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The good life: living for health and a life without risks? On a prominent script of nutrigenomics

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Like all scientific innovations, nutrigenomics develops through a constant interplay with society. Normative assumptions, embedded in the way researchers formulate strands of nutrigenomics research, affect this interplay. These assumptions may influence norms and values on food and health in our society. To discuss the possible pros and cons of a society with nutrigenomics, we need to reflect ethically on assumptions rooted in nutrigenomics research. To begin with, we analysed a set of scientific journal articles and explicated three normative assumptions embedded in the present nutrigenomics research. First, values regarding food are exclusively explained in terms of disease prevention. Health is therefore a state preceding a sum of possible diseases. Second, it is assumed that health should be explained as an interaction between food and genes. Health is minimised to quantifiable health risks and disease prevention through food–gene interactions. The third assumption is that disease prevention by minimisation of risks is in the hands of the individual and that personal risks, revealed either through tests or belonging to a risk group, will play a large role in disease prevention. Together, these assumptions suggest that the good life (a life worth living, with the means to flourish and thrive) is equated with a healthy life. Our thesis is that these three normative assumptions of nutrigenomics may strengthen the concerns related to healthism, health anxiety, time frames and individual responsibilities for health. We reflect on these ethical issues by confronting them in a thought experiment with alternative, philosophical, views of the good life.

Nutrigenomics: Script: Normative assumptions: Ethics: Good life: Health

Genomics has brought a new field of nutrition research namely nutrigenomics. Nutrigenomics studies how food and nutrients influence gene expression, protein expression and metabolic production, and thereby tries to understand how nutrition influences human physiology. Moreover, nutrigenomics aims to reveal how differences between the genotypes of individuals can cause variances in the metabolism that ultimately influence the health status of individuals. Nutrigenomics encompasses 'omics' research, such as genomics, transcriptomics, proteomics and metabolomics[1].

Although a great deal of uncertainty still exists in nutrigenomics research[1], and although many scientists doubt whether dietary advice or food products for individual genotypes will ever be possible[2], these new developments in food sciences are believed to have new ethical, legal, regulatory and social implications[3]. Here, we will argue that a set of normative assumptions is embedded in the way prominent research articles (co)design strands of nutrigenomics research, and that these assumptions may influence our everyday orientation towards food and health in various ways[4]. The aim of the present paper is to explicate and reflect upon parts of the normative framework bound up in nutrigenomics research.

According to our view of scientific and technological innovations such as nutrigenomics, these developments are not neutral but contain norms and suggest policies. Moreover, innovations such as nutrigenomics co-evolve with social arrangements[5,6]. This means not only that technologies change society, because they invoke new social actions and behaviour, but also that the society influences scientific and technological developments. Part of this co-evolution of society and science is evoked through the interplay between the representations of the scientists that work on the innovation and the ideas of the future users. On the one hand, innovators embed norms in their innovations on how their designs will be used. On the other hand, users shape the innovations according to their visions and how the design is actually used. New scientific developments such as nutrigenomics, therefore, develop through a constant interplay between the different actors involved. The way nutrigenomics is presented and how this fits with the ideas of the end-users form an important part of the interplay between the different actors. Within this process, norms and values may change, implying new moral dilemmas[7].

We argue that the actors envisioning and designing strands of nutrigenomics research make largely unnoticed assumptions about the role of health, food and genes. Some of these assumptions are about the norms and values of future nutrigenomics users. The interplay between these assumptions about food and health, and existing norms and values, may change consumer perspectives on food, with the potential to

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reinforce existing social norms and values about food and health within a broader social political or marketing context, while other ideas about food and health change or disappear.

In the present paper, we discuss three normative assumptions underpinning strands of nutrigenomics research as we found them in the present representations of nutrigenomics developments by scientific experts, food industrialists and health advisors. For this analysis, we first introduce the notion of script[4]. The idea that strands of research contain normative assumptions is based on this notion; these three assumptions together comprise a prominent script of nutrigenomics today. Finally, we compare these assumptions with the philosophical ideas of what a good, i.e. meaningful and happy, life comprises.

The first assumption found in the present nutrigenomics representations is that the values regarding food are exclusively explained in terms of health. Health itself is narrowed down to disease prevention, but, on the other hand, broadened towards an unremitting responsibility for active prevention. This conceptualisation is explained with the help of two contradictory images of end-users. The second assumption suggests that health can and should be explained in relation to quantifiable risks. This notion holds the promise of control and the minimisation or even banishment of risks. The third assumption is that disease prevention by minimisation of risks is ultimately in the hands of the individual (although perhaps on the basis of group membership), and that this kind of risk information should motivate personal disease prevention. We propose that the three normative assumptions of nutrigenomics may strengthen concerns related to health anxiety, time frames and individual responsibilities for health.

The notion of script

As mentioned previously, the idea that strands of research contain normative assumptions is based on the notion of script[4]. This concept helps to describe and understand the interaction between technology and society during technological development. It considers more than the immediate function of technologies and describes the roles that technology plays in different 'contexts of use' or, in other words, those in physical and social environments. According to this perspective, technologies are part of a complex network of actants, which are both human and non-human factors such as people, tools, products, machines and money, all of which cause or shift actions.

Akrich[4] argues that the creators of new innovations envision or 'inscribe' what a network around a new technology will look like. She calls this vision a 'script' and argues that through this script, technologies contain and produce a specific 'geography of responsibilities' or determinants[4]. This means that, while inventing and creating new innovations, developers decide what kind of actions a technology should prescribe for the actants involved and what kind of responsibilities it should delegate, and to whom or to what it should delegate these responsibilities. The designers also envision assumptions about the specific preferences, competences, motives, norms and values of the end-user. A very simple example is a potato chip designed in such a way that its fat is only partially digested. The assumption here is that consumers buy this type of low-fat potato chip because they consider it to be healthy.

The functioning of an artefact is, however, unpredictable (people may, for example, eat more potato chips). An artefact can embody several scripts, which implies that one particular script need not be a representative for the majority of the designers and a script can be criticised and rejected. This critique and rejection may cause the technology to fail or its end-users to redefine the original dominant script. The negotiations between the designer's visions of the proposed user and technology network, and the actual end-user and network, will in the end produce the final script of the technology, and will result in a network with unforeseen connections and responsibilities[4]. For instance, a functional food product on the market may not be exactly the product that a food producer envisioned, but the product can be seen as a compromise between the capability to measure health, legislation, law enforcement about health claims and safety, consumer values concerning what a product should encompass and consumer - behaviour.

The notion of script can be used to understand and assess the development of not only new products[8] but also innovations such as genomics[9]. Also, within nutrigenomics research, a script including assumptions about how people will use its knowledge or products in the future is embedded in the way the research is framed and its goals and functions for society are formulated. This involves implicit assumptions about morality, technology, the science economy and its end-users. Here, we will focus on issues of morality embedded within nutrigenomics, especially in relation to the role of food and health in our society.

Although the way the nutrigenomics script gets shaped in the end is not predictable – since users, and economical, moral and technological developments outside nutrigenomics can play a role – analysing the already existing script gives us insight into how the script may influence norms and values in our society and vice versa. This can be done by studying how normative assumptions embedded within representations of nutrigenomics diverge from or correspond to norms and values of the possible end-users and network, how norms and values may have to change to merge or resist the script or how these normative assumptions strengthen the already existing norms and values within society. Here, we will take the first step in an ethical assessment of nutrigenomics by making some of the normative assumptions of the present script of nutrigenomics transparent and available for moral deliberation.

We will explicate three main normative assumptions within an existing nutrigenomics script as it is envisioned by prominent representatives of nutrigenomics. The script that we have analysed encompasses the same assumptions about life, health and disease, but some exhibit a different emphasis on what an individual should do to live a healthy life. Nutrigenomics is still in its early development and its network is not yet fully shaped. At present, there are different and sometimes contradicting visions about the role of the consumer in the network around nutrigenomics, and where relevant, we will devote attention to these differences[9].

Method

We conducted a literature survey in order to find out more about the script of nutrigenomics research. In this survey,

we were primarily interested in the choices made within research by framing research goals and defining nutrigenomics. Additionally, we looked at the meaning of nutrigenomics for society and consumers. Note that our goal is not to analyse the motives of researchers but to unravel the underlying normative assumptions in the choices that are made within nutrigenomics research. To this end, we searched Google Scholar, Scopus and Web of Sciences for articles containing the words nutrigenomics, nutrigenetics or nutritional genomics written between 2000 and 2007. We selected articles about nutrigenomics research that were cited more than fifteen times. Apart from the script within nutrigenomics research, we were also interested in the scripts of intermediaries, such as the food industry, dieticians and research programmes to find out more about the role of the consumer and society within nutrigenomics. Our corpus included *Annals of Nutrition and Metabolism*, *Journal of the American Dietetic Association*, *Annals of the New York Academy of Sciences*, *British Journal of Nutrition*, *Current Opinion in Lipidology*, *The American Journal of Clinical Nutrition*, *Comprehensive Reviews in Food Science and Food Safety*, *Nutrition Bulletin*, *Nature Reviews Genetics*, *Journal of the American Dietetic Association* and *The FASEB Journal*. The selected accounts on the relationship between science and society were not restricted to a particular part of the articles, although most of them could be found in the Introduction and Discussion sections. We were particularly interested in how experts framed their research in relation to societal issues in the broader sense. This resulted in the use of papers about strategies to improve nutrigenomics sciences, food science research programmes that use nutrigenomics techniques, descriptions of the goals and applications of nutrigenomics, the use of nutrigenomics for dieticians and the food industry, and how consumers benefit from nutrigenomics. The selected papers were written by ten nutrigenomics scientists (Ordovas, Mooser, Müller, Kersten, Afman, Milner, Dwyer, Wahli, Saguy and Saris), four representatives of the food industry (German, Watzke, Mutch and Moskowitz) and two nutritionists (Trujillo and Davis).

We tried to find patterns in the assumptions made within definitions and aims within nutrigenomics research and will present excerpts of the articles that reflected these patterns. Definitions, aims and descriptions of processes and phenomena all contain choices about what should be studied within nutrigenomics research. These choices also imply the choices about the way nutrition should be viewed by the consumer. Second, we tried to find patterns in the descriptions of the society and the consumer. Our search resulted in descriptions of health, disease, society and the consumer. Most of the fragments we used could be found in the Introduction and Discussion of the articles. Our analysis provides a grounded indication of the present, largely unnoticed and taken-for-granted assumptions that deserve further attention, both in research and societal debate.

Three normative assumptions of nutrigenomics

The strands of research of nutrigenomics

Before starting the analysis, we first outline the four research strands that we distinguish within nutrigenomics research. All strands of research focus on the relationship between the food patterns, the genome and the health risks (susceptibilities), but they aim to give different applications.

Three of the strands attempt to offer information that can help to find susceptibilities for lifestyle-related diseases of individuals and groups. The first strand tries to gain risk information by DNA tests[10]. The second concentrates on the relationship between ethnicity, genome and susceptibilities[11]. The third strand of nutrigenomics research aims at developing new diagnostic tools to detect changes in homeostasis in an early and still reversible stage with the help of genomics, metabolomics and proteomics tools[12]. The information about susceptibilities found within these strands of research can be used to adjust diet and to make lifestyle changes.

The fourth and final research strand studies the influence of nutrients on genome level and tries to create foods especially tailored to individuals or groups with certain needs or lifestyles, and functional foods that improve health or other characteristics or capabilities such as the ability to focus[13].

The healthy life is a life without disease

The first assumption that the nutrigenomics articles draw upon equates the healthy life with a life without disease. This is assumed in the way that health and disease are described, and the crucial role that eating has in generating a healthy state. Fig. 1 and Quote 1 show a similar construction of health and disease within the script of nutrigenomics. Essentially, health and disease represent two extremes of a continuum. Unhealthy foods cause metabolic stress and disturb the homeostasis or balance in the body, pushing health into a grey zone that can be seen as a pre-disease state where a person is at risk of becoming ill. Over time, the balance becomes more and more upset until the damage is irreversible and a pathological state can no longer be prevented by healthily eating, but can only be treated pharmaceutically. This representation of the relationship between health and disease reduces health to 'the absence of disease', in which unhealthy eating is an important determinant of a shift from the health to disease pole.

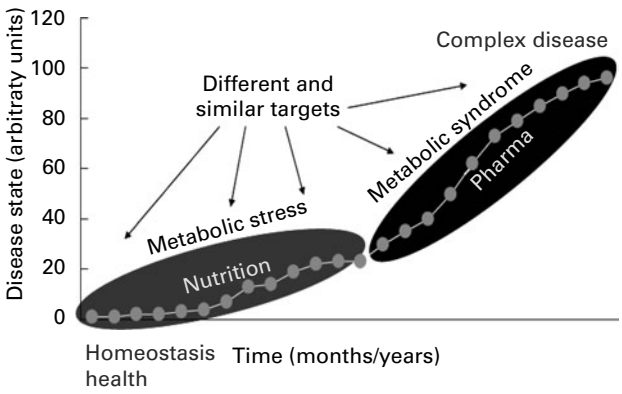

Fig. 1. Explanation of how multifactorial polygenic diseases such as the metabolic syndrome may develop and how in the earliest phases nutrition is crucial in preventing disease pathology[21].

Quote 1.
The shifting balance between health and disease *states involves the complex interplay of genes and the environment, which includes diet*[12].

A life without disease for as long as possible is presented as the ultimate objective in the ageing American society by this article for dieticians. Quote 2 claims that the healthy life is the right path, something that 'we' naturally strive for, which will allow us to 'die young as old as possible', meaning with as few diseases as possible. By framing it as the right path, striving for healthy, disease-free living is constructed as a moral obligation.

Quote 2.
The social implications of more people living longer revolve around quality of life, health status, and resource requirements of an increasingly aged population. With a focus on and adequate resources available to implement prevention-oriented, life cycle approaches that successfully reduce risk, delay chronic disease onset, and mitigate nutrition-related morbidity in disease, it should be possible to achieve the desired outcomes. To bring this about, we must think about nutrition and other preventive measures early and often. The ultimate objective is to achieve more years of life with minimal years of compromised health. We do this by starting on the right path, staying on the right path, and dying young as old as possible. *This is the* best way to live *to 100*[14].

Within this framework, two opposite images of the consumer were constructed. In Quote 3, the food industry representatives claim that people should gain knowledge about what is healthy and unhealthy. Here, the consumer is a knowledgeable and disciplined individual who has the power and the responsibility to follow the right (healthy) path.

Quote 3.
Consumers must recognize that they will become more empowered to improve their existing health and their prospects for future health but will also need to take responsibility for pursuing self-knowledgement[13].

Taken from an article outlining a European research project that studies the link between genes, obesity and lifestyle, Quotes 4 and 5 suggest that people are not able to resist all the pleasurable unhealthy foodstuffs around them and should therefore be helped by changing their food environment. To benefit the consumer, science and industry need to develop products that are tasty but not fattening. These products may be adapted to personal differences in taste perception by increasing a feeling of satiation and by adding chemicals that resemble creamy or fatty taste sensations[15], for example.

Quote 4.
Whilst there is considerable genetic variance in individual susceptibility to obesity, the current obesity epidemic is significantly influenced by adverse lifestyle factors. Given our general genetic background, it appears very difficult for humans to self-regulate food intake under current environmental circumstances. This worrying trend has challenged the scientific community to expand its research efforts using a wide variety of innovative approaches[15].

Quote 5.
*It is possible that differences between consumers in taste perception (*i.e. *sensitivity profiles to specific tastants) may influence development of satiation and food intake behaviour… Findings about triggers for satiation will then facilitate the tailored development, and prototype production, of new food products*[15].

Some reflections on the healthy life as a life without disease. The underlying script of these representations of health and the role of the consumer therein share problematic characteristics. Defining health as the absence of a disease makes striving for health problematic. In view of the number of diet-related diseases, the pre-disease state is therefore a state in which not one disease but a sum of diseases is contained and prevented. An individual's health can always be threatened by a disease that the individual has not been previously exposed to, and new diseases are constantly emerging, so as one disease is delayed or prevented, the next may be already on the way. Consequently, maintaining a healthy state becomes an ongoing responsibility.

Although food naturally plays an important role within nutrigenomics, framing it in relation to maintaining a healthy state brings about a second problem. By focusing on prevention of disease through food, health becomes, to a large extent, a main concern of everyday life. Food plays such a tremendous role in our lives[16,17] (a person needs to eat several times a day) that eating logically demands constant attention. Therefore, attaining a state of health through foods requires constant attentiveness expressed in exhibiting the right dietary behaviour. When one considers that controlling disease and health pharmaceutically is generally restricted to a specific point during the day, we can conclude that diet has an even greater impact on a healthy state than medicine. Healthy living in the sense of staying disease free through foods thus forms a distinct element of everyday life.

We have seen that there are two different constructions of to whom and how the responsibilities for this representation of a healthy life can be attributed. In both cases, the suggestion is that a healthy state is strived for in order to suit the consumer's needs, but one representation assigns responsibility to the consumer, thereby making health a substantial duty in life, while the other attributes responsibility more to the collective, the industry and science. Both push healthily living into this everyday existence, although they do this in two different ways.

German & Watzke[13] envision a consumer who should become 'empowered' to lead a healthy life through nutrigenomics. Consequently, their representation implies that the consumer is responsible for a healthy life. Taking the earlier observations about food into consideration, German & Watzke's vision of the consumer automatically intimates that health will form a large part of life with less time for other aspects. The healthy life can therefore only be achieved when the individual organises his/her day around healthy food and lifestyle.

Saris[15] envisions a consumer who is simply incapable of dealing with all the temptations around him, and therefore his/her food environment needs to be changed. This representation suggests that the time and effort needed to achieve the healthy disease-free life comes from producers, food innovators and scientists. The burden of responsibility is

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taken away from the consumer by simply making products healthy and by copying the taste of the unhealthy tempting products. Although in this model, attaining health seems less time consuming for the individual and some responsibility is taken away, this vision of the consumer also has significant implications for everyday existence. Making drastic changes in the food environment changes the meaning of the food. Food has many more meanings than simply its significance in terms of health. It is connected to rituals, symbols and belief systems. Food binds people to their faith and to others[18,19]. Food is also part of an individual's identity. It shapes group membership or sets groups apart in terms of ethnicity, race, nationality, class, individuality and sex. If food is produced only with a view to health or, more specifically, with a view to disease prevention, these other meanings may be lost[18,20]. Furthermore, changing the food environment raises issues of free choice, especially since food is traditionally a part of our identity and culture.

Health is quantified risk minimisation

Another assumption in the script is that instead of searching for cures for diseases, they can be prevented with the help of nutrition before any detrimental effects can be identified. Risks can be reduced or eliminated by changes in the diet. To achieve this, methods need to be developed or improved to measure the health state of the body and to calculate health risks.

Quote 6 asserts that nutrition should primarily focus on health and disease prevention, and consequently genomics-based biomarkers are needed to detect the pre-disease state. The goal is to measure the 'grey', or pre-disease, zone. The ultimate aim is to estimate disease risk. Health is therefore constructed as a state that can be measured and subsequently dealt with in the form of adequate risk management through food.

Quote 6.
[lines omitted] ... nutrition should focus primarily on health and disease prevention *and be complementary to pharmacological therapy, which targets the pathophysiological aspects of disease. To realize this goal, new genomics-based phenotypical biomarkers are needed that allow early detection of the onset of disease, or ideally, the predisease state of the metabolic syndrome, a condition referred to as metabolic stress [lines omitted]... Ultimately, the aim is to extrapolate findings from studies with mice and cells to human beings, where the impact of the genotype must be taken into account in order to* estimate the disease risk related to dietary stress*, overweight, and obesity. We will discuss strategies that use nutrigenomics to answer nutrition problems*[21].

Quote 7 presents a similar idea. While still presented in terms of ambitions, accurate predictions of health effects are framed as a precondition for staying or becoming healthy. Both the quantification of the disease risk and the promised accuracy of the predicted health effects suggest a sense of control over the individual's health once these data are within reach.

Quote 7.
An ambitious challenge for the next decade is to translate this type of nutrigenomics data into an accurate prediction of the beneficial or adversary health effects *of dietary components. The main goal is* prevention *of diet-related diseases*[22].

Quote 8, excerpted from a scientific paper sponsored in part by the food industry, refers to the fact that risks can be altered and managed by diets and dietary components. Optimising health by gaining risk information is primarily a technological problem that needs to be resolved. The whole process of processing data and translating this information into dietary advice is displayed as a very 'attractive aspiration'.

Quote 8.
It is enticing indeed to imagine that a drop of blood could be rapidly analyzed for its comprehensive metabolite profile*, uploaded into software capable of comparing this profile with those present in a massive database, and return information enabling a physician to make dietary recommendations to optimize health; however, several important points must be resolved if we are to achieve such an attractive aspiration*[19].

While epidemiological studies had already introduced the notion of risk prevention by food before nutrigenomics, nutrigenomics goes a step further and presupposes that these risks can be accurately measured in relation to certain foodstuffs and genetic profiles. The script thus presents health as a technological problem waiting to be resolved.

Some reflections on health as quantified risk minimisation. First of all, the assumption that 'health' can be split up and translated into predictable and alterable risks seems a utopian idea. Nutrigenomics itself has already revealed contradictory messages about food. One foodstuff can be healthy for the heart but detrimental to other organs. For example, β-sitosterol, which is found in soya and coconut oils, competes for cholesterol uptake in the intestine, but it is also converted by gut microflora to androstenedione, a precursor to oestrogen. Because it decreases cholesterol uptake, β-sitosterol might benefit in heart health. However, it is also proposed that the level of oestrogen resulting from β-sitosterol's conversion is a risk factor for breast cancer[23]. It can be expected that more foodstuffs with contradictory health messages will be discovered in the future. As such, a perfectly healthy life and diet becomes utterly complex and essentially unachievable; while a person anticipates on one risk, and this particular risk may be delayed, it may be substituted by another weak point in the body – a new risk on which one needs to anticipate. Needless to say, this delay–new risk scenario may become a vicious circle.

Second, controlling homeostasis in the body, calculating risks and performing risk prevention on this calculated basis is a very narrow definition of health. If this narrow 'risk' definition of health in the nutrigenomics script is compared with the notion of health that is promoted by one of the most important drivers of health promotion nowadays, the WHO, the script only partially corresponds with this notion. The WHO redefined health as:

Quote 9.
... not merely the absence of disease but the total physical, psychological and emotional wellbeing of individuals... (World Health Constitution, 1946).

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Recently, the WHO added a wellness dimension to health promotion[24], which is the optimal state of health of individuals and groups. The optimal state of health has two focal concerns: the realisation of the fullest potential of an individual – physically, psychologically, socially, spiritually and economically – and the fulfilment of an individual's expected role in the family, community, place of worship, workplace and other settings[25]. The meaning of health compared with the notion of health of the WHO is rather limited.

Nutrigenomics may decrease a feeling of well-being because of its focus on risk prevention and its emphasis on increasing risk by eating the wrong foods. This focus on risks may strengthen anxiety early in life about the link between the risk of disease and food. Risk information about food, in particular, may increase anxiety because of the contradiction of the necessity of food and the risks that it imposes[17]. Moreover, because of the pleasurable nature of food, this risk information may increase feelings of guilt if an individual fails to meet the 'health standards'[26]. Since nutrigenomics will not only reveal more health risks but also suggest that health risks associated with certain diets can be accurately measured, and for that matter, controlled, it may make health standards even more problematic than former health messages in relation to food.

A final concern is the formation of new time regimes. According to Harbers[27], the focus on future risks may absorb the pleasures and concerns of the present. Taking seriously the present script of genomics implies that time is no longer cyclic or linear. The distinctions between the future, past and present are blurred. Where an attitude of 'time will tell us' and 'let fate take its course' was normal about future health and disease, nutrigenomics makes it possible and desirable to deal with possible future problems at this very moment. Harbers argues that the separation between the past, present and future has an important function in making it possible to deal with everyday life. Nutrigenomics is a possible spoilsport in this respect[27].

Health is personal risk minimisation

Food scientists have traditionally used averages to calculate what is healthy and what is needed to stay healthy. By contrast, the nutrigenomics script assumes that the dietary needs to sustain this healthy stage differ between populations, (ethnic) groups and individuals. Nutrigenomics thereby focuses on the differences in diet-related health risks between different (ethnic) groups or populations and individuals based not only on genetic research and testing but also on diagnostic tools from proteomics and metabolomics. Nutrigenomics thus assumes that health needs to be seen in terms of ersonal risk minimisation either by knowledge about groups or by diagnostic and genetic tools.

The following two fragments illustrate the idea that the consumer will become healthier through health advice and special functional products based on certain genetic susceptibilities. Quote 10 from the nutrigenomics scientists, Ordovas & Corella[28], focuses on ethnic groups and on improving their health by gaining knowledge about genetic markers within these groups. Quote 11, from nutrigenomics scientists, Afman & Müller[16], shows another variant of the script. The quote shows that nutrigenomics aims to improve health with the help of special food products for groups and populations that can be identified by genetics tests.

> *Quote 10.*
> *The current hypothesis is that the dramatic increase in morbidity and mortality due to CVD and other age related diseases that the world population has been experiencing during recent years is due in part to the higher frequency of deleterious alleles that predispose certain ethnic groups to be especially sensitive to the influence of environmental CVD risk factors, such as diet and a sedentary lifestyle. Therefore, elucidating such ethnic-specific genetic markers will be important for efficacious prevention of chronic disorders in countries undergoing Westernization of lifestyles*[28].

> *Quote 11.*
> *Can food products be tailored to promote the health and well-being of groups in the population identified on the basis of their individual genomes? The potential is there and exciting new developments are unfolding*[21].

In addition to the assumption that health can be best sustained by measuring personal risks either through genetic testing or through risk group membership, it is assumed that the end-user *wants to know* his/her personal risks. The idea is that when people know about their personal risks, they are more inclined and empowered to change their lifestyles. Interestingly, this is not in line with the fact that some nutrigenomics scientists believe it impossible for individuals to adopt a healthy lifestyle in a society full of temptations (see our earlier observation). Quote 12, from Moskowitz *et al.* [29], illustrates the direct link that is made between (quantified) knowledge about a personal risk and the drive to act upon it.

> *Quote 12*
> *Each individual,* of course*, is* interested in his/her own *cholesterol level, and* far less interested in the population mean. *To make this knowledge actionable, each person must know how his/her own cholesterol relates to his/her particular health and risk of disease. Once known, the* individual *consumer can then take* a variety of actions *to change his/her own* personal metabolic status *in terms of cholesterol quantitatively assessed*[29].

Some reflections on health as personal risk minimisation

In practice, it is questionable if personal risk information, either directly acquired or inferred from group membership, will indeed trigger changes towards a healthier diet, even if people are open to this kind of information. Food studies show that people experience a dissonance between informing themselves about healthy food and enjoying the pleasure of an abundant food supply. People tend to connect healthy eating with eating less and with less pleasurable food. While the overall risk may be accepted, the personal relevance is easily denied. This strategy helps people to accept health information without being forced to change behaviour[30]. The assumption is that such an escape route is no longer available if an individual receives personal risk information. Apart from the fact that this assumption reflects a (too) simplistic notion of change in human behaviour[31], it also remains to

be seen if people are still open to personal risk information on a large scale if this implies that they have no choice but to accept the health information and act accordingly.

While the focus on nutrigenomics has gradually shifted from individual to group profiles, the implications in terms of risk prevention are still personal, albeit on the basis of group membership. Advice based on group instead of personal information may be more – rather than less – problematic, both in terms of efficacy and legitimacy. Not only is this membership imposed rather than self-chosen, but the information on which health advice is based is also general rather than strictly personal. This aspect of the information offered may undermine rather than support such advice.

Furthermore, knowledge of belonging to a certain risk group – while providing the possibilities for escape – can also evoke associations of social pressure, especially when the risks are evident for the outside world. An illustration of this phenomenon is the situation of women who are visibly pregnant and are refused hard cheese in some restaurants in The Netherlands because of the possibility that it contains traces of soft cheese that may endanger their pregnancy. These restaurants are not willing to take the responsibility of serving the cheese to this group of women. The example shows how the social environment (and probably the fear of liability) exerts pressure on certain clearly recognisable groups.

It is doubtful whether such a situation is desirable. Measuring health in terms of personal risks strongly implies that a person should be interested in his/her own risks. Advice easily becomes a social norm which prescribes that, depending on their personal risks, individuals should not spoil themselves with unhealthy food and lack of exercise. Indulgent behaviour is punished with a disease or, for instance, higher insurance costs. The danger is that such a script presupposes an individual who knows his/her personal risks and acts upon them as the only responsible citizen. The outside world may then put pressure on individuals who do not act 'responsible' – see our example with pregnant women. While this action may be seen by many as an unjustified intervention into the personal sphere, it also implies that, in the end, responsibility is attributed only to the individual actor.

Connecting health risks to food and genetic dispositions is not the problem here, but the practical application of the scientific results should try to prevent as much as possible these social pressures by engaging in reflexive forms of consultation and deliberation.

The healthy life is the good life

To summarise, the script that scientists and food advisors use for nutrigenomics draws on three different, but related, assumptions. First, a healthy life is a life without a disease. This healthy life can be achieved either by creating a 'healthy' market that protects consumers from the temptations of unhealthy foods or by providing personal risk information that empowers them to make the healthy choice. In both cases, the suggestion is that a healthy state is strived for in order to suit the consumer's needs. A second assumption is that health can be conceptualised in terms of risk minimisation. A last assumption is that risk prevention is first and foremost a personal matter, both in terms of motivation and in terms of responsibility and accountability.

We argue that these assumptions, taken together, suggest that striving for health is one of the most important goals in life. Therefore, this suggests that the healthy life equates to the good life. We have seen that once food is related to health only, striving for health can no longer be isolated from daily life because of the everyday nature of food. This is especially problematic because of the narrow definition of health that nutrigenomics suggests. Contradicting health messages about food-related health risks could cause anxiety early in life and the emphasis on maintaining a disease-free state causes an unremitting responsibility for maintaining health. Even though the vision that nutrigenomics empowers the consumer to live healthy and the vision that the consumer is incapable of dealing with his/her food environment suggest different attributions of responsibility for this healthy life, both imply that perfection in healthy living should be achieved. Nutrigenomics may increase the tendency in the society to overestimate the significance of health in a narrow sense. Because of the obvious importance of food, nutrigenomics is something that has the capability to change our everyday existence tremendously, and accordingly it occupies a prominent place in this trend.

Health may become a social norm to which everyone should comply. Achieving this norm may become so demanding in terms of time that individuals have no time for other activities. This concern was first raised by Crawford[32] in the 1980s. Crawford used the term healthism to describe this phenomenon, suggesting that health had become a 'super value', meaning that the health concept absorbed everything in the personal search for well-being or wellness: the pursuit of the good life was changed into a quest for health[32]. The idea of health as a super value makes health an absolute standard. The failure to achieve or strive for health is then seen as a failure to embrace life. The quest for health becomes such a demanding individual responsibility that the individual hardly has time for any responsibility beyond personal well-being.

Besides the fact that an equalisation of the good life to the healthy life causes people to neglect responsibilities other than striving for health and well-being, other philosophers and sociologists suggest that such a search does not increase the overall well-being[33,34]. For example, Callahan[33] and Achterhuis[34] fear that aiming for a healthy life is actually a desire for a longer life. They argue that if people strive to live as long and as healthy as possible, their needs can never be fulfilled; people will always desire an even longer and healthier life. While science and society may never be able to answer to this perceived ideal state of health, people will continue to chase more and more expensive health solutions in an attempt to achieve it. A person or society pursuing such an unattainable goal will be disappointed. There are indications that in some areas, the availability of medical services leads to a decreased feeling of health with declined satisfaction with personal health. Some argue that unrealistic expectations of the medicine's influence on subjective health, well-being and quality of life play a role in this diminished satisfaction. In short, medicine could give the illusion that people can live without disease and symptoms and with both physical and psychological well-being, resulting in an overall

dissatisfaction with health[35,36]. If this is so, nutrigenomics may be a never-ending hunt for healthier foods. Or, if nutrigenomics helps to improve our health, our opinion of what is healthy may change and our thirst for increased health may still persist. The focus on health in nutrigenomics and the promise of a healthy feeling may cause a similar feeling of discontent in people, especially when significant effort is required for living healthily through diets and special food products. As we have seen earlier, striving for a narrow meaning of health as represented in the nutrigenomics script may compromise a feeling of overall well-being even more. We have seen that feelings of unease about contradicting messages and guilt feelings associated with the pleasurable nature of food might be problematic.

In short, equating the good life with the healthy life, as the totality of assumptions within the nutrigenomics script suggests, seems problematic. Ethical scripts of the good life may point to the alternatives and suggest different scripts of health and its potential contribution to a thriving existence. The alternatives can give some indication that in what direction the present assumptions of the script of nutrigenomics have to be changed to become more ethically acceptable.

Alternative scripts of health in the good life

Since the ancient Greeks, many philosophers have argued that it is typically human to ask questions such as: 'What do I want out of life?'; 'What is the meaning of life?'; 'What makes life worthwhile for me and others?' The common thread running through the concepts of the good life is that the human life is only worthwhile if its meaning is examined in terms of values and if these values are then used as guidelines and perspectives for living[37]. In short, humans should examine what they really want, taking into account their abilities, talents, networks, interactions and changing vulnerabilities as time passes in order to have a good life. As such, the idea of the good life covers not only issues of living in a decent, just or moral way together with other people, but also issues of 'human flourishing' in which people strive to let their personal excellences bloom in order to reach what the ancient Greeks called eudemonia. According to Nussbaum[38], who comprehensively studied historical and systematic functions of the good life, eudemonia meant to the Greeks in ordinary discourse to 'living well and doing well'. According to this definition, the idea of the good life involves both social aspects and an individual, personal take. The training of human excellences also needs external sources to receive the actions representing excellence (e.g. generosity involves giving to others). Therefore, eudemonia can also be seen as something concerned with the well-being of the community and future generations[38], and is therefore used in philosophical reflections on ecological and social challenges such as environmentalism and consumption[39]. Other critical studies are dedicated to examining the role of modern technology in an updated concept of the good life[40].

Ideas of how to live the good life vary widely. Some philosophers argue in favour of happiness (e.g. Epicurus and John Stuart Mill), while others emphasise religion or philosophical meditation (e.g. Plato and Aristotle), and still others advocate a life of passion (e.g. Nietzsche). We would like to examine at least two long-standing and well-established ethical approaches of the good life and the role of health: the deontological and virtue ethical approaches. The views of these approaches on the relationship between diet and health are our own extrapolation based on authoritative interpretations, similar to that of Nussbaum[38].

The deontological ethical approach values the intention that a person has to fulfil his/her duties over the consequences of a person's actions. Deontology is focused on the question of how a person should lead his/her life. The good life is a moral life, i.e. a life in which a person acts out of good will and not out of the consequences of his/her actions. Rationality makes it possible for an individual to know his/her duties and the right thing to do. Kant's categorical imperative, 'act only on a maxim by which you can will that it, at the same time, should be a general law'[41,42], is the law that guides a person to make the right decisions and perform the right actions. According to this law, living healthily and following a healthy diet seems rational. Obviously, leading a life and following a diet that will cause disease is not something that you would want to be a general law. However, if this rule is put into a broader perspective in which pursuing health and following a healthy diet becomes complicated and time consuming, and causes people to worry about the future, matters change. Other duties, such as caring for others, might be given a lesser priority. Leading a life in which one is concerned with one's own wellness in a selfish way is not something that one would wish to see becomes a general law. In essence, in the deontological ethical approach, pursuing health and following a healthy diet is an important duty, but one that should be in balance with the other duties that a person has in life.

According to Aristotle, one of the main representatives of the virtue ethical approach, life's ultimate goal is to reach the state of eudemonia, which means flourishing or happiness. To live the good life, people need to let their personal excellence bloom[42]. Health only plays a subordinate role in this view. Health is merely a tool that is necessary to pursue the goals that lead an individual to eudemonia. Too much attention to physical health would only distract a person from the development of his/her virtues. When a person loses external functions like health, this may hinder the individual's reaching eudemonia, but it may also cause a person to let certain virtues bloom. For example, when a person suffers, he can still be generous, noble and courageous. Thus, in essence, health is only a means to allowing some virtues to flourish and should not be an end in itself. Along the same lines, a healthy diet is only important in making an individual happy and facilitates the pursuit of certain virtues.

In the foregoing, we have seen that, according to the deontological and virtue ethical approaches (Kant and Aristotle), health should be in balance with other duties and values or should only be a means to leading a virtuous life. This means that nutrigenomics should at a minimum enable its users to balance health with other aspects of food and life. The present assumptions of the script of nutrigenomics can be enriched by taking this balance into account.

Conclusion

The goal of the present paper is to make explicit normative assumptions of an important present script embedded in

nutrigenomics research. We have seen that this script assumes that the pursuit of health is a crucial goal in life and that such a pursuit can have negative aspects, especially when health is reduced to risk management. Moreover, according to two important ethical perspectives of the good life, an excessive concern with health does not contribute to a good, ethical life; these require that nutrigenomics allows health to be in balance with other aspects of food and life.

The present script embedded in nutrigenomics research is obviously not the only development that might help to shift our norms towards a view that equates the healthy life with the good life. For example, within policy circles, the healthy life is frequently promoted as the good life. The reason for this focus is not only the protection of individuals against future diseases but also the prevention of possible future economic difficulties in EU countries due to the rapidly ageing population[43]. Ignorance of the underlying assumptions of the present script in combination with other forces within our society may reinforce the idea that health is overly important in comparison with other values. This, however, implies all the disadvantages that are discussed in the present paper.

We do not intend to claim that preventing misery and disease through healthy diets should not be promoted. What we principally intend to argue is that the vision of life in which pursuing health is the dominant motivation is just one vision of what the good life means. If this is not discussed, and we as a society just 'go with the flow' of present normative assumptions of technology development, this would eliminate vital aspects from the sphere of public discussion, choice and politics[44]. Furthermore, we may lose a rich and diverse society with a variety of interpretations of the good life. Consciousness of the diversity of meanings of the good life and an open discussion about the possible integration of other visions of the good life in a new nutrigenomics script would be an appropriate means of addressing the spheres of public discussion, choice and politics and help co-shaping nutrigenomics in such a way as to enable it to incorporate alternative normative assumptions about health and nutrition in nutrigenomics.

Food does, of course, have an important role in maintaining the functioning of the body. Studying how this happens and how diets affect this functioning is one of the very fundamentals of food sciences. Logically, health is very important within nutrigenomics research. So, how can nutrigenomics researchers make sure that nutrigenomics developments stay open to alternative views of the good life? How can alternative normative assumptions play a role within nutrigenomics research? One way would be to broaden some of the already existing alternative scripts within nutrigenomics. As Quote 13 shows, in some representations of nutrigenomics research, attention is given to local cultural aspects of eating, although these aspects still seem to be treated in the light of controlling and surveilling a healthy life in the narrow sense[12].

> *Quote 13.*
> *In addition to accurate food intake information, databases are needed on the macro- and micronutrient content of local foods, a challenge for the diverse cultures and diets throughout the world*[12].

Attributing a more dominant role within nutrigenomics research to cultural facets would not only help to protect other meanings of food than health, it will also open up the possibility of more and more diverse scripts. Paying more attention to cultural aspects may protect the other functions of food referred to earlier, such as how food helps to bind people together, shape their identity and give pleasure in life. Broadening these research strands would acknowledge the importance of balance between different values, duties and priorities in life besides health. Moreover, by actively embedding different normative assumptions within its scripts, nutrigenomics will help to contribute to more diversity in the meaning of food and health within our society.

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