples. At all ages they have somewhat higher serum cholesterol values than the other Italians studied though their cholesterol levels would be considered very low in the U.S. or in Finland.

The cumulative frequency distributions of these variables, on a probability scale, are shown in Figure C8.1. In the graphs of relative body weight and blood pressure the heavy line is for ages

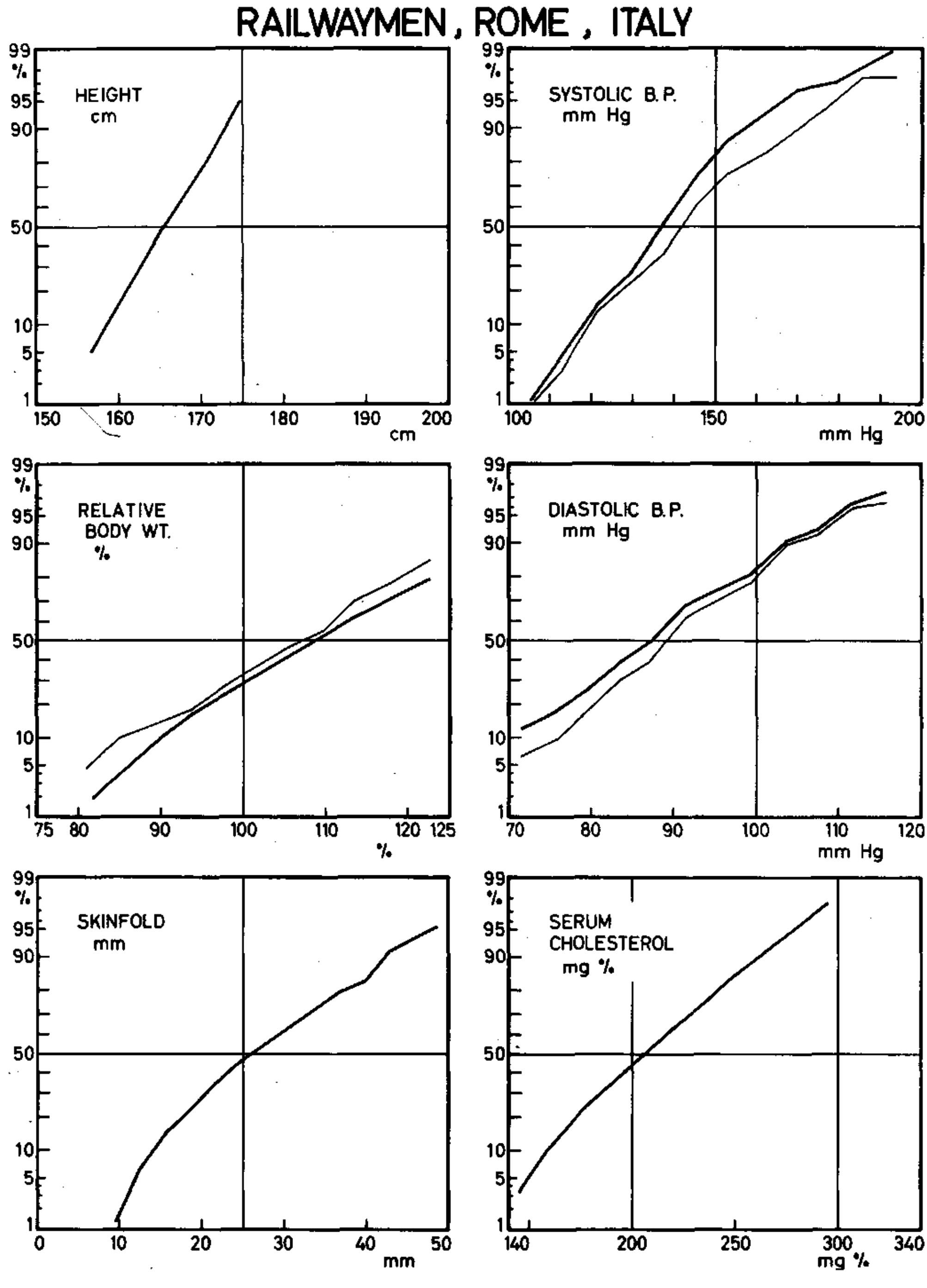
RAILWAYMEN, ROME, ITALY
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT. %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
99 % 95 90 50 10 5 1
150 160 170 180 190 200 cm
100 150 200 mm Hg
75 80 90 100 110 120 125 %
70 80 90 100 110 120 mm Hg
0 10 20 30 40 50 mm
140 200 250 300 340 mg %

Figure C8. 1

40—49, the light line for ages 50—59; for the other variables, all ages 40—59 are combined. Except for Σ skinfolds and systolic blood pressure, the distributions are reasonably "normal". The details of these distributions, by 5-year age groups, are given in the Appendix.

Smoking Habits

In common with other men in Italy, smoking among Rome railway men is confined to cigarettes; almost none smoke pipes or cigars. The majority of these Romans are cigarette smokers — 60.5 per cent (among electricians) is the lowest frequency of smoking, the highest being 75.5 per cent (among switchmen). The smoking habits are summarized in Table C8.3. Though fewer switchmen had never smoked (10.5 per cent), all of the groups were similar in the frequency of heavy smoking (20 or more cigarettes daily), the range being only from 27.4 per cent for maintenance of way men to 30.9 per cent for electricians.

Over the range 40—59 years, smoking habits tend to change with age. For all occupations combined, the percentage of heavy smokers drops with increasing age from a high of 36.0 per cent heavy smokers at 40—44 to a low of 23.4 at age 55—59. The percentage of non-smokers rises with advancing age and this trend is statistically significant; (comparing ages 40—44 with 55—59, chi-square = 5.179 and p = 0.025). But among smokers the trend to fewer heavy smokers at older ages is not significant; for example, comparing ages 40—44 with 55—59, chi-square = 1.606; those who continue to smoke do not change the intensity of their smoking as they grow older. The tendency for non-smoking to become more common with increasing age is due to an increase in stopped smokers; there is no trend in the percentage of men who never smoked to change with age but the increase in stopped smokers is significant; comparing ages 40—44 with 55—59 the percentages of stopped smokers are 13.7 and 24.2, respectively, and the difference is significant (chi-square = 5.061, p = 0.025).

The Rome railroad men more often tend to be heavy smokers compared with the men in the rural samples in Italy. The percentages of heavy smokers in the Rome, Crevalcore, Montegiorgio and Nicotera samples are 29.9, 17.7, 9.6 and 8.0, respectively. Further, considering only men who smoke, among the Romans 45.9 per cent are heavy smokers while only 28.2, 16.2 and 11.7 per cent in Crevalcore, Montegiorgio, and Nicotera, respectively, are in that category. All of these differences are highly significant.

Table C8.4 gives the distributions of the Rome railroad men specified as to smoking habits and classed as above and below the age-specific medians for relative body weight, Σ skinfolds, blood pressure and serum cholesterol concentration. As in other samples, the non-smokers tend to be relatively heavier, fatter and to have higher blood pressures than the smokers. All of these differences are statistically highly significant. Differences in smoking habits are not associated with differences in serum cholesterol in these men.

On the other hand, the heavy smokers tend to be more often below the medians for all of these variables except serum cholesterol. Compared with "other" smokers, the heavy smokers are more often underweight (chi-square = 6.097) but the differences in the other variables are not statistically significant.

Electrocardiographic Findings

The electrocardiographic findings in Rome are summarized in Tables C8.5

TABLE C8.3

Cigarette smoking habits of Rome railway men classed by occupation and age. Percentage of non-smokers and of heavy smokers (20 or more cigarettes daily).

AGE	CLERKS		SWITCHMEN		ELECTRICIANS		MAINTENANCE	
	Non	Heavy	Non	Heavy	Non	Heavy	Non	Heavy
40-44	36.2	34.1	18.0	33.3	32.0	41.6	32.7	34.5
45-49	33.9	39.6	24.1	31.5	37.8	20.0	35.5	21.0
50-54	37.8	26.7	26.0	32.0	42.9	31.4	33.9	29.2
55-59	48.8	28.0	31.6	5.3	45.7	28.6	44.5	24.4
40-59	37.6	19.4	24.1	29.0	39.5	30.9	36.1	27.4

TABLE C8.4

Smoking. Number of Rome railroad men below and above the age-specific median values (LOW and HIGH, respectively) classed as NON-SMOKERS, HEAVY (20 or more cigarettes daily) and OTHER (1-19 daily) smokers.

VARIABLE	NON-SMOKERS		HEAVY		OTHER	
	LOW	HIGH	LOW	HIGH	LOW	HIGH
Relative Body Weight	99	167	144	85	139	131
Σ Skinfolds	107	159	135	93	140	129
Systolic B.P.	111	155	120	109	151	120
Diastolic B.P.	115	151	127	102	141	129
Serum Cholesterol	134	131	108	118	140	130

TABLE C 8.5

RAILWAYMEN, ROME, ITALY

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

			AGE GROUP (Number of Men)			
ECG FINDING	ECG Code		40-44 (197)	45-49 (214)	50-54 (231)	55-59 (124)
Total with reportable ECG Items	I - IX		46 (233.5)	55 (257.0)	68 (294.4)	38 (306.5)
Q Waves	I	1	1 (5.1)	0	1 (4.3)	2 (16.1)
		2	4 (20.3)	3 (14.0)	4 (17.3)	1 (8.1)
		3	0	2 (9.3)	3 (13.0)	1 (8.1)
Axis Deviation	II					
Left		1	5 (25.4)	7 (32.7)	14 (60.6)	4 (32.3)
Right		2	0	0	3 (13.0)	0
High Amplitude R Waves	III					
Left type		1	6 (30.5)	9 (42.1)	7 (30.3)	4 (32.3)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	2 (9.3)	0	3 (24.2)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	0	1 (4.7)	2 (8.7)	1 (8.1)
No S-T-J plus segment downward		3	0	1 (4.7)	0	1 (8.1)
S-T - J 1 mm. or more, upward segment		4	0	0	0	0
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	0
- 1 mm. to -5 mm.		2	0	0	1 (4.3)	4 (32.3)
0 ± 1.mm.		3	6 (30.5)	6 (28.0)	5 (21.6)	6 (48.4)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	3 (15.2)	0	0	1 (8.1)
Accelerated Conduction		4	0	0	3 (13.0)	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	0
Right Bundle		2	1 (5.1)	0	5 (21.6)	2 (16.1)
Incomplete Right Bundle		3	1 (5.1)	0	2 (8.7)	2 (16.1)
Intraventricular Block		4	0	0	1 (4.3)	0
Arrhythmias	VIII					
Premature Beats		1	1 (5.1)	0	1 (4.3)	1 (8.1)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	0	0	0
Supra-vent. tachycardia		4	0	0	0	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	1 (4.7)	1 (4.3)	0
Sinus tachycardia		7	4 (20.3)	6 (28.0)	4 (17.3)	0
Sinus bradycardia		8	2 (10.2)	0	1 (4.3)	0
Technically poor records	IX	8	5 (25.4)	3 (14.0)	2 (8.7)	1 (8.1)

TABLE C 8.6

RAILWAYMEN, ROME, ITALY

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (193)	45-49 (208)	50-54 (220)	55-59 (118)
Exercise tests not made or incomplete	X 1 X 2	4 (20.3)	6 (28.0)	11 (47.6)	6 (48.4)
S-T Depression post-exercise (none at rest)	XI				
S-T - J 1 mm. or more, horiz. or downward segment	1	1 (5.2)	0	5 (22.7)	2 (16.9)
S-T - J 0.5 - 1 mm., horiz. or downward segment	2	1 (5.2)	1 (4.8)	1 (4.5)	4 (33.9)
No S-T-J plus segment downward	3	1 (5.2)	0	2 (9.1)	0
S-T - J 1 mm. or more, upward segment	4	4 (20.7)	4 (19.2)	11 (50.0)	5 (42.4)
T Wave Negativity post-exercise (none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	1 (4.8)	3 (13.6)	2 (16.9)
0 ± 1 mm.	3	3 (15.6)	2 (9.6)	8 (36.4)	2 (16.9)
Arrhythmias post-exercise (none at rest)	XV 1	0	0	0	1 (8.5)
Technically poor post-exercise records	XI 8	8 (41.5)	4 (19.2)	7 (31.8)	7 (59.3)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

ECG FINDING	ECG Code	40-44	45-49	50-54	55-59
At Rest					
Large Q Waves	I 1	1 (5.1)	0	1 (4.3)	2 (16.1)
Lesser Q Waves with Negative T Waves	I 2, 3 + V 1, 2	0	0	0	0
Deeply Negative T as sole anomaly	V 1 only	0	0	0	0
Other Negative T as sole anomaly	V 2, 3 only	5 (25.4)	5 (23.4)	1 (4.3)	2 (16.9)
S-T Depression as sole anomaly	IV 1-4 only	0	3 (14.0)	1 (4.3)	0
High Amplitude R with S-T Depression	III 1 + IV 1-4	0	0	0	1 (8.1)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	1 (5.1)	0	6 (25.9)	2 (16.1)
Arrhythmias	VIII 2-6	0	1 (4.7)	1 (4.3)	0
Post-exercise					
S-T Depression as sole anomaly	XI 1-4 only	5 (25.9)	4 (19.3)	13 (59.1)	8 (67.8)
Negative T as sole anomaly	XII 1-3 only	2 (10.4)	0	4 (18.2)	3 (25.4)
Ventricular Conduction Defect as sole anomaly	XIV 1, 2, 4 only	0	0	0	0
Arrhythmias as sole anomaly	XV 1 only	0	0	0	1 (8.5)

and C8.6. Only four men showed clear evidence (Code I, 1) of old myocardial infarction. The expectation from the findings on U.S. railroad employees of the same age would be 7.18 cases but the difference is not significant; the numbers are so small that confidence limits are very wide. Similarly, the prevalence of S-T depression and of negative T waves in rest is less than among the U.S. railroad men of the same ages but the differences do not reach statistical significance.

In regard to ECG items of less interest in the present connection there were also no great differences between the railroad men in Rome and those in the United States. Left axis deviation (Code II, 1) was more common among the Romans but the difference is not statistically significant. No case of A-V block occurred in either group. Among 766 Romans not a single case of left bundle branch block (Code VII, 1) was found while there were 12 cases among 2119 U.S. railroad employees (9 among 847 sedentary clerks) and this difference approaches statistical significance.

The post-exercise records showed 18 cases of S-T depression (Code XI, 1, 2, 3) among men who did not have this finding at rest, thus bringing to 29 the total number of men with S-T depression in either rest or post-exercise. There were 5 men with T wave inversion (Code V, 1, 2) in rest and 6 more were added post-exercise. Compared with U.S. railroad employees, these results are not significantly different.

Prevalence of Hypertension and Other Variables

Men aged 40—59 employed by the Italian Railroad in Rome had a rather high prevalence, 29.2 per cent, of hypertension if a blood pressure of 95 mm. or more in diastole (fifth phase) is the criterion. This is to be compared with the rural samples in Italy — 2.9 per cent in Nicotera, 11.3 per cent in Montegiorgio, 23.5 per cent in Crevalcore. The prevalence of diastolic hypertension at different ages is shown in Table C8.7.

The difference between the Rome railroad employees and the men at Crevalcore is highly significant; chi-square = 7.133 and p = less than 0.01. The prevalence rate for the Rome men is also substantially higher than the corresponding rates for the various classes of railroad employees in the United States. However, such comparisons must be made with reservations because the possibilities of considerable differences between observers cannot be ruled out (cf. Section B2, above).

The distributions of the hypertensive Rome railroad men into their decile classes for relative body weight, Σ skinfolds, and serum cholesterol concentration are shown in Figure C8.2. There is a marked tendency for hypertension to become more prevalent as the values for each of these other variables increases and this is most dramatic for relative body weight and Σ skinfolds. It is interesting to compare the prevalence of hypertension among men in the top 20 per cent (deciles 9, 10) with those in the bottom 20 per cent (deciles 1, 2) of the distributions of each of these variables. For relative weight, these prevalences are 47.1 and 12.4 per cent, respectively; for Σ skinfolds, the figures are 50.3 and 12.4; for serum cholesterol, 41.1 and 20.3 per cent. All of these differences are highly significant.

Overweight versus Other Variables

Table C8.8 shows the prevalence of overweight by two criteria, among the men classed by age. Overweight was

TABLE C8.7

Prevalence of diastolic hypertension (95 or more, 100 or more mm Hg, fifth phase) among men classed by age. Percentage among Rome railway men who are hypertensive, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm	95 mm	100 mm
Rome railway men	25.4	15.7	32.6	21.9	26.3	18.5	35.5	25.0
Mean, 18 samples	13.6	7.9	15.6	8.9	20.9	13.5	21.5	13.8

TABLE C8.8

Prevalence of overweight (110 or more and 120 or more per cent of "standard" average for height and age). Percentage of Rome railway men, classed by age, who are overweight, compared with the average for all 18 samples of men.

SAMPLE	40-44		45-49		50-54		55-59	
	110%	120%	110%	120%	110%	120%	110%	120%
Rome railway men	45.2	25.4	47.0	24.2	41.1	17.7	44.4	21.0
Mean, 18 samples	20.9	8.4	19.4	6.9	18.1	6.7	16.8	7.3

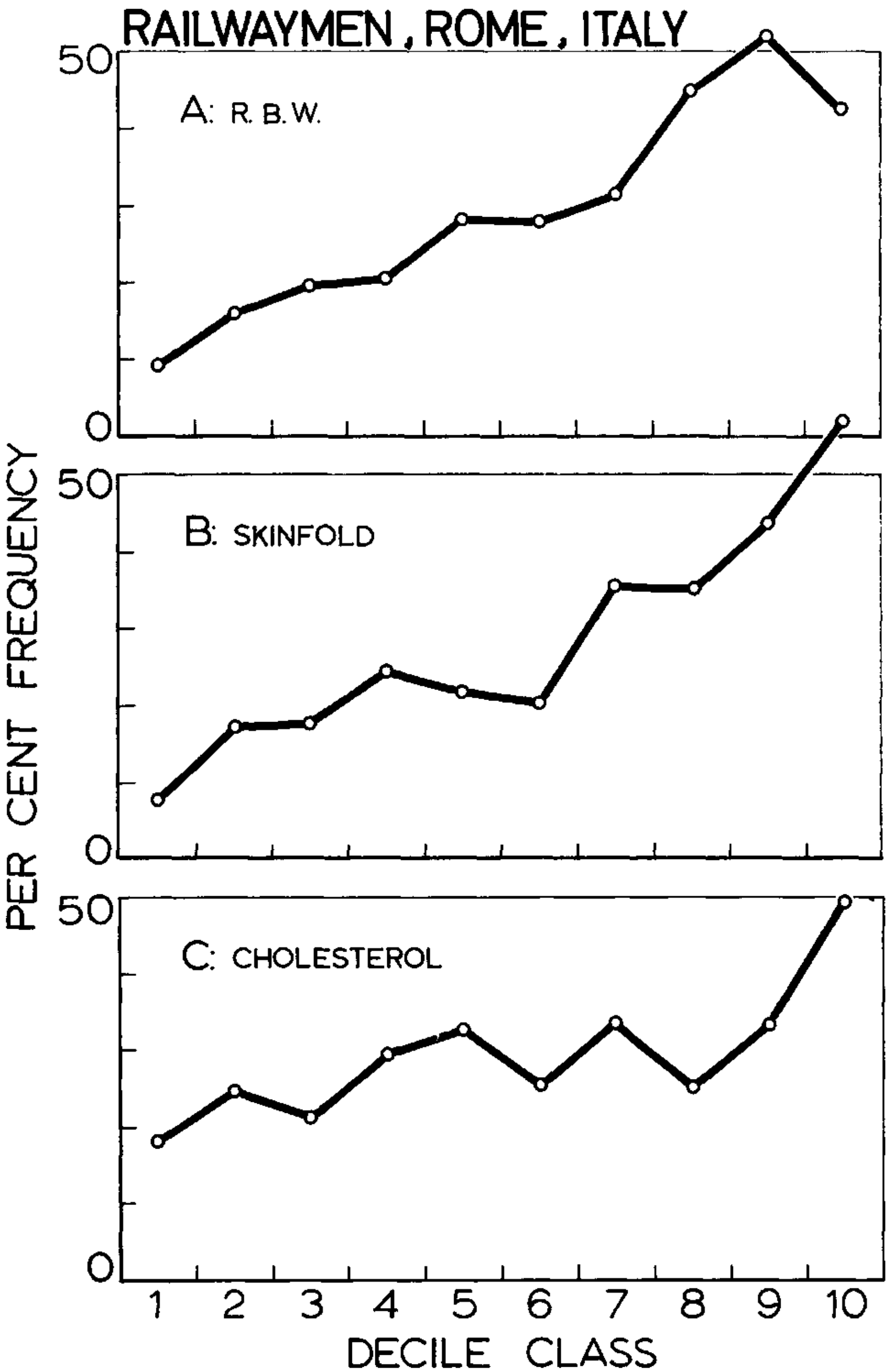
RAILWAYMEN, ROME, ITALY
A: R. B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
50
0
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C8. 2

common among the Rome railroad men. Taking 110 per cent or more of the average body weight for men of the same height and age in the Medico-Actuarial Investigations as the criterion, 23.3 per cent of the railroad men in Rome were overweight. This is to be compared with the samples of men of the same age in rural Italy — 18.1 per cent overweight in Nicotera, 20.7 per cent in Montegiorgio, 34.4 per cent in Crevalcore. Among the samples of U.S. railroad employees the prevalence of this degree of overweight ranges from 26 to 37 per cent in the several occupations.

The difference in prevalence of overweight between the Rome men and those in Crevalcore is highly significant but there is no significant difference in the comparison with Montegiorgio (chi-square = 1.278). The prevalence of overweight is significantly lower in Nicotera than among the Romans; chi-square = 4.446, p = about 0.04.

The distributions of these overweight railroad men in Rome into their decile classes for serum cholesterol and blood pressure are shown in Figure C8.3. Prevalence of overweight rises markedly with increasing values of these variables. The men with the highest serum cholesterol values (decile 10) have an overweight prevalence of 67 per cent; there is only 4 per cent overweight prevalence in the lowest cholesterol class; the corresponding figures for men classed by diastolic blood pressure are 59 and 3 per cent; among men in decile 10 in systolic pressure, 57 per cent are overweight but in decile 1 the figure is 6.5 per cent. The graphs in Figure C8.3 suggest that the relationships of the prevalence of overweight to the other variables are curvilinear upward.

Men in Rome Proper and Men Outside the City

A comparison between the railroad men in Rome itself and those stationed outside the city is, in effect a comparison between men in a great metropolis and men in the same jobs in small towns. Table C8.9 makes this comparison in terms of the number of men in each of the four occupations above and below the age-specific median of all Rome railroad men for each of six variables.

Among the 24 comparisons between men in the same occupation but working in Rome proper or outside the city, only two show statistically significant differences and these both concern body fatness. Switchmen outside Rome tend to be more often in the below-median class than expected — 23 cases observed, 17.2 expected — and the difference has chi-square = 4.41 (p = less than 0.05). Maintenance of way men show the same trend more markedly — 38 men below, 7 above the relative weight median — with chi-square = 7.96 (p = less than 0.01). These men tend to be the thinnest of all men in Rome but their counterparts outside the city are even thinner.

In one other variable maintenance of way men outside Rome tend to differ from their counterparts in Rome; outside Rome 30 of them are below and only 15 above the median, the number expected from the distribution of all maintenance of way men being 24.0. The difference has chi-square = 3.40 and p = less than 0.07.

Comparisons Between Occupations

The clerks clearly tend to be more often overweight and fat than the men in the other occupations and this is true both in Rome proper and outside the city. They also tend to be in the above-median class in both locations in all the other variables except serum cholesterol in the small group of clerks outside Rome. The maintenance of way men tend to be distinguished from the rest

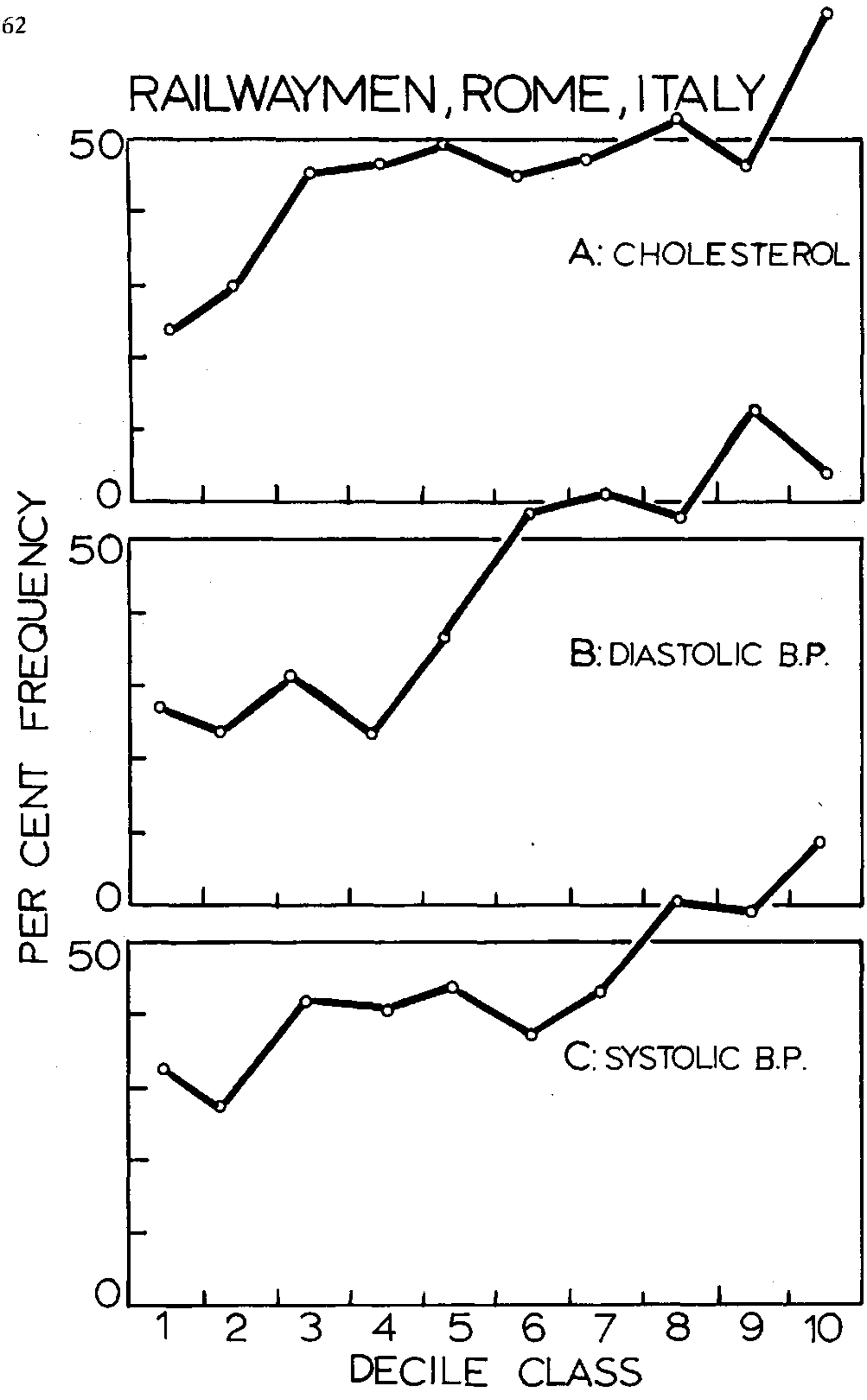
RAILWAYMEN, ROME, ITALY
50
0
A: CHOLESTEROL
50
0
B: DIASTOLIC B.P.
50
0
C: SYSTOLIC B.P.
PER CENT FREQUENCY
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C8. 3

TABLE C8.9

Numbers of Rome Railway men above and below age-specific medians for all men, by occupation and location. Occupations are Clerks (CL), Switchmen (SW), Maintenance of Way men (MW) and Electricians (EL).

		ROME PROPER				OUTSIDE ROME PROPER			
Decile	N	CL	SW	MW	EL	CL	SW	MW	EL
Σ SKINFOLDS									
1-5	380	16	42	36	58	27	44	115	42
6-10	379	44	46	20	70	78	28	60	33
RELATIVE BODY WEIGHT									
1-5	380	24	44	31	64	44	40	95	38
6-10	381	36	45	25	64	61	33	80	37
SYSTOLIC BLOOD PRESSURE									
1-5	382	30	49	25	70	47	38	87	36
6-10	379	30	40	31	58	58	35	88	39
DIASTOLIC BLOOD PRESSURE									
1-5	380	29	50	27	58	40	47	96	33
6-10	381	31	39	29	70	65	26	79	42
SERUM CHOLESTEROL									
1-5	383	24	43	32	62	53	43	97	29
6-10	374	35	44	24	66	52	30	78	45
STANDING HEIGHT									
1-5	381	16	63	34	58	38	48	95	29
6-10	380	44	26	22	70	67	25	80	46

of the railroad employees in being underweight, thin, and having low cholesterol values; they are not significantly different in regard to blood pressure. In regard to height, the maintenance of way men tend to be a little taller than the switchmen but shorter than the clerks and the electricians.

For estimation of probabilities of differences between occupations it seems reasonable to compare all clerks with all switchmen and electricians, ignoring location. Comparisons of the number of men in these two occupational categories found to be above and below the age-specific medians are summarized for six variables in Table C8.10.

There are no significant differences in systolic blood pressure or serum cholesterol but there are significant differences in all of the other variables. The most striking findings are the tendencies of the clerks to be fatter and taller than the switchmen and electricians. It is interesting that the difference in relative body weight is barely significant ($p = 0.05$) in spite of the sharp difference in body fatness. The bodies of the switchmen and electricians must have much more bone and muscle than those of the clerks.

At all ages the maintenance of way men are thinner than the men in any of the other occupations, the average Σ skinfolds being 23.7 mm., S.E. $= \pm 0.7$, compared with the next thinnest men, the switchmen, whose average was 25.5 ± 0.8 mm. But in relative body weight the order of these two groups is reversed, the averages being 106.6 $\pm$ 1.0 per cent for maintenance of way men and 105.5 $\pm$ 1.2 for switchmen. This suggests that the switchmen are less muscular than the men who maintain the roadbed.

In several respects the clerks and electricians, on the one hand, tend to differ from the switchmen and maintenance of way men on the other. The men in the former group tend to be relatively heavier, fatter, have higher blood pressures and serum cholesterol values. For example, the mean (and S.E.) values, ages 40—59, for serum cholesterol are 208.9 $\pm$ 3.3 and 213.5 $\pm$ 2.8 mg. per 100 ml. for clerks and electricians, respectively; the corresponding values for switchmen and maintenance of way men are 202.3 $\pm$ 3.1 and 202.7 $\pm$ 2.5, respectively. In the standard excercise test the recovery pulse rate, too, seemed to differentiate the occupations in the same way; averages being 106.6 $\pm$ 1.1 and 100.9 $\pm$ 1.1 beats per minute for clerks and electricians, respectively, and 96.8 $\pm$ 1.2 and 96.3 $\pm$ 1.0 for switchmen and maintenance of way men, respectively.

Salary Differences

The salaries of the Rome railroad employees in the occupations covered in the present study are highest for the station masters and lowest for the maintenance of way men, the lowest paid of the latter having only about 56 per cent of the salary of the most highly paid station masters. But in general, the salary differentials are not very large. Roughly, the pay of the maintenance of way men averages around two-thirds that of the station masters, the corresponding figures for the switchmen and electricians being more like three-fourths of the station masters' salaries.

Such differentials are not enough to mean that the men in the different occupations are grossly different in economic status. But costs of living have been rising in Italy and the margin between bare necessity and actual income is certainly substantially larger for the station masters than for the other employees and they also have a higher social status. As in other samples, socio-economic status tends to be inversely correlated with the physical activity on the job.

TABLE C8.10

Number of clerks compared with switchmen plus electricians (SW + EL) in the distribution above and below (HIGH and LOW, respectively) the age-specific medians of six measured variables of all Rome railroad men. O = observed, E = expected, Chi-Square values (one degree of freedom) calculated from all four cells of the 2 x 2 tables.

VARIABLE	OCCUPATION	LOW		HIGH		CHI-SQUARE
		O	E	O	E	
Σ Skinfolds	Clerk	43	71.6	122	93.4	28.21
	SW + EL	186	157.4	177	205.6	
Relative Wt.	Clerk	68	79.1	97	85.9	3.96
	SW + EL	186	174.9	179	190.1	
Systolic B.P.	Clerk	76	83.7	89	81.3	n.s.
	SW + EL	193	185.3	172	179.7	
Diastolic B.P.	Clerk	69	80.0	96	85.0	3.89
	SW + EL	188	177.0	177	188.0	
Serum Cholesterol	Clerk	77	78.9	87	85.1	n.s.
	SW + EL	175	173.1	185	186.9	
Height	Clerk	53	78.1	112	86.9	21.36
	SW + EL	198	172.9	167	192.1	

Summary

In the equivalent of a railroad division centered at Rome, Italy, 806 men aged 40—59, long-time employees of the Italian railroad system, were examined. Of these men 22.5 per cent were clerks, 22.2 per cent switchmen, 27.8 per cent electricians and 27.5 per cent maintenance of way men. The clerks are relatively sedentary, the maintenance of way men generally do heavy physical work, and the switchmen and electricians tend to be intermediate in physical activity.

Compared with the average of all men in the samples in these studies, these men tended to be slightly shorter, to have greater relative body weights, somewhat higher blood pressures, and to be much fatter; they corresponded closely to the general average for serum cholesterol. Compared with the men in the three samples in rural Italy, the Rome railroad men were much fatter, more often overweight, and had higher serum cholesterol values.

Most of these men smoked cigarettes, with little difference among occupations. The non-smokers among them tended to be relatively heavier and fatter and to have higher blood pressures than the smokers.

The frequency of electrocardiographic abnormalities in the Rome sample is a little lower than in the U.S. railroad samples, but the difference is not statistically significant.

The prevalence of hypertension among these Romans was much higher than in the rural Italian samples and was relatively high by any criterion. There was a marked tendency for the prevalence of hypertension to rise with increasing relative weight and Σ skinfolds; there was a similar but less striking relationship to serum cholesterol concentration.

Overweight was common among these Romans but the prevalence was not as high as in one of the rural samples of Italy. The prevalence of overweight rose greatly with increasing blood pressure and serum cholesterol values.

Comparison of the men in Rome proper and those stationed elsewhere in the area showed a significant difference only in respect to body fat; the men in Rome itself tended to be fatter than the men outside the city.

Comparisons between occupations within the railroad industry showed the clerks to have the highest values for relative body weight, Σ skinfolds, and blood pressure, being followed next by the electricians in these variables. In serum cholesterol, the electricians were highest, with the clerks second. In all of these variables the switchmen and maintenance of way men were similar.

Acknowledgments

The survey team in Rome included the following professional personnel: Drs. B. Floris, P. Marroni and L. Struglia.

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Dr. Flaminio Fidanza, the Institute of Human Physiology, University of Naples, was responsible for the analysis of serum cholesterols.

Miss Anna Bonanome provided conscientious assistance as secretary. The staff of the Stazione Termini of Rome gave enthusiastic support to the project.

C9. MEN IN VELIKA KRSNA, A SERBIAN VILLAGE

by Božidar S. Djordjević (Belgrade), Vladan Josipović (Belgrade), Srećko I. Nedelković (Belgrade), Toma Straser (Belgrade), Vladimir Slavković (Belgrade), Božidar Simić (Belgrade), Ancel Keys (Minneapolis) and Henry Blackburn (Minneapolis)

Introduction

During the survey of the rural men in Corfu, in 1961, representatives of the Faculty of Medicine of Belgrade University acted as observers. On their return to Yugoslavia interest developed in conducting parallel studies in Serbia with identical methods and arrangements to this end were made which, in effect, brought the Belgrade team into the program of cooperative studies reported here.

Velika Krsna, a village south of Belgrade, was selected to initiate the program in Serbia. Velika Krsna was chosen because the size of the population is suitable, it is within easy access by automobile from Belgrade and yet it is relatively isolated and untouched by industry and tends to remain a typical Serbian farming village of the older type. The plan was to organize a parallel study in another area of Serbia where the more primitive form of agriculture is giving way to a state-planned development of light industry. This second study is, in fact, now in operation at Zrenjanin, north of Belgrade, but the data from the initial examinations became available too late to be included in the present report.

As elsewhere in Yugoslavia, registry of the population is an important feature of the political and economic organization so it was not difficult to compile a roster of all men aged 40 through 59. Among a total of 571 men in the roster, 552 (or 96.7 per cent) were examined in the fall of 1962. During the examinations and the subsequent analysis of the data some cases of error in age were discovered and the number of men whose data are here reported is 510.

Among these men, the percentages in the age classes 40—44, 45—49, 50—54 and 55—59 were, respectively, 26.7, 15.8, 26.5 and 31.0. The peculiarity of this age structure, with an excess in the oldest class and a marked shortage of men aged 45—49, is not easily explained. The loss of men in World War II should have been greatest among the youngest men, those aged 17—22 at the start and 22—27 at the end of the war in their country. After the war, migration of Velika Krsna men to nearby Belgrade and other industrial centers should also be expected to involve the younger more than the older men. While these considerations make it understandable that the oldest men were the most numerous in 1962, the disproportions between the numbers in the 40—44 and 45—49 year-old classes is unexplained.

The identity of methods and criteria at Velika Krsna with those in the other studies in this cooperative program was assured by the experience of Professor B. S. Djordjević and Dr. V. Josipović in the survey at Corfu in 1961 and by the presence, at the start of the work at Velika Krsna, of Professor Ancel Keys and Dr. Henry Blackburn of Minneapolis and Dr. Gunnar Blomqvist of Stockholm.

Distribution of Measured Variables

Table C9.1 gives the median values, by age, of relative body weight, the sum of the skinfolds (over the triceps muscle and over the scapula), systolic and diastolic (fifth phase) blood pressure, and serum cholesterol concentration. The table also expresses these values as percentages of the averages of the medians of all men of corresponding age in the 18 samples in the present cooperative study.

In height, the Velika Krsna men show the usual slight age trend and correspond closely to the average for all samples. In relative body weight they also show a slight age trend but they are relatively seldom overweight at any age. This is understandable in view of the fact that they tend to be definitely thin. The median sum of skinfolds is only 13 mm. in the three younger age classes and only 12 mm. at ages 55—59. After allowing for the relatively invariable thickness of the true skin, the measurements indicate a median value for subcutaneous fat thickness of only 3 to 4 mm. This may be compared, for example, with the corresponding value for 13 to 14 mm. for U.S. railway clerks who are, in this sense about four times (i. e. 400 per cent) fatter than the men of Velika Krsna. The blood pressure shows a slight tendency to rise with age but in general the blood pressure is lower than the average of all the men in 18 samples and this difference is most pronounced at the oldest age.

Serum cholesterol concentration at Velika Krsna shows no age trend in these ages and is remarkably lower than even in the Japanese men at Tanushimaru but not quite as low as in the fishermen at Ushibuka, Japan.

Cumulative frequency distributions of these variables, on a probability scale, are shown in Figure C9.1. Departure from the straight line of a normal distribution on this scale is, as in other samples, notable in the distribution of the sum of the skinfolds. Height is normally distributed and the other variables are not grossly non-Gaussian in distribution. The details of these distributions are given in tables in the Appendix.

Smoking Habits

In Velika Krsna fewer men (48.3 per cent) smoke cigarettes, and more men had never smoked (40.9 per cent) than in any of the other samples in the present cooperative study. Only 13.6 per cent of the Velika Krsna men were heavy smokers, i. e. 20 or more cigarettes daily. In the percentage of men who never smoked the nearest approaches to Velika Krsna are Dalmatia (30.0), U.S. sedentary clerks (27.2) and Slavonia (26.4 per cent); it is notable that all three of the Yugoslav samples are in the list of the four samples with the largest proportion of men who had never smoked. The distribution, by age, of the men according to smoking habits is given in Table C9.2.

Some relationships between smoking habits and other variables are summarized in Table C9.3 which shows the number of men above and below the age-specific medians of the indicated variables for all Velika Krsna men. As

TABLE C9.1

Median for men at Velika Krsna and these values expressed as percentage of the average of the medians for men in all samples.

VARIABLE	MEDIAN				MEDIAN AS % OF AVERAGE			
	40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
Height, cm.	171	170	168	168	100.7	100.5	99.8	100.2
Relative Weight	89	88	88	86	90.7	91.5	92.4	91.4
Σ Skinfolds, mm.	13	13	13	12	61.3	63.7	62.8	60.3
Systolic B.P., mm.	124	128	130	130	94.7	96.2	94.9	92.5
Diastolic B.P., mm.	78	80	80	80	96.3	98.3	95.9	94.9
Serum Chol., mg.%	154	157	159	155	74.6	75.7	76.1	75.0

TABLE C9.2

Cigarette smoking habits of men of Velika Krsna. Percentage of men who never smoked, who had stopped, who smoked 1-9, 10-19, 20 or more cigarettes daily at the time of their examination.

SAMPLE	AGE	NEVER	QUIT	1-9	10-19	20 OR MORE
Velika Krsna	40-44	40.5	11.0	5.1	29.4	14.0
"	45-49	43.3	8.6	11.1	16.0	21.0
"	50-54	37.0	11.9	11.1	27.4	12.6
"	55-59	43.5	10.9	10.3	25.0	10.3
"	40-59	40.9	10.8	9.3	25.4	13.6

TABLE C9.3

Smoking. Number of men in Velika Krsna, Yugoslavia below (LOW) and above (HIGH) the age-specific medians, for age and area, of measured variables, classed according to smoking habits. HEAVY = 20 or more, OTHER = 1-19 cigarettes daily.

VARIABLE	SAMPLE	NON-SMOKERS		HEAVY		OTHER	
		LOW	HIGH	LOW	HIGH	LOW	HIGH
Relative Weight	Velika Krsna	119	144	33	35	101	75
Σ Skinfolds	"	112	151	31	37	110	66
Systolic B.P.	"	126	137	33	36	94	82
Diastolic B.P.	"	118	145	31	37	103	73
Serum Cholesterol	"	144	119	29	40	81	95

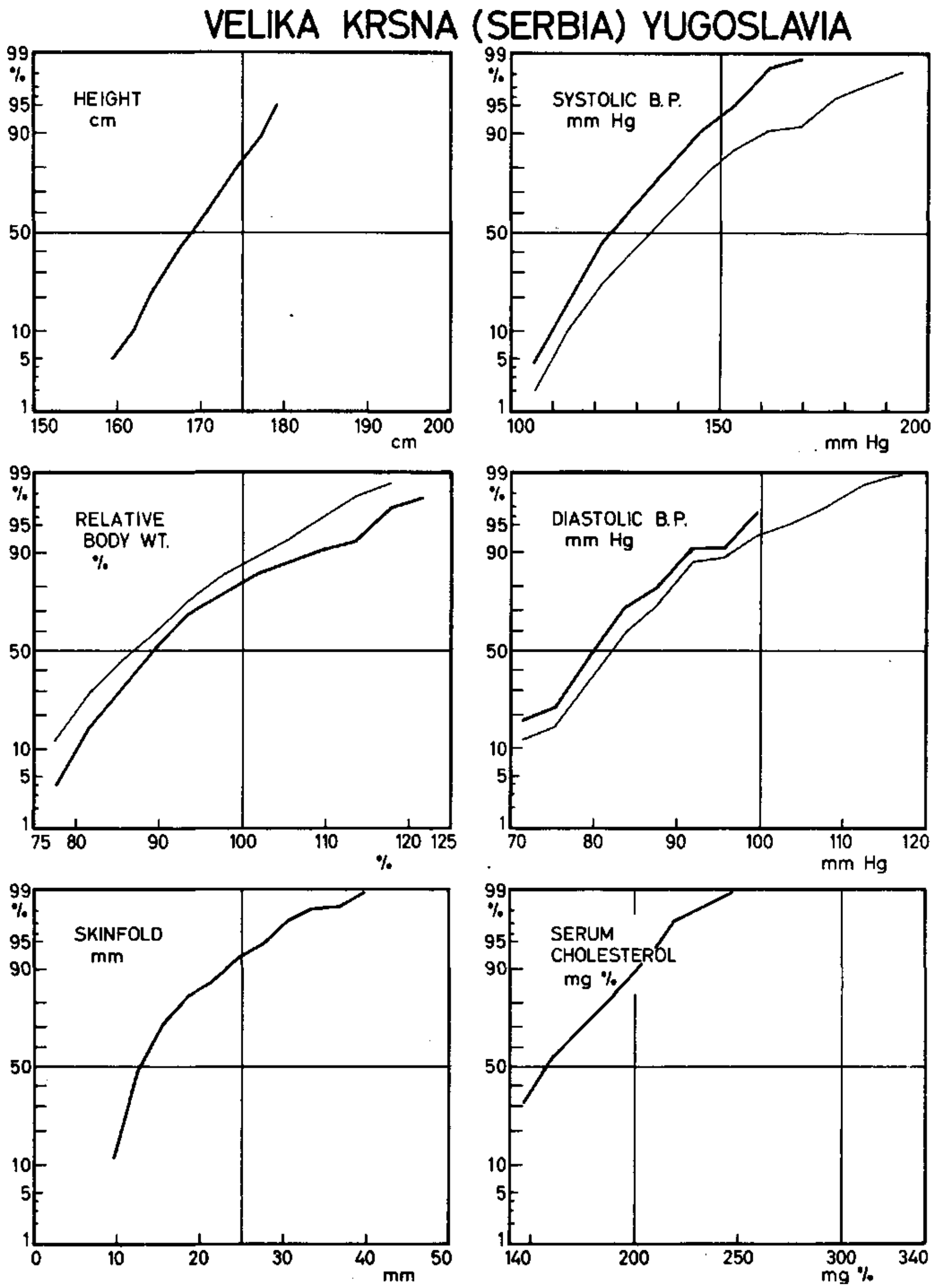
VELIKA KRSNA (SERBIA) YUGOSLAVIA
HEIGHT cm
SYSTOLIC B.P. mm Hg
RELATIVE BODY WT. %
DIASTOLIC B.P. mm Hg
SKINFOLD mm
SERUM CHOLESTEROL mg %
cm
mm Hg
%
mm Hg
mm
mg %

Figure C9. 1

in other samples of middle-aged men in these studies, non-smokers at Velika Krsna tend to differ from smokers in being more often relatively overweight and fat. The non-smokers also tend to have higher blood pressures than the smokers.

Serum cholesterol concentration seems to have a relationship to smoking habits according to the data in Table C9.3. However, there is a curious discrepancy in regard to serum cholesterol between men at Velika Krsna who never smoked and those who stopped smoking which is concealed in Table C9.3. Among "never" smokers, 121 men had cholesterol values below the cholesterol median while only 87 men were above that median. The corresponding distribution of stopped smokers is 23 men below and 32 above the median. The discrepancy between numbers of never smokers above and below the median is highly significant (chi-square $= 5.23$, $p = 0.02$) and, of course, the difference between never and stopped smokers is even less possible to ascribe to chance. No such difference between never and stopped smokers is found in regard to the other variables at Velika Krsna nor, in fact, in any of the other areas studied. A more general discussion of smoking habits and other variables is given in Section F, below.

Electrocardiographic Findings

Tables C9.4 and C9.5 summarize the electrocardiographic findings at Velika Krsna. Five records showed the major Q wave picture (Code I, 1) considered to represent definite old myocardial infarction. The prevalence of 9.8 per thousand for this finding is relatively high but, in contrast, among the Velika Krsna men the prevalence of S-T and T wave abnormalities is very low as are, in fact, any other serious abnormalities. Furthermore, the exercise tests produced a very small yield of additional ECG abnormalities — only one case of S-T depression and no negative T waves larger than 1 mm.

At Velika Krsna the most common ECG abnormality was high amplitude R waves, left type (Code III, 1). The frequency, however, is not surprising in these thin men, most of whom do heavy physical work. If these high R waves are discounted, the total frequency of significant ECG findings is extremely low at Velika Krsna.

The Prevalence of Hypertension

The data on prevalence of hypertension are summarized in Table C9.6. The prevalence of hypertension is low at Velika Krsna by any criterion — systolic pressure 140 mm. Hg or more, or 160 or more, diastolic pressure of 95 or more, or 100 or more. At all ages and with either systolic pressure criterion the men of Velika Krsna consistently exhibited a lower frequency of hypertension than the men in any of the other samples in these studies. For all ages 40—59 only 6.5 per cent has systolic pressures of 160 or more; only 5.3 per cent had diastolic pressures of 100 or more.

The prevalence of hypertension rose with age as expected. Using 95 mm. or more in diastole as the criterion, hypertension was 51 per cent more common at ages 55—59 than at ages 40—44. The distributions of these hypertensive men into the decile classes, for their ages, of relative body weight, the sum of the skinfolds, and serum cholesterol are shown in Figure C9.2.

In these figures the absence of relationships between hypertension and the other variables would be indicated by points randomly distributed about a horizontal trend line. These graphs do, in fact, correspond to the picture of lack of relationship for the sum of the skin-

TABLE C9.4

VELIKA KRSNA (SERBIA) YUGOSLAVIA

FREQUENCY OF RESTING ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code		AGE GROUP (Number of Men) 40-44 (136)	45-49 (82)	50-54 (135)	55-59 (157)
Total with reportable ECG Items	I - IX		47 (345.6)	32 (390.2)	64 (474.1)	61 (388.5)
Q Waves	I	1	0	0	2 (14.8)	3 (19.1)
		2	1 (7.4)	1 (12.2)	1 (7.4)	2 (12.7)
		3	3 (22.0)	0	0	1 (6.4)
Axis Deviation	II					
Left		1	6 (44.1)	1 (12.2)	4 (29.6)	6 (38.2)
Right		2	0	0	0	0
High Amplitude R Waves	III					
Left type		1	11 (80.9)	11 (134.1)	22 (163.0)	18 (114.6)
Right type		2	0	0	0	0
S-T Depression (rest)	IV					
S-T - J 1 mm. or more, horiz. or downward segment		1	0	0	0	1 (6.4)
S-T - J 0.5 - 1 mm., horiz. or downward segment		2	1 (7.4)	0	4 (29.6)	0
No S-T-J plus segment downward		3	0	1 (12.2)	0	1 (6.4)
S-T - J 1 mm. or more, upward segment		4	0	1 (12.2)	0	0
T-Wave Negativity (rest)	V					
- 5 mm. or more		1	0	0	0	0
- 1 mm. to -5 mm.		2	0	0	2 (14.8)	2 (12.7)
0 $\pm$ 1 mm.		3	2 (14.7)	2 (24.4)	4 (29.6)	4 (25.5)
A-V Conduction Defect	VI					
Complete Block		1	0	0	0	0
Partial Block		2	0	0	0	0
P-R over 0.21 second		3	0	0	0	1 (6.4)
Accelerated Conduction		4	0	0	0	0
Ventricular Blocks	VII					
Left Bundle		1	0	0	0	2 (12.7)
Right Bundle		2	0	0	0	4 (25.5)
Incomplete Right Bundle		3	1 (7.4)	0	2 (14.8)	0
Intraventricular Block		4	0	0	0	0
Arrhythmias	VIII					
Premature Beats		1	0	0	2 (14.8)	4 (25.5)
Ventricular tachycardia		2	0	0	0	0
Atrial fibrillation, flutter		3	0	2 (24.4)	0	2 (12.7)
Supra-vent. tachycardia		4	0	0	1 (7.4)	0
Ventricular rhythm		5	0	0	0	0
A-V nodal rhythm		6	0	0	1 (7.4)	0
Sinus tachycardia		7	3 (22.0)	1 (12.2)	3 (22.2)	1 (6.4)
Sinus bradycardia		8	1 (7.4)	1 (12.2)	3 (22.2)	1 (6.4
Technically poor records	IX	8	0	0	1 (7.4)	0

TABLE C9.5

VELIKA KRSNA (SERBIA) YUGOSLAVIA

FREQUENCY OF POST-EXERCISE ELECTROCARDIOGRAPHIC FINDINGS
(Rate per 1,000 men in parentheses)

ECG FINDING	ECG Code	AGE GROUP (Number of Men) 40-44 (136)	45-49 (82)	50-54 (133)	55-59 (157)
Exercise tests not made or	X 1				
incomplete	X 2	0	0	2 (14.8)	0
S-T Depression post-exercise					
(none at rest)	XI				
S-T - J 1 mm. or more, horiz.					
or downward segment	1	0	0	1 (7.4)	0
S-T - J 0.5 - 1 mm., horiz. or					
downward segment	2	0	0	0	0
No S-T-J plus segment downward	3	0	0	0	0
S-T - J 1 mm. or more, upward					
segment	4	1 (7.4)	1 (12.2)	3 (22.6)	5 (31.8)
T Wave Negativity post-exercise					
(none at rest)	XII				
-5 mm. or more	1	0	0	0	0
-1 to -5 mm.	2	0	0	0	0
0 ± 1 mm.	3	0	0	2 (15.0)	1 (6.4)
Arrhythmias post-exercise	XV				
(none at rest)	1	1 (7.4)	2 (24.4)	1 (7.4)	11 (70.1)
Technically poor post-exercise					
records	XI 8	1 (7.4)	1 (12.2)	2 (15.0)	4 (25.5)

FREQUENCY OF CERTAIN ECG FINDINGS AND COMBINATIONS OF CLINICAL IMPORT

ECG FINDING	ECG Code	40-44 (136)	45-49 (82)	50-54 (133)	55-59 (157)
At Rest					
Large Q Waves	I 1	0	0	2 (14.8)	3 (19.1)
Lesser Q Waves	I 2, 3 +				
with Negative T Waves	V 1, 2	0	0	0	0
Deeply Negative T as sole	V 1				
anomaly	only	0	0	0	0
Other Negative T as sole	V 2, 3				
anomaly	only	0	0	0	0
S-T Depression as sole	IV 1-4				
anomaly	only	0	1 (12.2)	0	0
High Amplitude R	III 1 +				
with S-T Depression	IV 1-4	0	1 (12.2)	3	2 (12.7)
Complete Heart Block	VI 1	0	0	0	0
Ventricular Conduction Defect	VII 1, 2, 4	0	0	0	6 (38.2)
Arrhythmias	VIII 2-6	0	2 (24.4)	2 (14.8)	2 (12.7)
Post-exercise					
S-T Depression as sole	XI 1-4				
anomaly	only	1 (7.4)	1 (12.2)	3 (22.6)	1 (25.5)
Negative T as sole	XII 1-3				
anomaly	only	0	0	2 (15.0)	0
Ventricular Conduction Defect as	XIV 1, 2, 4				
sole anomaly	only	0	0	0	0
Arrhythmias	XV 1				
as sole anomaly	only	1 (7.4)	1 (12.2)	1 (7.5)	7 (44.6)

TABLE C9.6

Prevalence of hypertension and overweight among men in Velika Krsna, Yugoslavia. Percentages of men classed by criteria: Systolic B.P. 140 or more and 160 or more; Diastolic B.P. 95 or more and 100 or more mm. Hg; Relative body weight 110 or more and 120 or more per cent.

SAMPLE	AGE	NO.	SYSTOLIC		DIASTOLIC		OVERWEIGHT	
		MEN	140	160	95	100	10%	20%
Velika Krsna	40-44	136	11.8	1.5	8.8	3.7	9.6	2.2
	45-49	82	23.2	3.7	9.8	3.7	9.8	2.4
	50-54	135	28.1	8.1	11.9	5.2	4.4	1.5
	55-59	158	40.5	10.8	13.3	7.6	3.8	1.3

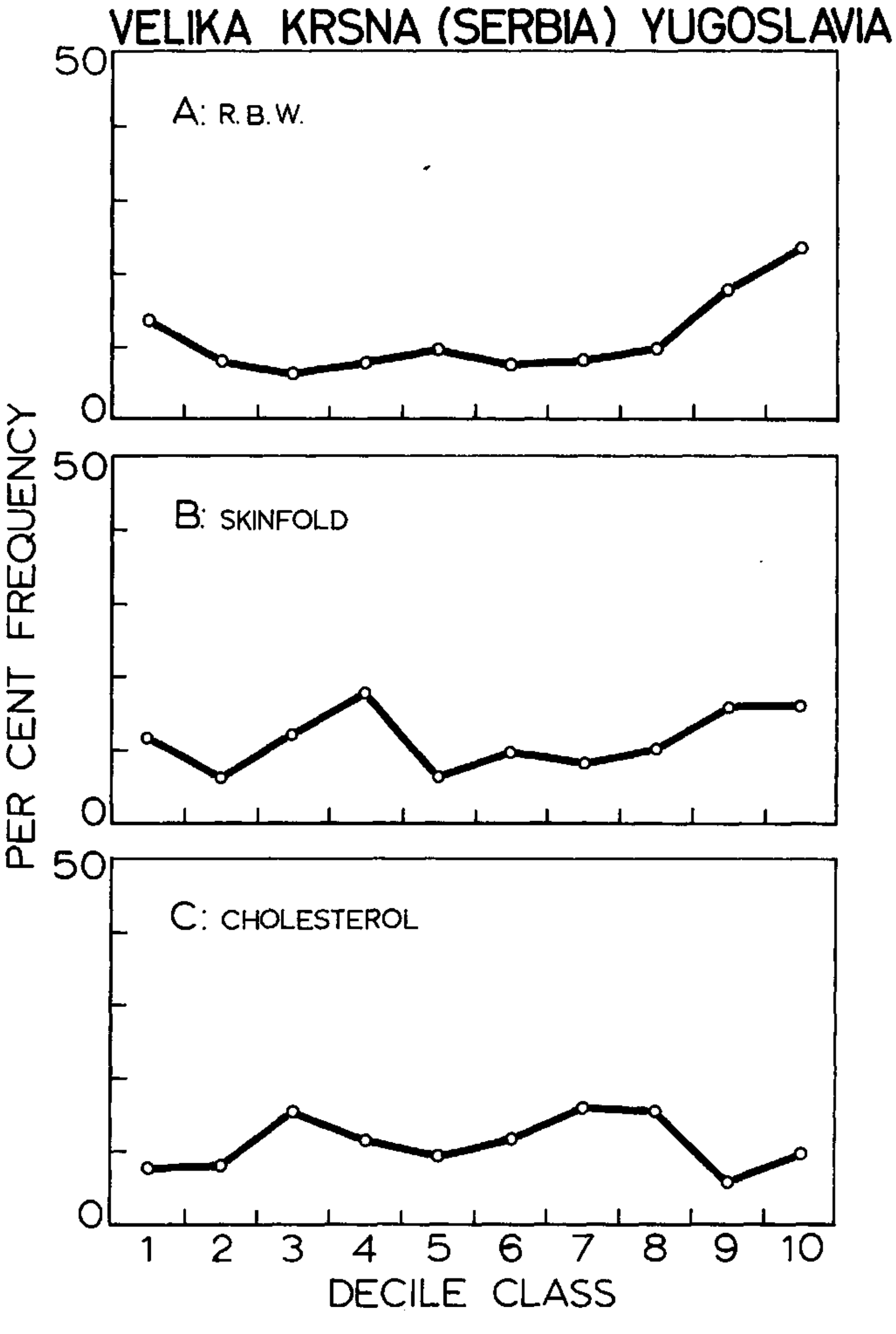
VELIKA KRSNA (SERBIA) YUGOSLAVIA
A: R.B.W.
B: SKINFOLD
C: CHOLESTEROL
PER CENT FREQUENCY
50
0
1 2 3 4 5 6 7 8 9 10
DECILE CLASS

Figure C9. 2

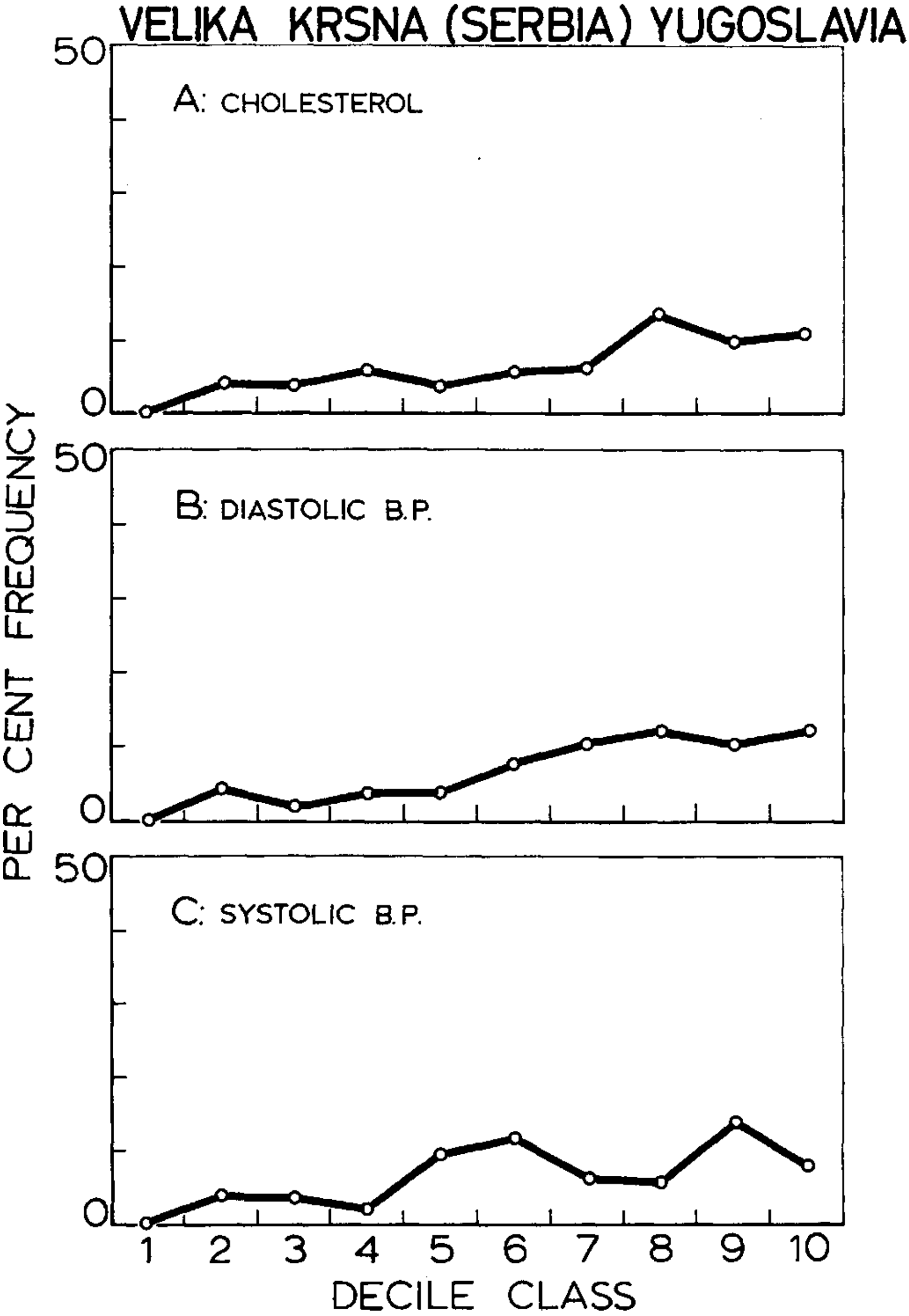
VELIKA KRSNA (SERBIA) YUGOSLAVIA
A: CHOLESTEROL
B: DIASTOLIC B.P.
C: SYSTOLIC B.P.
PER CENT FREQUENCY
50
0
1
2
3
4
5
6
7
8
9
10
DECILE CLASS

Figure C9. 3

folds and serum cholesterol. For relative body weight it appears that hypertension is unduly common in the top deciles, i. e. among the men in the top 20 or top 10 per cent of the relative weight distribution.

Prevalence of Overweight

It was noted above that the men of Velika Krsna tend to have low relative body weights. However, there are some cases of overweight in that sample. The data are shown in Table C9.6. If 110 or more per cent of the "standard" average body weight for height and age is the criterion, only 4.8 per cent of Velika Krsna men are overweight. The distributions of the overweight men, with relative body weight of 110 or more per cent, into the decile classes, for their ages, of serum cholesterol and blood pressure are shown in Figure C9.3.

Obviously, there is a definite trend for the prevalence of overweight to increase with increasing values of all three of these other variables. The numbers are small but the trends seem to be roughly linear.

Summary

In the fall of 1962 a study was made of 552 men aged 40—59 in the Serbian farming village of Velika Krsna. Methods and criteria were identical with those in the other surveys in the cooperative studies reported in this monograph. The men examined represented 96.7 per cent of all men of these ages in Velika Krsna.

Data are presented on height, relative body weight, body fatness (sum of skinfold thicknesses over the triceps muscle and over the tip of the scapula), smoking habits and electrocardiographic findings on 510 men. Compared with the averages for all samples of men in these studies, the men of Velika Krsna are of medium height, relatively underweight, markedly thin, seldom hypertensive and have strikingly low serum cholesterol concentrations. Apart from 5 men with old myocardial infarction, electrocardiographic abnormalities were relatively uncommon at Velika Krsna.

Smoking is less common at Velika Krsna than in the other samples. Compared with smokers, the non-smokers at Velika Krsna have higher relative body weights and thicker skinfolds and tend to have higher blood pressures.

Hypertension at Velika Krsna shows little relationship to body fatness or serum cholesterol but is most common among men in the top 20 per cent of the relative body weight distribution. Overweight is rare in Velika Krsna. The prevalence of overweight increases with increasing serum cholesterol and with increasing blood pressure.

Acknowledgments

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The team who conducted the work at Velika Krsna was headed by Prof. Božidar S. Djordjević and included Doctors Borica Balog, Ljubica Bozinovic, Vladan Josipovic, Veronika Macarol, Petar Milutinovic, Srecko Nedeljkovic, Aleksander Simic, Božidar Simic, Vladimir Slavkovic, Gradimir Stojanovic, Tomas Straser, and Nurse Desa Lovric. Advice and assistance at the start of the work were provided by Prof. Ancel Keys and Doctors Henry Blackburn and Gunnar Blomqvist.

D. PHYSICAL ACTIVITY, OCCUPATION AND SOCIO-ECONOMIC STATUS

Introduction

In many populations where there are large socio-economic differences between classes, coronary heart disease is reported to be much less common in the laboring class than in the middle and upper classes. Though most of these reports suffer from defects of sampling and many of them raise questions about criteria, a real difference in susceptibility can scarcely be doubted. Because this contrast in susceptibility between socio-economic classes is commonly associated with obvious differences in the average level of physical activity, it is tempting to conclude a cause and effect relationship.

But in these populations the socio-economic classes also differ in many other respects — differences in the incidence of infectious and parasitic diseases, in housing and exposure to thermal stresses, in medical care, in the quantity and character of the diet, and often in the use of alcohol and tobacco. Even differences in emotional status and "stress" may be suggested, though this is only speculation.

In Great Britain, where such socio-economic differences are less extreme but not negligible, an important etiological role of physical activity *per se* has been proposed on the basis of statistical studies of mortality records and autopsy reports (Morris. *et al.*, 1953; Morris and Crawford 1958; Morris, 1962). Some evidence in apparent confirmation has been reported from elsewhere. Physicians' reports in one study in the U.S.A. indicated that sedentary townsmen are more prone to myocardial infarction than farmers who are more active physically (Zukel, *et al.*, 1959). In a cross-sectional survey in rural Finland it was found that lumberjacks, who do very heavy physical work, have fewer abnormal electrocardiograms than other Finnish men of the same age (Karvonen, *et al.*, 1961).

However, many studies in countries where socio-economic contrasts are not extreme have produced equivocal or even contradictory results (Chapman, *et al.*, 1957; Spain and Bradess, 1957; Forssman and Lindegaard, 1958; Stamler, *et al.*, 1960; Paul, *et al.*, 1963). H. L. Taylor (1962) has reviewed this question and pointed out the difficulty in drawing valid conclusions from the evidence available at present.

Obviously, the question of the possible role of physical activity in the etiology of coronary heart disease requires much more study. One approach is to compare men who differ in occupations and in habitual physical activity in regard to the distribution of other characteristics presumed to be associated with differences in susceptibility to the disease. The data in the present investigations are relevant.

The study of U.S. Railroad employees deliberately selected specific occupations which were presumed to require different degrees of physical activity. A major feature of the study design was to compare clerks with switchmen who are comparable in economic status but who differ in physical activity. Comparisons of railroad employees in different occupations, presented in Section C1, above, failed to show important differences in the variables of concern here but it should be noted that detailed studies of the work of the men in these several occupations in the railroads indicated that the differences in physical activity are not as large as had been expected. These questions are discussed in Section C1, above.

Within the population samples studied in Europe there are larger differences in both physical activity and socio-economic status than between the railroad occupations studied in the U.S.A. However, in these populations the differences in physical activity are related to occupation and tend to be associated with substantial differences in economic circumstance and mode of life in other respects, including the diet. In these samples the subjects were classified in respect to both occupation and habitual physical activity and the analysis below will examine both factors. Some of the data were briefly considered above in Sections C2—C6, inclusive.

Comparison of activity or occupational groups in regard to relative body weight, Σ skinfolds, blood pressure and serum cholesterol in these series are readily made by observing the distribution of the men in the decile classes of the measured variables. It will be recalled that in each area all men in each quinquennial age group were classed, in respect to each variable of measurement, into 10 groups or decile classes of equal size, the 10 per cent of men with the lowest relative body weight being in decile class 1 for that variable, and so on. Accordingly, since each man was thereby classed in comparison with all of the other men of his age in the same area, the decile classification has the same relative meaning for men in all age groups and in all areas. This fact allows combination of men of different ages and even in different areas in order to provide numbers adequate for statistical analysis.

The measured variables considered here are relative body weight, body fatness (Σ skinfolds), arterial blood pressure and serum cholesterol. In relation to coronary heart disease, the upper ends of the distributions of these variables are of greatest interest. Accordingly, attention will be focussed on the upper 30 per cent (deciles 8—10) and top 10 per cent (decile 10) of the age- and sample-specific distributions.

A natural grouping of samples emerges from consideration of the frequency of coronary heart disease in the several areas. In this respect, the two Finnish samples and the men of Zutphen are distinguished from the samples in Croatia, rural Italy and Greece. Another grouping would be based on general economic status of the areas; interestingly, this consideration leads to the same separation — Finland and the Netherlands on the one hand, Croatia, rural Italy and Greece on the other. These two groupings, labelled A and B, respectively, for convenience, are used in the subsequent analysis.

Physical Activity — Socio-Economic Status Ignored

Tables D1 and D2 summarize the observed versus the expected (chance) frequency of high values of the several variables, "high" being the upper 30 per cent (deciles 8—10) of the distribu-

TABLE D1

Men with HIGH values (deciles 8-10) for the variables indicated, distributed by physical activity in East and West Finland and in Zutphen. Among all men in these samples, 13.4, 31.8, and 54.8 per cent were in Activity Classes 1, 2, and 3, respectively. Numbers of men expected = the distribution if physical activity were unrelated.

VARIABLE	TOTAL N HIGH	N OBSERVED HIGH, % OF EXPECTED Act. 1	Act. 2	Act. 3
Relative Weight	728	144.5	109.7	83.5
Σ Skinfolds	736	174.4	108.1	77.1
Systolic B.P.	721	108.7	95.2	100.7
Diastolic B.P.	718	119.5	103.4	93.3
Serum Cholesterol	728	114.8	93.3	100.3

TABLE D2

Men with HIGH values (deciles 8-10) for the variables indicated, distributed by physical activity in Dalmatia, Slavonia, Crevalcore, Montegiorgio, Crete, and Corfu. Among all men studied in these areas 10.9, 22.5, and 66.6 per cent were in Activity Classes 1, 2, and 3, respectively. Numbers of men expected = the distribution if physical activity were unrelated.

VARIABLE	TOTAL N HIGH	N OBSERVED HIGH, % OF EXPECTED Act. 1	Act. 2	Act. 3
Relative Weight	1260	163.9	122.0	82.1
Σ Skinfolds	1245	185.7	122.5	78.4
Systolic B.P.	1273	123.9	110.7	92.5
Diastolic B.P.	1263	128.5	112.6	91.1
Serum Cholesterol	1240	124.3	119.0	89.6

tions. The trend is similar in both groups of samples; the least active men are most apt to be relatively high in all of the five variables in both groups of samples. In terms of the degree of departure of observation from chance expectation, Σ skinfolds, and relative body weight are most striking but the concetrations of high values for systolic and diastolic blood pressure and serum cholesterol in Activity Class 1 are also statistically significant except for systolic blood pressure in the A group of samples.

On the other hand, the men characterized by the highest physical activity are under-represented in deciles 8—10 of these variables and this discrepancy too is significant for all variables for sample group B and for samples A + B combined though not for systolic blood pressure or serum cholesterol in the A group of samples considered alone.

Table D3 concerns the question as to whether high values of the measured variables are more common among sedentary men (Activity 1) than among moderately active men (Activity 2). The answer is yes for all variables and the difference is statistically significant for all variables expect serum cholesterol (chi-square $= 3.59$, $p = 0.06$) and systolic blood pressure (chi-square $=$ 3.41, $p = 0.07$).

Tables D1—D3 concern the men in the top 30 per cent of the distributions. Table D 4 summarizes the analysis of the data for the top 10 per cent (decile 10) of the distributions when men in Activity Class 1 are compared with those in Class 2. Among the men in Activity Class 1 the number observed to be in decile 10 of relative body weight is 21.1 per cent in excess of the expectation from the proposition that the relative weight distribution is similar in these two activity classes. The comparable figure for deciles 8—10 of relative weight is 22.4 per cent excess in Activity Class 1.

The data in Table D4 suggest that the influence of physical activity on the distribution of men with high values increases as we go to greater extremes of the variables of Σ skinfolds and blood pressure but does not change in regard to relative weight or serum cholesterol.

Consideration of Socio-Economic Status

The apparent significance of physical activity indicated in Tables D1—D4 is, of course, confounded with other factors that tend to be associated with differences in physical activity in these populations. It is notable that the major contribution to the differences related to physical activity in the fore-going data is made by the men in Activity Class 3. But most of these men are in a lower socio-economic class than the rest of the men. The question, then, is how to eliminate, or at least to reduce the confounding effect of variability in socio-economic status in examing the relationship between physical activity and the tendency to have high values of the variables of interest.

Consideration of occupation offers some help. Among the various occupations (see Occupation Code in the Appendix), those coded 1—13 generally connote a higher socio-economic status in these populations than the average of the rest of the occupations (Code numbers 14—94, excluding number 93, "student", which is not represented at these ages). These are professional men, executives, government officials (not including the lower civil service), proprietors, land owners, etc. They include almost no men in Activity Class 3 but they are not all sedentary and from questioning them at the time of examination they were placed in Clas-

TABLE D3

Number of men with high values (deciles 8-10) observed (O) and expected (E), if physical activity were unrelated. All 9 samples summed. "TOTAL N" = total men in all deciles 1-10 in Activity Classes 1 and 2.

VARIABLE	ACTIVITY 1		ACTIVITY 2		TOTAL
	O	E	O	E	N
Relative Weight	366	298.9	600	667.1	2508
Σ Skinfolds	424	320.5	596	699.5	2530
Systolic B.P.	277	256.4	535	555.6	2505
Diastolic B.P.	292	264.3	556	583.7	2535
Serum Cholesterol	280	259.4	548	568.6	2455

TABLE D4

Distribution of men with highest values (decile 10) into physical Activity Classes 1 and 2, compared with the distribution of men with high values (deciles 8-10). Table entries are numbers of men observed expressed as percentages of the numbers expected if physical activity played no role.

VARIABLE	DECILES 8-10		DECILE 10	
	Act. 1	Act. 2	Act. 1	Act. 2
Relative Weight	122.4	89.9	121.1	90.5
Σ Skinfolds	132.3	85.2	144.8	79.4
Systolic B.P.	108.0	96.3	115.8	92.7
Diastolic B.P.	110.5	95.3	120.9	90.6
Serum Cholesterol	107.9	96.4	107.4	96.6

ses 1 or 2 according to their description of their work and recreation. This last statement requires qualification; the interviewers in the field were not always careful to ask searching questions about the actual physical activity; when time was pressing there was a tendency to automatically assign farmers to Class 3 and professional men to Class 1. As a result, distinction between physical activity and socio-economic status is blurred and any independent contribution of socio-economic status that may appear in the subsequent analysis will be under-estimated.

With these reservations, an obvious approach is to compare men in the same activity class but differing in socio-economic status as judged by occupation. Another approach is to compare men in different activity classes but in the same general socio-economic classification. Because even Occupations 1—13 cover a wide range of socio-economic status, this last approach will probably over-estimate the independent significance of physical activity.

Physical Activity versus Socio-Economic Status

The analysis of physical activity and of socio-economic status as factors related to the distribution of men into age- and area-specific decile classes of the measured variables is illustrated by the example of relative body weight of the men in Activity Classes 1 and 2 in East Finland, West Finland and Zutphen (group A of samples). The data are given in detail in Table D5.

In this example there are two results:

1) When occupational class is constant, the men in Activity Class 1, compared with those in Class 2, who were observed to have high relative body weight (in the top 30 per cent of the age- and area-specific distribution of relative weight) numbered 141, while the chance expectation is 127.6 men. The excess is 10.5 per cent and activity alone is not significant (chi-square = 3.10, p = 0.08).

2) When physical activity class is constant, the men in Occupation Classes 1—13, compared with those in Classes 14—94, who were observed to have high relative weight numbered 128, while the chance expectation is 93.2 men. The excess is 37.3 per cent and occupational status alone is very highly significant (chi-square = 26.43, p = much less than 0.001).

Table D6 summarizes the analysis, made as in Table D5, of physical Activity Class 1 vs. Class 2, occupational class constant, and of Occupations 1—13 vs. 14—94, physical activity class constant, in respect to the distribution of the men in the A group of samples into the age- and area-specific deciles 1—7 and 8—10 for the five measured variables. Compared with Activity Class 2, the men in Activity Class 1 include excessive numbers of men with high values in all variables, but the observed distribution is significantly different from chance expectation only in the case of Σ skinfolds. When the men in Occupations 1—13 are compared with those in Occupations 14—94, the excess numbers observed tend to be larger and the deviations from expectations are statistically significant in all variables except blood pressure. Table D7 gives the same analyses for the B group of samples. Again the picture is similar.

Table D8 further condenses the data and gives the observed numbers of men in deciles 8—10 as percentages of the numbers expected. Table D8 also gives the chi-square values for the distributions. In regard to relative body weight and Σ skinfolds, the segregation of relatively overweight and obese men by the occupation classification is consider-

TABLE D5

Physical Activity Class 1 vs. Class 2 compared with Occupational Classes 1-13 vs. 14-94 in regard to the distribution of men with high relative body weight (age- and area-specific deciles 8-10). Sample group A (East and West Finland, Zutphen). O = observed number, E = expected number.

LINE	ACTIVITY CLASS	OCCUP. CLASS	DECILES 1-7		DECILES 8-10		DECILES 1-10	
			O	E	O	E	O	%
1	1	1-13	56	59.9	70	66.1	126	51.64
2	2	"	60	56.1	58	61.9	118	48.36
3	1+2	"	116		128		244	100.00
4	1	14-94	127	136.5	71	61.5	198	23.02
5	2	"	466	456.5	196	205.5	662	76.98
6	1+2	"	593		267		860	100.00
7	1	L. 1+L. 4	183	196.4	141	127.6	324	
8	2	L. 2+L. 5	526	512.6	254	267.4	780	
9	1	1-13	56	71.2	70	54.8	126	38.89
10	1	14-94	127	111.8	71	86.2	198	61.11
11	1	1-94	183		141		324	100.00
12	2	1-13	60	79.6	58	38.4	118	15.13
13	2	14-94	466	446.4	196	215.6	662	84.87
14	2	1-94	526		254		780	100.00
15	L. 9+L. 12	1-13	116	150.8	128	93.2	244	
16	L. 10+L. 13	14-94	593	558.2	267	301.8	860	

TABLE D6

Physical Activity Class 1 vs. Class 2 compared with Occupational Classes 1-13 vs. 14-94. Summarized from calculations as in Table D5. Sample Group A (East Finland, West Finland, Zutphen).

VARIABLE	ACTIVITY CLASS	OCCUP. CLASS	DECILES 1-7 O	DECILES 1-7 E	DECILES 8-10 O	DECILES 8-10 E
Relative Weight	1	Constant	183	196.4	141	127.6
" "	2	"	526	512.6	254	267.4
Relative Weight	Constant	1-13	116	150.8	128	93.2
" "	"	14-94	593	558.2	267	301.8
Σ Skinfolds	1	Constant	158	190.6	172	139.4
" "	2	"	540	507.4	253	285.6
Σ Skinfolds	Constant	1-13	106	143.1	143	105.9
" "	"	14-94	592	554.9	282	319.1
Systolic B.P.	1	Constant	223	236.7	105	101.3
" "	2	"	542	528.3	218	221.7
Systolic B.P.	Constant	1-13	178	170.6	71	68.4
" "	"	14-94	587	594.4	252	254.6
Diastolic B.P.	1	Constant	212	221.3	115	105.8
" "	2	"	550	540.7	236	245.2
Diastolic B.P.	Constant	1-13	161	166.8	87	81.2
" "	"	14-94	601	595.2	264	269.8
Serum Cholesterol	1	Constant	211	218.4	112	104.6
" "	2	"	538	530.6	216	223.4
Serum Cholesterol	Constant	1-13	150	167.7	96	78.3
" "	"	14-94	599	581.3	232	249.7

TABLE D7

Physical Activity Class 1 vs. Class 2 compared with Occupational Classes 1-13 vs. 14-94. Summarized from calculations as in Table D5. Sample Group B (Dalmatia, Slavonia, Crevalcore, Montegiorgio, Crete, Corfu).

VARIABLE	ACTIVITY CLASS	OCCUP. CLASS	DECILES 1-7 O	DECILES 1-7 E	DECILES 8-10 O	DECILES 8-10 E
Relative Weight	1	Constant	238	264.1	225	198.9
" "	2	"	606	579.9	346	372.1
Relative Weight	Constant	1-13	114	155.5	158	116.5
" "	"	14-94	730	688.5	413	454.5
Σ Skinfolds	1	Constant	213	254.8	252	210.2
" "	2	"	599	557.2	343	384.8
Σ Skinfolds	Constant	1-13	102	138.1	156	119.9
" "	"	14-94	710	673.9	439	475.1
Systolic B. P.	1	Constant	291	302.7	172	160.3
" "	2	"	637	625.3	317	328.7
Systolic B. P.	Constant	1-13	171	176.0	101	96.0
" "	"	14-94	757	752.0	388	393.0
Diastolic B. P.	1	Constant	286	297.3	177	165.7
" "	2	"	639	627.7	320	331.3
Diastolic B. P.	Constant	1-13	163	175.5	111	98.5
" "	"	14-94	762	749.5	386	398.5
Serum Cholesterol	1	Constant	278	281.6	168	164.4
" "	2	"	600	596.4	332	335.6
Serum Cholesterol	Constant	1-13	153	162.7	104	94.3
" "	"	14-94	725	715.3	396	405.7

TABLE D8

Activity 1 vs. Activity 2, Occupation Class constant; Occupations 1-13 vs. Occupations 14-94, Activity Class constant. "O/E, %" = numbers of men observed in deciles 8-10 as % of number expected. Chi-square calculated from the 2 x 2 tables, distributions observed and expected in deciles 1-7 and 8-10. "A" = East Finland, West Finland, Zutphen; "B" = Dalmatia, Slavonia, Crevalcore, Montegiorgio, Crete, Corfu.

VARIABLE	ACTIVITY CLASS	OCCUPATION CLASS	SAMPLES	O/E, %	CHI-SQUARE
Relative Weight	1	Constant	A	110.5	3.10
" "	"	"	B	113.1	8.67
" "	Constant	1-13	A	137.3	26.43
" "	"	"	B	135.6	31.38
Σ Skinfolds	1	Constant	A	123.4	18.43
" "	"	"	B	119.9	22.30
" "	Constant	1-13	A	135.0	28.62
" "	"	"	B	130.1	24.29
Systolic B. P.	1	Constant	A	103.7	n.s.
" "	"	"	B	107.3	n.s.
" "	Constant	1-13	A	103.8	n.s.
" "	"	"	B	105.2	n.s.
Diastolic B. P.	1	Constant	A	108.7	n.s.
" "	"	"	B	106.8	n.s.
" "	Constant	1-13	A	107.2	n.s.
" "	"	"	B	112.7	n.s.
Serum Cholesterol	1	Constant	A	107.1	n.s.
" "	"	"	B	102.2	n.s.
" "	Constant	1-13	A	122.6	7.23
" "	"	"	B	110.3	n.s.

ably greater than that achieved by the activity classification. Neither classification is very powerful in segregating men with relatively high blood pressure. For segregating high serum cholesterol, the occupational classification tends to be more effective than the activity classification but the difference is small.

Tables D6, D7 and D8, compared with Tables D3 show some of the extent to which differences in the distributions of high values of the variables, attributed to physical activity, are affected when account is taken of occupational status as well. The relationship of physical activity, *per se*, to high values of the variables is obviously over-estimated in Tables D1—D3.

Summary

The prevalence of specified high relative body weight and Σ skinfolds within samples is strongly related, inversely, to the estimated physical activity of the men in the sample. Similar relationships, but much less marked, tend to hold for arterial blood pressure and for serum cholesterol concentration. But it is necessary to allow for influences of socio-economic differences in estimating the influence of physical activity *per se*.

Without regard to physical activity, men may be classified into two broad socio-economic classes, an upper class made up of professional men, landowners, executives, important government officials, etc., and a lower class made up of all men in other occupations. The upper class so defined, contains men in Activity Class 1 (sedentary and light activity) and Class 2 (moderately active) but almost no men in Class 3 (heavy physical activity). This upper class of men shows a high concentration of relatively overweight and obese men and also tends to contain more men than expected with high blood pressure and high serum cholesterol values.

When men matched in socio-economic class but differing in physical activity are compared (Activity Class 1 vs. Class 2), the more sedentary men still tend to include undue numbers of men with high values of the measured variables but the apparent influence of physical activity is much less than when socio-economic class was ignored.

When men matched in physical activity but differing in socio-economic status are compared, the men in the upper class still tend to include undue numbers of men with high values of the measured variables but the apparent influence of socio-economic status is less than when physical activity is ignored.

E. ANTHROPOMETRIC INDICES AND SKELETAL FORM

Introduction

Various suggestions have been made about the possibility that susceptibility to coronary heart disease is related to the "constitution", that is to say to body or skeletal type (cf., e.g., Müller, 1909; Catsch, 1941; Kretschmer, 1955). Classification systems and methods for measuring of appraising body type still are far short of any accepted standardization, but there is a fair degree of agreement that coronary heart disease tends to be unduly common among men of the pyknic or athletic-pyknic types of Kretschmer (1955), i. e. the stocky, sturdy type as contrasted with the lanky, lean, slight, leptosomatic or asthenic type (or types).

Burkhardt (1939) concluded, from pathological-anatomic studies on 1232 cases, that persons with the pyknic physique are inclined to early arteriosclerosis but that at older ages this difference in susceptibility tended to disappear. Schettler (1961, p. 128) reached a similar conclusion from materials collected at Basle and Marburg, and Selberg (1951) reported that the development of aortic arteriosclerosis was some 20 years later among leptosomes than among pyknics.

The problem of differentiating the influence of basic skeletal type from concomitant characteristics in regard to relative obesity is illustrated by the work of Böhle *et al.* (1958), who reported a high dominance of the pyknic type among 321 men and 61 women with coronary heart disease and also noted that about half of the patients of both sexes were obese.

In the United States most attention in regard to coronary heart disease has been given to the "somatotype" classification of Sheldon *et al.*, (1940) because of the influential study of Gertler and White (1954) on young men (under 40) with clinical coronary heart disease among whom the "endomorphic-mesomorph" somatotype was much more common among the patients than among the control subjects. Confirmation of these findings was provided by Spain *et al.* (1953, 1963), particularly in a large study on men aged 36—50 in New York, and by Paul *et al.* (1963) in a follow-up study of industrial employees in Chicago.

The endomorphic-mesomorph of Sheldon corresponds in some degree to the mixed pyknic-athletic type of Kretschmer, a type that has been specially singled out as coronary-prone by Bähr (1938) and Linzbach (1959). Excessive frequency of coronary heart disease among "well-built", athletic type of soldiers in the British army was commented on by Newman (1946).

Somatotyping in Sheldon's system is

a relatively subjective rating that appeared to be unsuitable for our cooperative research programs with different populations. On the other hand, a quantitative description of certain aspects of the body type can be provided by the anthropometric items covered in these studies — standing height, sitting height, bi-acromial and bi-cristal diameters. Relative body weight is, of course, a crude mixture of influences of body type, muscular development, and body fat.

The ratio of sitting to standing height is obviously a crude measure of relative trunk plus head length compared with leg length; a high ratio suggests a stocky person, or at least one aspect of stockiness. Unfortunately, this ratio is not only determined by the skeletal components; the thickness of the buttocks is included in the sitting height, so the sitting height measurement of a steatopygous person will yield an erroneously high value for estimated trunk length.

Another and perhaps better indication of the place in the stockiness-leanness continuum is the laterality-linearity index, defined as the ratio of the sum of the bi-acromial and bi-cristal diameters to the body length or standing height. A high value for this index indicates a relatively broad skeletal framework.

The masculinity-femininity continuum of skeletal type would seem to be accessible to appraisal by means of the ratio of the bi-acromial to the bi-cristal diameters, a high index being the result of relatively wide shoulders and narrow hips and an indication of a more "masculine" type of skeleton.

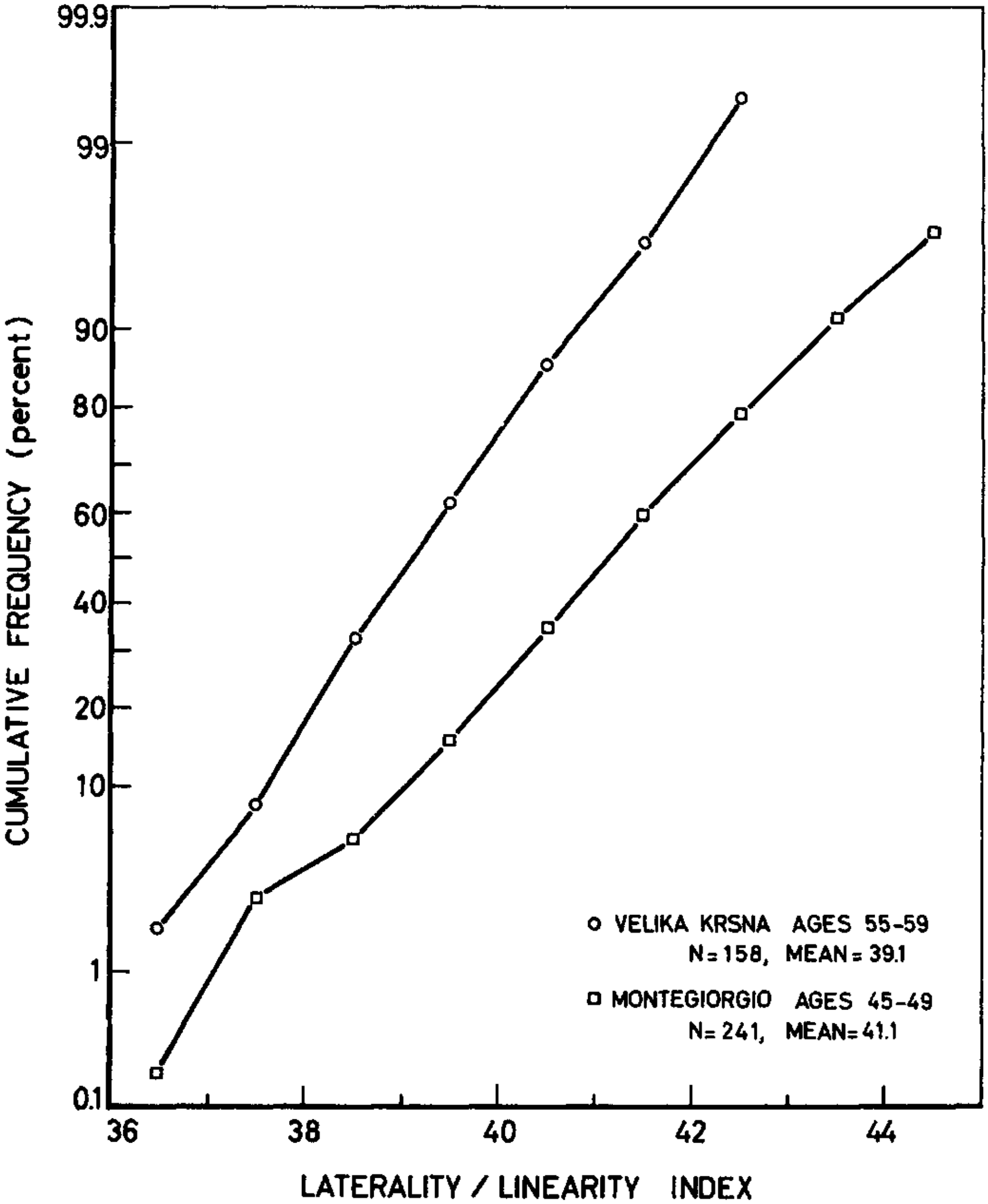
These three indexes, plus relative body weight and the sum of the skinfolds, by no means give a full and detailed picture of the "constitution" but it must be noted that, in fact, there is no agreement on what the "constitution" is supposed to be. However, these are quantitative variables, objectively measured and their distributions in the several population groups and comparisons with other variables merit examination.

Laterality-Linearity Index (L-L)

The laterality-linearity index (L-L) is the ratio of the sum of the bi-acromial and bi-cristal diameters to the total body length (standing height). This index proves to be normally distributed, thus simplifying the presentation and analysis of the data. Figure E1 gives two contrasting examples of the cumulative percentage frequency distribution plotted on a probability scale. Besides showing normality of the distributions, Figure E1 shows that the men of Montegiorgio and Velika Krsna differ; the men aged 55—59 of Velika Krsna are more linear (the index is smaller) than the men aged 45—49 of Montegiorgio.

Table E1 gives the means and standard deviations for the laterality-linearity index, by 5-year age groups, of the various samples of men. With the exception of East Finland and Slavonia, there is a general tendency for the values to rise slightly with age and this trend is significant in several of the samples (e. g. U.S.A. Switchmen, West Finland, Montegiorgio, Corfu). Such an age trend would be expected from a decrease of height with age with no change in the diameters of the girdles.

As noted above, the men of Velika Krsna differ significantly from those of Montegiorgio in being more linear in skeletal framework. In general, the most linear men are those of Velika Krsna and the railroad employees in the U.S.A., while the most lateral men (relatively broad skeletal form) are those in Montegiorgio, Crevalcore and Corfu, the other populations being intermediate.



99.9
99
90
80
60
40
20
10
1
0.1
CUMULATIVE FREQUENCY (percent)
36
38
40
42
44
LATERALITY / LINEARITY INDEX
○ VELIKA KRSNA AGES 55-59
N = 158, MEAN = 39.1
□ MONTEGIORGIO AGES 45-49
N = 241, MEAN = 41.1

Figure E1

TABLE E1

Laterality-Linearity index, mean values and standard deviations by 5-year age classes.

GROUP	AGES							
	40-44		45-49		50-54		55-59	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
U.S. Switchmen	39.3	1.4	39.4	1.5	39.6	1.5	39.7	1.4
U.S. Sedentary Clerks	39.0	1.4	39.4	1.7	39.6	1.6	39.5	1.6
Dalmatia	39.7	1.3	40.2	1.4	40.1	1.3	40.2	1.4
Slavonia	40.6	1.5	40.8	1.4	40.7	1.7	40.7	1.5
East Finland	39.9	1.6	40.0	1.6	39.9	1.6	39.8	1.2
West Finland	39.6	1.4	39.6	1.5	40.0	1.5	40.1	1.6
Crevalcore	40.5	1.9	40.6	1.9	40.8	1.6	40.8	2.1
Montegiorgio	40.8	1.6	41.1	1.8	41.2	1.7	41.5	1.8
Zutphen	39.6	1.5	39.8	1.5	39.8	1.6	40.0	1.6
Crete	40.1	1.5	40.1	1.5	40.1	1.4	40.2	1.3
Corfu	40.3	1.7	40.4	1.6	40.7	1.9	40.8	1.5
Velika Krsna	38.8	1.4	39.3	1.3	39.3	1.3	39.1	1.4
Rome Railway Men	41.0	1.5	41.3	1.5	41.2	1.6	41.3	1.6
All Men (mean, unweighted)	39.9	--	40.2	--	40.2	--	40.3	--

TABLE E2

Numbers of "LATERAL" (L-L = 41 or more) and "LINEAR" (L-L = under 40) men in the top (FAT) and bottom 20 per cent class of fatness (Σ skinfold decile classes 9 + 10 and 1 + 2 respectively). TOTAL N = number men in Σ skinfold decile classes 1, 2, 9, and 10.

SAMPLE	TOTAL N:		FAT LATERAL MEN		Chi^2
	LINEAR	LATERAL	OBSERVED	EXPECTED	
U.S. Switchmen	178	87	72	41.7	60.91
U.S. Sedentary Clerks	174	92	72	44.6	48.08
Dalmatia	90	99	67	50.8	20.90
Slavonia	50	161	94	83.2	11.20
Crevalcore	96	230	157	122.8	67.53
Montegiorgio	51	178	118	98.7	36.03
East Finland	118	123	89	63.8	40.59
West Finland	134	114	82	58.8	33.38
Zutphen	148	118	73	59.0	11.10
Crete	83	110	82	58.7	44.14
Corfu	50	108	67	56.1	12.80
Velika Krsna	127	28	17	12.8	2.37
Rome Railway Men	33	213	123	116.6	8.20
All Men	1332	1661	1113	853.5	363.3

Before accepting the reality of these indicated differences, it is necessary to consider two questions of the technical measurement. First, it may be asked whether a relatively high value for the index may not be, in part, an artifact produced by inclusion of the skin and subcutaneous fat in the diameter measurements. Though these tissues do contribute to the recorded diameters, except in very obese men the sites chosen have only a relatively thin overlay of soft tissue and this is reduced still further by compression with the pelvimeter.

The second question is whether slight differences in the technique of measurement of the diameters might be involved. This seems most unlikely because the differences, though small, are much greater than variations observed in measurements made by different investigators with the same subjects. A difference of 1.5 in the index, as between 39.5 and 41.0, for example, corresponds, at equal height of 170 cm., to a difference of 25.5 mm. in the sum of the two diameters, a value much greater than could be attributed to any ordinary differences in technique.

In regard to possible relationships between the laterality-linearity index and susceptibility to coronary heart disease, it is useful to explore the relationships between L-L and other variables that are believed to be associated with differences in susceptibility. For example, do men with high index values (relatively broad and stocky) tend to be unduly fat or to have elevated serum cholesterol values?

Table E2 summarizes the analysis of this question with regard to the sum of the skinfolds. Men who have an index value, L-L, under 40 are classed as "linear"; men with L-L = 41 or more are classed as "lateral". The distributions were obtained of "thin" and "fat" men (in Σ skinfold decile classes 1, 2 and 9, 10 respectively) into these L-L classes. The resulting 2×2 tables for each sample are condensed in Table E2 which also gives the chi-square value calculated from each 2×2 table.

In every case there is an excess of fat men (in the top 20 per cent of the distribution of sum of skinfolds for their age and sample) in the class of "lateral" men. The probability of obtaining the observed distribution by chance is vanishingly small in all cases except Velika Krsna. Hence it appears that men with wide skeletons tend to be represented with undue frequency among the fattest men, while the men with narrow skeletons congregate among the thinnest men. The result that emerges from this analysis is highly significant statistically and may also be biologically important. On the other hand, computation of the ordinary product-moment coefficient of correlation between these two variables produces small of negligible coefficients. This does not necessarily mean that there is a real discrepancy in the two sets of results but it does emphasize the point, discussed in Section B5, that serious errors may be produced by over-reliance on the product-moment coefficient of correlation when either of the variables concerned departs from a normal distribution or there is a non-linear relationship between the variables.

The same approach as with L-L versus body fatness was used in the examination of the relationship between diastolic blood pressure and the laterality-linearity index and the results are summarized in Table E3. In all samples there was an excess of the more lateral men in the top 20 per cent of the blood pressure distribution but this tendency was statistically significant within single samples only in the U. S. railway men, in East Finland, at Crevalcore, Zutphen and Crete; in the latter six samples p = less than 0.02 in every case. For all samples considered together, the average is an excess of 11.2

TABLE E3

Numbers of "LATERAL" (L-L = 41 or more) and "LINEAR" (L-L = under 40) men in the top (HIGH B. P.) and bottom 20 per cent classes of diastolic blood pressure (deciles 9, 10 and 1, 2, respectively). Total N = number of men in diastolic B. P. decile classes 1, 2, 9 and 10.

SAMPLE	TOTAL N		HIGH B. P. LATERAL MEN		Chi^2
	Linear	Lateral	Observed	Expected	
U.S. Switchmen	169	77	48	38.5	6.13
U.S. Sedentary Clerks	180	84	53	42.3	7.24
Dalmatia	85	97	50	48.0	n. s.
Slavonia	48	155	87	81.7	2.54
Crevalcore	99	230	129	117.4	7.06
Montegiorgio	44	190	102	98.2	n. s.
East Finland	132	92	58	42.4	16.83
West Finland	130	120	65	57.6	3.06
Zutphen	145	119	72	60.4	7.54
Crete	86	101	61	50.8	8.15
Corfu	52	110	58	54.3	n. s.
Velika Krsna	123	32	17	16.9	n. s.
Rome Railroad Men	43	205	109	105.0	n. s.
All Men	1336	1612	909	812.0	50.98

TABLE E4

Numbers of "LATERAL" (L-L = 41 or more) and "LINEAR" (L-L = under 40) men in the top (HIGH CHOL.) and bottom 20 per cent classes of serum cholesterol concentration (deciles 9, 10 and 1, 2, respectively). TOTAL N = number of men in cholesterol decile classes 1, 2, 9 and 10.

SAMPLE	TOTAL N		HIGH CHOL. LATERAL MEN		Chi^2
	Linear	Lateral	Observed	Expected	
U.S. Switchmen	168	76	46	38.9	3.30
U.S. Sedentary Clerks	179	76	38	37.0	n. s.
Dalmatia	91	98	50	47.2	n. s.
Slavonia	54	157	75	78.1	n. s.
Crevalcore	99	211	112	105.5	2.14
Montegiorgio	43	186	109	97.5	13.91
East Finland	132	89	42	43.1	n. s.
West Finland	81	153	78	79.1	n. s.
Zutphen	139	108	47	50.3	n. s.
Crete	76	101	63	52.5	9.24
Corfu	52	97	57	51.4	3.05
Velika Krsna	121	32	20	16.7	n. s.
Rome Railway Men	37	210	117	115.6	n. s.
All Men	1272	1594	854	806.5	12.52

per cent men with high blood pressure among the more lateral men and this deviation from chance expectation has the extraordinary value of chi-square = 50.98. The conclusion is that, in general, hypertension tends to be more common among the men with skeletons of the more lateral type than among men with small values for L-L.

Finally, this approach was applied to serum cholesterol concentration. The results are summarized in Table E4. The more lateral men tend to be represented with unexpectedly high frequency in the more hypercholesterolemic class of men in nine of the 13 samples but this trend is statistically significant only at Montegiorgio, Crete and Corfu. The trend among U. S. switchmen does not quite reach $p = 0.05$. For all samples combined there is a highly significant tendency for the more lateral men to have relatively high values for serum cholesterol.

Ratio of Sitting to Standing Height (S/S)

The ratio of sitting to standing height is normally distributed; two examples are given in Figure E2. Table E5 summarizes the data on 100 × the ratio of sitting to standing height (S/S) in the various population samples. Two points are clear in Table E5. In the first place, the variability of S/S is small, the standard deviation being only of the order of 2.5 per cent of the mean. Accordingly, even what at first sight may seem to be only trivial differences between mean values can be highly significant, statistically, when the numbers are fairly large, as they are in these samples.

The same methods were used in all samples and the same instructions about the technique of measurement were issued to all of the research teams, but it is impossible to insist that the values for S/S for the various samples are completely comparable. These height measurements seem to be so simple that it is difficult to persuade physicians and technicians about the great care needed in adjusting the posture to assure that the measurements are, in fact, always strictly comparable. However, within any one sample where the same observer made all of these measurements, the effect of variation and poor control of technique should merely increase the random error and comparisons between sub-samples should be valid.

For the present purposes, men with values of S/S = 54 or more are considered to be relatively "squatty" i. e. short-legged, while values of S/S = under 53 are relatively "lanky". It is of interest to ignore the men with intermediate values of S/S and to inquire how the characteristics of obesity, high blood pressure and high serum cholesterol concentration are distributed between the squatty and lanky men as defined here. The method used for this analysis is the same as used above in the analysis of laterality-linearity, i. e. attention is focussed on the bottom and top 20 per cent classes of the other variables considered.

Table E6 summarizes the results for the sum of the skinfolds. In all samples except Zutphen there is an excess of fat men in the squatty class and this is highly significant in most of the samples. For all samples combined there is an excess of 20.4 per cent of obese men in the squatty class and chi-square has the extremely high value of 100.20. In part, of course, this result may be an artifact in that fat men (with thick skinfolds) may also have fat buttocks which, in turn, will contribute to their sitting height. It seems unlikely, however, that this can explain all of the association between "squattiness" and the sum of the skinfolds. The difference between S/S = 53 and S/S = 54 corresponds to a difference of 1.8 cm. in sitting height when standing height =

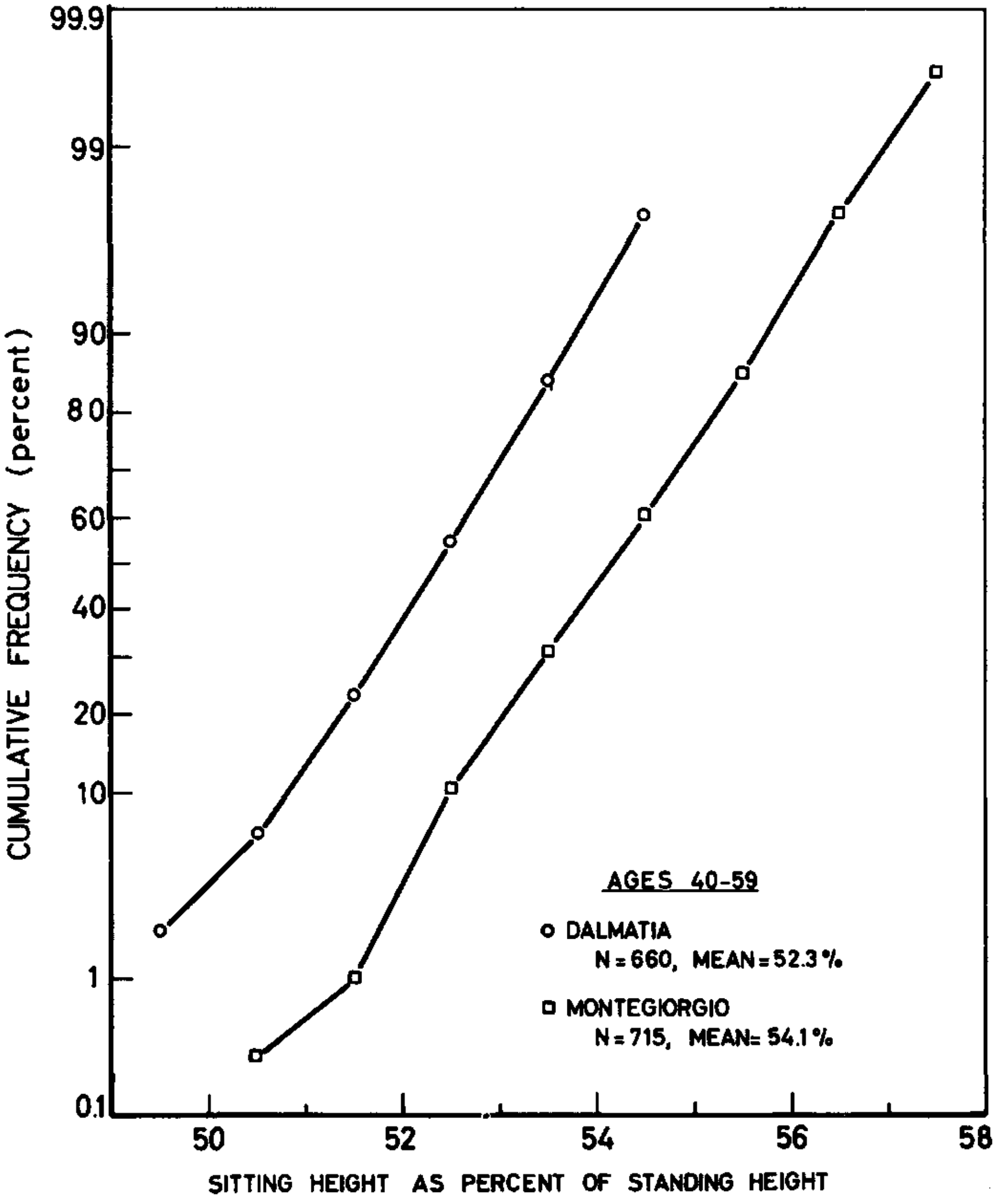

99.9
99
90
80
60
40
20
10
1
0.1
CUMULATIVE FREQUENCY (percent)
50
52
54
56
58
SITTING HEIGHT AS PERCENT OF STANDING HEIGHT
AGES 40-59
DALMATIA
N = 660, MEAN = 52.3 %
MONTEGIORGIO
N = 715, MEAN = 54.1 %

Figure E2

TABLE E5

Sitting height as per cent of standing height, mean values and standard deviation by 5-year age classes.

SAMPLE	AGES 40-44 Mean	S.D.	45-49 Mean	S.D.	50-54 Mean	S.D.	55-59 Mean	S.D.
U.S. Switchmen	52.8	1.39	52.7	1.32	52.5	1.35	52.6	1.11
U.S. Sedentary Clerks	52.5	1.26	52.6	1.29	52.6	1.27	52.4	1.28
Tanushimaru	54.6	1.40	54.5	1.37	54.6	1.66	54.6	1.36
Dalmatia	52.3	1.18	52.2	1.37	52.3	1.32	52.4	1.20
Slavonia	52.5	1.17	52.5	1.39	52.5	1.35	52.3	1.30
East Finland	52.3	1.40	53.6	1.39	53.3	1.48	53.2	1.41
West Finland	52.8	1.37	52.9	1.24	52.6	1.41	52.5	1.41
Crevalcore	52.9	1.48	52.7	1.37	52.6	1.35	52.7	1.46
Montegiorgio	54.3	1.24	54.2	1.28	54.0	1.35	54.0	1.28
Zutphen	52.7	1.42	52.7	1.30	52.4	1.37	52.4	1.24
Crete	53.6	1.40	53.4	1.51	53.0	1.54	52.9	1.33
Corfu	53.1	1.23	52.7	1.45	52.9	1.38	52.9	1.35
Velika Krsna	52.5	1.29	52.5	1.28	52.4	1.21	52.4	1.48
Rome Railway men	53.7	1.42	53.6	1.36	53.5	1.42	53.6	1.22
Mean, all men (unweighted)	53.04	--	53.06	--	52.94	--	52.92	--

TABLE E6

Numbers of "SQUATTY" (S/S = 54 or more) and "LANKY" (S/S = under 53) men in the top (FAT) and bottom 20 per cent age-specific Σ skinfold classes (deciles 1, 2 and 9, 10, respectively). Total N = men in Σ skinfold decile classes 1, 2, 9 and 10.

SAMPLE	TOTAL N Lanky	Squatty	FAT SQUATTY MEN Observed	Expected	100(O/E)	Chi^2
U.S. Switchmen	175	86	59	43.5	135.6	15.61
U.S. Sed. Clerks	168	73	46	35.1	131.1	8.40
Dalmatia	139	39	31	20.2	153.5	14.02
Slavonia	148	51	32	25.1	127.5	4.32
Crevalcore	171	93	58	44.7	129.8	10.90
Montegiorgio	33	189	118	105.6	111.7	21.39
East Finland	76	148	82	78.0	105.1	n.s.
West Finland	140	102	62	53.5	115.9	4.35
Zutphen	164	84	40	40.6	98.5	n.s.
Crete	60	126	76	65.7	115.7	9.47
Corfu	77	86	57	42.7	133.5	18.75
Velika Krsna	104	47	29	22.7	127.8	4.16
Rome Railroad Men	53	150	90	81.3	110.7	6.92
All Men	1508	1274	780	648.0	120.4	100.20

170 cm. and a contribution of 1.8 cm. of buttocks fat to the sitting height must be rare. We conclude, then, that men with the squatty type of skeletal constitution are inclined to be fatter than their lanky counterparts.

No such question of a possible artifact exaggerating the true relationship is raised in connection with diastolic blood pressure as summarized in Table E7. In 9 out of 13 samples the squatty men have an undue frequency of relatively high blood pressure and in 3 of these the tendency approaches or actually is significant. For all samples considered together, the squatty men include an excess of 6.6 per cent cases of relatively high blood pressure and this is statistically highly significant ($p =$ about 0.001).

Finally, Table E8 is concerned with S/S vs. high values for serum cholesterol. In 10 out of 13 samples the squatty men show an unexpected excess of men in the top 20 per cent of the age- and area-specific serum cholesterol distribution and this tendency is statistically significant in 3 of the samples. For all samples considered together, the excess of high cholesterol cases among squatty men averages 7.8 per cent and this is significant at $p =$ less than 0.001.

Bi-Acromial/Bi-Cristal Diameters, A/C

As indicated earlier, the ratio of the bi-acromial to the bi-cristal diameter A/C, may be considered to be some kind of an indication of the relative masculinity-femininity of the skeleton. Accordingly, it seemed to be desirable to examine the relationship, if any, between A/C and other variables of interest in connection with the tendency to coronary heart disease. The distribution of A/C is such that it was decided to concentrate on values of $A/C = 1.34$ and over and $A/C =$ under 1.28, these being relatively "tapered" and "straight", or "masculine" and "feminine", respectively. The ratio A/C is generally distributed normally; three examples are shown in Figure E3.

The distributions of men with these values for A/C into the bottom and top (deciles 1, 2 and 9, 10) 20 per cent classes for Σ skinfolds, diastolic blood pressure and serum cholesterol were determined for each of 13 samples; no significant results were obtained for any sample except in the Rome railroad employees.

In the Rome sample, 38 men with A/C of 1.34 or more were in deciles 9, 10 for Σ skinfolds but the chance expectation would be 53.2 men; (chi-square $= 17.28$, $p =$ less than 0.001), so it is concluded that in Rome there was a shortage of fat men in this more "masculine" grouping. Also in the Rome sample, the men with A/C of 1.34 or more included fewer cases (45) than expected (55.5) of relatively high diastolic blood pressure (chi-square $= 8.13$, $p =$ less than 0.01). But when all samples are considered together there were no significant differences between these extreme classes of A/C in regard to observed vs. expected frequency of high values of Σ skinfolds, diastolic blood pressure, or serum cholesterol.

Laterality-Linearity and ECG Abnormalities

Possible relationships between laterality-linearity index. L-L and the frequency of electrocardiographic abnormalities were sought by constructing two-by-two tables for L-L vs. each of five ECG abnormalities for each of 13 samples of men. For all 13 samples considered together, among the more lateral men a total of 151 cases of left axis deviation (Code II, 1) were observed but only 136.3 cases was the chance ex-

TABLE E7

Numbers of "SQUATTY" (S/S = 54 or more) and "LANKY" (S/S = under 53) men in the top (HIGH B.P.) and bottom 20 per cent age-specific diastolic blood pressure classes (deciles 1, 2 and 9, 10, respectively). Total N = men in diastolic B.P. decile classes 1, 2, 9 and 10.

SAMPLE	TOTAL N		HIGH B.P. SQUATTY MEN			Chi^2
	Lanky	Squatty	Observed	Expected	100(O/E)	
U.S. Switchman	175	87	52	44.2	117.6	3.67
U.S. Sed. Clerks	170	72	42	37.5	112.0	n.s.
Dalmatia	143	51	27	27.3	99.0	n.s.
Slavonia	143	53	26	26.0	100.0	n.s.
Crevalcore	157	113	63	57.8	109.0	n.s.
Montegiorgio	33	200	109	104.7	104.1	n.s.
East Finland	69	158	81	83.5	97.0	n.s.
West Finland	129	111	65	55.5	117.1	5.43
Zutphen	166	76	45	36.4	123.6	3.55
Crete	73	120	64	61.6	103.9	n.s.
Corfu	73	67	36	33.0	109.1	n.s.
Velika Krsna	111	35	18	18.0	100.0	n.s.
Rome Railroad Men	51	159	75	73.4	102.2	n.s.
All Men	1493	1302	703	659.2	106.6	10.81

TABLE E8

Numbers of "SQUATTY" (S/S = 54 or more) and "LANKY" (S/S = under 53) men in the top (HIGH CHOL.) and bottom 20 per cent age-specific serum cholesterol classes (deciles 1, 2 and 9, 10, respectively). Total N = men in serum cholesterol decile classes 1, 2, 9 and 10.

SAMPLE	TOTAL N		HIGH CHOL. SQUATTY MEN			Chi^2
	Lanky	Squatty	Observed	Expected	100(O/E)	
U.S. Switchmen	172	81	50	41.6	120.2	4.54
U.S. Sed. Clerks	158	84	39	42.7	91.3	n.s.
Dalmatia	148	38	22	19.8	111.1	n.s.
Slavonia	136	48	28	21.1	132.7	4.69
Crevalcore	166	93	51	49.6	102.8	n.s.
Montegiorgio	26	171	98	94.6	103.6	n.s.
East Finland	76	152	77	75.3	102.3	n.s.
West Finland	135	107	54	54.4	99.3	n.s.
Zutphen	158	82	46	39.0	117.9	3.14
Crete	62	115	65	56.5	115.0	6.36
Corfu	71	70	38	35.2	108.0	n.s.
Velika Krsna	104	38	20	18.7	107.0	n.s.
Rome Railroad Men	49	155	84	99.8	105.3	n.s.
All Men	1461	1234	672	623.2	107.8	13.96

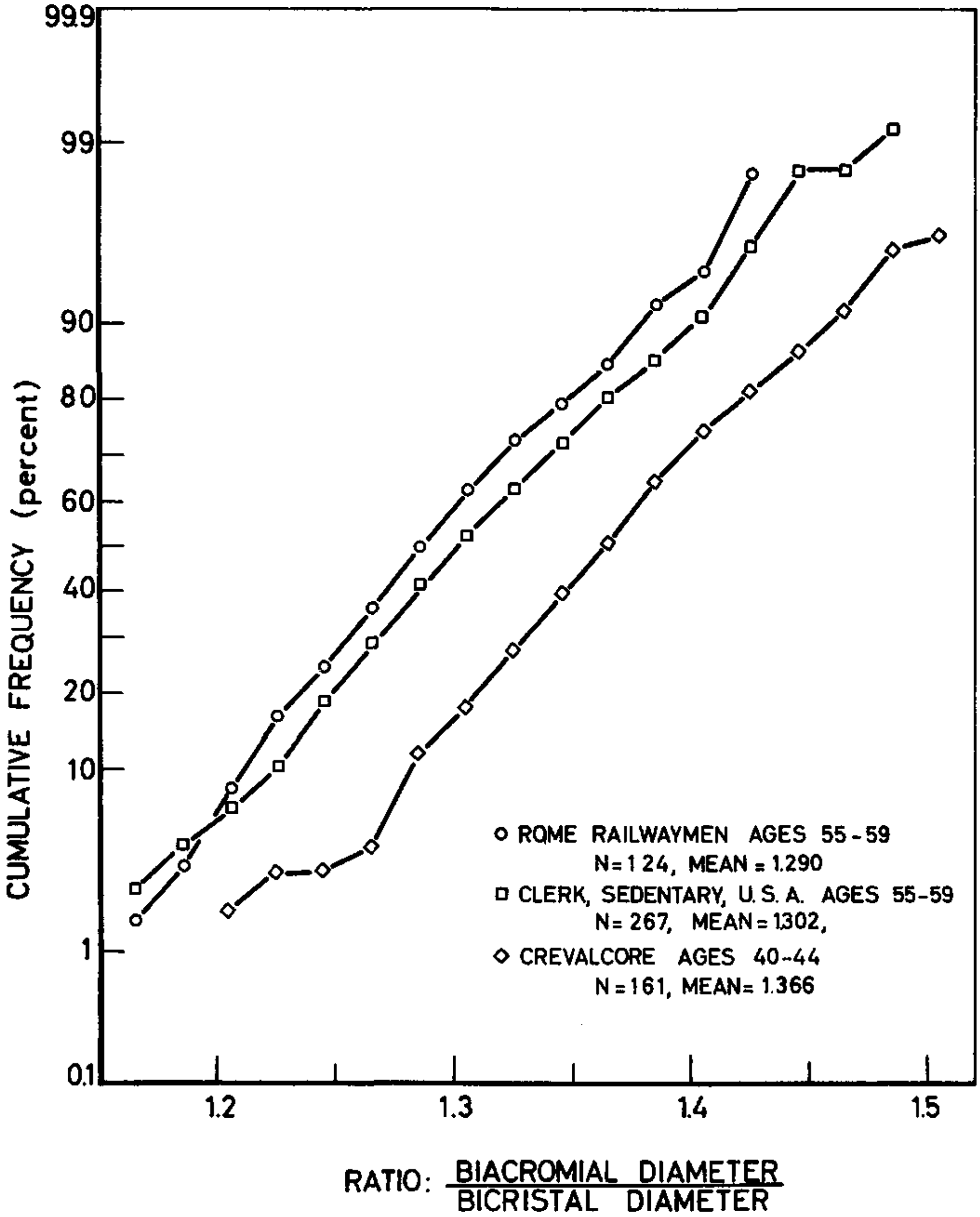

99.9
99
90
80
60
40
20
10
1
0.1
CUMULATIVE FREQUENCY (percent)
1.2
1.3
1.4
1.5
RATIO: BIACROMIAL DIAMETER / BICRISTAL DIAMETER
○ ROME RAILWAYMEN AGES 55-59
N=124, MEAN = 1.290
□ CLERK, SEDENTARY, U.S.A. AGES 55-59
N=267, MEAN=1.302,
◇ CREVALCORE AGES 40-44
N=161, MEAN=1.366

Figure E3

pectation (chi-square = 7.54, p = less than 0.01). Similarly, among all the more lateral men there were 229 cases of high R wave, left type (Code III, 1) but 263.0 would be expected (chi-square= 20.49, p = less than 0.001).

In the individual samples the analysis was generally unrewarding except that slightly fewer cases of S-T depression were observed than expected in Zutphen and slightly more than expected in Crete (11 observed, 16.4 expected, chi-square = 3.07 in Zutphen; 9 observed, 5.1 expected, chi-square = 5.40 in Crete).

The Skinfold Thickness

The detailed data on the distributions of the skinfold thickness (Σ skinfolds), given in the Appendix, show that this variable has almost no age trend from age 40—44 to 55—59 years in any of the population samples. The only qualification to this conclusion is that there is a trivial tendency for the skinfolds to be thinnest in the oldest (55—59) men; this is indicated in Table E9. Such tendency as there is to become thinner with age was most pronounced in Crete where in successive 5-year age groups the 90th centile cutting points for the sum of the skinfolds are, respectively, 38, 28, 27, and 23 mm. The corresponding 90th centile points for the triceps skinfold in Crete are 13, 14, 11 and 9 mm.

In the analyses in the present study we have used the sum of the two skinfolds, that over the triceps and that over the tip of the scapula ("Σ skinfolds"), as the measure of body fatness. This is a better measure than any single skinfold though both the triceps and the scapula values are very highly correlated with Σ skinfolds.

In some other studies skinfold thickness at other sites is reported but in most studies at least the triceps value is measured. To allow comparison with such other studies, the full distributions of the triceps skinfold thickness for each sample and age are given in the Appendix.

Table E9 also shows that, on the average, the skinfold over the triceps muscle tends to represent a constant fraction of Σ skinfolds, with no significant age trend. At the median level, the triceps skinfold averages 40.5 per cent of Σ skinfolds; at the 90th centile the corresponding average is 42.8 per cent. In other words, in the fattest men the triceps tends to represent a trifle more of Σ skinfolds than in men in the middle of the distribution.

Summary

Men with a relatively wide skeletal framework, judged from the ratio of the sum of the bi-acromial and bi-cristal diameters to the total height (L-L), were found to have unexpectedly high tendencies to obesity, high diastolic blood pressure and high serum cholesterol.

In the electrocardiograms, the more lateral men tended to show an excessive number of left axis deviations and a deficit of cases of high R waves, left type.

"Squatty" men (high values of the ratio of sitting to standing height, S/S) were also found to include unduly high numbers of obese men and men with high values for diastolic blood pressure and serum cholesterol.

The ratio of the bi-acromial to the bi-cristal diameter (A/C) is suggested as a kind of indicator of relative masculinity-femininity of the skeleton. This measure was not found to be related to the frequency of high values for diastolic blood pressure or serum cholesterol. There was a slight deficit (4. 1 per cent) of obese men (deciles 9, 10 in Σ skinfolds) among the men with high values of A/C.

TABLE E9

Skinfold thickness, trend with age. Unweighted averages of the medians and of the 90th centile cutting points of 15 samples comprising 10,103 men.

ITEM	MEDIANS				90TH CENTILES			
	40-44	45-49	50-54	55-59	40-44	45-49	50-54	55-59
No. of men	2079	2729	2805	2490	2079	2729	2805	2490
Triceps	9.00	8.40	8.67	8.40	15.67	15.40	15.33	14.80
Scapula	12.61	12.81	13.01	12.28	20.61	20.48	20.55	20.15
Σ Skinfolds	21.61	21.21	21.68	20.68	36.28	35.88	35.88	34.95
Triceps as % of Σ Skinfolds	41.6	39.6	40.0	40.6	43.2	42.9	42.7	42.3

Σ skinfolds shows almost no age trend from 40—44 to 55—59 except for a trivial tendency to be minimal in the oldest men. The skinfold over the triceps muscle also shows no significant age trend and at all ages tends to represent a constant fraction of Σ skinfolds.

F. SMOKING HABITS

A major by-product of investigations on the relation of lung cancer to smoking has been the finding, in certain populations, that the death rate ascribed to coronary heart disease is related to the habit of smoking cigarettes (Doll and Hill, 1956; Hammond and Horn, 1958). This finding has been confirmed in prospective (follow-up) studies in the U.S.A. directed primarily at coronary heart disease (Doyle *et al.,* 1962).

In the present-day cultural setting of the U.S.A. and Great Britain, men who smoke cigarettes are more prone to have heart attacks and to die of coronary heart disease than their contemporaries who do not smoke and the risk increases with the number of cigarettes smoked daily. But this increased risk has not been shown to extend to men who smoke only pipes or cigars. Moreover, coronary heart disease is not unduly frequent in *all* populations that are characterized by heavy cigarette smoking (Keys, 1962). These and other reasons suggest that cigarette smoking itself may not be a direct factor in the etiology of the disease; the tendency to smoke cigarettes may be associated with other characteristics of the person and his mode of life more directly responsible for increased susceptibility to this disease. It is entirely possible that the kind of person who is inclined to be a heavy cigarette smoker would also be prone to coronary heart disease even if he did not smoke.

Elsewhere we have noted that some of the peculiarities in the reported relationship of coronary heart disease susceptibility to smoking habits might be explained on the hypothesis that cigarette smoking is particularly baleful in populations subsisting on high-fat diets and whose blood cholesterol levels are correspondingly elevated (Keys and Blackburn, 1963). Even if cigarette smoking does not promote atherogenesis, it is conceivable that smoking might trigger the clinical event, perhaps by causing arrhythmias, in the sensitive situation where the coronary arteries are already seriously diseased.

Previous studies have reported interesting but not always consistent differences between smokers and nonsmokers. Thomas (1958, 1960) found that heavy-smoking medical students are more often overweight than their fellows who smoke little or not at all, but the reverse is true among middle-aged men in Finland (Karvonen *et al.,* 1959), and in the U.S.A. (Blackburn *et al.,* 1962). Again, heavy cigarette smokers have been reported to have a tendency to higher serum cholesterol levels than their non-smoking counterparts in some populations (Karvonen *et al.,* 1959; Thomas, 1960; Bronte-Stewart *et al.,* 1960), but this may not be the case in other populations (Blackburn *et al.*, 1962).

The data on smoking habits in the present series of studies may be helpful in indicating the extent to which interrelationships between smoking habits and other variables are universal and not merely associations in a common culture. Some information about smoking habits was given for each sample separately in Section C, above. The present section deals with comparisons among samples and with the detailed analyses of relationships between smoking habits and other variables that are more suitable considered with the smoking data from all the samples at the same time.

Comparison of the Samples

Table F1 summarizes the cigarette smoking habits of the men in 15 samples. The highest frequency of non-smokers, as well as of men who never smoked regularly, is at Velika Krsna; the lowest frequency of non-smokers is in the fishermen of Ushibuka but the smallest proportion of men who never smoked cigarettes is at Zutphen. At the other extreme, men who always smoke at least 20 cigarettes a day are most common in the two Japanese samples; at Tanushimaru 42.1 per cent of the men 40—59 years old are in this heavy smoking category. The lowest percentages of heavy cigarette smokers are at Montegiorgio and Zutphen.

Zutphen is alone among these populations in having a high frequency of cigar and pipe smoking; men who smoke both cigarettes and cigars or pipes are common there, as elsewhere in the Netherlands, but in none of the other sample areas. It is interesting, too, that at one time, at least, 92.4 per cent of the men of Zutphen had been regular cigarette smokers and at the time of this study there were more light smokers (of cigarettes) than in any other sample.

The statistical significance of the differences between samples in cigarette smoking habits has been tested by chi-square applied to the data in 2×2 tables of the numbers of non-smokers versus those of the regular smokers (10 or more cigarettes every day). The more interesting results of the chi-square test are given in Table F2.

In smoking habits expressed in this way, there is no significant difference between U.S. railroad switchmen and Rome railroad employees but the Rome railroad men clearly smoke more than the U.S. railroad clerks. The Rome railroad men smoke more than men in the other Italian samples, i. e. those in Crevalcore and Montegiorgio. Though the men in Dalmatia do not differ in this respect from those in Slavonia, the men in both of these areas of Croatia smoke more than the men of Velika Krsna. In Finland, too, there is a real difference between the samples, the East Finland (Karelia) men smoking more than the men of West Finland, but in part this difference may reflect the fact that the use of the Russian type of cigarette ("paperossi"), which contains much less tobacco, is fairly common in Karelia.

Consideration of the frequency of heavy smoking (20 or more cigarettes daily) changes the general picture little but a few details are altered. The relatively high frequency of heavy smoking in Crete (29.6 per cent) puts the men in that sample in a heavier smoking category than the men in Corfu (chi-square = 9.85, or Dalmatia (chi-square = 8.39). In respect to such heavy cigarette smoking, the men of Tanushimaru prove to be insignificantly different from the men of Ushibuka.

Perhaps the most striking feature of these comparisons is the similarity of the smoking habits of these populations that have so many cultural differences.

TABLE F1

Cigarette smoking habits of men 40-59 in 15 samples. Percentages of the men who NEVER smoked regularly, who are NON-SMOKERS (never + quit), LIGHT smokers (less than 10 daily), REGULAR (10 or more cigarettes daily), or HEAVY (20 or more daily), and the smoking RATIO (ratio of regular to non-smokers).

SAMPLE	TOTAL N	NEVER %	NON %	LIGHT %	REGULAR %	HEAVY %	RATIO
U.S. Clerks	858	27.2	47.9	6.2	45.7	16.4	0.96
U.S. Switchmen	836	16.4	35.2	5.6	59.2	30.1	1.68
Dalmatia	668	29.8	41.3	7.4	51.3	22.6	1.24
Slavonia	694	26.5	41.5	9.5	51.0	18.9	1.28
East Finland	815	19.5	31.5	10.1	58.4	31.4	1.83
West Finland	855	24.3	42.2	15.5	42.3	14.8	1.02
Crevalcore	987	25.1	36.3	19.5	44.2	17.7	1.18
Montegiorgio	714	25.9	41.2	27.7	31.1	9.5	0.76
Zutphen	869	7.6	25.6	30.2	44.2	10.7	1.75
Crete	685	23.6	42.6	10.3	47.1	29.6	1.10
Corfu	529	24.4	36.5	13.3	50.2	21.7	1.38
Velika Krsna	508	41.0	51.8	9.4	38.8	13.6	0.75
Tanushimaru	509	15.7	31.7	10.6	57.7	42.1	2.12
Ushibuka	494	15.0	22.3	8.2	69.5	37.4	3.12
Rome Railroad Men	765	18.7	34.8	10.8	54.4	29.9	1.56

TABLE F2

Significance of differences between samples in cigarette smoking habits indicated by the distribution of men into the classes non-smokers and smokers (10 or more cigarettes daily). The sample with the greater smoking habit is indicated by full capitals. The probability of chance explanation is given under the heading p.

COMPARISON	Chi-square	p
DALMATIA vs. Slavonia	0.11	non-sig.
U.S. SWITCHMEN vs. Rome Railroad Men	0.39	" "
ROME RAILROAD MEN vs. U.S. Clerks	23.36	Less than 0.001
ROME RAILROAD MEN vs. Crevalcore	7.03	" " 0.01
ROME RAILROAD MEN vs. Montegiorgio	36.47	" " 0.001
U.S. SWITCHMEN vs. U.S. Clerks	32.27	" " 0.001
CORFU vs. Crete	6.59	" " 0.02
USHIBUKA vs. Tanushimaru	5.39	" " 0.03
DALMATIA vs. Velika Krsna	15.58	" " 0.001
SLAVONIA vs. Velika Krsna	23.13	" " 0.001
CREVALCORE vs. Montegiorgio	14.47	" " 0.001
EAST FINLAND vs. West Finland	30.56	" " 0.001

Except for Montegiorgio and Ushibuka at the two extremes, the percentage of regular (10 or more daily) cigarette smokers varies only from 39 to 59 per cent.

Some of the differences in smoking habits are certainly ascribable, in part, to economic rather than cultural or innate psychological factors. Cigarettes are much cheaper in Japan, Greece, and Yugoslavia than in Italy where heavy cigarette smoking is a formidable expense for such farmers as those at Montegiorgio who have a very small cash income.

Non-Smokers

Non-smokers comprise men who never smoked, at least never smoked regularly, and those who smoked for a time and then stopped. Conceivably, these two kinds of non-smokers might differ in respect to one or more of the variables of present concern so before pooling them for later comparison with the smokers this question was examined. For each of the samples the men who never smoked were compared with the stopped smokers by examining the respective distributions above and below the median (for all men in the same 5-year age group in the same sample) for each of the five variables — relative weight, sum of skinfolds, systolic and diastolic blood pressure, and serum cholesterol concentration. Test by chi-square failed to show a single significant ($p = 0.05$) difference in any of the 60 sets of comparisons. It was concluded, therefore, that it would be justifiable to pool all non-smokers of each sample in further analyses.

Cigarette Smoking and Physical Activity

Before examining possible relationships between cigarette smoking habits and other variables, it is desirable to determine whether in such analyses it is necessary to separate the men according to physical activity. For this purpose the distribution of men classed by smoking habits and by physical activity was determined for the various samples. In none of these samples was there a significant difference in the distribution of smoking habits among sedentary and light activity men as compared with the men of the same age in the same area who customarily engaged in heavy physical activity.

The data for all the samples may be illustrated by Table F3, which covers one sample each from Yugoslavia, Finland, Italy, and Greece. In this table the comparison is made between confirmed non-smokers (men who never smoked or have long stopped) and men who always smoke 10 or more cigarettes a day. There is nothing like a consistent trend and the departures of the observed (O) from the expected (E) numbers do not approach statistical significance.

Relative Body Weight and Fatness

Table F4 summarizes the distribution of the men, classed by smoking habits, into LOW (deciles 1—3) and HIGH (deciles 8—10) values for relative body weight. If relative body weight were unrelated to smoking habits, among all men in any given smoking category about 30 per cent would be expected to be in the LOW weight class and an equal number in the HIGH weight class.

It is obvious from Table F4 that the distribution observed does not conform to chance expectation. In every sample there are more non-smokers in the HIGH than in the LOW weight class. The discrepancy is very large indeed except for Tanushimaru where the proportion of HIGH to LOW is only 1.15

TABLE F3

Distribution according to cigarette smoking habits of men classified by habitual level of physical activity in 4 representative samples. O = number of men observed, E = expected. Chi-square values calculated with Yates' correction.

	SMOKING	ACT. 1 + 2		ACTIVITY 3	
		O	E	O	E
SLAVONIA	Never + Quit	77	69.0	199	207.0
	10 or more/day	86	94.0	288	280.0
	Chi-square = 1.96				
EAST FINLAND	Never + Quit	77	72.4	177	181.6
	10 or more/day	128	132.6	337	332.4
	Chi-square = 0.85				
MONTEGIORGIO	Never + Quit	95	104.0	198	189.0
	10 or more/day	87	78.0	135	144.0
	Chi-square = 2.55				
CORFU	Never + Quit	141	132.4	51	59.6
	10 or more/day	174	182.6	91	82.4
	Chi-square = 2.91				

TABLE F4

Smoking and relative body weight. Numbers of men, classed by cigarette smoking habits, with LOW (deciles 1-3) and HIGH (deciles 8-10) values for relative body weight. "LIGHT" = 1-9 daily, "MODERATE" = 10-19, "HEAVY" = 20 or more.

SAMPLE	NEVER + QUIT		LIGHT		MODERATE		HEAVY	
	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
U.S. Clerks	95	150	15	15	103	53	44	38
U.S. Switchmen	49	117	11	20	95	47	95	66
Dalmatia	61	107	12	14	73	39	54	37
Slavonia	35	190	22	20	96	34	56	24
East Finland	51	109	24	29	88	33	76	67
West Finland	65	152	43	27	95	40	46	30
Crevalcore	60	139	53	53	122	51	55	51
Montegiorgio	63	119	69	46	66	33	27	15
Zutphen	52	85	83	64	98	73	26	37
Crete	55	111	18	22	51	23	79	46
Corfu	31	82	18	26	61	27	48	23
Velika Krsna	65	96	20	9	48	28	17	19
Tanushimaru	46	53	4	3	39	37	63	59
Ushibuka	22	42	13	5	64	31	47	58
Rome Railroad Men	47	109	17	30	59	43	104	48
TOTAL	797	1661	422	383	1158	592	837	618

to 1.00. The reverse situation prevails among the "moderate" (10—19 cigarettes daily) and the "heavy" (20 or more daily) smokers; the moderate smokers particularly are more often relatively underweight than overweight. The "light" (less than 10 cigarettes daily) smokers show no consistent trend in regard to relative body weight.

Table F5 summarizes in the same way the distribution of the thinnest and the fattest men, i. e. the men in deciles 1—3 and 8—10 for skinfold thickness. The picture is similar to that for relative body weight; obesity is unduly common among the non-smokers; moderate smokers include an undue proportion of the thinnest men.

Among urban men in the U.S.A. a direct effect of smoking on relative weight and obesity is indicated from observations on persons who stop smoking after cultivating the habit for many years (Brozek and Keys, 1957). In most cases there is a gain in body weight and very often a real problem of obesity control arises. Recently stopped smokers often are inclined to eat candy or take between-meal snacks though they never did this previously when they were smoking. It could be suggested that the weight gain after stopping smoking may result from a substitute of a new eating habit for the former habit of smoking. This explanation does not suffice for the findings in the present surveys because there is no difference in the distribution of relative weight or fatness between men who never smoked and those who smoked and then stopped. A direct effect of smoking on appetite seems to be a reasonable explanation.

Arterial Blood Pressure

The relationship between blood pressure and smoking habits has been analyzed in the same way as was done with relative body weight, i. e. attention was concentrated on the distribution of the 30 per cent of the men with the highest blood pressure as contrasted with the 30 per cent of the men with the lowest blood pressure values. Tables F6 and F7 summarize the findings for systolic and diastolic blood pressure, respectively.

Non-smokers tend to include an undue proportion of men with relatively high systolic blood pressure; this was seen in all samples except Zutphen, Tanushimaru and U.S. Railroad Clerks. For the entire material combined, the excess of men with relatively high blood pressure among the non-smokers surpasses chance expectation with very high statistical significance. The largest number of decile 8—10 men expected among the non-smokers at the upper limit of $p = 0.01$ would be 1 277, while 1 372 was the number actually observed.

Among light smokers (less than 10 cigarettes per day), there is no consistent trend in regard to the frequency of high or low systolic blood pressures. In 6 samples there is a statistically significant excess of high blood pressure men in this class but there is an equally significant *shortage* of high systolic blood pressure men among the light smokers in West Finland and Crevalcore. For all light smokers combined the systolic blood pressure distribution is very close to chance expectation.

The excess of high systolic blood pressure among non-smokers is reflected in a corresponding shortage of men with such high values among the "regular" smokers, i. e. those men who always smoke 10 or more cigarettes a day. The samples of men of Zutphen and Tanushimaru are, again, exceptional in not exhibiting the trend that is so clear among the men in the other samples.

The diastolic blood pressure distributions, summarized in Table F7, show the same trends as observed in regard

TABLE F5

Smoking and body fatness. Numbers of men, classed by cigarette smoking habits, with LOW (deciles 1-3) and HIGH (deciles 8-10) values for sum of skinfold thickness. "LIGHT" = 1-9 daily, "MODERATE" = 10-19, "HEAVY" = 20 or more.

SAMPLE	NEVER + QUIT		LIGHT		MODERATE		HEAVY	
	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
U.S. Clerks	104	142	12	16	94	57	48	44
U.S. Switchmen	56	114	16	20	96	50	83	65
Dalmatia	66	106	16	17	72	42	45	32
Slavonia	35	128	19	20	96	33	56	24
East Finland	44	109	28	21	84	92	89	60
West Finland	55	165	46	29	106	37	48	25
Crevalcore	69	137	58	58	112	49	56	51
Montegiorgio	57	123	70	55	63	30	25	17
Zutphen	48	90	82	65	106	65	23	39
Crete	57	124	16	17	54	27	78	38
Corfu	34	87	18	25	69	26	38	21
Velika Krsna	57	98	22	6	52	28	19	20
Tanushimaru	41	61	2	1	45	29	62	59
Ushibuka	-	-	-	-	-	-	-	-
Rome Railroad Men	46	97	17	36	63	44	101	59
TOTAL	769	1581	422	386	1112	609	771	554

TABLE F6

Smoking and systolic blood pressure. Numbers of men, classed by cigarette smoking habits, with LOW (deciles 1-3) and HIGH (deciles 8-10) values for systolic blood pressure. "LIGHT" = 1-9 daily, "MODERATE" = 10-19, "HEAVY" = 20 or more.

SAMPLE	NEVER + QUIT		LIGHT		MODERATE		HEAVY	
	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
U.S. Clerks	131	127	9	20	77	70	40	40
U.S. Switchmen	75	101	11	13	94	66	71	71
Dalmatia	67	102	8	18	72	45	52	34
Slavonia	64	103	13	21	77	55	54	28
East Finland	75	86	26	27	67	68	74	61
West Finland	92	126	57	24	70	67	38	39
Crevalcore	87	122	60	49	91	64	54	60
Montegiorgio	81	89	53	62	56	41	23	23
Zutphen	67	66	81	77	86	81	29	35
Crete	75	103	17	26	47	31	64	43
Corfu	38	75	17	26	65	32	39	26
Velika Krsna	74	84	11	14	46	34	20	22
Tanushimaru	57	49	4	0	33	39	59	65
Ushibuka	22	41	12	9	56	48	58	51
Rome Railroad Men	76	98	25	26	63	47	64	60
TOTAL	1081	1372	404	412	1000	788	739	658

TABLE F7

Smoking and diastolic blood pressure. Numbers of men, classed by cigarette smoking habits, with LOW (deciles 1-3) and HIGH (deciles 8-10) values for diastolic blood pressure. "LIGHT" = 1-9 daily, "MODERATE" = 10-19, "HEAVY" = 20 or more.

SAMPLE	NEVER + QUIT		LIGHT		MODERATE		HEAVY	
	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
U.S. Clerks	117	126	14	20	86	49	40	42
U.S. Switchmen	75	97	12	16	96	69	68	69
Dalmatia	69	100	10	16	65	43	55	41
Slavonia	60	104	18	22	77	47	53	35
East Finland	50	88	27	28	81	56	84	70
West Finland	79	142	46	20	79	59	52	35
Crevalcore	82	141	46	59	100	48	64	46
Montegiorgio	85	95	57	58	51	37	22	24
Zutphen	53	81	85	71	98	74	27	32
Crete	75	104	18	23	41	33	69	43
Corfu	40	75	21	21	59	37	39	26
Velika Krsna	78	86	13	12	44	30	17	25
Tanushimaru	44	42	6	0	40	42	63	69
Ushibuka	22	47	15	7	55	41	55	54
Rome Railroad Men	58	99	22	28	66	43	83	59
TOTAL	987	1427	410	401	1038	708	791	670

TABLE F8

Smoking and serum cholesterol concentration. Numbers of men, classed by cigarette smoking habits, with LOW (deciles 1-3) and HIGH (deciles 8-10) values for serum cholesterol. "LIGHT" = 1-9 daily, "MODERATE" = 10-19, "HEAVY" = 20 or more.

SAMPLE	NEVER + QUIT		LIGHT		MODERATE		HEAVY	
	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH
U.S. Clerks	129	123	16	16	68	80	43	36
U.S. Switchmen	82	81	16	13	66	73	83	80
Dalmatia	84	82	6	20	52	50	55	44
Slavonia	64	97	20	17	72	55	46	32
East Finland	80	74	27	28	60	66	78	77
West Finland	122	99	36	27	67	85	30	46
Crevalcore	106	113	65	40	81	68	36	67
Montegiorgio	71	93	72	48	49	48	21	24
Zutphen	67	66	77	61	87	84	17	36
Crete	82	99	22	19	35	26	57	52
Corfu	52	68	21	24	49	32	35	31
Velika Krsna	88	70	14	11	31	46	20	26
Tanushimaru	44	45	3	1	24	44	77	58
Ushibuka	31	33	17	10	41	51	58	54
Rome Railroad Men	83	85	32	20	58	58	55	65
TOTAL	1185	1228	444	355	840	866	711	728

to systolic blood pressure but the departures from random expectation are even more marked: High diastolic blood pressure is unduly common among non-smokers, light smokers show no consistent trend one way or the other, while men with high diastolic blood pressure are underrepresented among the moderate and heavy cigarette smokers.

Serum Cholesterol

Table F8 concerns serum cholesterol concentration. There is no consistent pattern for all areas, though certain areas show interesting pictures. For example, in Slavonia there is a 21 per cent excess of high (deciles 8—10) cholesterol values among non-smokers as compared with men who smoke 10 or more cigarettes daily, and this is highly significant ($p = 0.001$). On the other hand, in West Finland there is a 10.7 per cent *deficit* of high values for cholesterol among the non-smokers and this is also significant ($p = 0.04$).

Degree of Smoking

It was observed that non-smokers tend to be heavier, fatter and to have higher blood pressures than cigarette smokers. But it does not follow that as smoking increases the men progressively tend to become lighter, thinner and to have lower blood pressures. Table F9 compares heavy smokers with moderate smokers (20 or more vs. 10—19 cigarettes daily).

Compared with moderate smokers, the heavy smokers tend to be in the top of the distribution (deciles 9 and 10) for relative weight (13 of 15 samples), body fatness (12 of 14 samples), systolic (11 of 15) and diastolic blood pressure (13 of 15 samples). In regard to these variables, the moderate smokers would seem to have better characteristics than either non-smokers or heavy smokers. This is shown, for example, by computing the frequency of high blood pressure among each class of smokers expected, as compared with observed, on the basis of no difference between the classes of smokers. When this calculation is made for systolic blood pressure in all samples combined, the percentage difference between observed and expected frequency of hypertension proves to be +11.8 per cent for non-smokers, +0.9 per cent for light smokers, —11.1 per cent for moderate smokers and —5.1 per cent for heavy smokers.

Arterial Pressure vs. Fatness and Smoking

Non-smokers tend to be fatter than smokers so it may be asked whether the trend to higher blood pressures among non-smokers in most of the samples, can be dependent on this tendency. Cigarette smoking depresses the appetite, thinner men tend to have lower-blood pressures — is this the explanation?

Some light can be thrown on this question by eliminating the fatter men from the analysis. Table F10 shows, for eight samples, the percentage excess of cases of relative systolic hypertension (the top 3 deciles of the systolic blood pressure distribution) among non-smokers, calculated from the number of cases observed and the number expected if non-smokers and smokers were alike.

Ignoring relative obesity ("ALL"), in every sample there is an excessive frequency of relative "hypertension" among the non-smokers, ranging from 12.9 per cent among U.S. Switchmen to 32.7 per cent at Corfu, the (unweighted) average being 19.6 per cent. The chi-square values show that the excess has statistical significance in six of the samples. When only relatively thin men are considered (deciles 1—7 in Σ skin-

TABLE F9

Distribution of men with high values (deciles 9, 10) for certain variables among heavy (20 or more daily) and "regular" (10-19 daily) cigarette smokers. Tabulated values are numbers of heavy smokers expressed as % of chance expectation. * = p less than 0.05, ** = p less than 0.01.

MEN IN DECILES 9 AND 10 FOR:

SAMPLE	RELATIVE WEIGHT	FATNESS	SYST. B.P.	DIAST. B.P.	CHOLES-TEROL
U.S. Clerks	113.7	118.5	104.8	102.4	86.0
U.S. Switchmen	118.1	123.3**	115.7	111.0	96.1
Dalmatia	105.0	96.8	107.0	116.1	96.2
Slavonia	115.4	112.8	82.0	101.1	102.6
East Finland	127.6**	109.2	86.2	98.7	97.5
West Finland	118.8	125.0	98.0	101.0	107.8
Crevalcore	140.8**	126.0	118.8*	116.6	121.4**
Montegiorgio	136.8	136.9	115.9	114.3	119.2
Zutphen	129.7*	140.5*	106.2	136.8*	125.8
Crete	110.7	123.3	99.1	100.7	99.7
Corfu	121.2	123.8	105.7	104.1	109.3
Velika Krsna	115.8	124.7	130.5	132.8*	116.9
Tanushimaru	93.5	128.3**	102.9	99.3	83.5**
Ushibuka	121.9*	-	110.7	111.1	91.8
Rome Railroad Men	92.4	99.4	105.4	107.4	110.7

TABLE F10

Percentage excess of cases of relative systolic hypertension (top 3 deciles) among non-smokers: 1) ignoring relative obesity (= "ALL") and, 2) omitting men in the top 3 deciles of Σ Skinfolds (= "NOT FAT"). "CHI-SQUARE" is calculated from numbers of smokers vs. non-smokers in decile classes 1-3 and 8-10 of systolic B.P. (one degree of freedom).

SAMPLE	% EXCESS HIGH B.P.		CHI-SQUARE	
	ALL	NOT FAT	ALL	NOT FAT
U.S. Switchmen	12.9	8.8	3.97	0.76
Dalmatia	17.8	19.7	8.00	2.72
Slavonia	21.9	28.4	12.29	6.14
Crevalcore	16.2	17.6	8.13	4.15
Crete	12.1	14.4	3.99	1.81
Corfu	32.7	48.9	1.78	10.69
Rome Railroad Men	22.5	18.3	10.49	3.02
Ushibuka	20.8	26.1	1.13	0.91
All 8 Samples	18.4	19.1	60.17	25.25

folds), there is also an excessive number of cases of hypertension among the non-smokers, ranging from 8.8 per cent among U.S. Switchmen to 48.9 per cent among men at Corfu, the average being 22.8 per cent. The chi-square values are smaller (except at Corfu) when the analysis is confined to thinner men but this is at least partly explained by the fact that the number of non-fat, non-smokers is relatively small in most samples.

The upshot of this analysis is to conclude that the tendency for non-smokers to have higher blood pressures than cigarette smokers is not explained by body fatness. Either cigarette smoking tends to keep the blood pressure lower than it would be otherwise or non-smokers are simply the kind of men who more often tend to become hypertensive.

Age and Smoking Habits

The prevalence of cigarette smoking in these samples falls with increasing age over the range 40—59 years in U.S. and Italian railroad workers, in Dalmatia, Zutphen and Crete, and not in the other samples. In those samples where the percentage of non-smokers increases with age, this mainly reflects a rise in stopped smokers, though in Dalmatia and Zutphen the percentage of never smokers also rises with age.

The percentage of heavy smokers (20 or more daily) in these samples tends to fall with age except in Dalmatia, Slavonia, Nicotera, Corfu and among U.S. clerks. Among the men who do smoke, in general, the percentage of heavy smokers tends to remain constant, i. e. the intensity of smoking does not change among those who continue to smoke but again there are exceptions. Among smokers, the percentage of heavy smokers tends to fall with age in East Finland, Velika Krsna, Crevalcore, Montegiorgio, Zutphen and in the U.S. clerks.

The total picture in regard to age and smoking habits, then, is that at ages 40—59 age is relatively unimportant except for a tendency for a few men to stop smoking and a few others to cut down from former heavy smoking.

Summary

Except at Velika Krsna the majority of the men in all samples smoked cigarettes at the time of the examinations, the highest prevalence being in Japan which also had the highest percentage of heavy smokers (20 or more cigarettes daily). At Velika Krsna 51.8 per cent were non-smokers and 41.0 per cent had never smoked regularly. The highest percentage of stopped smokers was found in the U.S. railroad clerks (20.7 per cent). U.S. railroad switchmen smoked more than U.S. railroad clerks but no more than the Italian railroad employees.

In none of the measured characteristics in any of the samples was there any significant difference between men who had stopped smoking and those who had never smoked but non-smokers consistently differed from smokers in being relatively heavier and fatter. The non-smokers also tended to have higher blood pressures than the smokers except at Tanushimaru, Japan, where there was no consistent difference between smokers and non-smokers though significant differences in one direction or the opposite were observed in several samples.

For all samples considered together, fewer heavy smokers were above than below the age- and area-specific median in relative body weight, Σ skinfolds, systolic and diastolic blood pressure but the lowest frequency of high values in these variables was found among the

"moderate" smokers (10—19 cigarettes daily). Light smokers (under 10 cigarettes daily) tended to have lower serum cholesterol values than their fellows in the same samples but otherwise serum cholesterol showed little or no relationship to smoking habits in most areas. Exceptions were Slavonia, Montegiorgio, Crete and Corfu, where non-smokers tended to have high cholesterol values and Velika Krsna where the opposite tendency prevailed.

In general, smoking habits were unrelated to physical activity but did change somewhat with age, the proportion of stopped smokers rising with increasing age. However, among smokers, the intensity of smoking did not change significantly with age over the range 40—59 years.

The tendency for non-smokers to have higher blood pressures than the smokers could not be explained by the excess of obese men among the non-smokers.

G. THE INTER-RELATIONS OF ELECTROCARDIOGRAPHIC FINDINGS AND PHYSICAL CHARACTERISTICS OF MIDDLE-AGED MEN

by Henry Blackburn, R. W. Parlin and Ancel Keys (Minneapolis)

The electrocardiogram (ECG) was employed in these studies because of its relevance to the identification of cardiac abnormalities and to prediction of risk of future disease (Blackburn *et al.*, 1960). The special problems in application of electrocardiography to population studies have been discussed elsewhere, along with the efforts made to present, in unambiguous terms, the ECG findings of generally agreed interest (Blackburn *et al.*, 1960; Higgins, *et al.*, 1963; Blackburn, 1965).

In the appropriate parts of Section C, above, detailed distributions are given by area of all principal ECG abnormalities found on the initial examination in men aged 40 through 59. The method of sampling, response rates, and characteristics of these populations are reported in Section A and the standardized procedures for recording and classification of the ECG are noted in Section B ("Methods"), above.

The systematic tabulating is here made of the frequency of specified ECG abnormalities according to classes of major physical characteristics measured: sum of subcutaneous skinfolds (Σ skinfolds) and relative body weight (RBW), systolic blood pressure (SBP) and diastolic blood pressure (DBP), and serum cholesterol (SC). The five ECG items selected are of interest in regard to their anatomic and functional correlates of myocardial infarction and hypertrophy, and ischemia — large Q waves (Code I, 1), left axis deviation of at least —30 degrees (Code II, 1), high amplitude R waves, left type (Code III, 1), negative T waves (Code V 1, 2) and S-T segment depression immediately after a standard three-minute exercise test (Code XI, 1—4).

In other reports relationships will be considered between these clearly defined ECG items and the prevalence of clinical manifestations of cardiovascular disease. On follow-up study of the men, the risk of subsequent heart disease and death associated with particular ECG findings will be ascertained. If significant relationships are found, it is necessary that the degree of association with other risk factors be estimated.

In this analysis the values for each physical characteristic are arrayed within quinquennial age classes, providing a ranking by quintiles of each subject within his own age and area class. Subjects having a given ECG abnormality are compiled according to where they fall along the quintile distribution of the physical characteristic. The relation between ECG findings and absolute levels of the physical measurement is not given, but rather the relative standing within his population of a subject with a particular ECG abnormality.

In Tables G1 through G5 the concentration of men with specified ECG findings is indicated by quintile classes from the lowest twenty per cent (quintile 1) to the highest twenty per cent of men (quintile 5) as well as the concentration of men above and below the group median.

These ECG findings are usually too infrequent to attempt such analyses within single areas but the consistency of the trends may be inspected, along with the relationships found for all areas pooled.

Absence of a relationship between an ECG finding and a physical characteristic would be indicated by approximately equal numbers of cases in the Tables G 1—5, or equal proportions in the Figures G 1—5, within each quintile class of physical characteristic. There are approximately 5 130 men above and below the median cut for each physical variable and 2 052 in the base population for each quintile class.

Q Waves (I, 1)

The relationship of specified large Q waves, widely considered to represent old myocardial infarction, to five physical characteristics is shown by area in Table G1 and for 12 areas combined in Table G1 and Figure G1. A total of 74 of these "hard core" Q items occurred among 10,260 men aged 40—59, a prevalence of less than 1 per cent.

The Q wave finding is concentrated among the thinner men (Σ skinfolds) (chi-square, quintile 1 vs. 5 = 5.65, $p < .025$), and lighter men (RBW) (chi-square, quintile 1 vs. 5 = 10.12, $p < .005$). The differences are statistically significant between the upper and lower quintiles, and the trend is consistent for all areas.

A relationship of "infarct" Q waves to systolic blood pressure is apparent, due to an excess of cases in the highest blood pressure quintile (chi-square, quintile 1 vs. 5 = 5.07, $p < .025$). A less distinct relationship exists with diastolic pressure where there is a paucity of Q wave cases in the lowest quintile and an excess in the highest (chi-square, quintile 1 vs. 5 = 4.35, $p < .05$). A similar and not very striking general relationship holds between the prevalence of ambulant infarct cases by ECG criteria and the serum cholesterol level "after the event" (chi-square, quintile 1 vs. 5 = 3.81, $p = .05$).

Left Axis Deviation (II, 1)

The cut-off value for abnormal left axis deviation most often used clinically is —30 degrees, a distinctly upward and leftward electrical orientation of the frontal plane QRS vector. It is considered a "non-specific" finding suggesting myocardial disease and here occurred in about 4 % of the total men of all populations.

In Table G2 and Figure G2 "abnormal" left axis deviation has little association with the other physical characteristics, and no statistically significant differences occur.

High Amplitude R Waves, Left Type ("Left Ventricular Hypertrophy") (III, 1)

The criteria for "left hypertrophy" are here entirely based on high R wave amplitudes in selected leads. An overall relationship of these findings with left ventricular myocardial hypertrophy exists in clinical-pathological studies but application of these criteria results in many individual misclassifications.

TABLE G1

THE RELATIONSHIP OF
LARGE Q WAVES (I, 1)
IN THE ELECTROCARDIOGRAM TO PHYSICAL CHARACTERISTICS
OF MEN AGED 40-59 YEARS

	AREA													
	USRR 2162	EF 815	WF 858	ZU 871	YS 669	YN 697	VK 510	MO 718	CR 980	IRR 766	CT 685	CU 529	TOTAL 10, 260	PER CENT
ΣSF														
Median <	15	4	4	6	0	1	2	2	5	3	0	2	44	
Cut >	11	3	2	3	0	2	3	2	0	1	1	1	29	
Quintile 1	8	3	1	2	0	1	1	1	4	3	0	1	25	34.2
2	6	1	2	2	0	0	1	1	0	0	0	0	13	17.8
3	3	1	2	2	0	0	1	0	1	0	0	1	11	15.1
4	6	1	1	0	0	1	2	2	0	0	0	1	14	19.2
5	3	1	0	3	0	1	0	0	0	1	1	0	10	13.7

All samples, quintile 1 vs. 5, Chi-square = 5.65 (p < .025)

RBW														
Median <	15	4	5	6	0	1	2	1	5	3	0	1	43	
Cut >	11	2	1	3	0	2	3	3	0	1	1	2	29	
Quintile 1	8	3	3	3	0	1	1	1	5	3	0	0	28	38.9
2	3	0	2	2	0	0	1	0	0	0	0	1	9	12.5
3	7	1	1	2	0	0	1	0	0	0	0	1	13	18.0
4	3	1	0	2	0	1	2	3	0	1	0	1	14	19.4
5	5	1	0	0	0	1	0	0	0	0	1	0	8	11.1

All samples, quintile 1 vs. 5, Chi-square = 10.12 (p < .005)

SBP														
Median <	8	2	3	5	0	1	3	1	1	1	0	3	28	
Cut >	18	5	3	4	0	2	3	3	4	3	1	0	46	
Quintile 1	2	2	1	1	0	0	2	1	1	1	0	1	12	16.2
2	4	0	2	2	0	1	1	0	0	0	0	1	11	14.9
3	4	1	0	3	0	0	0	0	1	0	0	1	10	13.5
4	7	0	1	0	0	1	2	2	0	1	0	0	14	18.9
5	9	4	2	3	0	1	1	1	3	2	1	0	27	36.5

All samples, quintile 1 vs. 5, Chi-square = 5.07 (p < .025)

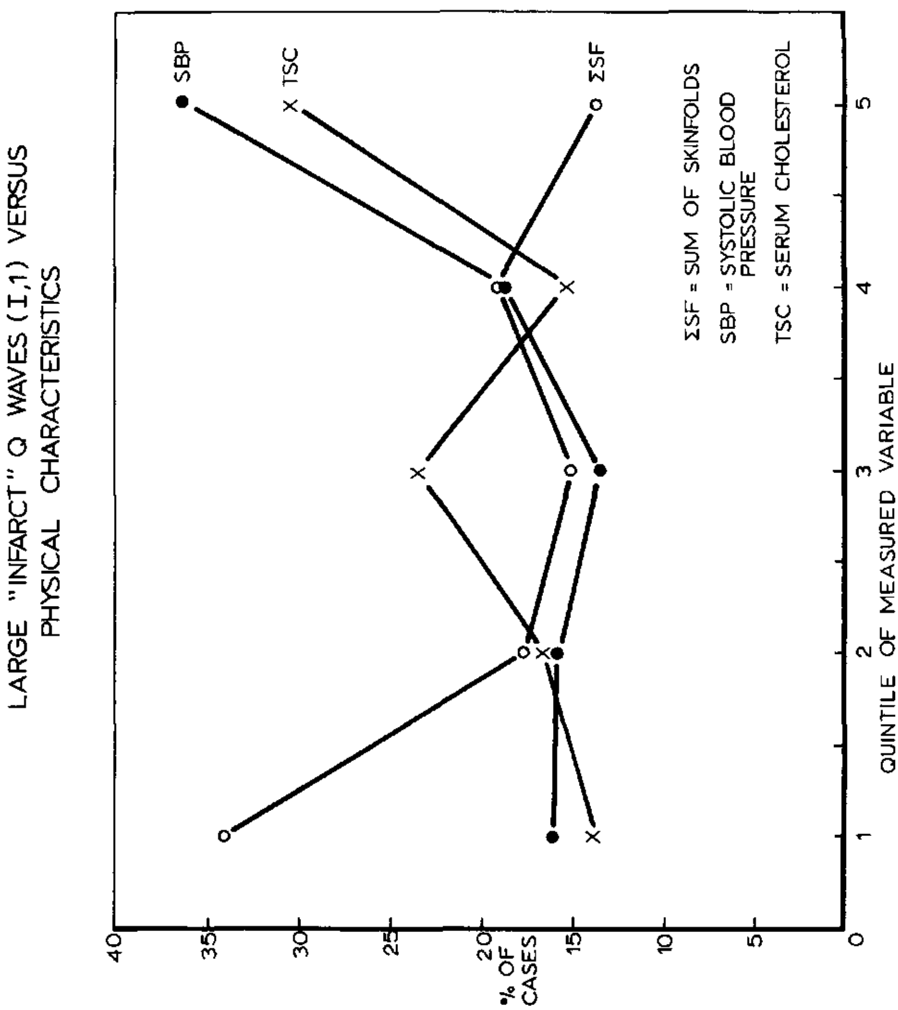
DBP														
Median <	9	2	3	5	0	1	5	1	3	2	0	2	33	
Cut >	17	5	3	4	0	2	0	3	2	2	1	1	40	
Quintile 1	1	1	0	1	0	0	2	1	1	0	0	1	8	11.0
2	5	0	2	3	0	0	3	0	2	1	0	0	16	21.9
3	6	1	2	2	0	2	0	0	0	1	0	2	16	21.9
4	7	2	0	0	0	0	0	2	1	1	0	0	13	17.8
5	7	3	2	3	0	1	0	1	1	1	1	0	20	27.4

All samples, quintile 1 vs. 5, Chi-square = 4.35 (p < .05)

S. CHOL.														
Median <	11	4	1	2	0	1	3	1	3	3	0	2	31	
Cut >	15	3	5	7	0	2	2	3	1	1	1	1	41	
Quintile 1	4	1	1	0	0	0	1	1	1	0	0	1	10	13.9
2	4	1	0	2	0	1	2	0	1	1	0	0	12	16.7
3	5	2	1	2	0	0	0	1	2	2	0	2	17	23.6
4	3	0	3	1	0	1	1	0	0	1	1	0	11	15.3
5	10	3	1	4	0	1	1	2	0	0	0	0	22	30.6

All samples, quintile 1 vs. 5, Chi-square not significant

Total no. men in each quintile = 2052
Total no. men above and below median = 5130



LARGE "INFARCT" Q WAVES (I,1) VERSUS
PHYSICAL CHARACTERISTICS
% OF
CASES
0
5
10
15
20
25
30
35
40
1
2
3
4
5
QUINTILE OF MEASURED VARIABLE
SBP
TSC
ΣSF
ΣSF = SUM OF SKINFOLDS
SBP = SYSTOLIC BLOOD
PRESSURE
TSC = SERUM CHOLESTEROL

Figure G1

TABLE G2

THE RELATIONSHIP OF
LEFT AXIS DEVIATION > 30° (II, 1)
IN THE ELECTROCARDIOGRAM TO PHYSICAL CHARACTERISTICS
OF MEN AGED 40-59 YEARS

	AREA													
	USRR 2162	EF 815	WF 858	ZU 871	YS 669	YN 697	VK 510	MO 718	CR 980	IRR 766	CT 685	CU 529	TOTAL 10,260	PER CENT
ΣSF														
Median <	40	11	21	14	9	19	10	23	21	15	19	5	207	
Cut >	24	13	18	21	14	21	7	21	20	15	13	5	192	
Quintile 1	20	5	8	4	5	14	1	7	9	6	8	3	90	22.6
2	11	5	10	8	4	5	7	10	10	6	11	1	88	22.1
3	14	4	4	7	1	4	3	10	9	7	2	2	67	16.8
4	17	5	7	11	5	8	1	10	5	6	4	3	72	18.1
5	12	5	10	15	8	9	4	7	8	5	7	1	81	20.4

All samples, quintile 1 vs. 5, Chi-square not significant

RBW	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER CENT
Median <	30	17	18	19	7	19	7	16	18	16	13	3	183	
Cut >	34	7	21	16	16	21	10	28	21	14	17	7	212	
Quintile 1	18	6	5	5	4	9	2	5	8	3	6	1	72	18.2
2	12	3	8	10	2	8	4	9	9	8	5	2	81	20.4
3	3	9	9	9	3	4	2	12	3	7	9	1	71	17.9
4	18	2	6	6	5	11	4	8	11	4	5	3	83	21.0
5	13	4	11	5	9	8	5	10	8	8	5	3	87	22.5

All samples, quintile 1 vs. 5, Chi-square not significant

SBP	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER CENT
Median <	33	12	19	18	7	19	4	21	23	9	23	6	194	
Cut >	31	12	20	17	15	21	13	23	18	21	9	4	204	
Quintile 1	12	4	9	9	2	8	1	9	10	5	10	2	81	20.4
2	16	6	7	4	3	7	3	8	7	2	8	4	75	18.8
3	9	3	4	8	2	9	3	9	8	4	5	1	65	16.3
4	9	6	10	4	8	8	4	7	9	8	5	2	80	20.1
5	18	5	9	10	7	8	6	11	7	11	4	1	97	24.4

All samples, quintile 1 vs. 5, Chi-square not significant

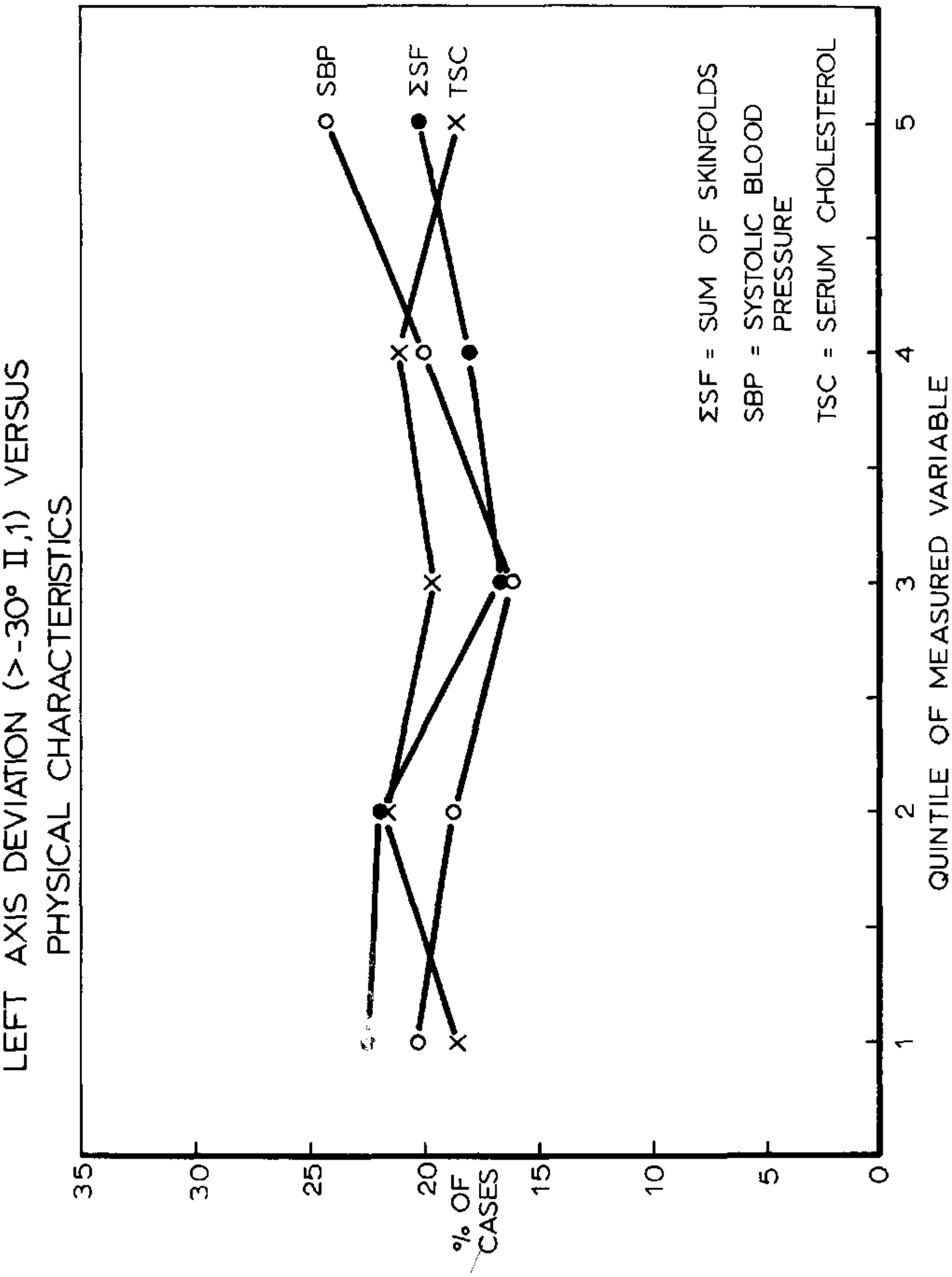
DBP	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER CENT
Median <	28	14	20	20	6	22	6	22	16	9	17	4	184	
Cut >	36	10	20	15	16	18	11	22	25	21	15	6	215	
Quintile 1	11	6	10	11	1	7	1	10	8	4	6	1	76	19.0
2	9	7	7	5	3	9	1	11	8	3	7	3	73	18.3
3	17	2	8	5	5	8	5	4	3	7	5	2	71	17.8
4	12	3	6	4	6	6	2	9	17	8	8	2	83	20.8
5	15	6	9	10	7	10	8	10	5	8	6	2	96	24.1

All samples, quintile 1 vs. 5, Chi-square not significant

S. CHOL.	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER CENT
Median <	36	16	20	16	6	25	8	21	16	17	12	5	198	
Cut >	26	8	20	15	16	14	9	23	24	13	19	5	192	
Quintile 1	18	4	6	5	1	8	2	11	6	6	4	1	72	18.6
2	11	8	12	7	4	11	4	8	4	7	6	2	84	21.8
3	11	5	6	7	2	11	3	4	13	4	6	4	76	19.7
4	12	3	8	5	7	5	6	11	11	4	9	1	82	21.2
5	10	4	8	7	8	4	2	10	6	5	6	2	72	18.6

All samples, quintile 1 vs. 5, Chi-square not significant

Total no. men in each quintile = 2052
Total no. men above and below median = 5130



LEFT AXIS DEVIATION (>-30° II,1) VERSUS
PHYSICAL CHARACTERISTICS
% OF CASES
0
5
10
15
20
25
30
35
1
2
3
4
5
QUINTILE OF MEASURED VARIABLE
SBP
ΣSF
TSC
ΣSF = SUM OF SKINFOLDS
SBP = SYSTOLIC BLOOD PRESSURE
TSC = SERUM CHOLESTEROL

Figure G2

The inverse relationship of "left hypertrophy" by ECG and body fatness and relative weight is shown in Table G3 and Figure G3 and is statistically significant in the analysis around the median cut-off value for skinfold obesity (chi-square, median cut = 6.76, $p < .01$), and between upper and lower quintiles for RBW. There is, however an inverted U-shaped distribution which is unexplained. A clear monotonic relation exists between high R amplitudes and increasing systolic blood pressure (chi-square, quintile 1 vs. 5 = 67.77, $p < .0001$), which is also present for diastolic pressure. There is no consistent relation to serum cholesterol level throughout the areas, but a slightly peaked distribution of the ECG item according to quintile class of serum cholesterol is found in the totals for all population samples and is unexplained.

Negative T Waves (V, 1—2)

Negative T waves in specified ECG leads represent "non-specific" myocardial ischemia and other functional cellular phenomena, as well as myocardial infarction and fibrosis. In Table G4 and Figure G4 no evidence appears of an association of this finding with fatness, overweight or serum cholesterol, but a distinct increase in frequency of this finding occurs among the top 20 per cent of values for systolic and diastolic blood pressure. The excess frequency is as striking among systolic hypertensives (chi-square, quintile 1 vs. 5 = 17.66, $p < .0001$) as it is among men in the upper 20 % of diastolic pressures.

Post-exercise S-T Depression (XI, 1—4)

The ECG criteria employed here combine the presence of distinctly abnormal (0.1 mv or more) junctional S-T depression and the "ischemic"-type, horizontal or sagging S-T segment depression. These are subjects with no abnormal S-T depression in their resting ECGs and would be considered clinically to have isolated "positive" or "borderline" ECG exercise responses. In Table G5 and Figure G5 the occurrence of these ECG exercise responses clearly relates to increasing fatness (chi-square, quintile 1 vs. 5 = 23.40, $p < .001$), increasing relative weight (chi-square, quintile 1 vs. 5 = 7.09, $p < .01$) and blood pressure (chi-square, quintile 1 vs. 5, SBP = 39.75, $p < .0001$) but the relation to serum cholesterol level is not statistically significant.

Discussion

The relationship of specified ECG abnormalities to physical characteristics in these pooled samples of middle-aged men raises many questions; the first concerns their overall validity. This depends, in turn, on the reliability of the individual measures and ECG classifications as well as the appropriateness of lumping data from such varied cultures. Finally, among the numerous comparisons made, there is the possibility of chance findings of statistically significant differences.

"Infarct" Q Waves (I, 1). Reading agreement in this Laboratory is on the order of 90 per cent within and between observers on the presence or absence of item I, 1 Q waves in the ECG; and the clinical relevance of this finding to myocardial infarct is well established and widely accepted (Blackburn *et al.*, 1960). Though the numbers of large Q waves in these total populations are small (0.7 % of all men aged 40—59), the concentration of "old infarct" cases within classes of the physical characteristics is fairly consistent throughout the samples and is in the same direction for

TABLE G3

THE RELATIONSHIP OF
HIGH AMPLITUDE R WAVES (LEFT TYPE) (III, 1)
IN THE ELECTROCARDIOGRAM TO PHYSICAL CHARACTERISTICS
OF MEN AGED 40-59 YEARS

	AREA													
	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER
ΣSF	2162	815	858	871	669	697	510	718	980	766	685	529	10, 260	CENT
Median <	27	77	83	22	9	41	24	17	32	18	19	22	391	
Cut >	26	68	56	15	10	38	38	7	23	18	16	18	323	
Quintile 1	7	24	22	5	3	16	7	7	10	7	5	9	122	17. 1
2	13	36	41	12	3	19	12	6	15	8	8	7	180	25. 2
3	14	37	33	8	4	15	15	4	11	3	11	11	166	23. 2
4	9	27	29	7	5	17	16	5	11	5	5	10	146	20. 4
5	10	21	14	5	4	12	12	2	8	3	6	3	100	14. 0

All samples, quintile 1 vs. 5, Chi-square not significant

RBW

Median <	23	68	76	17	8	48	25	16	33	20	22	20	376	
Cut >	29	76	63	20	11	31	37	8	22	6	13	20	336	
Quintile 1	8	29	28	10	4	17	10	9	13	5	5	8	146	20. 5
2	15	22	31	5	2	19	10	4	18	14	11	9	160	22. 5
3	10	40	32	6	4	18	14	5	9	3	8	9	158	22. 2
4	4	31	29	6	5	14	15	4	9	4	6	9	136	19. 0
5	15	22	19	10	4	11	13	2	6	0	5	5	112	15. 7

All samples, quintile 1 vs. 5, Chi-square = 4. 50 (p < .05)

SBP

Median <	14	59	55	17	8	31	17	8	18	5	11	12	255	
Cut >	39	86	84	20	11	48	45	16	36	21	24	28	458	
Quintile 1	4	21	21	10	1	10	5	2	6	0	2	6	88	12. 3
2	4	25	17	3	6	14	7	2	8	4	8	3	101	14. 2
3	8	22	32	5	3	16	16	5	10	6	5	9	137	19. 2
4	12	34	35	6	5	15	15	5	11	5	7	7	157	22. 0
5	25	43	34	13	4	24	19	10	19	11	13	15	230	32. 2

All samples, quintile 1 vs. 5, Chi-square = 67. 77 (p < .0001)

DBP

Median <	16	68	74	13	8	30	22	10	16	11	11	17	296	
Cut >	37	77	65	29	11	49	40	14	38	15	24	23	417	
Quintile 1	4	23	37	7	3	11	6	5	5	2	6	7	116	16. 3
2	8	30	21	5	2	13	10	3	9	4	3	6	114	16. 0
3	9	27	27	4	6	17	14	3	6	10	5	9	137	19. 2
4	8	33	22	10	5	16	12	7	17	2	12	5	149	20. 9
5	24	32	32	11	3	22	20	6	17	8	9	13	197	27. 6

All samples, quintile 1 vs. 5, Chi-square = 22. 14 (p < .0001)

S. CHOL.

Median <	31	80	76	18	5	41	26	13	24	17	13	22	366	
Cut >	21	65	62	17	14	36	36	11	30	9	22	16	339	
Quintile 1	12	28	27	5	0	17	12	5	10	8	2	9	135	19. 1
2	10	31	33	8	2	19	10	5	9	6	9	10	152	21. 6
3	16	34	29	9	5	11	19	4	13	4	8	8	160	22. 7
4	9	28	22	8	10	17	10	6	15	6	9	4	144	20. 4
5	5	24	27	5	2	13	11	4	7	2	7	7	114	16. 2

All samples, quintile 1 vs. 5, Chi-square not significant

Total no. men in each quintile = 2052
Total no. men above and below median = 5130

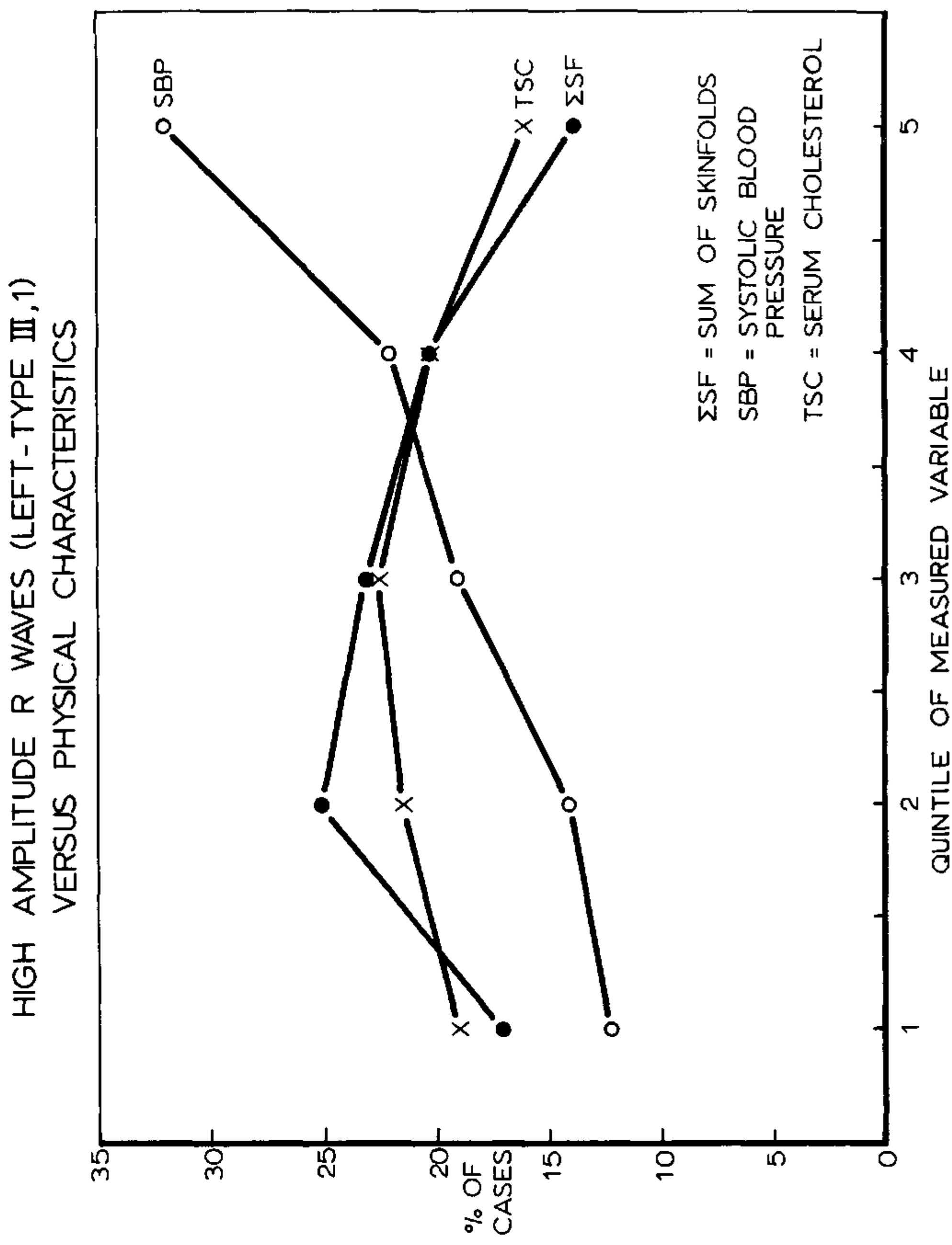

HIGH AMPLITUDE R WAVES (LEFT-TYPE III,1)
VERSUS PHYSICAL CHARACTERISTICS
SBP
TSC
ΣSF
ΣSF = SUM OF SKINFOLDS
SBP = SYSTOLIC BLOOD PRESSURE
TSC = SERUM CHOLESTEROL
% OF CASES
35
30
25
20
15
10
5
0
1
2
3
4
5
QUINTILE OF MEASURED VARIABLE

Figure G3

TABLE G4

THE RELATIONSHIP OF

NEGATIVE T WAVES (V, 1 & 2)

IN THE ELECTROCARDIOGRAM TO PHYSICAL CHARACTERISTICS

OF MEN AGED 40-59 YEARS

ΣSF	USRR 2162	EF 815	WF 858	ZU 871	YS 669	YN 697	VK 510	MO 718	CR 980	IRR 766	CT 685	CU 529	TOTAL 10, 260	PER CENT
Median <	19	12	6	7	2	4	3	4	11	2	1	4	75	
Cut >	11	15	7	9	1	8	1	4	6	3	3	7	75	
Quintile 1	6	5	4	3	0	0	1	2	6	6	0	1	28	20.0
2	11	6	0	2	1	2	2	1	3	1	1	2	32	22.8
3	2	3	3	4	1	3	1	1	3	1	0	1	23	16.4
4	5	5	2	3	1	1	0	2	2	2	2	4	29	20.7
5	6	8	4	4	0	6	0	2	3	1	1	3	28	20.0

All samples, quintile 1 vs. 5, Chi-square not significant

RBW	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER CENT
Median <	16	12	5	8	2	2	1	4	10	2	2	3	67	
Cut >	12	14	8	8	1	10	3	4	7	3	2	8	80	
Quintile 1	7	5	3	4	0	0	0	2	7	0	0	2	30	20.4
2	6	5	1	1	2	2	0	0	3	0	2	1	23	15.6
3	4	5	2	3	0	1	1	2	1	3	1	0	23	15.6
4	6	4	3	2	1	3	3	2	4	0	0	3	31	21.1
5	5	7	4	6	0	6	0	2	2	2	1	5	40	27.2

All samples, quintile 1 vs. 5, Chi-square not significant

SBP	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER CENT
Median <	7	10	5	8	2	0	1	3	7	1	2	2	48	
Cut >	23	17	8	8	1	12	3	5	10	4	2	9	102	
Quintile 1	3	5	4	1	1	0	1	2	5	1	0	1	24	16.0
2	4	4	1	4	1	0	0	0	2	0	1	1	18	12.0
3	4	1	0	4	0	1	0	3	1	1	2	1	18	12.0
4	7	3	2	2	1	5	1	1	0	0	0	4	26	17.3
5	12	14	6	5	0	6	2	2	9	3	1	4	64	42.7

All samples, quintile 1 vs. 5, Chi-square = 17.66 (p < .0001)

DBP	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER CENT
Median <	12	8	8	6	2	3	0	4	7	0	3	4	57	
Cut >	18	19	5	10	1	9	4	4	10	5	1	7	93	
Quintile 1	3	4	5	0	1	0	0	2	3	0	0	1	19	12.7
2	4	2	2	5	1	1	0	1	3	0	2	2	23	15.3
3	7	3	3	2	0	2	1	1	2	1	1	1	24	16.0
4	5	7	1	2	0	3	0	1	5	1	0	4	29	19.3
5	11	11	2	7	1	6	3	3	4	3	1	3	55	36.7

All samples, quintile 1 vs. 5, Chi-square = 16.86 (p < .0001)

S. CHOL.	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER CENT
Median <	4	13	14	4	6	2	4	5	3	7	8	2	73	
Cut >	0	15	13	1	7	1	0	7	5	9	7	2	73	
Quintile 1	2	1	2	4	2	1	2	2	0	1	3	0	21	14.4
2	2	9	8	0	4	1	2	3	3	5	4	1	42	28.8
3	0	8	6	0	2	1	0	2	2	5	3	2	32	21.9
4	0	4	6	1	1	0	0	1	1	3	2	0	23	15.8
5	0	6	5	0	4	0	0	4	2	2	3	1	28	19.2

All samples, quintile 1 vs. 5, Chi-square not significant

Total no. men in each quintile = 2052

Total no. men above and below median = 5130

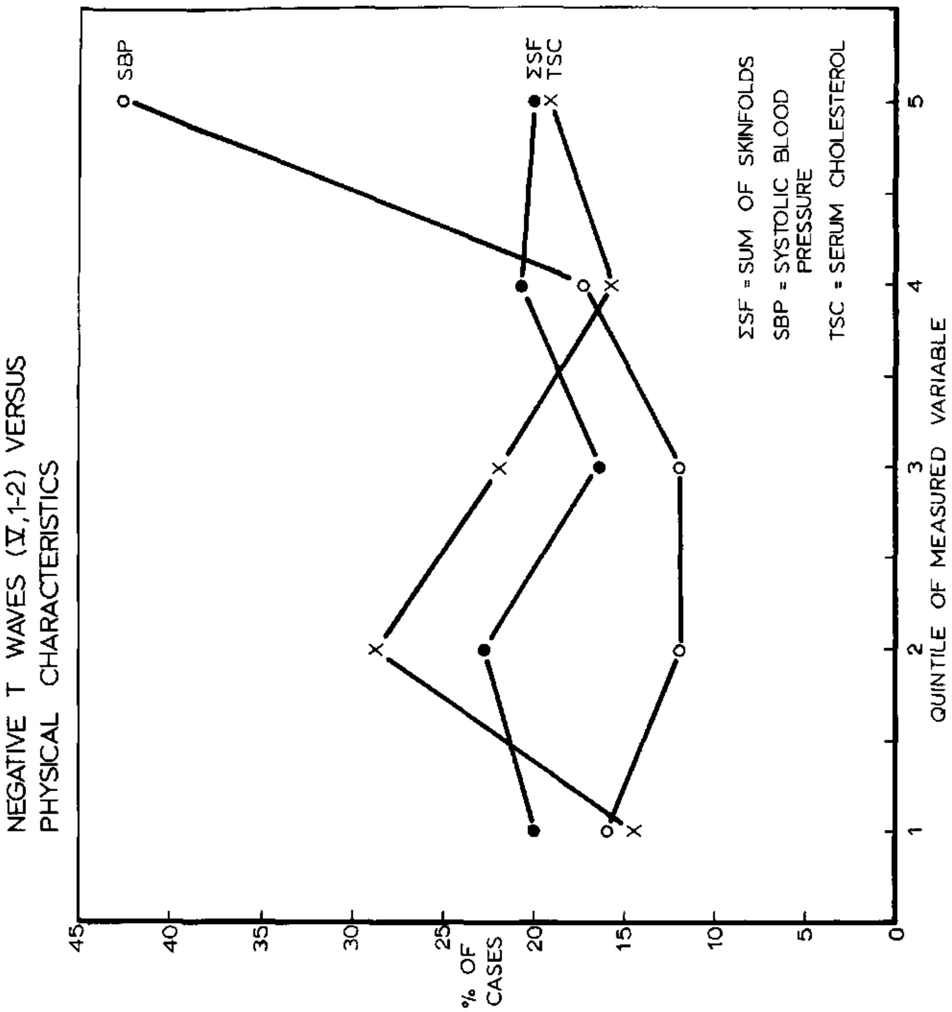

NEGATIVE T WAVES (V,1-2) VERSUS PHYSICAL CHARACTERISTICS
SBP
ΣSF
TSC
ΣSF = SUM OF SKINFOLDS
SBP = SYSTOLIC BLOOD PRESSURE
TSC = SERUM CHOLESTEROL
% OF CASES
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
QUINTILE OF MEASURED VARIABLE

Figure G4

TABLE G5

THE RELATIONSHIP OF
POST-EXERCISE S-T DEPRESSION (XI, 1-4)
IN THE ELECTROCARDIOGRAM TO PHYSICAL CHARACTERISTICS
OF MEN AGED 40-59 YEARS

	AREA													
	USRR	EF	WF	ZU	YS	YN	VK	MO	CR	IRR	CT	CU	TOTAL	PER
ΣSF	2162	815	858	871	669	697	510	718	980	766	685	529	10,260	CENT
Median <	71	10	10	14	4	10	10	16	21	24	17	11	218	
Cut >	85	14	18	25	7	15	6	25	22	38	24	22	301	
Quintile 1	30	5	2	6	1	5	3	3	9	9	4	4	81	15.6
2	31	4	6	2	1	3	5	10	6	10	9	3	90	17.3
3	25	4	4	8	3	3	3	5	9	11	9	9	93	17.9
4	34	6	5	12	0	5	1	7	7	13	5	6	101	19.5
5	36	5	11	11	6	9	4	16	12	19	14	11	154	29.7

All samples, quintile 1 vs. 5, Chi-square = 23.40 (p < .0001)

RBW

Median <	71	13	11	15	3	8	9	16	20	26	16	11	219	
Cut >	82	11	16	24	8	17	7	25	23	36	25	22	296	
Quintile 1	30	6	4	5	1	5	5	4	9	9	6	4	88	17.1
2	27	3	6	6	2	2	4	11	4	7	7	5	84	16.3
3	28	7	4	9	0	5	1	4	13	15	7	6	99	19.2
4	31	4	5	12	2	4	2	11	12	14	10	10	117	22.7
5	37	4	8	7	6	9	4	11	5	17	11	8	127	24.7

All samples, quintile 1 vs. 5, Chi-square = 7.09 (p < .01)

SBP

Median <	62	6	8	12	7	8	7	17	15	21	16	12	191	
Cut >	94	17	20	27	4	17	9	24	28	41	25	21	327	
Quintile 1	15	2	3	7	2	2	1	7	3	7	7	4	60	14.6
2	27	3	5	2	3	2	3	6	8	7	8	6	80	15.4
3	35	3	3	7	2	8	4	8	8	12	4	7	101	19.5
4	41	7	8	6	1	6	1	10	14	21	6	6	127	24.5
5	38	8	9	17	3	7	7	10	10	15	16	10	150	29.0

All samples, quintile 1 vs. 5, Chi-square = 39.75 (p < .0001)

DBP

Median <	65	7	10	20	6	8	9	19	14	22	18	13	211	
Cut >	91	16	18	19	5	17	7	22	29	40	23	22	309	
Quintile 1	28	3	5	7	5	3	2	7	6	5	8	5	84	16.2
2	29	3	3	10	1	2	3	7	4	11	6	6	85	16.4
3	25	5	3	6	1	9	5	11	11	14	7	6	103	19.9
4	38	6	10	8	2	3	2	4	10	18	6	6	113	21.8
5	36	6	7	8	2	8	4	12	12	14	14	10	133	25.7

All samples, quintile 1 vs. 5, Chi-square = 11.21 (p < .001)

S. CHOL.

Median <	79	17	13	15	3	12	8	19	14	31	15	15	241	
Cut >	74	7	15	23	8	12	8	22	29	31	24	17	270	
Quintile 1	31	4	5	3	1	5	4	6	8	12	2	9	90	17.6
2	32	9	4	6	2	4	1	10	5	15	10	3	101	19.8
3	31	8	4	10	1	3	6	4	9	12	6	8	102	20.0
4	24	1	5	12	4	7	2	12	10	11	8	6	102	20.0
5	35	2	10	7	3	5	3	9	11	12	13	6	116	22.7

All samples, quintile 1 vs. 5, Chi-square not significant

Total no. men in each quintile = 2052
Total no. men above and below median = 5130

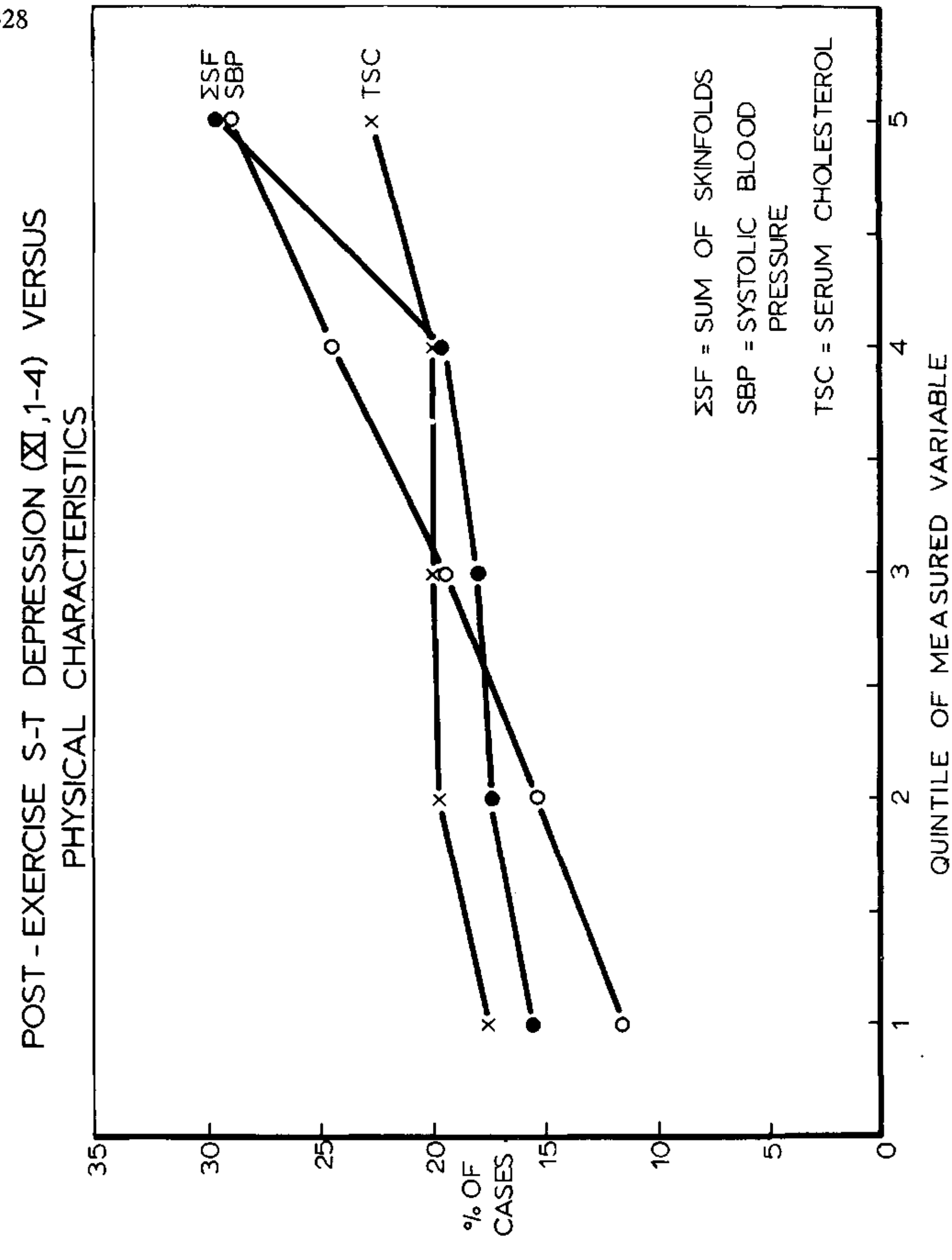

POST - EXERCISE S-T DEPRESSION (XI,1-4) VERSUS
PHYSICAL CHARACTERISTICS
ΣSF
SBP
TSC
ΣSF = SUM OF SKINFOLDS
SBP = SYSTOLIC BLOOD PRESSURE
TSC = SERUM CHOLESTEROL
% OF CASES
35
30
25
20
15
10
5
0
1
2
3
4
5
QUINTILE OF MEASURED VARIABLE

Figure G5

each pair of the highly inter-correlated variables of weight-obesity and systolic-diastolic pressure (Table G1).

The distinct association of "old infarct", so described, with the thinner-lighter men and the absence of a stronger association with serum cholesterol are somewhat unexpected. The Q waves are a hard core of cases with manifest coronary heart disease, representing but a fraction of all those with anatomic or functional myocardial damage and coronary artery disease, and the relationships found are after the event. The proportion of these ECG cases which were clinically "silent" is being investigated. The effects of the disease itself and, in some cases, the therapeutic adjustments made after the "attack" may explain, in part, the cross-sectional relationships found. Conclusions about future disease risk based on information from cross-sectional analyses may, of course, be biased and the relative strength of risk factors calculated from prevalence and incidence studies is a subject of general interest and study in cardiovascular epidemiology. These findings on the Q wave confirm, however, follow-up information available that elevated arterial blood pressure and serum cholesterol are more important risk factors for myocardial infarction than are overweight or obesity (Keys, *et al.*, 1963; Kannel, *et al.*, 1964).

Left Axis Deviation $\geq -30°$ (II, 1). This ECG criterion is read with considerable reliability. The leftward and upward orientation of the frontal plane QRS vector can be caused either by anatomical left ventricular hypertrophy or by alteration of the time course of depolarization by myocardial infarction and fibrosis. Both prevalence and incidence data concerning the clinical importance of this phenomenon indicate an important association with heart disease (Harlan *et al.*, 1962).

Here marked "abnormal" left axis, occurring in 4 per cent of all men ages 40—59, has no significant relationship among the total of middle-aged men to their characteristics of body build, blood pressure, or blood cholesterol. The ECG findings of left axis deviation may thus provide information independent of the other risk factors in assessing risk of future disease. Follow-up data from these studies on the predictive import of left axis will be of interest.

"Left Ventricular Hypertrophy" (III, 1). The different frequencies of occurrence of high amplitude R waves in the samples is striking, from less than 3 per cent in U.S. railmen to 12 per cent in Slavonia (YN) and 17 per cent in Finland. Systematic area differences due to different ECG apparatus or technique are unlikely, since standard methods were employed and amplitude calibration was applied to all records. The criteria used involve high QRS amplitudes in any of several ECG leads which, from other studies, might be expected to be roughly 70 per cent sensitive in detection of anatomic hypertrophy, and about 70 per cent specific for identification of those truly without cardiac hypertrophy.

Questions about the effect on surface potential differences of different heart sizes relative to chest size and body weight, and about the effect of proximity of the heart to the chest wall are among the more complex in electrophysiology. It is, however, common clinical experience to find largest ventricular complexes in the ECGs of men with very thin chests, in children, and in highly trained athletes.

The distribution of ECG "left hypertrophy" according to body build is inconsistent between areas, and this, plus the U-shaped frequency distribution of the item renders attempts at interpretation hazardous. Clearly, however, increments in the cardiac load from arterial blood pressure are reflected in an excess of high voltages in the body surface ECG.

Negative T Waves (V, 1—2). Negative T waves of the type defined are non-specific indicators of myocardial damage or ischemia. They are read with high repeatability, and occur about twice as frequently among these middle-aged men as do clear ECG signs of old myocardial infarction.

In working population groups the usual clinical considerations among hospital and patient groups about the probable genesis of negative T waves do not hold, (e.g., acute pericarditis or myocarditis, drug and electrolyte effects, etc.) because of the great rarity of transient influences on the T wave at any given time in such populations. The records are taken in a random time relationship to prior meals and the procedure is the same in all of the areas. Meal or glucose effects on the T wave which may exist (Ostrander and Weinstein, 1964) cannot account for the strong relationship to elevated blood pressure.

Finally, the occurrence of cases with manifest valvular heart disease is extremely rare in total adult populations, and parasitic heart involvement does not occur in these areas. It is, therefore, probable that we are dealing with a crude statistic related to myocardial ischemia or damage from coronary artery disease. These findings are more likely to exist silently in a population than are infarctions (manifested by large Q waves), so that their interrelations could be conceivably of more interest than other ECG abnormalities considered tantamount to frank clinical disease.

Despite the greater numbers of T than Q wave cases observed among all areas, no significant relationship of negative T waves to obesity is found. The concentration of negative T waves in the *highest* quintile of blood pressure is entirely responsible for the association observed with blood pressure. Elevated blood pressure appears to be the most important factor in the overall occurrence of negative T waves in a population, while the factors responsible for negative T waves are unrelated to serum cholesterol.

Post-exercise S-T Depression (XI, 1—4). The ECG exercise test is difficult to apply and interpret in population studies but is of great general interest (Report of Research Committee ISC, 1964). Coding of lesser degrees of S-T depression is unreliable for the individual case, which is an important consideration in studying such interrelationships. Observer agreement is high only for item XI, 1, the more marked S-T depression category. The original published code (Blackburn *et al.*, 1960) does not adequately distinguish junctional from ischemic-type depression and until more is known about their relative significance they should be separately analyzed, especially in a study of detailed inter-relationships. Considerable opportunity exists therefore for the finding of inexplicable and perhaps meaningless relationships.

On the other hand, S-T depression in the post-exercise ECG provides the largest numbers of individual ECG phenomena for analysis. The interrelations found with the exercise ECG test are, moreover, either quite strong or very weak, without areas of borderline significance. It appears safe from Table G 5 and Figure G 5 to assume some overall relation of positive exercise ECG response (? myocardial ischemia) to extreme obesity, and a very strong relationship between the ECG and an exercise load superimposed on increasing levels of arterial pressure. These are reasonable and not unexpected results, interpretable by accepted principles.

However, the S-T response, which is another ECG item clinically related to myocardial ischemia though more elusive and transient than T waves or infarction, shows here no relationship to an isolated individual measure of serum cholesterol. Deaths from clinical attacks of myocardial infarction are highly related to, and the risk crudely predicted by, the serum cholesterol level in clinical "health", as well as by post-exercise ECG responses of the S-T. There is no *a priori* necessity that serum cholesterol level and the S-T response be highly correlated, and here it is clear that they are not.

The relationships found overall are similar to those found within the U.S. railway study above (Blackburn *et al.*, 1961), and to those found in the resting ECG of men over age 40 in the Tecumseh community study of the University of Michigan (Ostrander *et al.*, 1965).

Summary

The inter-relationships between measured physical characteristics and several objectively categorized electrocardiographic abnormalities are examined among men aged 40—59 in large total population samples. Despite many limitations, this may be the only way in which an approximation of the true inter-relationships may be obtained. Large Q waves, equivalent to an anatomic diagnosis of myocardial infarction, and most gross ECG abnormalities, occur too rarely to be studied in detail within one population and pooling of men of similar age from many areas is made here as a practical approach to a preliminary look at the relationships.

More or less expected associations were found in some cases, readily explainable under existing hypotheses and facts. For example, "infarct Q waves", high "left hypertrophy" type R waves, negative T waves, and "positive" (depressed) S-T responses after effort tests are moderately to highly associated with increments in arterial blood pressure, and left "hypertrophy" is unrelated to serum cholesterol. Less expected however, is the definite relationship found between "infarct Q waves" and being lightweight and thin, and the impressive absence of any significant relationship between other "coronary" ECG patterns (i.e. negative T waves and positive exercise tests) and serum cholesterol. Marked left axis deviation, ominously regarded clinically, is unrelated to any of the other measured risk factors. Finally, all positive associations of ECG abnormalities with arterial blood pressure are more distinct with the systolic than with the diastolic blood pressure levels.

The implications are clear for evaluation of the predictive import of these ECG items in follow-up studies among middle-aged men. In particular, study of the post-exercise responce of the S-T segment as a risk factor for subsequent disease must be made with consideration of the association with extreme obesity and especially with blood pressure. Nothing is yet known about the predictive import of the exercise ECG response in the absence of these conditional factors.

INTER-RELATIONS OF ELECTROCARDIOGRAPHIC FINDINGS AND CIGARETTE SMOKING HABIT

There is evidence that cigarette smoking habit is significantly associated with risk of future coronary disease from follow-up study of volunteer groups (Doll and Hill, 1956; Hammond and Horn, 1958; Doyle *et al.*, 1962). The inter-relations of smoking with diagnostic and predictive ECG items is therefore of interest.

Detailed smoking habit and ECG

classification codes are contained in the Appendix. In brief, the smoking classification employed for this analysis is as follows:

Never — this group consists predominantly of those who never regularly smoked cigarettes, but because of the necessity to simplify the classification, and because of the paucity, among these groups, of exclusively pipe or cigar smokers, the latter are contained in this category.

Occasional and Light — less than 1 cigarette daily was classified only for the U.S. Railroad men, and the light class consists of regular smokers of 1 through 9 cigarettes daily.

Moderate — regular smokers of 10 through 19 cigarettes daily.

Heavy — regular smokers of 20 or more cigarettes daily.

Stopped — the stopped smokers class is based on the current history given on examination without regard to duration since stopping, duration or amount of prior smoking, reason for stopping, or current history with regard to cigar or pipe smoking.

Since both electrocardiographic findings and smoking habit are age-related between 40 to 60 years, detailed analysis was made for each ECG item according to age quinquennium and smoking class. These findings will be discussed, though the tabular and graphic relationships, for simplicity, are based on age-adjusted values. The age-specific rate per 1 000 men was calculated for each of the four age classes, summed and divided by four. The material for all areas is pooled.

Large Q Waves (I, 1). A trend by age in large "infarct" Q waves occurs but as seen in Table G6 and Figure G6 there is no clear association between the prevalence of this item and smoking habit. Stopped smokers have the highest age-adjusted rate of "infarct" Q waves (10.7 per 1 000) and persons who have never smoked the lowest (2.1 per 1 000). Moderate and heavy smokers, though lying between these extremes have rates that are comparable to those for the stopped smokers.

Left Axis Deviation $\geqq -30°$ (II, 1). No significant association between the existence of marked left axis deviation and smoking habit is found in the age-adjusted rates in Table G7 and Figure G6. Though the stopped smokers have a noticeably lower prevalence of this finding, prevalences in the other three smoking categories are indistinguishable.

High Amplitude R Waves, Left Type (III, 1). In Table G8 and Figure G6 it is seen that stopped smokers have the highest rates of "left hypertrophy" and that heavy smokers have substantially lower rates than other men. The difference between prevalence rates for heavy smokers (60.1 per 1 000) and all other men (86.4 per 1 000) is statistically significant ($d = 26.3$, S. E. $= 6.65$, $p = .0001$).

Negative T Waves (V, 1—2). An age trend exists for negative T waves in the resting ECG. In Table G9 and Figure G6, there is a decreasing rate for this item according to intensity of smoking, heavy smokers having the lowest rate (8.1 per 1 000). Again the stopped smokers show an interesting departure from the other groups, negative T waves being 3 times as frequent among them as among heavy smokers.

Post-exercise S-T Depression (XI, 1—4). A consistent increase by age occurs in combined junctional and segmental S-T depressions in the ECG taken after standard exercise. In Table G10 and Figure G6 there is a trend downward in prevalence of this finding according to increased smoking intensity. Again the highest rate occurs among the heterogeneous group of stopped smokers.

TABLE G6

Frequency (f) of large Q waves (Code I, 1) in the electrocardiograms of men age 40-59 years by smoking habit class. Rate is age-adjusted rate per 1000 men.

AREA	SMOKING HABIT CLASS Stopped Smoking		Never Smoked		Light & Moderate Regular Smokers		Heavy Smokers	
	f	rate	f	rate	f	rate	f	rate
U.S. Railroad Men	4	9.3	3	7.2	11	15.2	9	19.3
East Finland	4	29.5	0	0.0	2	6.4	1	3.6
West Finland	1	6.0	0	0.0	2	7.7	3	22.0
Zutphen	5	56.6	0	0.0	4	7.8	0	0.0
Dalmatia	0	0.0	0	0.0	0	0.0	0	0.0
Slavonia	0	0.0	0	0.0	3	9.7	0	0.0
Velika Krsna	0	0.0	2	7.4	2	9.4	1	14.7
Montegiorgio	1	7.0	0	0.0	2	6.4	1	11.9
Crevalcore	0	0.0	0	0.0	4	8.4	1	5.6
Rome Railroad Men	1	6.4	1	10.4	1	6.1	1	3.5
Crete	0	0.0	0	0.0	0	0.0	0	0.0
Corfu	1	13.9	0	0.0	2	8.6	0	0.0
All areas combined	17	10.7*	6	2.1*	33	7.1*	17	6.7*

* Average of the rates for all areas.

TABLE G7

Frequency (f) of left axis deviation > 30° (Code II, 1) in the electrocardiograms of men age 40-59 years by smoking habit class. Rate is age-adjusted rate per 1000 men.

AREA	SMOKING HABIT CLASS Stopped Smoking		Never Smoked		Light & Moderate Regular Smokers		Heavy Smokers	
	f	rate	f	rate	f	rate	f	rate
U.S. Railroad Men	10	22.9	17	37.2	27	39.5	11	22.5
East Finland	1	6.8	4	33.2	11	38.0	8	34.4
West Finland	7	47.9	9	40.6	14	40.4	10	75.8
Zutphen	4	47.0	9	62.6	21	37.0	1	8.3
Dalmatia	1	10.9	5	23.5	11	48.2	6	33.3
Slavonia	2	18.3	8	43.9	20	62.4	10	75.2
Velika Krsna	2	33.3	9	38.6	7	41.5	1	15.6
Montegiorgio	8	72.6	12	65.2	18	51.0	5	77.5
Crevalcore	4	30.7	12	49.2	19	43.4	5	29.9
Rome Railroad Men	8	57.6	5	30.8	13	44.5	7	31.4
Crete	3	22.8	8	50.6	9	49.6	12	54.1
Corfu	1	13.9	1	8.6	6	25.6	2	15.1
All areas combined	51	32.0*	99	40.3*	176	43.4*	78	39.4*

* Average of the rates for all areas.

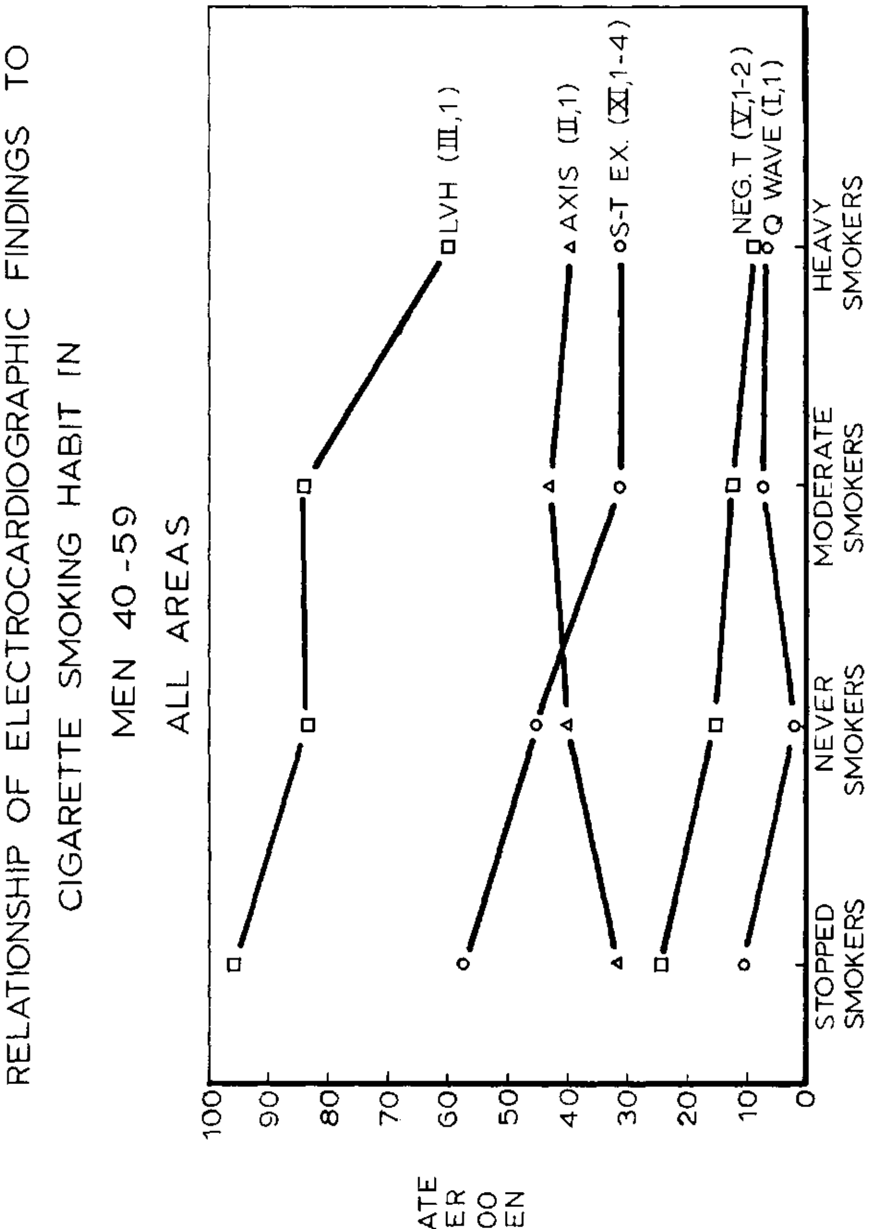

RELATIONSHIP OF ELECTROCARDIOGRAPHIC FINDINGS TO
CIGARETTE SMOKING HABIT IN
MEN 40-59
ALL AREAS
RATE PER 1000 MEN
100
90
80
70
60
50
40
30
20
10
0
STOPPED SMOKERS
NEVER SMOKERS
MODERATE SMOKERS
HEAVY SMOKERS
LVH (III,1)
AXIS (II,1)
S-T EX. (XI,1-4)
NEG. T (V,1-2)
Q WAVE (I,1)

Figure G6

TABLE G8

Frequency (f) of high amplitude R waves, left type (Code III, 1) in the electrocardiograms of men age 40-59 years by smoking habit class. Rate is age-adjusted rate per 1000 men.

AREA	SMOKING HABIT CLASS							
	Stopped Smoking		Never Smoked		Light & Moderate Regular Smokers		Heavy Smokers	
	f	rate	f	rate	f	rate	f	rate
U.S. Railroad Men	16	35.6	16	35.5	16	21.8	6	11.7
East Finland	30	210.0	22	184.9	59	193.6	35	135.4
West Finland	23	148.8	33	155.0	63	173.3	18	140.8
Zutphen	2	23.5	5	64.3	29	52.4	2	17.2
Dalmatia	2	19.2	8	39.2	8	36.4	1	6.1
Slavonia	14	158.8	19	114.9	34	117.3	11	77.1
Velika Krsna	8	146.2	32	156.2	12	163.7	10	145.8
Montegiorgio	5	57.6	2	9.1	15	43.8	2	22.8
Crevalcore	13	109.5	12	47.0	24	58.6	6	36.2
Rome Railroad Men	6	50.8	5	38.3	11	43.3	4	14.5
Crete	7	55.6	8	50.6	12	66.6	8	39.2
Corfu	9	134.1	14	111.5	9	41.0	8	74.4
All areas combined	135	95.8*	176	83.9*	292	84.3*	111	60.1*

* Average of the rates for all areas.

TABLE G9

Frequency (f) of negative T waves (Code V, 1-2) in the electrocardiograms of men age 40-59 years by smoking habit class. Rate is age-adjusted rate per 1000 men.

AREA	SMOKING HABIT CLASS							
	Stopped Smoking		Never Smoked		Light & Moderate Regular Smokers		Heavy Smokers	
	f	rate	f	rate	f	rate	f	rate
U.S. Railroad Men	5	12.7	9	19.6	11	20.0	6	12.3
East Finland	8	61.3	3	28.3	12	39.5	4	18.0
West Finland	4	27.0	5	24.0	4	12.6	0	0.0
Zutphen	5	52.4	2	10.3	7	12.9	1	15.6
Dalmatia	0	0.0	2	9.6	1	4.0	0	0.0
Slavonia	0	0.0	4	19.7	6	17.6	2	12.5
Velika Krsna	1	14.7	3	13.7	0	0.0	0	0.0
Montegiorgio	2	15.9	3	17.0	3	8.4	0	0.0
Crevalcore	4	31.4	2	7.2	7	15.8	4	20.1
Rome Railroad Men	4	33.3	0	0.0	0	0.0	1	3.6
Crete	1	8.0	2	10.4	1	5.3	0	0.0
Corfu	3	39.7	3	22.5	3	16.2	2	15.1
All areas combined	37	24.4*	38	15.2*	55	12.7*	20	8.1*

* Average of the rates for all areas.

TABLE G10

Frequency (f) of post exercise S-T depression (Code XI, 1-4) in the electrocardiograms of men age 40-59 years by smoking habit class. Rate in age-adjusted rate per 1000 men.

AREA	SMOKING HABIT CLASS							
	Stopped Smoking		Never Smoked		Light & Moderate Regular Smokers		Heavy Smokers	
	f	rate	f	rate	f	rate	f	rate
U.S. Railroad Men	23	51.0	33	73.6	23	32.0	19	38.4
East Finland	5	35.6	2	21.8	7	23.0	5	22.4
West Finland	4	23.5	7	32.4	14	35.7	4	32.1
Zutphen	7	91.4	4	40.5	29	52.3	4	43.6
Dalmatia	1	10.9	3	13.0	3	12.8	1	6.1
Slavonia	3	28.3	4	22.7	4	12.6	5	36.3
Velika Krsna	1	15.6	6	27.0	4	25.0	0	0.0
Montegiorgio	6	66.7	11	67.0	16	42.6	3	47.8
Crevalcore	4	29.9	11	47.3	15	38.4	6	38.5
Rome Railroad Men	17	129.3	11	76.7	8	34.1	6	26.4
Crete	15	114.1	10	49.8	5	26.9	10	48.9
Corfu	7	92.1	9	73.4	10	45.7	4	36.8
All areas combined	93	57.4*	111	45.4*	138	31.8*	67	31.4*

* Average of the rates for all areas.

TABLE G11

Frequency (f) of large Q waves (Code I, 1) in the electrocardiograms of men age 40-59 years by occupational physical activity class. Rate is age adjusted rate per 1000 men.

AREA	OCCUPATIONAL PHYSICAL ACTIVITY CLASS					
	LIGHT		MODERATE		HEAVY	
	f	rate	f	rate	f	rate
U.S. Railroad Men	13	12.9	13	18.3	--	--
East Finland	4	40.2	2	12.4	1	2.2
West Finland	2	29.8	4	33.3	0	0.0
Zutphen	5	19.8	4	8.0	0	0.0
Dalmatia	0	0.0	0	0.0	0	0.0
Slavonia	1	6.4	0	0.0	2	3.6
Montegiorgio	2	36.9	1	4.2	1	1.6
Crevalcore	2	17.0	0	0.0	3	3.9
Rome Railroad Men	1	10.4	1	2.7	2	9.5
Crete	0	0.0	0	0.0	1	2.4
Corfu	1	5.8	1	5.0	1	4.4
All areas combined	31	16.3*	26	7.6*	11	2.8*

* Average of the rates for all areas.

Discussion and Conclusions

There is no significant relationship of the prevalence of "infarct" Q waves to cigarette smoking habit among men in these combined areas though non-smokers have the lowest rates.

Any possible relationship of left axis deviation with coronary heart disease is apparently independent of smoking habit.

There are fewer men with high, left type, R waves among smokers. If this relationship were causal it might be mediated through two other factors associated with habitual heavy cigarette smoking, lower average blood pressure and increased obstructive lung disease.

Similar explanations can be brought forward for the apparent lower frequency of negative T waves and post-exercise S-T depression in heavy smokers who have lower average blood pressure and relative weight. It has not been determined whether an important proportion of heavy cigarette smokers were excluded, for clinical cardiac disease, from the exercise test. However, all examined subjects received a resting electrocardiogram.

The stopped smokers are the most divergent of all classes, and among them are concentrated the highest numbers of infarct Q cases, high R waves, negative T waves and "positive" post-exercise tests. More detailed delineation of this group according to physical characteristics and clinical disease prevalence is indicated. The results among stopped smokers are in the opposite direction to that which might be expected from the unusually high ventilatory function values found among men of the same age, similarly classified (Blackburn *et al.*, 1965).

INTER-RELATIONS OF ELECTROCARDIOGRAPHIC FINDINGS AND LEVEL OF OCCUPATIONAL PHYSICAL ACTIVITY

Because of interest in the hypotheses concerning physical activity and coronary heart disease we have attempted to analyse here the relationship between five important ECG findings and three reasonable, if crude, categories of activity according to occupational class among men aged 40 through 59. Though individual areas are analysed, results are pooled for all areas combined, and age-adjusted rates for ECG items were made from quinquennial rates according to activity class.

Large Q Waves (I, 1). Table G11 and Figure G7 show the interesting diminution of "infarct" Q waves according to increasing activity of the occupation. Though the prevalence overall is low the difference is consistent within each age quinquennium as it is in the pooled data. The frequencies of large Q waves observed in the three activity classes (sedentary = 16.3 per 1 000, moderate = 7.6 per 1 000, active = 2.8 per 1 000) differ significantly from each other ($p < .003$ in each case).

Left Axis Deviation $\geq -30°$ (II, 1). Table G12 and Figure G7 indicate no significant relationship between marked, "abnormal" left axis deviation in the ECG, and level of activity.

High Amplitude R Waves, Left Type (III, 1). Table G13 and Figure G7 show the stepwise increase of large voltages in the ECG with increasing physical activity of occupation. The differences between rates for light (47.1 per 1 000) and those for moderate

RELATIONSHIP OF ELECTROCARDIOGRAPHIC FINDINGS TO PHYSICAL ACTIVITY OF OCCUPATION IN MEN AGED 40-59

ALL AREAS

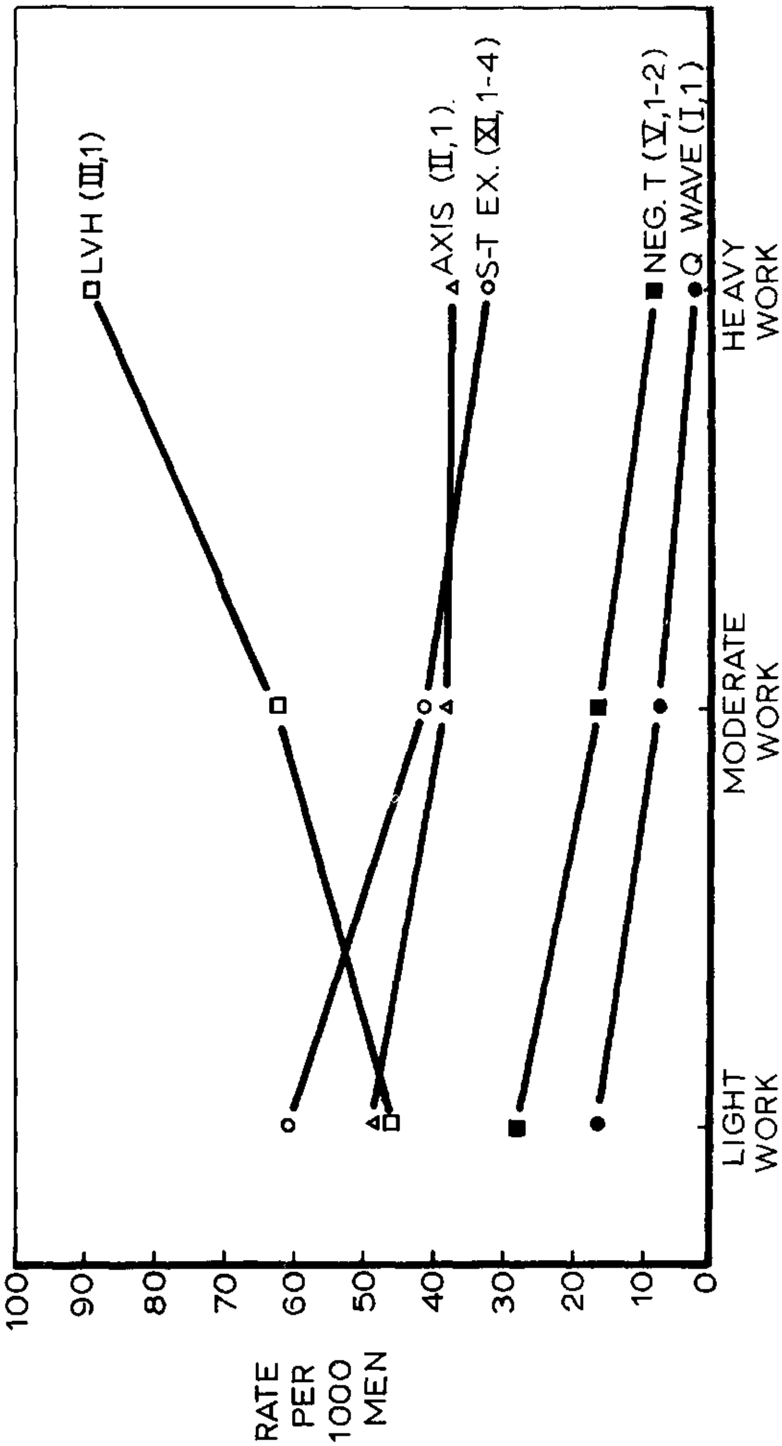


Figure G7

TABLE G12

Frequency (f) of left axis deviation > 30° (Code II, 1) in the electrocardiograms of men age 40-59 years by occupational physical activity class. Rate is age adjusted rate per 1000 men.

AREA	OCCUPATIONAL PHYSICAL ACTIVITY CLASS					
	LIGHT		MODERATE		HEAVY	
	f	rate	f	rate	f	rate
U.S. Railroad Men	36	37.8	29	24.2		
East Finland	6	61.2	3	20.0	15	26.2
West Finland	3	31.0	10	78.0	27	41.3
Zutphen	12	50.0	20	35.0	3	26.3
Dalmatia	6	96.9	1	8.9	16	29.1
Slavonia	12	89.4	2	31.2	26	46.7
Montegiorgio	3	35.7	11	54.4	30	70.2
Crevalcore	5	37.8	7	40.7	29	41.4
Rome Railroad Men	5	37.0	18	45.1	10	39.8
Crete	2	49.1	13	59.2	17	39.9
Corfu	2	11.6	5	24.9	3	16.5
All areas combined	92	48.9*	119	38.3*	176	37.7*

* Average of the rates for all areas.

TABLE G13

Frequency (f) of high amplitude R waves, left type (Code III, 1) in the electrocardiograms of men age 40-59 years by occupational physical activity class. Rate is age adjusted rate per 1000 men.

AREA	OCCUPATIONAL PHYSICAL ACTIVITY CLASS					
	LIGHT		MODERATE		HEAVY	
	f	rate	f	rate	f	rate
U.S. Railroad Men	29	29.7	23	19.1	--	--
East Finland	7	69.0	15	107.4	124	215.7
West Finland	10	113.2	18	147.0	111	168.6
Zutphen	9	42.2	23	40.6	6	57.6
Dalmatia	0	0.0	3	41.5	16	30.5
Slavonia	11	88.3	8	125.7	60	122.8
Montegiorgio	1	11.9	5	27.5	18	40.0
Crevalcore	6	54.0	4	21.8	45	65.2
Rome Railroad Men	5	36.4	11	33.1	9	36.6
Crete	0	0.0	12	61.7	23	55.7
Corfu	12	73.6	12	59.6	16	98.0
All areas combined	90	47.1*	134	62.3*	428	89.1*

* Average of the rates for all areas.

TABLE G14

Frequency (f) of negative T waves (Code V, 1-2) in the electrocardiograms of men age 40-59 years by occupational activity class. Rate is age adjusted rate per 1000 men.

AREA	OCCUPATIONAL PHYSICAL ACTIVITY CLASS					
	LIGHT		MODERATE		HEAVY	
	f	rate	f	rate	f	rate
U.S. Railroad Men	17	17.3	13	10.7	--	--
East Finland	9	91.8	8	57.8	10	18.2
West Finland	5	52.4	3	27.2	5	8.3
Zutphen	7	27.9	8	14.6	1	9.6
Dalmatia	0	0.0	0	0.0	3	4.8
Slavonia	4	26.7	0	0.0	8	13.4
Montegiorgio	1	11.9	3	17.4	4	7.6
Crevalcore	4	32.2	2	11.3	11	14.8
Rome Railroad Men	2	20.8	2	9.2	1	3.8
Crete	0	0.0	2	9.2	2	4.8
Corfu	6	31.6	5	24.3	0	0.0
All areas combined	55	28.4*	46	16.5*	45	8.5*

* Average of the rates for all areas.

TABLE G15

Freuqency (f) of post exercise S-T depression (Code XI, 1-4) in the electrocardiograms of men age 40-59 years by occupational physical activity class. Rate is age adjusted rate per 1000 men.

AREA	OCCUPATIONAL PHYSICAL ACTIVITY CLASS					
	LIGHT		MODERATE		HEAVY	
	f	rate	f	rate	f	rate
U.S. Railroad Men	56	59.0	42	35.4	--	--
East Finland	3	36.0	8	61.9	8	13.8
West Finland	6	77.5	4	32.4	19	27.8
Zutphen	15	64.8	25	43.6	4	41.4
Dalmatia	2	31.2	1	8.9	5	7.8
Slavonia	6	50.1	1	16.7	9	17.5
Montegiorgio	6	122.6	13	67.7	17	33.0
Crevalcore	5	37.0	10	58.0	21	32.7
Rome Railroad Men	10	70.9	9	24.9	8	37.3
Crete	3	58.4	13	57.9	24	55.7
Corfu	10	63.6	10	47.8	10	59.0
All areas combined	122	61.0*	136	41.4*	125	32.6

* Average of the rates for all areas.

(62.3 per 1 000) workers are statistically significant (d = 15.2, S. E. = 6.52, $p < .02$) as is that between heavy (89.1 per 1 000) and moderate workers (d = 26.8, S. E. = 6.13, $p < .0001$). The difference exists within each 5-year age class.

Negative T Waves (V, 1—2). Table G14 and Figure G7 show the regular decrease in prevalence of important negative T waves among men in occupations involving light (28.4 per 1 000), moderate (16.5 per 1 000) and heavy (8.5 per 1 000) physical activity. The difference in prevalence rate between light and moderate activity classes (S. E. = 4.04, p = .003) and between moderate and heavy activity classes (S. E. = 2.50, p = .001) are both statistically significant. The association is principally due to the findings in the decade 50—59 years.

Post-exercise S-T Depression (XI, 1—4). Table G15 and Figure G7 indicate the consistent reduction in post-exercise S-T depressions, all types, among men of all areas with increasing habitual physical activity of occupation. If anything, the prevalence among sedentary men is underestimated since they are more likely than the average to be excluded for disabilities from the standard work test.

Though the difference in prevalence between light (61.0 per 1 000) and moderate (41.4 per 1 000) workers is clearly significant statistically (d = 19.6, S. E. = 3.23, p = .001), and that between moderate and heavy (32.6 per 1 000) is only of doubtful significance (d = 0.8, S. E. = 4.30, p = .05) the trends are consistent throughout the detailed analyses by quinquennial age class.

Discussion and Conclusions

If large Q waves so-defined (I,1) represent in fact a core of well established coronary cases (infarction), the relationship seen here between prevalence of coronary disease and activity habit is impressive. However, it must be recalled that several influences tend to concentrate prevalence of this disease in sedentary classes in cross-sectional surveys, including retirement and job change due to illness (Taylor *et al.*, 1964). Most of this bias is eliminated, but possibly not all, in the mode of sampling, interrogation and classification used in these studies.

Left axis deviation of severe degree is not influenced by activity class though there are leftward trends of QRS axis observable among athletes (Rautaharju, 1958).

Clearly the left ventricular mass, crudely reflected in high voltages at specified surface leads (Code III, 1) would appear to be associated with the habitual occupation of middle-aged men. The finding cannot be adequately explained by differences in body build or the absence of insulating subcutaneous fat among the heavy workers.

The same factors concentrating "coronary cases" (infarct Q waves, I, 1) among sedentary workers, and the same likelihood of this being an inadequate explanation of the differences found, may apply to the excess of non-specific T and post-exercise S-T findings among these men. All three "coronary-related" ECG findings show relationships with occupation as strong as those found with arterial pressure and much more significant associations than those found on cross-sectional analysis with serum cholesterol level and smoking habit.

H. GRADES OF OBESITY AND HYPERCHOLESTEROLEMIA — PRACTICAL STANDARDS

For many purposes it is desirable to classify men with respect to body fatness and serum cholesterol concentration and to identify grades of obesity and of hypercholesterolemia. However, acceptable reference standards and norms have been lacking and no reasonable classification system has been seriously proposed for either variable, in spite of a large amount of literature and propaganda about the health significance of these characteristics.

Various cutting points have been used for the purposes of analyzing the relationship of serum cholesterol level to the incidence of clinical coronary heart disease in follow-up studies in the United States: 275 mg. per 100 ml. (Doyle *et al.*, 1957), 260 (Dawber *et al.*, 1957), 221 (Keys *et al.*, 1963), 256 (Paul *et al.*, 1963), 270 (Chapman and Massey, 1964). Many opinions have been hazarded about the "normal range" or "upper limit of normality" for serum cholesterol; insofar as these have any real basis they mainly relate to findings, not properly analyzed statistically, on non-random samples of so-called "healthy" people in particular populations that are not necessarily characterized by desirable distributions of this variable. In the United States the most commonly cited "range of normality" is 150—250 mg. cholesterol per 100 ml. (see, e. g. Hepler, 1951; Damm, 1965), but evidence to support these figures is not offered. As for obesity, not even such poorly based guidance has been offered; the erroneous identification of relative body weight with obesity is an unacceptable substitute which has created much confusion.

In most relatively developed countries both serum cholesterol and body fatness (measured by skinfolds or other objective criteria of actual fat in the body) are age-related, tending to rise from youth to reach a maximum in middle age. Further, at any given age high values for these variables are associated with increased risk of coronary heart disease and reduced life expectancy (Technical Group, 1956; Dawber *et al.*, 1959; Doyle *et al.*, 1959; Keys *et al.*, 1963; Paul *et al.*, 1963; Chapman and Massey, 1964). Standards proposed for these variables should reflect these considerations if they are to be applied in health guidance. Obviously, it is undesirable to use standards based solely on distributions of these variables in populations in which obesity and high levels of serum cholesterol are unduly common and are associated with an unfavorable disease frequency.

The data in the present series of studies would seem to provide suitable bases, with numbers adequate for statistical treatment, for classification systems for obesity and hypercholesterolemia in middle-aged men. The sum of the skinfold thicknesses (over the triceps and over the tip of the scapula), is a suitable indicator, easily measured, of body fatness or obesity. The samples are, strictly, representative only of the populations selected for study but there is no reason to suggest that these populations are peculiar or that the samples are not reasonably representative of populations who are currently "healthy".

Over the age range of 40 through 59 years there are, in general, no important age trends in either Σ skinfolds or serum cholesterol in this material. Isolated exceptions are tendencies for the oldest (55—59) U. S. switchmen to have higher serum cholesterol values than at younger ages, and, in Crete, for relative obesity to become more and more rare with advancing age. Accordingly, for many purposes, it is acceptable to group all men aged 40—59 in each sample.

Bases for Classification — Choice of Samples

The combined data from all samples of men studied could be used as the basis for a proposed classification in regard to obesity and hypercholesterolemia and, as will be seen, one set of calculations was made on this basis. However, the examination findings as well as vital statistics suggest separation of the samples into two categories: the men in Finland, the Netherlands and in the U.S.A. (Group A) and the men in Greece, Italy and Yugoslavia (Group B). Further, it seemed wise to omit for these purposes the data from Japan and Nicotera (because of some questions as to comparability of ECG data) and from the Rome railway men (because of questions about the sample).

Table H1 summarizes death rates from the sum of all causes in 1961 (data compiled by the World Health Organization) and prevalence rates of ECG abnormalities in the samples studied. The death rate averages were computed as unweighted averages of the rates for the countries concerned and also as weighted averages, using the figures for population of men of specified age in each country. Whichever average is used among men of these ages the death rates are substantially lower in Group B countries than in Group A. Using the unweighted averages, for all ages 40—59, the Group A rate is 127.9 per cent of the Group B rate; for weighted averages the rate is 123.5 per cent.

In the samples studied, the prevalence of ECG evidence of definite or possible coronary heart disease is about twice as high in Group A as in Group B countries. For major Q waves (Code I, 1) the unweighted averages for the four 5-year age classes are 9.98 per 1 000 men in Group A, 4.03 in Group B countries; this difference is highly significant (chi-square = 8.882, $p = 0.002$). If we add to these prevalences those for T inversion or S-T depression in rest, the rates are 32.9 per 1 000 men in Group A and 17.4 in Group B; this difference is even more highly significant.

Norms for Σ Skinfolds and Serum Cholesterol Classes

Figure H1 shows the Σ skinfold distributions (on a probability scale) for all 18 samples of men and for the samples of men in rural Italy, Yugoslavia and Greece ("Group B" countries). Figure H2 similarly shows the distributions of serum cholesterol values. These graphs allow easy selection of appropriate cutting points to define grades of obesity and hypercholesterolemia.

TABLE H1

Comparison of men of specified age in GROUP A countries (Finland, Netherlands, U.S.A., white) and in GROUP B countries (Greece, Italy, Yugoslavia). Death rates (1961) from all causes (per 100,000), and prevalence of specified E.C.G. abnormalities. Values for ages 40-59 are unweighted averages of values for the quinquennial age groups.

COUNTRIES	ITEM	40-44	45-49	50-54	55-59	40-59
Group A	Death rate, unweighted av.	401	646	1071	1674	948
" B	" " " "	322	493	814	1343	743
Group A	Death rate, population weighted av.	402	670	1123	1702	974
" B	" " " " "	334	526	875	1441	794
Group A	No. men in samples studied	1080	1076	1175	1156	4487
" B	" " " " "	897	1312	1399	1187	4795
Group A	Old infarcts/1000	7.4	7.5	9.4	15.6	10.0
" B	" " "	0	2.3	7.1	6.7	4.0
Group A	Infarcts + cases T, ST abnormal/1000	26.8	29.8	28.1	46.7	32.9
" B	" " " " " " "	10.0	18.8	20.7	20.2	17.4

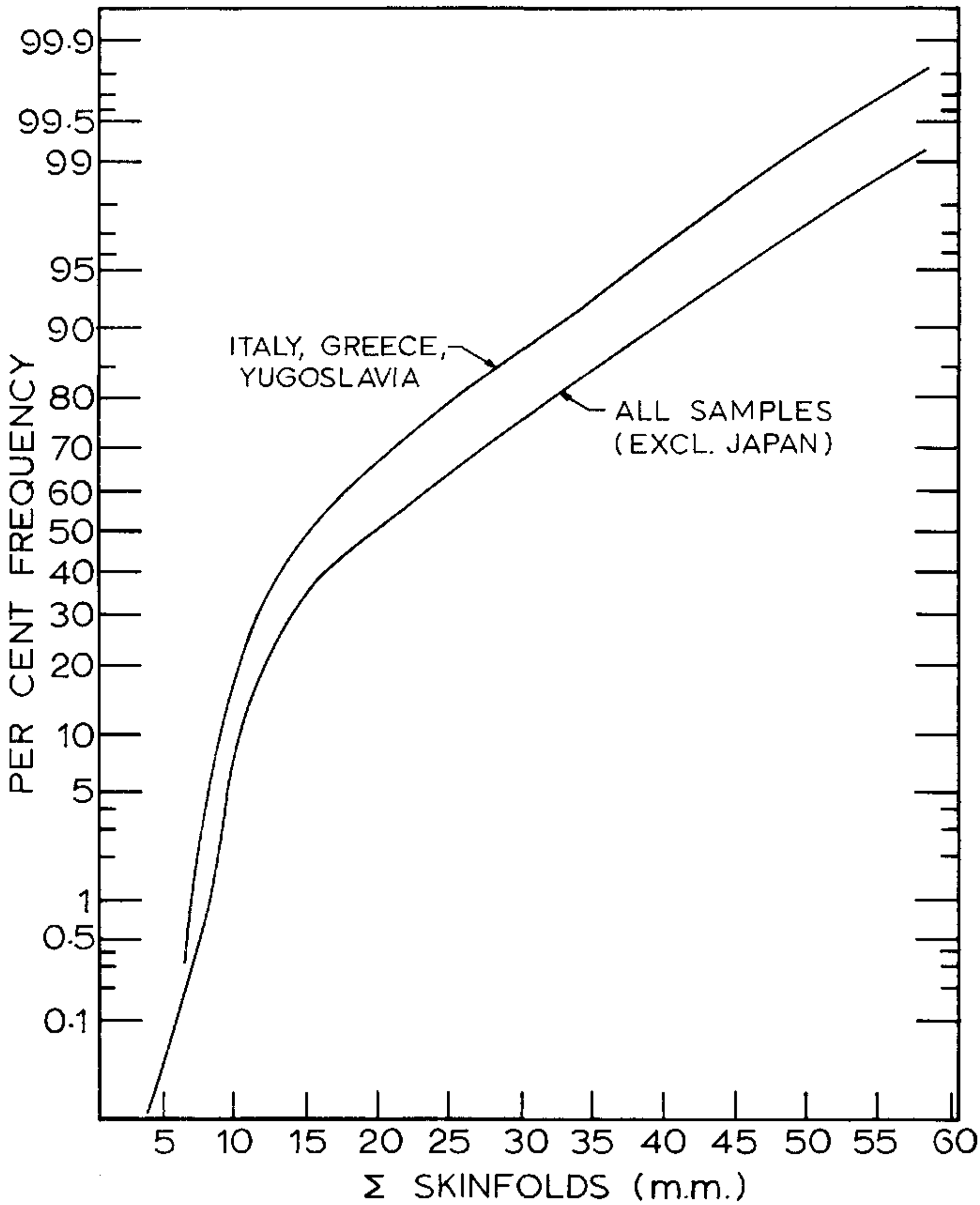
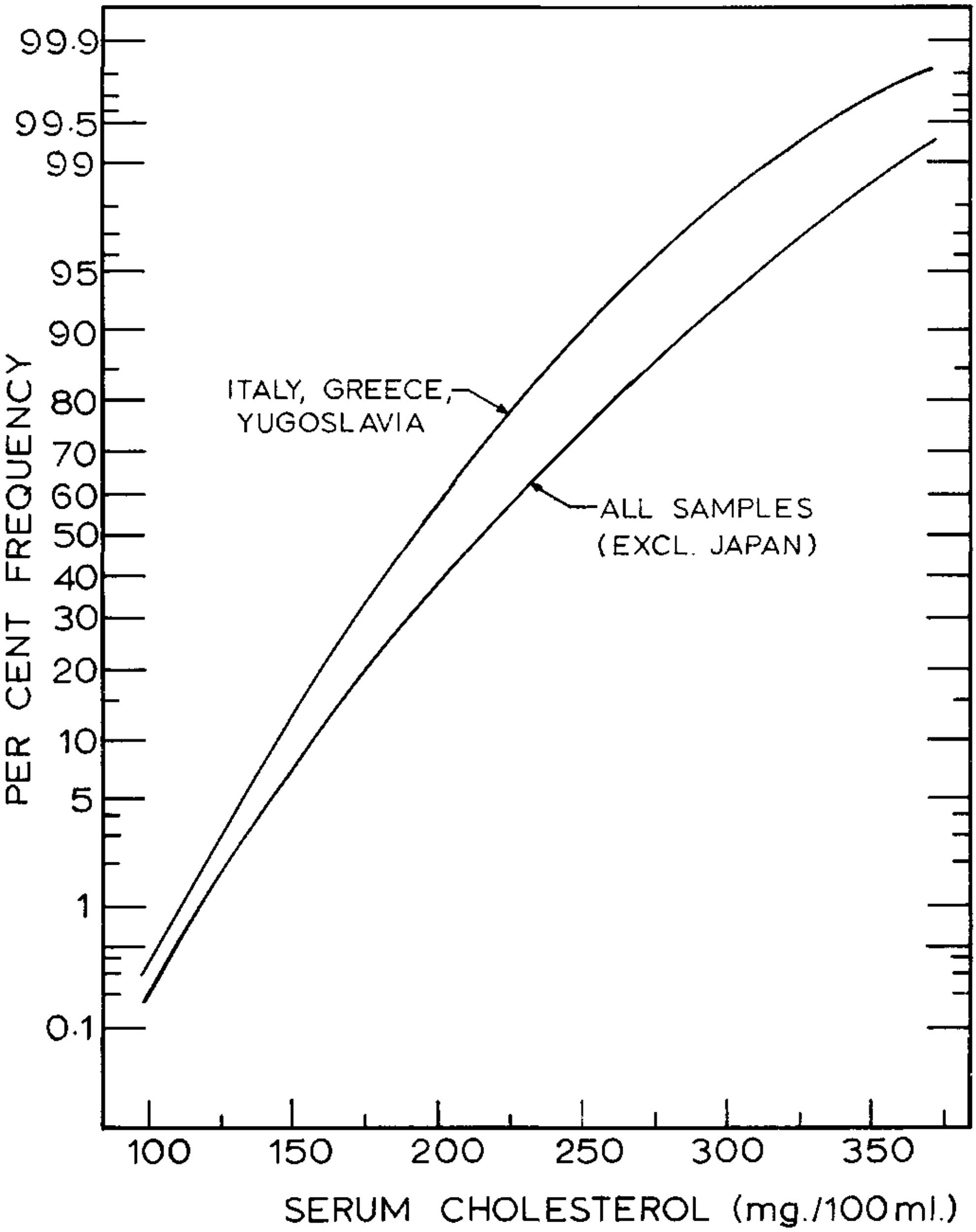

99·9
99·5
99
95
90
80
70
60
50
40
30
20
10
5
1
0·5
0·1
PER CENT FREQUENCY
ITALY, GREECE, YUGOSLAVIA
ALL SAMPLES (EXCL. JAPAN)
5 10 15 20 25 30 35 40 45 50 55 60
Σ SKINFOLDS (m.m.)

Figure H1



99.9
99.5
99
95
90
80
70
60
50
40
30
20
10
5
1
0.1
PER CENT FREQUENCY
ITALY, GREECE, YUGOSLAVIA
ALL SAMPLES (EXCL. JAPAN)
100
150
200
250
300
350
SERUM CHOLESTEROL (mg./100ml.)

Figure H2

TABLE H2

Classifications of obesity and hypercholesterolemia based on distributions of men in all samples, excluding Japan and Nicotera (A + B) and in Greece, Italy and Yugoslavia, excluding Rome railway men and Nicotera (B).

CLASSIFICATION	OBESITY		HYPERCHOLESTEROLEMIA	
	SKINFOLDS Range (mm.)	% of MEN in Range	CHOLESTEROL Range (mg./100.)	% of MEN in Range
A+B)				
1. Severe	over 45	4.8	over 310	4.7
2. Marked	40-45	4.8	291-310	4.3
3. Moderate	36-39	5.2	276-290	5.0
4. Slight	33-35	5.2	261-275	6.8
B)				
1. Severe	over 37	4.9	over 270	4.9
2. Marked	32-37	5.2	251-270	5.3
3. Moderate	29-31	4.1	241-250	4.3
4. Slight	26-28	5.4	231-240	5.2

TABLE H3

Percentages of men who exceed specified values for Σ skinfolds and for serum cholesterol. Values specified are those above which are found 20%, 15%, 10% and 5% of men in the combined distribution of "low-risk" areas.

SAMPLE	Σ Skinfolds (mm.) over:				Serum Cholesterol mg.% over:			
	25	28	31	37	230	240	250	270
1. U.S. Switchmen	67	58	48	29	55	46	38	24
2. U.S. Sed. Clerks	76	66	54	33	55	46	38	24
3. U.S. Non-Sed. Clerks	71	62	55	38	54	47	42	25
4. U.S. Executives	77	69	59	39	60	53	45	22
5. East Finland	16	12	9	5	73	67	60	46
6. West Finland	20	15	11	7	68	60	52	36
7. Zutphen	42	32	22	10	50	41	32	19
8. Dalmatia	16	12	8	3	16	10	6	3
9. Slavonia	17	13	10	5	22	17	12	5
10. Crevalcore	39	31	25	13	22	17	11	6
11. Montegiorgio	16	10	7	4	21	16	11	6
12. Crete	13	9	6	2	27	20	15	7
13. Corfu	16	12	9	4	24	18	13	6
14. Velika Krsna	7	5	2	1	2	1	0	0
15. Rome Railroad Men	51	41	32	18	28	21	15	7
16. Tanushimaru	8	5	3	2	19	16	13	9
17. Ushibuka	-	-	-	-	1	0	0	0
18. Nicotera	16	12	8	5	12	6	3	0
Mean, Lines 1-7	53	45	37	23	59	51	44	28
Mean, Lines 8-14	18	13	10	5	19	14	10	5
Mean, Lines 1-18	33	27	22	13	34	28	23	14

If the top 20 per cent of the distribution is considered to represent obesity or hypercholesterolemia, grades may be assigned: Grades 1, 2, 3 and 4 are the 80th to the 84th centiles, 85th to 89th, 90th to 94th and 95th or over. Descriptive terms may be applied to these cuts: 'slight', 'marked', 'severe', and 'extreme', respectively. Table H2 gives these cutting points for all samples combined and for the six samples in Group B countries.

In view of the superiority of the Group B countries in death rates and in ECG findings, it seems proper to advocate the B classification system in questions concerning "health" and risk of death or coronary heart disease at these ages. Table H3 shows the prevalence of obesity and of hypercholesterolemia, with this classification, in each of the samples studied.

APPENDIX

CODES FOR OCCUPATIONS - BY CLASSES

I. PROFESSIONAL

1 Architect
1 Engineer (design, etc.)
2 Artist, sculptor
2 Newspaperman
2 Librarian
2 Musician, composer
2 Writer
3 Dentist
4 Doctor (M. D.)
5 Druggist
5 Pharmcist
6 Judge
6 Lawyer
7 Military officer
8 Monk
8 Pastor
8 Priest
8 Rabbi
9 Scientist, chemist, economist, psychologist, statistician, mathematician, physicist
10 Teacher, school administrator

II. BUSINESS, GOVERNMENT OFFICIAL, ETC.

11 Businessman
11 Executive
11 Manager, business, not farm
11 Merchant
12 Government official
12 Tax collector, assessor
13 Landowner
13 Proprietor, employer
13 Shopowner
14 Salesman, office or travelling
15 Salesman, shop or store

III. FOREMAN

16 Building trades
17 Factory
18 Logging and lumber
19 Mining
20 Misc. foreman
21 Road and railroad
22 Ship's officer

IV. CLERICAL, ETC.

23 Accountant, cashier in bank
24 Clerk, stenographer, secretary
24 Cashier in store, restaurant
24 Postal clerk

IV. CLERICAL, ETC. CONT.

24 Railroad clerk
25 Draftsman
26 Telegrapher
26 Telephonist
26 Typist

V. PROTECTION, ETC.

27 Fireman
28 Guard, customs agent
28 Policeman
29 Postman, mailman
30 Watchman

VI. FOOD HANDLER

31 Baker
32 Butcher
33 Candy or pastry maker
34 Cook, chef
35 Dairyman, cheese maker, etc.
36 Grocer
37 Miller
38 Restaurant, cafe keeper, inn keeper, coffee house keeper
39 Waiter

VII. SKILLED LIGHT CRAFTS

40 Harness maker, saddle maker
40 Shoemaker
41 Jeweler
41 Watchmaker, watch repairman, horologist
42 Photographer
43 Printer, bookbinder
43 Tailor
44 Undertaker, mortician

VIII. TRANSPORTATION

24 Railroad clerk
45 Dock worker
45 Stevedore, longshoreman
46 Driver, auto, bus, taxi, chauffeur
47 Driver, mule, horse, etc.
48 Conductor (railway, trolley, bus)
48 Railroad conductor, brakeman
48 Bus or street car (trolley) conductor

VIII. TRANSPORTATION CONT.

49 Railroad dispatcher, station master
50 Railroad engineer, fireman
51 Railroad maintenance of way
52 Railroad switchman
53 Sailor (not officer)

IX. BUILDING TRADES

16 Building trades foreman
54 Bricklayer
54 Mason, stone mason, stone cutter, stone worker
55 Builder, general
56 Cabinet maker, joiner
56 Carpenter, finish
57 Carpenter, general
58 Cement worker
58 Plasterer
59 Electrician
60 Painter
61 Plumber, pipe fitter

X. METAL WORKER, MECHANIC

62 Blacksmith
62 Iron worker
62 Foundryman
63 Engineer, stationary
64 Machinist
64 Mechanic, general
64 Welder
65 Mechanic, auto

XI. AGRICULTURE, FISHERIES, FORESTING

66 Surveyor
66 Agronomist, agriculturalist
67 Farmer, employee, farmhand, farmworker, fieldhand
68 Farmer, manager, share cropper
69 Farmer, self-employed
70 Fisherman
71 Flower grower, florist
71 Truck gardener
72 Forester
73 Logger, lumberjack
74 Lumberman
75 Herdsman, stableman
75 Shepherd

XII. MINES

19 Mining foreman
76 Miner, underground
77 Mine worker, aboveground

XIII. FACTORY WORKERS

17 Foreman
78 Light work
79 Moderate work
80 Heavy work

XIV. SERVICES

39 Waiter, food handler
45 Porter, bellman, bellhop
71 Gardener
81 Attendant, usher
81 Nurse
82 Barber
83 Barman
84 Janitor
85 Servant
86 Soldier (not officer), border guard
87 Street cleaner

XV. GENERAL LABOR

51 Roadbuilder, maintenance
88 Chimney sweep
88 Laborer, common
88 Odd jobs, heavy
88 Unskilled laborer, workman
89 Quarryman

XVI. MISCELLANEOUS

89 Entertainer
90 Odd jobs, not heavy
91 Peddler, hawker
92 Misc. skilled & semi-skilled crafts e.g., locksmith, tinsmith or sheet metal worker, furrier, glassblower, glazer, well driller, etc.
92 Cooper, potter, weaver, basket maker
93 Student
94 Warehouseman, warehouseworker

XVII. NOT OCCUPIED

95 Pensioner, retired
96 Beggar
97 Invalid
98 Unemployed

CODES FOR OCCUPATIONS - ALPHABETICAL

Code No.	Occupation	Code No.	Occupation
23	Accountant	11	Executive
66	Agronomist, agriculturalist	17	Factory foreman
1	Architect	78	Factory, light work
2	Artist, sculptor	79	Factory, moderate work
12	Assessor, tax	80	Factory, heavy work
81	Attendant	67	Farmer, employee, farmhand
31	Baker	68	Farmer, manager, share cropper
82	Barber	69	Farmer, self-employed
83	Barman	27	Fireman
96	Beggar	70	Fisherman
45	Bellman, bellhop	71	Flower grower, florist
62	Blacksmith	72	Forester
43	Bookbinder	16	Foreman, building trades
54	Bricklayer	17	Foreman, factory
55	Builder, general	18	Foreman, logging and lumber
16	Building trades foreman	19	Foreman, mining
11	Businessman	20	Foreman, miscellaneous
32	Butcher	21	Foreman, road and railroad
56	Cabinet maker, joiner	62	Foundry man
33	Candy maker	71	Gardener
56	Carpenter, finish	12	Government official
57	Carpenter, general	36	Grocer
23	Cashier, bank, etc.	28	Guard
24	Cashier, store, restaurant	40	Harness maker
58	Cement worker	75	Herdsman, stableman*
46	Chauffeur	38	Inn keeper
34	Chef	97	Invalid
9	Chemist	62	Iron worker
88	Chimney sweep	84	Janitor
24	Clerk	41	Jeweler
12	Collector, tax	56	Joiner
48	Conductor (railway, trolley, bus)	6	Judge
34	Cook	88	Laborer, common
92	Cooper	13	Landowner
28	Customs agent	6	Lawyer
35	Dairyman, cheese maker, etc.	2	Librarian
3	Dentist	73	Logger, lumberjack
45	Dock worker	18	Logging and lumber foreman
4	Doctor (M.D.)	45	Longshoreman
25	Draftsman	74	Lumberman
46	Driver, auto, bus, etc.	64	Machinist
47	Driver, mule, horse, etc.	11	Manager, business, not farm
5	Druggist	68	Manager, farm
9	Economist	54	Mason*
59	Electrician	9	Mathematician
13	Employer	65	Mechanic, auto
1	Engineer (design, etc.)	64	Mechanic, general
63	Engineer, stationary	11	Merchant
89	Entertainer	7	Military officer

Code No.	Occupation
37	Miller
76	Miner, underground
77	Mine worker, aboveground
19	Mining foreman
20	Miscellaneous foreman
92	Miscellaneous skilled and semi-skilled crafts*
8	Monk
2	Musician, composer
2	Newspaperman
81	Nurse
88	Odd jobs, heavy
90	Odd jobs, not heavy
12	Official, government
60	Painter
8	Pastor
33	Pastry maker
91	Peddler, hawker
95	Pensioner
5	Pharmacist
42	Photographer
9	Physicist
61	Pipe fitter
58	Plasterer
61	Plumber
28	Policeman
45	Porter
24	Postal clerk
29	Postman, mailman
92	Potter
8	Priest
43	Printer
13	Proprietor
9	Psychologist
89	Quarryman
8	Rabbi
21	Railroad foreman
24	Railroad clerk
48	Railroad conductor, brakeman
49	Railroad dispatcher, station master
50	Railroad engineer, fireman
51	Railroad maintenance of way
52	Railroad switchman
38	Restaurant, cafe keeper, inn keeper, coffee house keeper
95	Retired
51	Road builder, maintenance
21	Road and railroad foreman
40	Saddle maker
53	Sailor (not officer)

Code No.	Occupation
14	Salesman, office or travelling
15	Salesman, shop or store
9	Scientist
10	School administrator
24	Secretary
85	Servant
75	Shepherd
21	Ship's officer (foreman)
40	Shoemaker
13	Shopowner
92	Skilled and semi-skilled (misc.)*
86	Soldier (not officer), border guard
9	Statistician
24	Stenographer
45	Stevedore
87	Street cleaner
93	Student
66	Surveyor
43	Tailor
12	Tax collector, assessor
46	Taxi driver
10	Teacher
26	Telegrapher
26	Telephonist
71	Truck gardener
26	Typist
44	Undertaker, mortician
98	Unemployed
88	Unskilled laborer, workman
81	Usher
39	Waiter (food handler)
94	Warehouseman or warehouse worker
41	Watchmaker, watch repairman, horologist
30	Watchman
92	Weaver, basket maker
64	Welder
2	Writer

*Notes

75 Herdsman: includes shepherd, goat-herd, cowherd, swineherd, stable-man, etc.

54 Mason: includes stone worker, stone cutter, but not quarryman or cement worker.

92 Misc. skilled and semi-skilled crafts: locksmith, tinsmith or sheet metal worker, furrier, glassblower, glazer, well driller, etc.

SMOKING CLASSIFICATION CODES

Card Col.	Punch	Cigarettes	Card Col.	Punch	Pipefuls
36			37		
	0	Never		0	Never
	1	Stopped < 1 yr.		1	Stopped < 1 yr.
	2	Stopped 1-9 yrs.		2	Stopped 1-9 yrs.
	3	Stopped 10 or more yrs.		3	Stopped 10 or more yrs.
	4	Now < 5/day		4	Now < 3/day
	5	Now 5-9/day		5	Now 3-4/day
	6	Now 10-19/day*		6	Now 5-9/day
	7	Now 20-29/day		7	Now 10-19/day
	8	Now 30 or more/day		8	Now 20 or more/day

Card Col.	Punch	Cigars	Card Col.	Punch	Formerly
38			39		
	0	Never		0	< 5 cigs./day
	1	Stopped < 1 yr.		1	5-9 cigs./day
	2	Stopped 1-9 yrs.		2	10-19 cigs./day
	3	Stopped 10 or more yrs.		3	20-29 cigs./day
	4	Now < 2/day		4	30 or more cigs./day
	5	Now 2-4/day		5	Light pipe, no cigs.
	6	Now 5-7/day		6	Heavy pipe, no cigs.
	7	Now 8 or more/day		7	Light cigar, no cigs.
				8	Heavy cigar, no cigs.
				9	Pipe + Cigar, no cigs.

* Classifications applicable to U.S. Railroad samples are similar to these, though slightly less refined. Note, however, that for U.S. Railroad samples, the upper limit for moderate cigarette smokers is 20 cigarettes per day rather than 19 as indicated above.

THE ELECTROCARDIOGRAPHIC CODE

The prevalence data from all areas were coded systematically by the classification to follow. Attention is directed to the small modification found here from the original published code (Blackburn, Keys, et al., 1960), under items IV and XI. "Junctional-type" S-T depression was thereby segregated from "ischemic-type." Subsequent revision of the code, along with greater details of coding procedure is to be found in Rose and Blackburn (1965).

Findings are reported only when they appear in the designated leads (listed on the right hand side of the classification below). "I, II, V_2-V_6" means any of leads I, II, $V_{2,3,4,5 \text{ or } 6}$; "$V_1$ through V_4" means all of leads V_1 through V_4. A positive finding in any of the designated leads is reportable unless the classification stipulates otherwise. Within each major category (Roman Numeral) only the most significant deviation is reported (generally the lowest Arabic Numeral). A finding which meets a criterion in a single complex only and therefore might be an artifact or expression of beat-to-beat variation is not to be reported as positive. Standardization is 1 cm. = 1 mv.

CODE FOR RESTING ELECTROCARDIOGRAMS

COL.	PUNCH	CATEGORY	LEADS
I	0	NO HEREIN REPORTABLE ECG ITEMS I-VIII INCLUSIVE	
		Q AND QS PATTERNS (Q must be 1 mm. or more with associated R of 1 mm. or more)	
	1	CLASS I (any of a through g)	
		a. Q/R = 1/3 or more and Q duration = 0.03 sec. or more	I, II, V_2-V_6
		b. Q duration = 0.04 sec. or more	I, II, V_1-V_6
		c. Q duration = 0.04 sec. or more and R amplitude 3 mm. or more	aVL
		d. Q duration = 0.05 sec. or more and a Q wave present in aVF	III
		e. Q duration = 0.05 sec. or more	aVF
		f. QS pattern when R wave is present in adjacent precordial lead to the right	V_2-V_6
		g. QS pattern	V_1 through V_4 V_1 through V_5 V_1 through V_6
	2	CLASS II (any of a through i)	
		a. Q/R = 1/5 to 1/3 and Q duration = 0.03 sec. or more	I, II, V_2-V_6
		b. Q duration = 0.03 to 0.04 sec.	I, II, V_2-V_6
		c. Q duration = 0.03 to 0.04 sec. and R amplitude 3 mm. or more	aVL
		d. Q duration = 0.04 to 0.05 sec. and a wave present in aVF	III
		e. Q duration = 0.04 to 0.05 sec.	aVF
		f. Q amplitude = 5 mm. or more	III, aVF

COL.	PUNCH	CATEGORY	LEADS
		g. QS pattern and absence of Code VII_1	V_1 through V_3
		h. Decreasing absolute R amplitude and smallest R = 2 mm. or less and absence of Code III_2 or $VII_{2,3}$	V_1 through V_3, V_4
		i. Q duration = 0.04 sec. or more or a QS pattern	(Ancillary leads, see text)
	3	CLASS III (any of a through c)	
		a. Q/R = 1/3 or more and Q duration less than 0.03 sec.	I, II, V_2-V_6
		b. QS pattern and absence of Code VII_1 or III_1	V_1 and V_2
		c. Q/R = 1/5 to 1/3 and Q duration less than 0.03 sec.	I, II, V_2-V_6
II		QRS AXIS DEVIATION	
	1	Left QRS axis = -30° or greater	I, II and III
	2	Right QRS axis = +120° or greater (The algebraic sum of major positive and major negative waves must be negative in I, positive in III, and in I must be one half or more of that in III)	I, II and III
III		HIGH AMPLITUDE R WAVES	
	1	Left R more than 26 mm.	V_5, V_6
		R more than 20 mm.	I, II, III, aVF
		R more than 12 mm.	aVL
	2	Right QRS duration less than 0.12 sec. and R amplitude = 5 mm. or more and R/S ratio = 1.0 or more and QRS transition zone or decreasing R/S to left of V_1. (Includes incomplete RBBB which meets above criteria).	V_1
IV		S-T JUNCTION AND SEGMENT (Measured from preceding P-R interval at onset of QRS)	
		Depression:	
	1	S-T-J depression of 1 mm. or more and S-T segment horizontal or downward sloping	I, II, aVL, aVF, V_1-V_6
	2	S-T-J depression 0.5-0.9 mm. and S-T segment horizontal or downward sloping	I, II, aVL, aVF, V_1-V_6
	3	No S-T-J depression as must as 0.5 mm. but S-T segment sloping down and reaching 0.5 mm. or more below P-R baseline	I, II, aVL, aVF, V_1-V_6

COL.	PUNCH	CATEGORY	LEADS
	4	S-T-J depression of 1 mm. or more and S-T segment upward sloping	I, II, aVL, aVF, V_1-V_6
V		T WAVE ITEMS	
	1	T amplitude = minus 5 mm. or more	I, II, V_2-V_6
		when R amplitude = 5 mm. or more	aVL
		when QRS mainly upright	aVF
	2	T amplitude = minus 1 to 5 mm.	I, II, V_2-V_6
		when R amplitude = 5 mm. or more	aVL
		when QRS mainly upright	aVF
	3	T wave flat or small diphasic (negative phase less than 1 mm.)	I, II, V_3-V_6
		when R amplitude = 5 mm. or more	aVL
		when QRS mainly upright	aVF
VI		A-V CONDUCTION	
	1	Complete A-V block (permanent or intermittent)	any
	2	Partial A-V block	any
	3	P-R interval over 0.21 sec. (<u>any</u> heart rate)	I, II, III
	4	Accelerated conduction ("Wolff-Parkinson-White")	any
VII		VENTRICULAR CONDUCTION	
	1	Left bundle branch block (LBBB):	
		QRS duration 0.12 sec. or greater in	I, II, III
		<u>and</u> R peak duration 0.06 sec. or more in any of	I, II, aVL, V_5, V_6
	2	Complete right bundle branch block (RBBB):	
		QRS duration 0.12 sec. or greater in	I, II, III
		<u>and</u> R prime greater than R in	V_1
	3	Incomplete RBBB: R prime greater than R <u>and</u> QRS duration less than 0.12 sec.	V_1
		(report under III, 2 if those criteria are met)	
	4	Intraventricular block: QRS 0.12 sec. or more <u>and</u> no LBBB or RBBB pattern	I, II, III
VIII		ARRHYTHMIAS	
	0	Any combination of arrhythmias below	
	1	Frequent (10 per cent or more of recorded beats) premature auricular, nodal or ventricular beats	
	2	Ventricular tachycardia (over 100/min.)	
	3	Atrial fibrillation or flutter	
	4	Supra-ventricular tachycardia	
	5	Ventricular (idioventricular) rhythm (up to 100/min.)	
	6	A-V nodal rhythm (up to 100/min.)	
	7	Sinus tachycardia (over 100 /min.)	
	8	Sinus bradycardia (under 50/min.)	
	9	Arrhythmias not mentioned above	

CODE FOR POST-EXERCISE ELECTROCARDIOGRAMS

COL.	PUNCH	CATEGORY
X		EXERCISE TEST
	1	No exercise test made
	2	Exercise test stopped
	3	Exercise test completed

COL.	PUNCH	CATEGORY
XI		S-T ITEMS POST-EXERCISE
	1	Change from no coded S-T item at rest to S-T item Type IV, 1 post-exercise
	2	Change from no coded S-T item at rest to S-T item Type IV, 2 post-exercise
	3	Change from no coded S-T item at rest to S-T item Type IV, 3 post-exercise
	4	Change from no coded S-T item at rest to S-T item Type IV, 4 post-exercise
	5	Change from one coded S-T item at rest to a lower numerical S-T item post-exercise (IV, 3 to Type IV, 1, etc.)
	6	Change from one coded S-T item at rest to a higher numerical item post-exercise (IV, 1 to Type IV, 3, etc.)
	7	No change from resting coded S-T item
	8	Change from any coded S-T item at rest to no reportable S-T item post-exercise
	9	Questionable S-T depression post-exercise due to technical considerations
XII		T ITEMS POST-EXERCISE
	1	Change from no coded T item at rest to T item Type V, 1 post-exercise
	2	Change from no coded T item at rest to T item Type V, 2 post-exercise
	3	Change from no coded T item at rest to T item Type V, 3 post-exercise
	4	Change from one coded T item at rest to a lower numerical T item post-exercise (V, 3 to Type V, 2, etc.)
	5	Change from one coded T item at rest to a higher numerical T item post-exercise (V, 2 to Type V, 3, etc.)
	6	No change from resting coded T item
	7	Change from any coded T item at rest to no reportable T item post-exercise
	8	Questionable T item post-exercise due to technical considerations
XIII		A-V CONDUCTION, POST-EXERCISE
	1	Change from no coded A-V conduction item at rest to complete A-V block post-exercise
	2	Change from no coded A-V conduction item at rest to partial A-V block post-exercise
	3	Change from no coded A-V conduction item at rest to P-R interval more than 0.21 sec. post-exercise
	4	Change from no coded A-V conduction item at rest to accelerated conduction
	5	Change from one coded A-V conduction item at rest (VI, 1-4) to another A-V condution item post-exercise
	6	No change from resting coded A-V conduction item
	7	Change from any A-V conduction item at rest to no A-V conduction item post-exercise
XIV		VENTRICULAR CONDUCTION, POST-EXERCISE
	1	Change from no coded ventricular conduction item at rest to left bundle branch block (LBBB)
	2	Change from no coded ventricula conduction item at rest to complete right bundle branch block (RBBB)

COL.	PUNCH	CATEGORY
	3	Change from no coded ventricular conduction item at rest to incomplete right bundle branch block
	4	Change from no coded ventricular conduction item at rest to intraventricular block
	5	Change from one coded ventricular conduction item at rest (VII, 1-4) to another ventricular conduction item post-exercise
	6	No change from resting coded ventricular conduction item
	7	Change from any ventricular conduction item at rest (VII, 1-4) to no ventricular conduction item post-exercise
XV		ARRHYTHMIAS, POST-EXERCISE (exclude VIII, 7-8, sinus tachy- and bradycardia)
	1	Change from no coded arrhythmia at rest to any reportable arrhythmia post-exercise
	2	Change from one coded arrhythmia at rest to another arrhythmia post-exercise
	3	No change from coded resting arrhythmia
	4	Change from any arrhythmia at rest to no arrhythmia post-exercise

"STANDARD" AVERAGE RELATIVE BODY WEIGHT

The following table was used for calculating the relative body weights for the men in all samples. It is based on the table of average weights for height and age resulting from the Medico-Actuarial Mortality Investigations (Association, 1912, Davenport, 1923), reproduced in many places and sometimes improperly referred to as "Davenport's Table" (see Keys and Brozek 1953, pp. 250-256).

The original tabular values in English units, converted to the metric system, were graphed and the lines smoothed by hand. Interpelations and some small extrapolation were made where necessary.

As applied here, the tabular values refer to height without shoes, and weight wearing only light underclothing. Values in the body of the table are weights in kilograms for height in steps of 0.5 cm.

Ht.,	20 YEARS		21 YEARS		22 YEARS		23 YEARS		24 YEARS	
cm.	.0	.5	.0	.5	.0	.5	.0	.5	.0	.5
155	54.0	54.3	54.5	54.8	54.9	55.2	55.4	55.6	55.8	56.1
156	54.5	54.8	55.0	55.3	55.5	55.7	55.9	56.2	56.4	56.6
157	55.1	55.4	55.5	55.8	56.0	56.3	56.4	56.7	56.9	57.1
158	55.6	55.9	56.1	56.3	56.5	56.8	57.0	57.2	57.4	57.7
159	56.1	56.4	56.6	56.8	57.1	57.3	57.5	57.7	57.9	58.2
160	56.7	56.9	57.1	57.5	57.6	58.0	58.0	58.4	58.5	58.9
161	57.2	57.4	57.8	58.2	58.3	58.7	58.7	59.1	59.2	59.6
162	57.7	58.0	58.5	58.9	59.0	59.4	59.4	59.8	59.9	60.3
163	58.3	58.6	59.2	59.6	59.7	60.1	60.2	60.6	60.6	61.0
164	59.0	59.4	60.0	60.4	60.4	60.8	60.9	61.3	61.4	61.7
165	59.7	60.1	60.7	61.1	61.2	61.6	61.6	62.0	62.0	62.4
166	60.4	60.8	61.4	61.8	61.9	62.3	62.3	62.7	62.8	63.2
167	61.2	61.6	62.2	62.5	62.6	62.9	63.1	63.4	63.5	63.8
168	61.9	62.3	62.8	63.0	63.2	63.5	63.7	63.9	64.1	64.3
169	62.6	63.0	63.3	63.5	63.8	64.0	64.2	64.5	64.6	64.9
170	63.3	63.7	63.8	64.2	64.3	64.7	64.8	65.1	65.2	65.5
171	64.0	64.4	64.5	64.9	65.0	65.4	65.4	65.8	65.8	66.2
172	64.8	65.1	65.2	65.6	65.7	66.1	66.2	66.5	66.6	67.0
173	65.4	65.8	65.9	66.3	66.4	66.8	66.8	67.2	67.3	67.7
174	66.2	66.6	66.6	67.0	67.1	67.5	67.6	68.0	68.0	68.4
175	66.9	67.3	67.3	67.7	67.8	68.2	68.3	68.7	68.7	69.1
176	67.6	68.0	68.1	68.5	68.6	69.0	69.0	69.4	69.4	69.8
177	68.3	68.7	68.8	69.2	69.3	69.7	69.8	70.2	70.2	70.6
178	69.0	69.4	69.5	69.9	70.0	70.4	70.5	70.9	70.9	71.3
179	69.8	70.2	70.2	70.6	70.8	71.2	71.2	71.6	71.6	72.0
180	70.5	70.9	71.0	71.4	71.5	71.9	71.9	72.3	72.4	72.8
181	71.3	71.7	71.8	72.2	72.3	72.7	72.8	73.2	73.2	73.6
182	72.2	72.6	72.7	73.1	73.2	73.6	73.6	74.0	74.0	74.4
183	73.1	73.5	73.6	74.0	74.0	74.4	74.5	74.9	74.9	75.5
184	74.0	74.4	74.4	74.8	74.9	75.3	75.4	75.8	76.0	76.6
185	74.8	75.2	75.3	75.7	75.8	76.2	76.2	76.7	77.2	77.7
186	75.7	76.1	76.2	76.7	76.6	77.1	77.2	77.8	78.2	78.7
187	76.6	77.1	77.2	77.5	77.6	78.0	78.3	78.9	79.2	79.8
188	77.6	78.0	78.0	78.4	78.4	78.8	79.4	79.8	80.3	80.7
189	78.4	78.8	78.9	79.3	79.3	79.7	80.2	80.7	81.2	81.6
190	79.3	79.7	79.8	80.2	80.2	80.6	81.2	81.5	82.0	82.5
191	80.2	80.7	80.7	81.1	81.1	81.5	82.0	82.5	83.0	83.4
192	81.1	81.6	81.6	82.0	82.0	82.4	83.0	83.4	83.8	84.2
193	82.0	82.5	82.5	82.9	82.9	83.3	83.8	84.3	84.7	85.2
194	83.0	83.4	83.4	83.8	83.8	84.3	84.8	85.2	85.6	86.1

Ht.,	25 YEARS		26 YEARS		27 YEARS		28 YEARS		29 YEARS	
cm.	.0	.5	.0	.5	.0	.5	.0	.5	.0	.5
155	56.3	56.4	56.7	56.9	57.2	57.3	57.6	57.8	58.1	58.3
156	56.6	56.8	57.0	57.2	57.5	57.7	58.0	58.2	58.4	58.6
157	57.0	57.2	57.4	57.6	57.9	58.1	58.4	58.5	58.8	59.0
158	57.4	57.7	57.8	58.1	58.3	58.6	58.8	59.1	59.2	59.5
159	57.9	58.2	58.4	58.7	58.8	59.1	59.3	59.6	59.7	60.0
160	58.5	58.9	59.0	59.4	59.4	59.7	59.9	60.2	60.3	60.6
161	59.2	59.6	59.7	60.1	60.0	60.2	60.4	60.7	60.9	61.2
162	59.9	60.3	60.4	60.8	60.5	60.8	61.0	61.3	61.5	61.8
163	60.6	61.0	61.1	61.5	61.1	61.5	61.6	62.0	62.1	62.5
164	61.4	61.7	61.8	62.2	61.8	62.2	62.4	62.7	62.8	63.2
165	62.0	62.4	62.5	62.9	62.5	62.9	63.0	63.4	63.5	63.8
166	62.8	63.2	63.2	63.6	63.2	63.6	63.8	64.1	64.2	64.6
167	63.5	63.9	64.0	64.3	64.0	64.3	64.5	64.8	64.9	65.2
168	64.2	64.6	64.6	65.0	64.6	65.0	65.2	65.5	65.6	65.9
169	65.0	65.4	65.4	65.8	65.4	65.8	65.9	66.2	66.3	66.6
170	65.7	66.1	66.1	66.5	66.1	66.5	66.6	66.9	67.0	67.3
171	66.4	66.8	66.8	67.2	66.8	67.2	67.3	67.6	67.7	68.0
172	67.1	67.5	67.5	67.9	67.5	67.9	68.0	68.3	68.4	68.7
173	67.8	68.2	68.2	68.6	68.2	68.6	68.7	69.1	69.0	69.4
174	68.5	68.9	68.9	69.3	68.9	69.3	69.4	69.8	69.8	70.1
175	69.2	69.6	69.6	70.0	69.6	70.0	70.2	70.5	70.5	70.8
176	69.9	70.3	70.4	70.7	70.4	70.7	70.8	71.2	71.2	71.6
177	70.6	71.0	71.0	71.4	71.0	71.4	71.6	71.9	72.0	72.3
178	71.4	71.8	71.8	72.2	71.8	72.2	72.3	72.7	72.7	73.2
179	72.3	72.7	72.7	73.1	72.7	73.1	73.2	73.7	73.6	74.1
180	73.2	73.6	73.6	74.0	73.6	74.1	74.1	74.6	74.5	75.0
181	74.0	74.4	74.5	74.9	74.6	75.1	75.1	75.6	75.5	76.1
182	74.9	75.3	75.4	75.9	75.6	76.2	76.1	76.7	76.6	77.1
183	75.8	76.4	76.4	76.9	76.7	77.3	77.2	77.7	77.7	78.2
184	76.9	77.5	77.4	77.9	77.8	78.4	78.3	78.8	78.8	79.3
185	78.0	78.6	78.4	79.0	78.9	79.5	79.3	79.9	79.8	80.4
186	79.1	79.7	79.5	80.1	80.0	80.5	80.4	80.9	80.9	81.5
187	80.2	80.7	80.6	81.1	81.0	81.6	81.5	82.0	82.0	82.5
188	81.2	81.6	81.6	82.2	82.2	82.7	82.5	83.1	83.1	83.6
189	82.1	82.5	82.7	83.3	83.2	83.8	83.6	84.2	84.1	84.7
190	83.0	83.4	83.8	84.4	84.3	84.8	84.7	85.3	85.2	85.7
191	83.8	84.2	85.0	85.6	85.3	85.9	85.8	86.3	86.3	86.8
192	84.7	85.1	86.1	86.8	86.4	87.0	86.9	87.4	87.4	87.9
193	85.6	86.1	87.3	88.0			87.5		88.0	
194	86.6	87.0								

Ht.,	30-31 YRS.		32-33 YRS.		34-35 YRS.		36-37 YRS.		38-39 YRS.	
cm.	.0	.5	.0	.5	.0	.5	.0	.5	.0	.5
155	58.5	58.7	58.8	59.0	59.0	59.2	59.4	59.6	59.9	60.1
156	58.9	59.1	59.1	59.3	59.3	59.5	59.8	60.0	60.2	60.4
157	59.2	59.4	59.5	59.7	59.7	59.9	60.2	60.4	60.6	60.8
158	59.7	59.9	59.9	60.2	60.1	60.4	60.6	60.9	61.0	61.3
159	60.2	60.5	60.6	60.7	60.7	60.9	61.2	61.4	61.5	61.8
160	60.2	60.8	60.8	61.0	61.2	61.5	61.7	62.1	62.1	62.4
161	61.1	61.4	61.3	61.6	61.8	62.1	62.3	62.7	62.6	62.9
162	61.7	62.0	61.9	62.2	61.4	62.7	63.0	63.3	63.2	63.5
163	62.3	62.7	62.5	62.9	63.0	63.4	63.7	64.0	63.8	64.2
164	63.0	63.5	63.2	63.6	63.7	64.1	64.4	64.8	64.6	64.9
165	63.7	64.0	63.9	64.3	64.4	64.8	65.1	65.4	65.3	65.6
166	64.4	64.8	64.6	65.0	65.1	65.5	65.8	66.1	66.0	66.3
167	65.1	65.4	65.3	65.7	65.8	66.1	66.5	66.8	66.7	67.0
168	65.8	66.1	66.0	66.4	66.5	66.9	67.2	67.5	67.4	67.7
169	66.5	66.8	66.8	67.1	67.2	67.5	67.9	68.2	68.1	68.4
170	67.2	67.5	67.5	67.8	67.9	68.3	68.6	69.0	68.8	69.2
171	67.9	68.2	68.2	68.7	68.7	69.2	69.4	69.9	69.6	70.1
172	68.6	68.9	69.2	69.6	69.6	70.1	70.3	70.8	70.5	71.0
173	69.2	69.6	70.1	70.5	70.5	71.0	71.2	71.6	71.4	71.8
174	70.0	70.3	70.9	71.3	71.4	71.9	72.1	72.5	72.3	72.7
175	70.7	71.1	71.7	72.1	72.3	72.7	73.0	73.4	73.2	73.6
176	71.5	72.0	72.5	73.0	73.2	73.6	74.4	74.3	74.1	74.5
177	72.4	72.9	73.4	73.7	74.1	74.5	74.8	75.2	75.0	75.4
178	73.2	73.8	74.3	74.8	75.0	75.4	75.7	76.1	75.9	76.4
179	74.3	74.7	75.3	75.7	75.8	76.3	76.6	77.0	77.0	77.5
180	75.2	75.7	76.1	76.6	76.8	77.2	77.5	77.9	78.1	78.6
181	76.2	76.7	77.1	77.6	77.8	78.3	78.5	79.0	79.2	79.7
182	77.2	77.8	78.1	78.7	78.8	79.4	79.5	80.1	80.2	80.8
183	78.3	78.9	79.5	79.7	79.9	80.5	80.2	81.2	81.3	81.9
184	79.4	79.9	80.3	80.8	81.0	81.5	81.7	82.2	82.4	83.0
185	80.5	81.0	81.4	81.9	82.0	82.6	82.8	83.3	83.5	84.0
186	81.3	82.1	82.4	83.0	83.2	83.8	83.9	84.5	84.6	85.3
187	82.6	83.1	83.5	84.0	84.4	84.9	85.2	85.8	85.9	86.5
188	83.6	84.2	84.6	85.1	85.5	86.0	86.4	86.9	87.1	87.6
189	84.7	85.3	85.7	86.2	86.6	87.1	87.5	88.0	88.2	88.7
190	85.8	86.3	86.7	87.3	87.7	88.7	88.6	89.1	89.4	89.9
191	86.8	87.3	87.8	88.3	88.7	89.5	89.6	90.1	90.6	91.1
192	87.9	88.4	88.9	89.5	89.8	90.3	90.7	91.2	91.7	92.2
193	89.1	89.6	90.0	90.6	91.0	91.6	91.4	92.0	92.8	93.3

Ht.,	40-41 YRS.		42-43 YRS.		44-45 YRS.		46-49 YRS.		50-59 YRS.	
cm.	.0	.5	.0	.5	.0	.5	.0	.5	.0	.5
155	60.3	60.5	60.8	61.0	61.3	61.4	61.7	61.9	62.2	62.4
156	60.7	60.9	61.1	61.3	61.6	61.8	62.1	62.2	62.5	62.7
157	61.1	61.2	61.5	61.7	62.0	62.2	62.4	62.6	62.9	63.1
158	61.5	61.8	61.9	62.2	62.4	62.7	62.8	63.1	63.4	63.6
159	62.0	62.3	62.4	62.7	62.9	63.2	63.4	63.6	63.9	64.2
160	62.6	62.9	63.0	63.3	63.5	63.8	63.9	64.1	64.4	64.6
161	63.2	63.4	63.6	63.9	64.1	64.4	64.4	64.7	64.9	65.1
162	63.7	64.0	64.2	64.5	64.7	65.0	65.0	65.3	65.4	65.8
163	64.4	64.7	64.8	65.2	65.3	65.7	65.6	66.0	66.1	66.5
164	65.0	65.4	65.5	65.9	66.0	66.3	66.3	66.7	66.8	67.2
165	65.8	66.1	66.2	66.6	66.7	67.0	67.0	67.4	67.5	67.9
166	66.5	66.8	66.9	67.3	67.4	67.7	67.7	68.1	68.2	68.6
167	67.2	67.5	67.6	68.0	68.0	68.4	68.4	68.8	68.9	69.3
168	67.9	68.2	68.3	68.6	68.7	69.1	69.1	69.5	69.7	70.1
169	68.6	68.9	69.0	69.3	69.4	69.8	69.8	70.2	70.6	71.0
170	69.3	69.7	69.7	70.1	70.1	70.5	70.6	71.0	71.3	71.7
171	70.1	70.5	70.5	71.0	71.0	71.4	71.4	71.8	72.1	72.6
172	71.0	71.5	71.4	71.9	71.9	72.3	72.3	72.7	73.1	73.5
173	71.9	72.4	72.3	72.8	72.8	73.2	73.2	73.7	74.0	74.4
174	72.3	73.3	73.2	73.6	73.7	74.1	74.2	74.6	74.8	75.2
175	73.7	74.1	74.1	74.5	74.6	75.1	75.1	75.5	75.7	76.1
176	74.6	75.0	75.0	75.5	75.5	76.0	76.0	76.4	76.6	77.0
177	75.5	75.9	75.9	76.3	76.4	76.9	76.9	77.3	77.5	77.9
178	76.4	76.9	76.8	77.3	77.3	77.9	77.8	78.3	78.4	78.9
179	77.5	78.1	77.9	78.5	78.4	78.9	78.8	79.4	79.4	79.9
180	78.6	79.1	79.0	79.5	79.4	80.0	79.9	80.5	80.4	80.9
181	79.7	80.2	80.1	80.6	80.5	81.0	81.0	81.5	81.4	81.9
182	80.7	81.3	81.2	81.7	81.5	82.1	82.0	82.6	82.4	83.1
183	81.8	82.4	82.2	82.8	82.6	83.1	83.1	83.7	83.6	84.3
184	82.9	83.4	83.3	83.9	83.7	84.3	84.2	84.8	84.8	85.5
185	84.0	84.5	84.4	84.9	84.8	85.4	85.3	85.9	86.0	86.6
186	85.1	85.7	85.6	86.2	86.0	86.6	86.4	87.0	87.3	87.9
187	86.4	87.0	86.8	87.5	87.2	87.9	87.7	88.3	88.6	89.2
188	87.6	88.2	88.1	88.7	88.5	89.1	88.9	89.5	89.8	90.4
189	88.8	89.4	89.3	90.0	89.7	90.4	90.2	90.8	91.1	91.7
190	90.1	90.7	90.6	91.2	91.0	91.6	91.5	92.1	92.4	93.0
191	91.3	91.9	91.8	92.4	92.2	92.8	92.8	93.4	93.6	94.2
192	92.6	93.1	93.1	93.6	93.4	94.0	94.0	94.7	94.9	95.6
193	93.4	94.0	94.3	94.7	94.8	95.4	95.2	95.8	96.1	96.6

TABLE

SWITCHMEN, U.S.A.

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	5	10	20	30	40	50	60	70	80	90	95
		HEIGHT, cm.										
40-44	281	164	167	170	172	174	175	177	178	180	184	186
45-49	243	165	168	170	172	173	175	176	178	179	182	184
50-54	152	164	166	168	170	172	174	175	177	179	181	184
55-59	159	164	165	167	169	171	172	174	176	178	180	183
		RELATIVE BODY WEIGHT, Per Cent										
40-44	280	84	88	94	99	102	106	109	114	117	122	126
45-49	243	82	88	92	98	100	103	106	110	114	121	130
50-54	152	84	89	94	99	103	105	109	112	114	119	125
55-59	158	81	86	91	97	102	104	109	111	116	121	128
		SUM OF SKINFOLDS, mm.										
40-44	281	13	16	21	24	27	31	34	38	41	46	52
45-49	243	14	16	20	23	26	29	32	35	39	45	49
50-54	152	15	20	24	27	30	33	36	39	43	48	54
55-59	159	13	16	20	24	28	32	34	37	42	47	52
		SYSTOLIC BLOOD PRESSURE, mm. Hg.										
40-44	281	110	114	120	124	127	130	134	140	145	157	164
45-49	243	110	113	120	125	129	133	137	143	151	165	171
50-54	153	112	118	123	130	131	136	140	148	158	170	185
55-59	159	116	120	126	130	135	140	149	156	165	175	188
		DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.										
40-44	281	70	71	76	79	80	83	86	88	91	99	102
45-49	243	70	74	77	80	80	84	88	90	95	101	108
50-54	153	71	74	76	80	81	85	89	90	96	105	110
55-59	159	70	73	78	80	83	88	90	93	100	107	112
		SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.										
40-44	278	170	183	201	213	225	233	245	256	274	291	320
45-49	239	174	181	199	213	222	232	244	259	274	295	324
50-54	150	192	194	206	218	224	232	244	256	274	294	319
55-59	156	167	190	208	224	236	250	262	273	283	297	319

TABLE

SEDENTARY CLERKS, U.S.A.

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO.	CENTILE										
	MEN	5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	166	165	166	169	173	173	175	176	178	180	182	185
45-49	185	163	166	169	170	172	174	175	177	180	182	184
50-54	239	162	164	167	169	170	172	173	176	177	181	183
55-59	267	162	164	167	169	170	172	173	175	177	180	183
						RELATIVE BODY WEIGHT, Per Cent						
40-44	166	82	87	91	94	100	103	107	110	113	119	124
45-49	185	82	87	92	97	99	102	104	106	111	116	122
50-54	238	82	87	93	96	99	102	106	110	114	122	125
55-59	267	82	86	90	95	98	101	104	107	111	120	124
						SUM OF SKINFOLDS, mm.						
40-44	166	14	16	20	25	29	33	36	39	43	52	56
45-49	185	15	19	25	28	30	34	36	39	41	45	48
50-54	239	16	19	24	28	30	33	36	39	44	53	61
55-59	268	18	20	26	28	30	32	35	37	44	49	55
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	167	117	119	121	125	129	134	138	140	148	158	169
45-49	184	110	118	121	126	130	133	140	147	153	160	170
50-54	239	114	120	127	130	136	142	147	154	164	176	188
55-59	268	116	121	127	130	135	140	147	157	162	175	191
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	167	66	70	76	79	80	83	87	90	94	100	108
45-49	184	70	72	76	80	81	85	88	90	95	100	108
50-54	239	70	74	80	82	85	88	90	93	98	102	113
55-59	268	73	74	78	80	83	86	90	92	97	104	113
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	163	167	182	195	207	220	234	245	259	280	300	317
45-49	185	170	183	196	207	220	234	245	258	280	301	326
50-54	238	175	187	206	215	224	232	243	256	269	283	318
55-59	267	178	190	207	217	229	242	253	267	280	297	312

TABLE

NON-SEDENTARY CLERKS, U.S.A.

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	32	. .	167	169	171	172	173	175	176	180	181	. .
45-49	38	. .	167	168	169	170	172	174	175	178	180	. .
50-54	38	. .	164	165	169	171	172	174	176	178	182	. .
55-59	47	. .	166	169	171	172	173	174	176	178	180	. .
						RELATIVE BODY WEIGHT, Per Cent						
40-44	32	. .	87	94	98	99	104	112	119	122	125	. .
45-49	38	. .	86	89	93	97	100	106	109	112	115	. .
50-54	38	. .	86	89	95	100	105	108	113	119	121	. .
55-59	47	. .	85	91	95	97	101	105	109	115	126	. .
						SUM OF SKINFOLDS, mm.						
40-44	32	. .	15	22	26	32	37	41	45	48	53	. .
45-49	39	. .	12	16	23	30	34	35	38	43	48	. .
50-54	38	. .	18	23	27	29	37	40	43	47	53	. .
55-59	47	. .	21	24	27	29	31	33	35	41	51	. .
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	32	. .	114	120	122	128	130	132	134	140	158	. .
45-49	39	. .	114	120	127	129	133	137	142	149	153	. .
50-54	38	. .	124	129	131	137	138	144	154	156	174	. .
55-59	47	. .	120	128	134	141	144	156	163	172	194	. .
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	32	. .	70	72	75	80	80	82	88	90	95	. .
45-49	39	. .	69	72	77	78	80	82	86	89	95	. .
50-54	38	. .	77	81	84	86	88	92	96	100	107	. .
55-59	47	. .	72	78	82	84	90	92	96	99	111	. .
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	31	. .	182	193	211	224	228	232	248	268	290	. .
45-49	37	. .	186	200	216	222	230	250	254	266	295	. .
50-54	38	. .	204	214	235	246	255	271	281	308	328	. .
55-59	47	. .	185	198	208	214	221	250	256	269	289	. .

TABLE

EXECUTIVES, U.S.A.

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	46	..	170	172	174	176	177	180	181	182	188	..
45-49	35	..	166	170	172	175	177	180	180	181	182	..
50-54	73	..	169	172	174	176	177	179	180	182	184	..
55-59	96	..	168	170	172	174	176	178	179	182	183	..
						RELATIVE BODY WEIGHT, Per Cent						
40-44	46	..	87	95	97	102	106	108	110	112	116	..
45-49	35	..	89	93	95	100	103	106	108	112	116	..
50-54	73	..	92	96	100	102	103	107	110	113	115	..
55-59	96	..	88	90	95	99	101	105	108	111	119	..
						SUM OF SKINFOLDS, mm.						
40-44	46	..	18	22	26	29	33	36	40	43	52	..
45-49	35	..	23	24	26	30	31	34	38	42	46	..
50-54	72	..	22	29	30	34	38	40	41	44	50	..
55-59	96	..	20	24	28	31	34	37	39	44	49	..
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	46	..	111	115	119	120	123	125	130	135	146	..
45-49	35	..	114	118	120	124	130	130	138	145	153	..
50-54	73	..	120	124	129	133	139	144	155	164	168	..
55-59	97	..	120	124	128	130	133	137	146	154	168	..
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	46	..	71	74	76	78	80	82	85	91	95	..
45-49	35	..	71	72	78	80	81	83	85	90	92	..
50-54	73	..	78	80	82	86	89	90	95	98	103	..
55-59	97	..	72	76	80	82	85	86	88	91	97	..
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	45	..	179	198	204	222	242	251	258	268	274	..
45-49	35	..	190	218	224	234	241	250	254	268	287	..
50-54	72	..	194	206	216	230	243	255	262	298	320	..
55-59	95	..	197	208	219	234	247	254	260	274	288	..

TABLE

CREVALCORE, ITALY

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	174	158	161	163	166	167	169	171	173	174	176	179
45-49	303	156	160	162	165	167	168	169	170	172	175	178
50-54	291	158	160	162	165	166	168	170	171	173	176	177
55-59	219	155	158	161	163	165	167	168	170	173	175	178
						RELATIVE BODY WEIGHT, Per Cent						
40-44	175	85	88	92	96	101	105	110	114	120	128	133
45-49	300	82	86	91	96	100	103	107	111	116	124	128
50-54	288	84	87	91	96	99	102	105	110	114	122	128
55-59	216	84	86	90	94	98	101	104	112	118	125	132
						SUM OF SKINFOLDS, mm.						
40-44	176	10	12	14	17	21	23	26	29	32	40	43
45-49	303	10	11	14	17	18	21	26	30	34	38	42
50-54	294	10	12	15	18	20	22	25	28	32	37	42
55-59	218	9	12	14	17	20	22	25	30	36	41	46
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	175	115	120	125	130	132	136	140	146	154	161	172
45-49	299	117	120	130	133	138	142	147	150	157	169	180
50-54	290	120	127	132	138	141	147	151	160	166	180	188
55-59	218	127	130	139	143	150	157	161	169	174	185	198
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	175	70	73	76	79	80	84	88	90	92	98	107
45-49	299	71	75	78	80	84	87	90	91	95	100	109
50-54	289	73	77	80	81	85	88	90	92	97	104	109
55-59	218	72	78	80	82	87	90	90	94	98	104	110
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	170	136	156	166	174	184	194	202	215	226	256	272
45-49	294	134	146	167	178	186	194	204	217	238	257	290
50-54	284	136	150	172	182	190	198	207	216	232	246	270
55-59	214	140	152	170	179	190	204	216	226	241	257	287

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TABLE

MONTEGIORGIO, ITALY

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	123	157	159	162	163	164	165	167	168	170	174	177
45-49	246	156	157	160	162	164	165	166	168	169	172	174
50-54	217	154	156	158	160	162	163	164	167	169	171	173
55-59	130	154	156	158	160	161	162	164	166	168	171	173
						RELATIVE BODY WEIGHT, Per Cent						
40-44	123	80	82	89	92	96	99	102	107	110	117	123
45-49	246	80	84	88	92	95	98	102	108	112	120	128
50-54	217	77	81	84	89	92	94	99	103	107	114	122
55-59	130	78	79	82	86	88	94	97	102	108	121	125
						SUM OF SKINFOLDS, mm.						
40-44	123	9	9	10	11	13	15	18	21	24	28	32
45-49	247	8	10	11	12	14	16	18	20	25	32	37
50-54	216	9	9	10	11	13	14	16	20	22	28	34
55-59	130	8	9	10	11	12	14	16	18	22	26	33
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	123	111	112	118	120	124	128	130	135	139	145	154
45-49	247	115	119	123	129	130	134	138	140	146	158	169
50-54	217	114	119	123	129	131	137	140	146	154	161	172
55-59	131	115	120	130	135	139	142	146	151	160	173	189
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	123	68	70	70	72	76	78	80	80	82	91	95
45-49	247	70	70	74	76	79	80	82	84	90	93	98
50-54	217	70	70	75	78	80	81	83	89	90	98	102
55-59	131	70	72	76	80	81	83	85	88	90	97	108
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	122	150	157	165	175	184	192	201	210	224	249	264
45-49	244	144	155	169	183	192	200	208	219	235	257	290
50-54	216	148	157	169	182	191	199	207	222	232	248	268
55-59	128	155	162	173	183	191	198	203	213	228	263	273

TABLE

NICOTERA, ITALY

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
45-49	230	..	154	158	160	161	163	165	167	169	172	..
50-54	173	..	155	157	158	162	163	165	166	169	173	..
55-59	117	..	155	157	159	160	162	164	166	168	170	..
				RELATIVE BODY WEIGHT, Per Cent								
45-49	230	..	78	82	86	87	94	99	104	111	118	..
50-54	123	..	74	78	81	85	87	92	98	102	114	..
55-59	117	..	76	78	83	87	91	97	102	106	116	..
						SUM OF SKINFOLDS, mm.						
45-49	230	..	9	10	11	12	13	16	19	26	32	..
50-54	123	..	8	9	10	11	13	15	17	19	25	..
55-59	117	..	8	10	12	13	14	16	19	22	27	..
				SYSTOLIC BLOOD PRESSURE, mm. Hg.								
45-49	230	..	110	114	118	122	125	128	132	138	142	..
50-54	123	..	111	116	118	122	127	132	136	142	158	..
55-59	117	..	113	120	126	130	136	140	145	150	170	..
			DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.									
45-49	230	..	64	68	70	72	75	77	80	80	84	..
50-54	123	..	64	70	70	72	75	78	80	83	88	..
55-59	117	..	64	70	72	75	78	80	82	85	90	..
			SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.									
45-49	31	..	..	144	..	..	184	..	..	227	..	..
50-54	19	..	..	137	..	..	174	..	..	192	..	..
55-59	18	..	..	152	..	..	166	..	..	217	..	..

TABLE

DALMATIA, YUGOSLAVIA

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	85	165	166	169	171	173	175	176	178	179	182	186
45-49	183	162	166	168	170	171	173	174	176	178	182	184
50-54	211	163	165	169	170	172	173	175	177	179	182	184
55-59	190	161	165	166	169	170	172	174	175	177	180	184
						RELATIVE BODY WEIGHT, Per Cent						
40-44	86	78	82	84	86	90	94	98	102	103	108	115
45-49	184	78	80	85	88	90	93	95	98	104	111	116
50-54	212	76	78	83	85	87	90	92	96	100	107	113
55-59	189	74	77	79	82	85	88	91	97	103	111	117
						SUM OF SKINFOLDS, mm.						
40-44	85	9	10	11	12	13	15	17	21	24	34	37
45-49	184	9	10	10	12	13	15	17	20	25	31	36
50-54	212	8	9	10	11	12	14	16	18	23	28	31
55-59	189	8	9	10	10	11	13	15	17	24	32	36
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	84	110	115	126	130	131	136	140	141	147	160	169
45-49	184	110	120	121	125	130	135	138	140	150	164	170
50-54	212	115	120	122	130	131	137	140	145	155	165	175
55-59	192	112	120	124	130	130	135	140	150	152	165	175
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	84	66	70	70	76	80	85	89	90	92	95	102
45-49	184	68	70	70	75	79	80	82	88	92	96	102
50-54	212	68	70	70	75	79	82	85	90	92	98	100
55-59	192	68	70	74	77	80	82	85	88	92	99	102
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	84	136	146	155	163	176	182	200	214	227	251	270
45-49	181	119	141	156	168	176	185	198	208	220	237	246
50-54	211	126	136	155	166	174	186	198	208	225	241	260
55-59	190	130	142	152	164	177	188	198	208	222	246	260

TABLE

SLAVONIA, YUGOSLAVIA

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	5	10	20	30	40	50	60	70	80	90	95
							CENTILE					
							HEIGHT, cm.					
40-44	102	160	161	164	166	168	170	172	173	175	178	181
45-49	182	160	162	163	165	166	168	169	170	173	175	177
50-54	197	155	159	161	163	165	166	168	170	172	175	179
55-59	216	158	161	163	165	166	168	169	171	173	176	179
							RELATIVE BODY WEIGHT, Per Cent					
40-44	102	78	81	85	88	93	95	100	103	106	112	123
45-49	181	78	80	84	88	91	94	97	103	107	120	127
50-54	197	75	77	81	83	86	88	92	98	103	114	121
55-59	215	74	77	80	84	88	91	93	98	104	111	116
							SUM OF SKINFOLDS, mm.					
40-44	102	9	10	10	12	13	15	18	20	23	28	37
45-49	181	8	9	10	11	13	15	17	22	26	33	42
50-54	197	8	9	10	10	12	13	14	16	22	31	40
55-59	215	8	9	10	11	12	14	15	17	22	27	35
							SYSTOLIC BLOOD PRESSURE, mm. Hg.					
40-44	102	108	111	120	125	130	130	135	140	146	165	171
45-49	180	112	116	120	125	130	130	137	140	151	163	170
50-54	197	110	115	120	128	130	131	139	144	152	161	172
55-59	216	110	115	123	130	138	140	146	152	162	171	180
							DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.					
40-44	102	66	68	70	75	78	79	80	85	90	97	105
45-49	180	68	69	72	77	78	80	85	89	90	100	108
50-54	197	66	68	70	76	78	80	82	86	89	96	106
55-59	216	64	68	72	78	80	84	86	90	95	100	104
							SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.					
40-44	95	141	149	162	178	186	196	210	217	232	249	273
45-49	176	140	147	159	177	186	197	207	218	237	255	275
50-54	192	140	152	164	176	186	200	206	217	232	260	270
55-59	213	136	146	162	174	182	194	202	220	234	256	275

TABLE

KARELIA, FINLAND

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	207	160	161	164	165	167	168	170	172	174	177	179
45-49	234	158	161	163	165	166	168	169	171	173	177	178
50-54	196	158	160	163	165	167	168	170	171	172	174	176
55-59	168	158	159	162	163	165	167	169	170	172	175	177
						RELATIVE BODY WEIGHT, Per Cent						
40-44	205	80	83	86	90	92	94	97	101	104	110	116
45-49	230	79	82	86	89	92	94	98	102	106	110	118
50-54	194	76	79	83	86	89	93	95	99	105	111	117
55-59	168	76	78	82	85	89	90	93	96	101	110	119
						SUM OF SKINFOLDS, mm.						
40-44	207	9	10	11	12	13	13	15	18	22	28	35
45-49	239	9	10	11	12	13	15	18	20	25	31	35
50-54	197	9	9	11	11	13	14	17	21	24	30	36
55-59	172	8	8	10	11	12	14	16	18	22	32	40
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	206	120	124	130	135	138	141	145	150	154	164	168
45-49	235	120	125	130	134	138	140	145	150	160	173	185
50-54	197	121	130	135	139	143	149	154	158	169	179	188
55-59	171	127	130	139	144	148	153	160	166	174	184	208
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	206	70	75	80	80	85	87	90	90	95	100	102
45-49	235	74	78	80	82	85	88	90	92	98	102	110
50-54	197	70	77	80	85	88	90	92	96	100	104	110
55-59	170	72	78	81	86	90	90	94	98	100	107	110
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	207	181	193	220	232	248	265	276	288	302	328	360
45-49	239	197	208	222	239	259	272	284	295	313	335	360
50-54	196	191	208	220	238	251	262	280	302	315	340	358
55-59	172	162	190	211	231	245	259	268	280	292	317	343

TABLE

WEST FINLAND

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
							HEIGHT, cm.					
40-44	166	162	164	168	169	171	173	174	175	177	180	182
45-49	221	162	164	167	168	170	171	173	174	176	178	181
50-54	240	161	163	167	168	170	172	173	174	176	178	181
55-59	220	160	162	165	167	169	170	171	173	175	178	178
							RELATIVE BODY WEIGHT, Per Cent					
40-44	164	82	86	90	93	95	98	101	104	107	115	124
45-49	216	80	82	86	90	94	96	100	105	109	115	122
50-54	238	80	82	85	89	92	97	101	104	109	115	130
55-59	217	77	80	85	88	92	95	98	101	105	114	119
							SUM OF SKINFOLDS, mm.					
40-44	168	10	11	12	13	15	16	19	21	25	32	39
45-49	224	10	11	12	13	15	16	19	21	26	32	40
50-54	245	9	11	12	13	15	16	19	23	27	35	40
55-59	222	9	10	11	12	14	16	19	21	24	31	40
							SYSTOLIC BLOOD PRESSURE, mm. Hg.					
40-44	168	109	112	120	125	130	133	136	141	147	159	169
45-49	224	114	119	122	126	130	135	139	142	148	156	162
50-54	245	113	118	124	130	134	139	143	146	152	165	178
55-59	222	115	121	129	132	139	143	150	155	164	177	186
							DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.					
40-44	168	65	67	70	74	78	80	80	83	86	92	98
45-49	224	68	70	74	77	78	80	81	85	88	92	96
50-54	245	68	70	73	78	80	82	84	88	90	100	104
55-59	222	70	72	76	78	80	82	86	89	90	97	101
							SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.					
40-44	168	193	201	216	227	238	248	260	278	293	314	335
45-49	223	186	201	216	228	242	255	267	277	300	319	346
50-54	244	178	197	214	231	245	257	277	284	306	323	348
55-59	222	182	195	216	228	238	251	258	269	282	305	325

TABLE

ZUTPHEN, NETHERLANDS

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	181	164	165	168	171	174	175	177	179	180	183	185
45-49	237	164	166	169	172	174	175	176	178	180	183	184
50-54	235	163	166	168	170	172	174	175	177	180	182	185
55-59	225	162	163	167	169	171	172	174	176	178	182	184
						RELATIVE BODY WEIGHT, Per Cent						
40-44	181	82	85	91	93	96	99	102	105	108	111	115
45-49	236	83	85	89	92	95	97	100	103	106	111	118
50-54	234	79	82	88	91	95	97	100	102	105	113	115
55-59	224	79	82	87	91	94	97	99	101	106	110	114
						SUM OF SKINFOLDS, mm.						
40-44	181	12	14	16	20	22	24	27	29	32	38	40
45-49	236	11	13	16	20	22	23	26	28	32	37	40
50-54	234	12	13	16	20	22	24	26	30	32	37	44
55-59	225	12	14	16	18	21	22	26	28	32	38	40
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	181	120	125	130	130	136	140	145	150	153	160	170
45-49	236	117	120	129	130	135	140	145	150	156	165	178
50-54	233	118	120	128	132	138	140	146	155	163	175	180
55-59	225	120	122	130	135	140	145	150	158	168	176	188
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	180	70	75	80	80	85	90	90	94	98	100	106
45-49	236	70	73	80	80	85	90	90	93	98	104	110
50-54	233	72	75	80	80	85	90	90	95	100	108	118
55-59	225	70	75	80	82	85	88	90	95	100	106	110
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	174	168	177	198	209	224	233	244	253	268	285	306
45-49	219	170	186	201	215	226	235	247	257	272	298	320
50-54	224	176	187	200	209	219	227	239	252	265	289	315
55-59	214	164	177	197	206	217	226	238	252	264	292	324

TABLE

CRETE, GREECE

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	158	157	159	162	163	165	166	168	170	172	174	178
45-49	199	156	158	161	163	165	166	168	169	171	174	176
50-54	172	157	159	161	164	165	166	168	170	171	174	176
55-59	146	156	158	160	162	164	165	167	168	170	173	174
						RELATIVE BODY WEIGHT, Per Cent						
40-44	157	80	82	86	88	92	94	96	100	104	112	117
45-49	200	76	79	82	85	88	91	94	97	103	111	116
50-54	172	73	75	81	84	88	92	94	98	102	112	117
55-59	146	75	77	81	84	86	88	90	94	97	103	104
						SUM OF SKINFOLDS, mm.						
40-44	160	9	10	10	12	13	14	17	20	24	30	36
45-49	202	9	10	10	11	12	14	15	18	22	28	33
50-54	175	8	9	10	12	13	15	17	20	23	27	32
55-59	148	9	10	10	11	13	14	15	17	19	23	27
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	158	110	112	118	122	128	131	136	142	150	155	165
45-49	201	110	116	120	123	130	132	136	140	145	155	166
50-54	173	110	115	122	127	130	135	139	145	152	164	175
55-59	146	113	119	125	130	134	138	145	152	160	174	188
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	158	62	68	72	75	76	80	82	87	90	96	100
45-49	201	65	70	72	75	78	80	82	85	89	97	99
50-54	173	63	70	72	75	80	81	85	89	90	95	101
55-59	146	69	70	73	75	80	83	85	89	90	94	100
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	152	148	156	169	177	186	198	206	217	233	260	270
45-49	190	143	154	169	178	188	199	206	219	235	251	272
50-54	167	153	158	176	183	195	210	218	232	250	270	282
55-59	143	155	163	172	193	199	208	226	235	245	257	284

TABLE

CORFU, GREECE

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
		HEIGHT, cm.										
40-44	120	157	159	162	164	166	167	169	172	174	176	179
45-49	114	154	158	161	162	164	166	167	170	172	177	179
50-54	169	156	159	160	162	164	166	167	169	170	172	174
55-59	126	155	158	160	161	162	164	165	166	168	172	175
		RELATIVE BODY WEIGHT, Per Cent										
40-44	120	78	80	84	88	92	94	100	102	106	114	126
45-49	114	76	79	83	87	89	93	100	104	110	115	119
50-54	168	75	77	82	85	88	92	95	98	103	110	123
55-59	126	74	77	80	83	87	90	94	97	103	111	121
		SUM OF SKINFOLDS, mm.										
40-44	120	9	10	11	12	14	16	19	20	24	30	34
45-49	114	9	10	11	12	14	15	18	20	26	31	37
50-54	169	9	10	11	12	13	14	16	19	23	31	42
55-59	126	9	10	10	11	12	14	16	19	24	30	36
		SYSTOLIC BLOOD PRESSURE, mm. Hg.										
40-44	120	105	109	115	121	128	130	134	138	140	154	164
45-49	114	102	110	119	121	125	130	134	139	146	160	173
50-54	169	110	111	120	125	130	134	138	140	151	164	176
55-59	126	110	111	120	125	130	135	140	150	158	167	175
		DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.										
40-44	120	65	70	72	76	80	81	82	85	89	92	100
45-49	114	67	70	72	75	79	80	82	86	90	98	107
50-54	169	70	71	75	78	80	81	85	89	90	97	108
55-59	126	65	70	74	76	80	81	85	88	90	95	100
		SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.										
40-44	120	139	146	158	172	185	193	203	220	232	262	309
45-49	111	140	147	163	176	193	203	209	222	233	259	300
50-54	165	141	162	174	186	194	202	216	232	246	258	274
55-59	125	142	154	171	180	186	194	201	212	227	251	264

TABLE

TANUSHIMARU, JAPAN

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	112	152	155	157	159	160	162	163	164	165	167	169
45-49	117	151	154	156	158	160	161	162	164	165	168	170
50-54	137	151	153	155	157	158	159	161	163	165	167	170
55-59	143	151	152	154	156	159	160	161	162	163	165	167
						RELATIVE BODY WEIGHT, Per Cent						
40-44	111	76	80	82	85	87	89	91	94	95	98	102
45-49	116	72	77	79	82	84	86	88	90	93	100	104
50-54	137	71	75	79	80	82	84	87	90	93	100	109
55-59	143	73	75	79	81	82	84	86	89	92	99	102
						SUM OF SKINFOLDS, mm.						
40-44	110	10	11	12	12	14	15	16	18	22	23	24
45-49	113	10	10	12	13	14	15	17	18	21	24	28
50-54	136	9	10	11	12	14	14	16	17	21	26	32
55-59	140	10	11	12	12	13	15	16	18	21	26	28
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	112	96	102	110	112	117	120	124	132	138	145	154
45-49	117	103	108	114	118	120	128	132	136	142	152	164
50-54	137	105	110	114	120	125	132	137	140	146	160	173
55-59	143	107	112	120	124	132	138	148	156	166	183	209
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	112	50	51	58	62	64	68	70	74	78	83	86
45-49	117	51	58	62	68	70	70	74	78	84	90	93
50-54	137	56	60	64	68	70	72	75	80	82	90	105
55-59	143	58	60	64	70	71	78	80	88	92	100	105
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	109	97	109	140	147	157	167	183	212	237	277	298
45-49	111	107	111	131	147	155	165	185	198	220	259	311
50-54	132	106	114	133	149	164	178	187	216	231	266	290
55-59	139	109	116	134	144	155	168	183	205	225	257	313

TABLE

USHIBUKA, JAPAN

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	107	152	153	156	157	159	160	161	162	165	167	170
45-49	114	152	153	156	157	159	160	162	163	165	167	169
50-54	129	149	151	154	156	157	158	160	161	163	165	168
55-59	107	148	150	153	156	157	159	160	162	165	168	169
						RELATIVE BODY WEIGHT, Per Cent						
40-44	107	74	77	82	85	88	91	93	96	99	102	107
45-49	114	76	78	81	84	87	89	91	93	96	101	109
50-54	129	76	77	80	82	85	87	88	90	92	97	103
55-59	107	68	72	77	80	82	84	86	88	92	96	101
						SUM OF SKINFOLDS, mm.						
40-44												
45-49												
50-54						Data Not Available						
55-59												
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	115	105	110	114	120	120	126	132	135	140	152	169
45-49	128	102	107	114	120	120	128	135	145	155	165	174
50-54	139	110	112	118	125	130	135	140	150	156	176	195
55-59	118	110	114	120	128	135	140	144	154	165	181	213
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	115	52	60	66	70	72	75	78	80	82	90	95
45-49	128	60	64	68	70	74	76	80	80	90	97	100
50-54	139	60	65	70	72	75	80	80	84	87	96	104
55-59	118	64	67	70	74	77	80	84	86	90	96	105
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	112	100	106	114	122	130	142	150	155	164	181	195
45-49	127	103	109	114	124	133	143	153	158	169	182	195
50-54	136	89	103	114	122	132	137	146	158	168	179	189
55-59	118	94	107	116	126	134	144	152	161	171	184	196

TABLE

RAILWAYMEN, ROME, ITALY

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	197	158	160	162	163	165	166	167	169	172	175	176
45-49	215	156	159	162	164	165	166	168	169	170	172	174
50-54	231	156	158	161	163	164	165	166	168	170	172	174
55-59	124	156	157	159	161	163	164	166	168	170	173	176
						RELATIVE BODY WEIGHT, Per Cent						
40-44	197	86	90	95	100	104	108	113	117	121	127	131
45-49	215	86	90	96	100	104	108	112	116	122	129	136
50-54	231	83	87	95	99	103	106	110	113	118	125	128
55-59	124	78	82	93	100	104	108	112	114	121	126	129
						SUM OF SKINFOLDS, mm.						
40-44	197	13	14	17	20	22	26	30	34	38	44	49
45-49	215	12	15	19	21	23	27	30	33	38	45	50
50-54	231	11	13	16	20	23	25	28	32	36	40	45
55-59	124	10	13	17	20	23	26	29	30	34	39	43
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	197	113	119	123	129	131	135	138	140	147	158	168
45-49	215	116	118	128	133	136	138	141	145	151	160	169
50-54	232	115	118	126	130	135	138	141	148	152	162	173
55-59	124	119	122	129	135	140	142	150	155	166	174	184
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	197	68	70	76	80	83	86	89	91	96	102	108
45-49	215	70	72	79	80	84	89	90	95	100	106	110
50-54	232	70	72	80	82	86	89	90	93	98	105	110
55-59	124	73	78	80	85	88	90	91	97	100	103	107
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	195	146	154	168	182	196	207	216	225	234	252	262
45-49	214	247	159	173	185	197	206	218	229	240	260	284
50-54	231	147	159	173	186	198	209	219	231	242	267	283
55-59	124	153	158	170	183	193	204	212	225	239	261	270

TABLE

VELIKA KRSNA (SERBIA) YUGOSLAVIA

CENTILES (CUTTING POINTS) BELOW WHICH ARE FOUND

5, 10, 20, ETC. PER CENT OF THE MEN

AGE	NO. MEN	CENTILE 5	10	20	30	40	50	60	70	80	90	95
						HEIGHT, cm.						
40-44	136	160	163	164	167	169	171	172	173	175	178	180
45-49	81	161	163	164	166	168	170	171	173	174	178	180
50-54	135	157	160	163	165	167	168	170	172	174	176	178
55-59	158	159	161	164	166	167	168	170	172	174	177	179
						RELATIVE BODY WEIGHT, Per Cent						
40-44	136	80	81	85	86	88	89	92	95	99	109	114
45-49	81	66	78	81	84	87	88	91	94	100	109	115
50-54	135	76	78	81	83	85	88	90	93	96	103	109
55-59	158	73	76	78	80	83	86	89	92	95	101	108
						SUM OF SKINFOLDS, mm.						
40-44	136	9	10	10	11	12	13	14	16	18	23	27
45-49	81	9	9	10	11	12	13	14	15	18	25	31
50-54	135	9	9	10	11	12	13	14	15	18	22	28
55-59	158	8	9	10	11	11	12	14	15	19	24	27
						SYSTOLIC BLOOD PRESSURE, mm. Hg.						
40-44	136	106	109	112	120	120	124	127	130	130	141	148
45-49	82	107	110	117	120	121	128	130	132	140	148	156
50-54	135	110	110	119	124	128	130	133	139	144	157	170
55-59	158	110	115	120	128	130	130	140	143	150	160	177
						DIASTOLIC BLOOD PRESSURE, 5th Phase, mm. Hg.						
40-44	136	67	69	70	76	77	78	80	81	87	90	98
45-49	81	70	70	76	77	78	80	81	84	88	93	97
50-54	135	70	70	76	78	80	80	84	86	88	96	100
55-59	158	69	70	76	79	80	80	85	88	90	98	105
						SERUM CHOLESTEROL CONCENTRATION, mg. per 100 ml.						
40-44	136	112	121	133	141	149	154	162	168	179	191	203
45-49	82	115	120	132	143	151	157	168	178	194	201	226
50-54	135	111	116	133	144	152	159	168	179	186	204	216
55-59	158	119	126	134	139	149	155	164	179	190	207	219

TABLE

Distributions of thickness of the skinfold over the triceps muscle. Entries in the table are the cutting points, in mm., for the centiles given in the column headings. Below these values 5, 10, 20 etc., per cent of the men are found.

AGE	NO. MEN	CENTILES 5	10	20	30	40	50	60	70	80	90	95
					U.S.A. RAILROAD SWITCHMEN							
40-44	282	6	6	8	10	10	12	14	15	17	19	21
45-49	241	6	6	8	9	10	11	12	14	15	18	20
50-54	153	6	8	9	10	12	12	14	15	16	19	22
55-59	159	5	6	8	10	10	12	14	15	16	19	22
					U.S.A. RAILROAD SEDENTARY CLERKS							
40-44	166	6	6	8	10	12	13	14	16	18	21	24
45-49	185	6	7	10	11	12	13	15	16	17	20	21
50-54	239	6	8	9	10	12	13	14	16	18	20	24
55-59	269	6	8	10	10	12	12	14	16	18	21	22
					U.S.A. RAILROAD NON-SEDENTARY CLERKS							
40-44	31	--	6	10	12	13	16	18	18	20	22	--
45-49	39	--	6	7	9	10	12	15	16	18	20	--
50-54	38	--	8	9	10	12	13	16	18	18	25	--
55-59	47	--	10	10	12	12	14	14	16	17	20	--
					U.S.A. RAILROAD EXECUTIVES							
40-44	46	--	8	10	12	13	14	16	18	19	20	--
45-49	35	--	8	10	11	12	12	14	16	18	20	--
50-54	73	--	8	10	12	12	14	15	18	18	22	--
55-59	96	--	8	9	12	12	14	15	16	18	20	--
					NICOTERA, ITALY							
40-44	0	--	--	--	--	--	--	--	--	--	--	--
45-49	229	3	4	4	4	4	5	6	8	10	13	15
50-54	123	3	3	4	4	4	5	6	6	8	9	12
55-59	117	3	3	4	4	5	5	6	7	8	10	12

TABLE

Triceps skinfold thickness

AGE	NO. MEN	CENTILES 5	10	20	30	40	50	60	70	80	90	95
						DALMATIA, YUGOSLAVIA						
40-44	86	4	4	4	5	6	6	8	8	10	12	14
45-49	183	4	4	4	5	6	6	7	8	10	12	13
50-54	211	3	4	4	4	5	6	7	8	9	10	12
55-59	190	3	4	4	4	5	6	6	8	9	12	14
						SLAVONIA, YUGOSLAVIA						
40-44	103	3	4	4	5	6	7	8	10	10	14	16
45-49	182	3	4	4	5	6	7	8	10	11	13	16
50-54	197	3	4	4	4	5	6	6	8	10	12	14
55-59	205	3	4	4	4	5	6	6	8	9	11	15
						EAST FINLAND (KARELIA)						
40-44	207	3	4	4	5	5	6	7	8	10	14	19
45-49	239	4	4	4	5	6	7	7	9	11	15	17
50-54	197	3	4	4	5	6	6	8	9	12	15	18
55-59	172	3	3	4	5	5	6	7	9	11	14	18
						WEST FINLAND						
40-44	168	4	4	5	6	6	7	8	10	11	14	17
45-49	224	4	4	5	6	6	7	8	9	11	13	17
50-54	245	4	4	5	6	6	7	8	10	12	15	17
55-59	222	3	4	4	5	6	7	8	9	10	14	16
						CREVALCORE, ITALY						
40-44	174	4	5	6	8	10	11	12	15	17	21	22
45-49	304	4	5	6	7	9	10	12	15	17	20	22
50-54	292	4	6	6	8	9	10	12	13	15	19	21
55-59	220	4	5	6	8	9	10	12	14	17	20	23
						MONTEGIORGIO, ITALY						
40-44	123	3	3	4	4	4	6	7	8	9	11	12
45-49	247	3	4	4	4	5	6	6	8	10	12	13
50-54	216	3	4	4	4	5	6	6	8	8	10	12
55-59	129	3	3	4	4	5	5	6	7	8	10	12

TABLE

Triceps skinfold thickness

AGE	NO. MEN	CENTILES 5	10	20	30	40	50	60	70	80	90	95
ZUTPHEN, NETHERLANDS												
40-44	181	4	6	6	8	8	10	10	12	14	16	18
45-49	237	4	5	6	8	8	9	10	11	12	14	16
50-54	234	4	5	6	8	8	10	10	12	13	15	18
55-59	225	4	6	6	7	8	10	10	11	12	14	16
CRETE, GREECE												
40-44	160	3	4	4	4	5	6	6	8	10	13	14
45-49	202	3	4	4	4	5	5	7	8	10	14	20
50-54	175	3	3	4	5	5	6	7	8	10	11	12
55-59	148	3	3	4	4	5	5	6	6	7	9	11
CORFU, GREECE												
40-44	120	4	4	4	5	5	6	7	9	10	11	15
45-49	114	3	4	4	4	5	6	7	8	10	12	15
50-54	169	4	4	4	4	5	6	6	8	9	12	16
55-59	126	3	4	4	4	4	5	6	7	10	12	15
ROME, ITALY, RAILROAD EMPLOYEES												
40-44	196	5	6	7	8	9	10	11	12	14	17	20
45-49	215	4	6	7	8	9	10	10	12	14	17	19
50-54	231	4	5	6	8	8	10	10	12	13	15	17
55-59	124	4	5	6	7	8	9	10	11	12	14	15
VELIKA KRSNA, YUGOSLAVIA												
40-44	136	4	4	4	4	5	5	6	7	8	10	11
45-49	82	4	4	4	4	5	5	6	7	8	11	14
50-54	135	3	4	4	4	5	5	6	7	8	10	12
55-59	158	3	4	4	4	5	5	6	7	8	12	13

Prevalence of hypertension. Number of men with diastolic blood pressure (fifth phase) of 95 mm. or more, and of 100 mm. or more. N = total men; OBS = cases observed; cases expected from the prevalence in all 18 samples. Chi-square value given in parenthesis.

SAMPLE	AGE	N	95 or more		100 or more	
			OBS.	E	OBS.	E
Nicotera	45-49	230	3	38.346	2	22.446
	50-54	123	6	24.531	4	15.995
	55-59	117	7	25.005	5	16.170
	45-59	470	16	87.882	11	54.611
	"		(75.03)		(40.48)	
U.S. Switchmen	40-44	281	40	41.990	27	24.936
	45-49	243	50	40.513	34	23.714
	50-54	153	34	30.514	23	19.896
	55-59	159	43	33.981	33	21.975
	40-59	836	167	146.998	117	90.521
	"		(N.S.)		(8.97)	
U.S. Sedentary Clerks	40-44	167	33	24.955	21	14.820
	45-49	184	39	30.676	22	17.957
	50-54	239	63	47.666	42	31.080
	55-59	268	66	57.277	47	37.040
	40-59	858	201	160.574	132	100.897
	"		(13.20)		(11.37)	
U.S. Non-Sedentary Clerks	40-44	31	3	4.632	1	2.751
	45-49	39	7	6.502	2	3.806
	50-54	38	14	7.579	11	4.942
	55-59	47	21	10.045	13	6.496
	40-59	155	45	28.758	27	17.995
	"		(10.72)		(4.61)	
U.S. Executives	40-44	46	6	6.874	4	4.082
	45-49	35	3	5.835	2	3.416
	50-54	71	30	14.160	20	9.233
	55-59	95	20	20.303	13	13.130
	40-59	247	59	47.172	39	29.861
	"		(N.S.)		(N.S.)	
Tanushimaru	40-44	112	2	16.736	2	9.938
	45-49	117	4	19.506	4	11.418
	50-54	137	10	27.323	9	15.215
	55-59	143	22	30.562	15	19.764
	40-59	509	38	94.127	30	56.335
	"		(42.18)		(13.91)	
Dalmatia	40-44	83	11	12.403	6	7.365
	45-49	183	27	30.510	16	17.859
	50-54	211	38	42.082	16	27.438
	55-59	193	31	41.248	18	26.675
	40-59	670	107	126.243	56	79.337
	"		(N.S.)		(8.28)	

SAMPLE	AGE	N	95 or more		100 or more	
			OBS.	E	OBS.	E
Slavonia	40-44	102	14	15.242	9	9.051
	45-49	181	31	30.176	20	17.664
	50-54	197	22	39.290	16	25.618
	55-59	217	48	46.377	27	29.992
	40-59	697	115	131.085	72	82.325
	"		(N.S.)		(N.S.)	
East Finland	40-44	206	45	30.783	27	18.280
	45-49	235	64	39.179	41	22.934
	50-54	197	70	39.290	47	25.618
	55-59	170	65	36.332	43	23.496
	40-59	808	244	145.584	158	90.328
	"		(87.09)		(60.32)	
West Finland	40-44	168	14	25.104	7	14.908
	45-49	224	13	37.345	8	21.860
	50-54	245	36	48.863	25	31.860
	55-59	222	30	47.446	16	30.683
	40-59	859	93	158.758	56	99.311
	"		(114.28)		(22.54)	
Crevalcore	40-44	164	27	24.507	14	14.553
	45-49	302	62	50.349	31	29.472
	50-54	290	75	57.838	45	37.712
	55-59	228	65	48.728	39	31.512
	40-59	984	229	181.422	129	113.249
	"		(16.36)		(N.S.)	
Montegiorgio	40-44	123	7	18.380	3	10.915
	45-49	247	22	41.180	7	24.105
	50-54	217	32	43.278	18	28.219
	55-59	131	20	27.997	11	18.106
	40-59	718	81	130.835	39	80.345
	"		(24.23)		(24.88)	
Zutphen	40-44	180	53	26.897	35	15.973
	45-49	237	69	39.513	42	23.129
	50-54	233	72	46.470	54	30.299
	55-59	225	71	48.087	51	31.097
	40-59	875	265	160.967	182	100.498
	"		(88.22)		(79.74)	
Ushibuka	40-44	115	8	17.184	4	10.205
	45-49	128	17	21.340	11	12.492
	50-54	139	18	27.722	12	18.076
	55-59	118	15	25.219	9	16.309
	40-59	500	58	91.465	36	57.082
	"		(15.19)		(8.75)	

SAMPLE	AGE	N	95 or more		100 or more	
			OBS.	E	OBS.	E
Crete	40-44	158	22	23.610	9	14.021
	45-49	201	27	33.511	10	19.616
	50-54	173	19	34.503	11	22.497
	55-59	146	14	31.203	8	20.179
	40-59	678	82	122.827	38	76.313
	"		(17.16)		(22.39)	
Corfu	40-44	120	10	17.932	7	10.649
	45-49	114	17	19.006	10	11.125
	50-54	169	22	33.705	13	21.977
	55-59	126	14	26.929	8	17.414
	40-59	529	63	97.572	38	61.165
	"		(15.28)		(10.40)	
Rome Railway Men	40-44	197	50	29.438	31	17.482
	45-49	215	70	35.845	47	20.982
	50-54	232	61	46.270	43	30.169
	55-59	124	44	26.501	31	17.138
	40-59	768	225	138.054	152	85.771
	"		(70.56)		(60.60)	
Velika Krsna	40-44	136	12	20.322	5	12.069
	45-49	82	8	13.671	3	8.002
	50-54	135	16	26.924	7	17.555
	55-59	158	21	33.768	12	21.837
	40-59	511	57	94.685	27	59.463
	"		(18.75)		(20.34)	

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