Characteristics of Individuals with Multiple Behavioral Risk Factors for Coronary Heart Disease: The Netherlands

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Abstract: To test the hypothesis that risk factors are interrelated, the simultaneous occurrence of smoking, inadequate nutrition, obesity, and physical inactivity was studied in a random sample (n = 1,951) of the Dutch adult population. Although the results did not suggest systematic clustering, the assumption of independence of these risk factors could not be maintained. Sociodemographic and health-related characteristics of the group with three or four risk factors were assessed (n = 246). Comparison with a prudent life-style group (zero risk factors, n = 387) by means of discriminant analysis indicated that the target group included proportionally more men (odds ratio: OR = 3.3), of all ages, with low education and occupation (OR = 3.5 and 1.7). The two groups did not differ in awareness of cardiovascular risk factors, preventive orientation regarding cardiovascular risk, or disease in general, and the effectiveness of health education in modifying life-style. The target group exhibited a distorted perception of the healthfulness of its own life-style and unfavorable attitudes toward modifying existing smoking, eating habits, and physical activity. (*Am J Public Health* 1982; 72:986–991.)

Introduction

Aspects of daily life-style, individually and in combination, have a significant impact on a person's overall health status.[1,2] In cardiovascular epidemiology, population studies have almost invariably incriminated certain components of life-style (cigarette smoking, a diet excessive in calories, saturated fat, cholesterol and salt, a marked imbalance between energy intake and output with consequent obesity, and a consistently sedentary habit) as major risk factors predisposing an individual to the development of coronary heart disease (CHD).[3] The accumulation of a number of risk habits may have a multiplicative effect;[4] thus we should strive to identify and influence those who exhibit such a life-style. In multifactorial preventive trials, health education, directed toward high-risk individuals, seems to be feasible and effective.[5–8]

We designed a nationwide survey in the Netherlands on CHD risk factors—smoking, dietary intake, obesity and physical activity—to tackle a major difficulty in public health education: "reaching the audience in which change seems to be most needed." Thus the objectives of this paper were:

- To investigate whether there is an underlying risk-taking way of life, reflected in the simultaneous occurrence of risk factors;
- To characterize that segment in the Dutch adult population (target group segmentation) in which a set of risk factors was aggregated, and to identify guidelines for health education directed toward this target group.

Materials and Methods

In the Netherlands in 1978, a multi-stage stratified random sample of 2,562 men and women, aged 18 to 64 years, representative of the Dutch adult population was drawn in three stages: 1) selection of communities within each province representing strata of urbanization levels; 2) selection of addresses within each community representing the various neighbourhoods; 3) selection of a member of the household who satisfied the study criteria of being aged 18 to 64 years. The response rate was 77 per cent; there was a 14 per cent refusal, and 9 per cent could not be reached. All subjects participating in the survey were personally interviewed in their homes according to a partially structured questionnaire, by a team of 174 professional interviewers. Of the 1,973 subjects in the survey, complete information on relevant variables was available for 889 men and 1,062 women.

In addition to information on risk factors, data were collected on the respondent's perception of his/her life-style

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and common habits, belief in the possibility of risk reduction and disease prevention, preferences concerning content and methods of health education, and demographic and socioeconomic characteristics of the subjects.

In the data analysis we defined "high risk" categories as follows:

- For *smoking:* current smokers;
- For *nutrition:* dietary habits were qualitatively measured by a diet history recall,[9,10] and incorporated into a score;*
- For *obesity:* body mass indices (BMI) of ≥ 26 for women and ≥ 27 for men were chosen as cut-off points;**
- For *physical activity:* we ascertained the number of minutes per week engaging in sports, walking, or cycling in leisure time. High risk was defined as: not regularly practicing any activity, or practicing one regularly but 90 min/week or less for walking, 75 min/week or less for cycling, or 60 min/week or less for sports.

Sociodemographic information collected is shown in Table 1. The perception of the healthfulness of own life-style and habits was assessed with questions such as: "Do you think your life-style (smoking behavior, nutrition, body weight, physical activity) is conducive to health?" Awareness of cardiovascular risk was studied by having the subjects identify three risk factors from a list of ten items, some of which are generally considered to be associated with CHD, i.e., hypertension, smoking, diet rich in fat, hypercholesterolemia, physical inactivity, and stress. A health-oriented attitude (Table 1) was defined as answering all items in a scale correctly.***

Preventive orientation was defined as agreement with the following:

- Maintaining good health: i.e., one is accountable for one's own health;
- Preventability of CHD risk: i.e., CHD risk can be reduced by influencing the risk indicators;
- Prevention of diseases: i.e., at least five diseases from the following list were identified as more or less preventable: lung cancer, stomach-ulcer, stroke, atherosclerosis, heart attacks, hypertension, and obesity;
- Health education is an effective tool in promoting a prudent life-style.

Simultaneous occurrence of risk habits was studied by comparing observed and expected rates for zero, one, two, three and four risk factors. The expected rates were calculated on the assumption of independence. The significance of independent occurrence was assessed by Chi-square.[12]

Target group segmentation of life-style was performed by using Fisher's linear discriminant function[12] to examine which of a series of demographic and socioeconomic characteristics discriminate between two groups. The function describes the target group with three or more risk factors in comparison to the prudent life-style group (zero risk factors) in an additive linear model of the various determinants: $y = \beta_0 + \beta_1 \times_1 + \beta_2 \times_2 + \ldots + \beta_n \times_n$. For the analysis, the determinants $\times_1, \times_2, \ldots, \times_n$ were arranged in categories. The coefficient β indicates whether a variable distinguishes between the two groups. In this way the independent contribution of a determinant can be estimated and effects of interrelations between determinants, which cannot be detected in 2 × 2 contingency tables, will be eliminated. In this form the technique yields results similar to those of a binary regression analysis.

By taking the antilogarithm of a coefficient, one can also get a more quantitative idea of the importance of a determinant. The antilogarithm of β, exp β, is an estimate of the odds ratio (OR).[13] This measure is the ratio of the relative occurrence (odds) of that determinant in the two groups.

Results

The occurrence of the risk factors individually and in combination is shown in Table 2. One-fifth had no risk habits, two-thirds had one or two, one in ten had three, and all four risk habits were aggregated in one in 100. In the Netherlands, the self-reported prevalence of smoking was 46 per cent and of obesity 18 per cent; 44 per cent of the Dutch adult population was physically inactive. By definition, 30 per cent of the population was assigned a dietary risk.

The assumption of independent occurrence of risk habits was not supported by the Chi-square test ($\chi^2 = 15.23$, df = 4, $p < 0.05$). The overall picture of observed/expected rates (O/E) for the five categories of risk habits, however, did not suggest a strong interrelatedness of the risk factors. For example, the highest ratio of 1.3 indicated a 30 per cent increase in subjects with four risk factors over that which would be expected if no association existed. Stratification for gender had no influence on this finding.

Almost equal proportions with one or two risk factors were found in the two sexes. Significant sex differences were observed for the presence of zero risk habits (men 14 per cent, women 24 per cent), three risk habits (men 15 per cent, women 8 per cent), and four risk habits (men 3 per cent, women 1 per cent). These differences of risk habits in men and women were uniform over all age categories.

Univariate distributions of sociodemographic variables and health-oriented aspects for categories of life-style (Table 1) demonstrated notable differences in sex, marital status, education, and occupation. As to perception of life-style, the proportion of subjects who believed that their own life-style was healthful showed a decreasing trend, but was still substantial (55 per cent) in the high risk category. The same

*The lower 30 per cent of the score distribution constituted the high risk group and had the following estimated nutrient composition: fat (≥ 40 energy%), polyunsaturated fat (< 8 energy%), carbohydrates (≤ 47 energy%), cholesterol (≥ 350 mg/day), dietary fiber (≤ 8 g. per 4.2 kJ), and alcohol (≥ 7 energy%).

**BMI was computed from stated height and weight i.e., the ratio of weight (in kg) and the square of the height (in m).

***Attitude items (available on request to author) were tested in a pilot study with 150 individuals. The answers ranging from "strongly agree" to "strongly disagree" were scored in a five-points Likert-type scale. To test unidimensionality, correlation coefficients between the individual items and the total score were computed. Deletion of attitude items with a correlation coefficient of $r < 0.40$, led to a reduction to 11 items for the smoking and health education scales, seven items for nutrition, and six for physical activity. The reliability of the scales, expressed as Cronbach's alpha,[11] was 0.86, 0.89, 0.73, and 0.76 respectively.

TABLE 1—Comparison of Categories of Life-Style by Univariate Analysis

Life-Style Category Number of Risk Habits	I 0 (n = 387)	II 1,2 (n = 1, 318)	III 3,4 (n = 246)
Age (yr) Median	41	39	39
Men	33%	46%	62%
Unmarried	15	14	13*
Divorced/Widowed	10	9	5
Large Family Size[a]	17	20	23*
Rural Urbanization	41	41	48*
Low Education[b]	46	54	72
Low Occupation[c]	19	26	42
Low Familial Social Class[d]	55	58	66
Perceived as Healthful			
Own Life-Style	79%	67%	55%
Smoking	3	6	9
Own Nutrition	88	82	76
Own Body Weight	71	58	49
Own Physical Activity	79	70	66
Awareness of Cardiovascular Risk	62%	62%	61%*
Health-Oriented Attitude Toward			
Smoking	43%	21%	4%
Nutrition	29	18	10
Physical Activity	54	37	22
Health Education	42	27	18
Preventive Orientation Regarding			
Maintaining Good Health	35%	29%	18%
Cardiovascular Risk	68	63	60
Diseases in General	66	61	47
Health Education	62	60	56*

*(Life-style categories I and III not significantly different $\chi^2_{(1)} < 3.84$).
[a]Five or more members.
[b]Primary school and low vocational training.
[c]Blue and lower white collar workers.
[d]According to the standards of the Netherlands Central Bureau of Statistics.

TABLE 2—Occurrence of Risk Factors, Individually and in Combination, in the Study Population

Smoking	Inadequate Nutrition	Obesity	Physical Inactivity	Observed Rate (%)	Expected Rate (%)*	O/E**
				19.8	17.4	1.1
+				13.4	14.8	
	+			6.5	7.4	
		+		4.6	4.0	
			+	12.5	13.6	0.9
+	+			7.9	6.3	
+		+		2.2	3.2	
+			+	10.9	11.6	
	+	+		1.2	1.6	
	+		+	4.4	5.8	
		+	+	4.1	3.0	1.0
+	+	+		0.6	1.4	
+	+		+	6.7	5.0	
+		+	+	2.9	2.6	
	+	+	+	1.1	1.3	1.1
+	+	+	+	1.4	1.1	1.3
n = 897 (46%)	n = 578 (30%)	n = 351 (18%)	n = 856 (44%)	100.2 (n = 1, 951)	100.1 (n = 1, 951)	

Chi-square test for independence = 15.23 df: 4 ($p < 0.05$)

+Risk habit present.
*Expected rates calculated on the assumption of independence of the individual risk habits.
**Observed/expected rates for categories of risk habits.

TABLE 3—Sociodemographic and Life-Style Characteristics of the "Target" Group (three or four behavioral risk habits) Contrasted to Zero Risk Factor Group by Linear Discriminant Analysis

Determinant	Categories versus (Reference)	Discriminant Coefficient β	Odds Ratio exp β
Sex	Men	1.1890*	3.3
	(Women)		
Age	18–24 years	0.6089	1.8
	25–34	0.2781	1.3
	35–44	0.2599	1.3
	45–54	0.1143	1.1
	(55–64)		
Civil Status	Unmarried	−0.1859	0.8
	Divorced/Widowed	−0.3325	0.7
	(Married)		
Family Size	5 or More Members	0.3341	1.4
	(1–4 Members)		
Urbanization	Rural	0.2320	1.3
	(Urban)		
Education	Primary School/Low Vocational Training	1.2440*	3.5
	(Higher Education)		
Occupation	Blue and Lower White Collar Workers	0.5165*	1.7
	(All Others)		
Familial Social Class	Lower Class	0.0855	1.1
	(All Others)		

*significant at 0.05 level

trend can be observed for the separate risk factors. Also varying over the categories were attitude toward risk factors, and preventive orientation, i.e., faith in the preventability of diseases in general and in being accountable for one's own health. No essential differences were observed in the belief of the preventability of cardiovascular risk, nor in the awareness of cardiovascular risk factors. The order in which important cardiovascular risk factors were reported was stress (70 per cent), diet excessive in fat (46 per cent), and hypertension (40 per cent). Smoking and physical inactivity shared the fourth place with 35 per cent, and hyperlipidemia (31 per cent) was the least mentioned. Health education is regarded as a favorable and effective "tool" for life-style modification by approximately 60 per cent in all categories.

The results of the target group segmentation on the life-style characteristics are given in Table 3. By means of the discriminant function coefficients, odds ratios (OR) were derived. Determinants with an OR value between 0 and 1 are relatively more frequent in the reference group (zero risk factors).

Independent demographic and socioeconomic determinants of a "risky" life-style were sex (men), education (low) and occupation (low); marital status and familial social class no longer discriminated between the two categories of life-style. The odds for men (OR = 3.3) indicated that in the category in which three or four risk habits were aggregated there were proportionally about three-and-a-half times more men than women.

To find out which knowledge and attitude variables in Table 1 were most relevant for the target group, we included all these health-related determinants in a multivariate model together with the significant discriminating sociodemographic variables (sex, education, occupation). The differences observed in the univariate analysis were confirmed for "perception as healthful" and for "health-oriented attitudes" but not for "preventive orientation." We concluded that a distorted perception of the healthfulness of one's own life-style and unfavorable attitudes toward modifying current smoking, diet, and physical activity will have to be taken into account when designing intervention programs.

The preferences of the target group for communication channels are summed up in Table 4. In an open-ended question, one-fifth showed no preference. Audio-visual media, especially television, were the favorite delivery systems.

Discussion

In contrast to aggregation, which is the mere description of simultaneous occurrence of risk habits,[6] clustering is a phenomenon in which a combination of three or four risk habits occurs more often than one would expect on the basis of probability. Thus a smoker would more likely be physically inactive also or display an inadequate dietary pattern when compared to a nonsmoker. In this study, a clear-cut coronary risk-taking life-style could not be established. To expect systematic clustering for all habits, however, may have been somewhat optimistic; a known inverse relationship exists between obesity and smoking on the one hand, and inadequate nutrition on the other. In the MRFIT base-

TABLE 4—Per Cent Preference for Methods of Health Education of the Target Group

"In what way do you prefer to learn about a healthy way of life?" (open-ended question)	%			%			%
No preference	22						
School education	1						
Other ways	15						
Health education	62	:	Individually by a				
			General practitioner	12			
			Group counseling	5			
			Mass communication	45	:	Audiovisual media	31
						Television	29
						Radio	2
						Printed media	14
						Leaflets	4
						Newspapers	5
						Magazines	5

line survey,[14] smokers consumed more calories, cholesterol, alcohol, and saturated fat and also weighed significantly less than nonsmokers. This was confirmed in our study by O/E rates of 0.7 for obesity and smoking and 0.4 for smoking, obesity, and inadequate nutrition.

Clustering of biological cardiovascular risk factors, cholesterol, triglyceride, blood pressure and obesity has been reported.[15] To our knowledge, clustering has not yet been studied in the domain of behavioral risk factors. Aggregation, however, has been investigated, and it should be easy to look into the matter of clustering on the basis of such data.[1,2,14,16–18]

Some methodological issues in our study could explain the weak interrelationships found, e.g., the reliability of self-reported behaviors, the tendency to repeat only socially desirable behaviors, fear of the outcome variables on the part of respondents; physical activity may have been insufficiently ascertained, and the dietary pattern has been measured only qualitatively.

Another general shortcoming is that the number of risk factors was limited. Not included, but also inherent to a model of cardiovascular preventive health behavior,[19] are high stress occupation, type 'A' behavior, and untreated chronic hypertension.

To support and guide public health education in the Netherlands, we studied the profile of the segment in the population in which three or four of the cardiovascular risk factors—smoking, inadequate nutrition, obesity, and physical inactivity—were accumulated. Segmentation of this target group could improve cost-effectiveness of educational efforts. Segmentation does not necessarily lead to selection—education can be transmitted to the entire population—but it can promote a more target group-directed approach in health education.

In our study, men with a low level of education and occupation constitute the target group in which three or four risk habits were aggregated. These results are similar to those of others. In Dutch intervention trials,[17,18] the prevalence of a combination of risk indicators was highest among men and in the lower social classes. In North Karelia,[6] a high risk factor score calculated from the observed levels of smoking, serum cholesterol, systolic and diastolic blood pressure was ten times more common in men than in women and, among men, the prevalence was higher among those living in rural areas, with lower education level and family income. Positive health behavior,[16] an index based on eight measures of health response such as seat belt use, smoking and exercise, was associated with being female and more highly educated.

For cardiovascular prevention programs aiming to reach this target group, our findings indicate a strategy in which emphasis is placed on attitude and perception change rather than on knowledge, even though (as in a report from a major US city[20]) probable causes of heart attacks are not fully recognized in the Dutch population. In this respect, there is no difference between the target group and the prudent life-style group.

The perceived seriousness of the influence of one's own life-style on health is an important factor in influencing behavior[21] and can stimulate a more preventive health orientation.

The choice of communication methods, important for the effectiveness of health education, should first of all be based on objective measures. Expensively trained and specialized professionals are probably not the most efficient delivery systems for health education and training. Lay personnel may be highly effective in community settings.[22] A cost-effective total campaign for delivering health education and training may also include mass media as important components. The Stanford[5] and WHO collaborative[7] trial demonstrated in a quasi-experimental design the effectiveness of a combination of personal and mass instruction techniques in reducing risk factors in high risk individuals. For public health education we favor this latter strategy, which corresponds with the preference of our target group (Table 4).

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