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Healthy food and healthy choices: A new European profile approach☆

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Abstract

Poor or unbalanced nutrition, or both, is linked to the development of a variety of diseases, including cardiovascular disease, obesity, and diabetes mellitus, which collectively represent significant causes of disability and premature death and impose a substantial economic burden. As a result, health authorities and regulatory bodies across Europe are implementing policies to promote healthy eating habits with the aim to attenuate the burgeoning incidence of diet-related diseases. In order to support these efforts, and within the context of a project dedicated to interrelations between nutrition and atherosclerosis, European experts convened on October 24, 2008 at a Session on "Healthy food and healthy choices: A new European profile approach," during an international symposium in Venice, Italy. The aim of this session was to review issues relating to dietary policies, eating behaviour, food labelling, and nutritional profiling of foods. The present article highlights the key points of this session. Since eating takes place in a behavioural, social, and cultural context, a more relaxed pattern of interacting with food needs to be fostered, especially in children. Excessive regulation alone is insufficient and probably counter-productive to substantially impact population eating practices because automatic behaviour dominates our decision-making process with respect to food choices. Consumers urgently need simple, practical tools to help them make healthy food choices in a real-life setting. Front of pack labelling allows consumers to see the levels of key nutrients in foods; nevertheless more research is needed to assess how people use the different food labelling systems in real-life contexts. While policy changes including legislation and regulation can play an important role in changing behaviour, individuals need more assistance, education, and tools to help them to increase their personal responsibility for their health particularly with respect to diet.

Keywords: Disease prevention; Food choice; Nutritional profiles; Food labelling; Eating behaviour; Atherosclerosis; Cardiovascular disease

1. Introduction

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Non-communicable diseases (NCDs) such as obesity, diabetes mellitus, cardiovascular disease (CVD), stroke, and cancer are becoming increasingly significant causes of disability and premature death and are creating a substantial economic burden on national health budgets in developed and developing countries alike [1]. Since the occurrence of a variety of NCDs is linked to poor or unbalanced nutrition, or both (beginning as early as infancy or even in utero), this socio-economic burden is likely to escalate if the present global dietary trend continues unabated, particularly against a backdrop of reduced energy expenditures of individuals [2]. Indeed, according to the World Health Organisation (WHO) Europe, a combination of two factors – deviation

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from recommended diets and an energy intake surpassing daily requirements – represent the major contributing factors to the alarming increase in obesity and its clinical sequelae [3]. In light of this deleterious shift in nutritional dynamics, health authorities and regulatory bodies in countries across Europe are at various stages of formulating, evaluating, and executing policies to promote healthy eating habits with the long term goal of preventing or attenuating the burgeoning incidence of diet-related diseases.

In order to bolster and support the efforts of nutritional policy programs at the country level, the EU has recently developed comprehensive regulatory guidelines on health claims and nutritional profiles of foods. These recommendations are complemented by the European Technology Platform on Food for Life (launched in Brussels on July 5, 2005) whose mission is to promote the development of improved food products that positively impact public health and the quality of life of consumers across Europe. Recognising that a well-balanced diet is a cornerstone of good health, WHO Europe has also put forward a comprehensive action plan for food and nutrition policy to tackle NCDs. This wide-ranging plan recommends, for example, providing comprehensive and understandable information on health nutrition, engaging health care providers to influence individuals' diet and lifestyle choices, and instituting surveillance systems for nutritional status, food consumption, and physical activity patterns [3].

To help support the activities of these organisations as well as EU and national parliaments and public health policy makers with respect to dietary policies, food labelling, and assessing the nutritional profile of foods, a panel of European experts in public health, nutrition, and behavioural sciences was convened by the Giovanni Lorenzini Medical Science Foundation in the Session on "Healthy food and healthy choices: A new European profile approach," in Venice, Italy, on October 24, 2008. The purpose of this Session was to review and discuss the following issues:

- Translating nutrients into healthy foods and healthy eating patterns.
- Understanding the decision-making process in food choice.
- Healthy food and healthy choices: lessons from France.
- The impact of healthier food labelling in the United Kingdom.
- Assessment of nutritional profiles using a novel system based on a comprehensive approach and its successful preliminary application in Italy.

This article summarises the broad range of material presented and discussed during the meeting and comments on the conclusions made.

Table 1
Approaches to translating nutrients into foods and food patterns.

USDA pyramid [5]
NAR (nutrient adequacy ratio) [6]
NQI (nutrition quality index) [7]
RRR (recommended to restricted ratio) [8]
CFN (calories-for-nutrient score) [9]
NNR (naturally nutrient-rich score) [10]
MI (Mediterranean index) [11]
EU food-based dietary guidelines [12]

2. A report from a Session held at the 7th International Symposium on Multiple Risk Factors in Cardiovascular Diseases: Prevention and Intervention—Health Policy, in Venice, Italy, on 24 October, 2008

Speakers: ***V. Azaïs-Braesco, F. Brighenti, P. Scarborough, F. Visioli, C. Vögele***

TRANSLATING NUTRIENTS INTO HEALTHY FOODS AND HEALTHY EATING PATTERNS

F. Brighenti

In light of the relationship between diet and health, considerable attention has been traditionally focussed on nutrient adequacy. Numerous systems have been issued by regulatory and health agencies to reflect the Dietary Recommended Values (DRV), including for example the Recommended Daily Allowance (RDA), Dietary Reference Intakes (DRI) [4], Estimated Safe and Adequate Daily Dietary Intake (ADI), and Upper Tolerable Limit (UL). The problem arises, however, when translating nutrient recommendations into healthy foods and healthy eating patterns. Over the years, a plethora of dietary guidelines and food classification models have been proffered to help individuals plan and assess food choices based on nutrient composition (Table 1) [5–12]. As a consequence of these types of dietary guidelines, two side effects emerge: (1) the need for labelling schemes that can be easily understood by consumers and (2) the need for law enforcement to ensure that labels truly reflect food composition and to protect consumers against deceptive advertising.

Some of the popular nutrition labelling systems currently used in European markets include traffic-lights [13], Green Keyhole [14], Confédération des industries Agro-Alimentaires de l'UE guidance daily amounts (CIAA GDAs) [15], Unilever Choices [16], PepsiCo Smartspot [17], and 5 A DAY [18]. How consumers perceive, understand, like, and use nutritional information on food labels and the impact of labelling on consumer food purchases are reviewed in detail in subsequent sections.

Law enforcement issues in relation to nutrition labelling and advertising are currently a hotly debated topic across Europe, especially in the context of the wider public debate about ill-health due to dietary imbalance and the seemingly inexorable rise in incidence of obesity in adults and children. In this regard, one piece of legislation in the UK serves as a valuable benchmark for television advertising to children

[19]. Ofcom, the independent regulator of television, radio, telecommunications and wireless communications services in the UK, recently introduced restrictions on the television advertising of food and drink products specifically to children. These wide-ranging scheduling restrictions applied specifically to food and drink products high in fat, salt and sugar (HFSS) and included a total ban on HFSS food and drink advertisements in and around all programmes appealing to children under 16. In addition, content rules, such as banning the use of celebrities, applied to all food and drink advertising to children regardless of program scheduling.

The European Food Safety Authority (EFSA) has also recently issued guidelines indicating the nutrient profiles that foods (or certain groups of foods) must contain to support nutrition and health claims [20]. It is expected that enforcement of this type of legislation will be invaluable to avoid consumers being misled with nutrition or health claims as they try to make healthy food choices.

While nutritional guidelines and regulations are useful tools to help correct a dietary imbalance in countries across the EU, the scientific evidence upon which they are based must be critically evaluated and regularly updated to promptly accommodate changes in scientific beliefs and medical opinions that inevitably happen over time. For example, in the 1970s, nuts were considered unhealthy because of their fatty, energy-dense composition; however, in recent years a paradigm shift has occurred and now nuts are considered to be qualifying components for healthy diets [21]. Finally, it is important not to forget that nutritional profiling can be used effectively to identify foods with good nutritional quality relative to their price [22], and this may prove helpful in overcoming the economic barriers (faced by many lower income members of society) to a more wide spread adoption of healthy food choices.

UNDERSTANDING THE DECISION-MAKING PROCESS IN FOOD CHOICE: REASON, DRIVE OR LEARNED BEHAVIOUR?

C. Vögele

It is currently estimated that a positive change in health behaviour has the potential to substantially reduce the global disease burden (diabetes by >80%, coronary heart disease [CHD] by >80%, colon cancer by >70%, and stroke by >70%) and to markedly increase the overall life expectancy of the population by an average of 9.3 years [23]. Nevertheless, the key question is how to achieve a meaningful positive change in health behaviour of the population.

The Challenge of Changing Health Behaviour

Based on models from economics, health experts and politicians often make the assumption that humans are rational decision makers, capable of maximising their own welfare and making perfectly informed decisions when given sufficient information. In terms of dietary behaviour, for example, the assumption is that, given the right information and motivation, people can successfully reduce their food intake to match their caloric expenditure over the long term. Efforts to treat and prevent obesity at a population level, therefore, depend to a large degree on educating people to regulate their food intake through publicising general guidelines on nutrition, promoting tailored diets, and labelling foods with nutrition information. The continued growth of the obesity epidemic despite the employment of these techniques should make people question the assumptions underlying these approaches.

Information Overload Negatively Impacts Food Choices

Policy makers also often embrace the psychological concept that having personal choices has positive affective and motivational consequences [24]—in other words, the more information and the more choices the better. Unfortunately, too much information or too many choices can actually have the opposite effect, with consumers becoming overwhelmed and ultimately avoiding making any decision or choice.

Food labelling, in particular, is considered a tool that enables consumers to choose healthier foods and negotiate their way through today's 'obesogenic society' more successfully. While it is often asserted that more choices increase intrinsic motivation, perceived control, and life satisfaction, the evidence of such effects is ambiguous. Existing studies often provide contradictory or inconclusive results linking health claims and food choice [25]. One potential reason for this lack of association may be the limited capacity of humans to process more than 7 (± 2) pieces of information at any one point in time. Any more information may lead to option paralysis.

The concept of option paralysis – that is, the tendency, when given unlimited choices, to make none – is illustrated by a series of elegant psychological studies showing that consumers buy less if given more choices. In a field study by Iyengar and Lepper [24], a table in a delicatessen shop was set with a display of either 6 or 24 jars of exotic jams. These investigators found that customers purchased more jars when presented with a limited array of 6 choices than they did when offered a more extensive array of 24 choices (30% vs. 3%, respectively).

Decision-Making in Relation to Eating

The assumption that humans are rational decision makers implies that eating is a conscious act. Nevertheless, most routine behaviours such as eating do not typically originate with a conscious decision, and are, therefore, probably automatic [26]. It is estimated that only approximately 5% of the brain's information processing capacity is dedicated to conscious decision-making at any one point in time. Thus, conscious control over eating is the exception not the rule, and, in this setting, self-regulation can easily be depleted. Evidence of self-regulatory depletion comes from a study by Baumeister and colleagues in 1998 in which people were asked to perform two consecutive acts of self-regulation [27]. Study participants who were asked to resist chocolate chip cookies for 20 min performed worse when subsequently solving a puzzle than those not shown cookies.

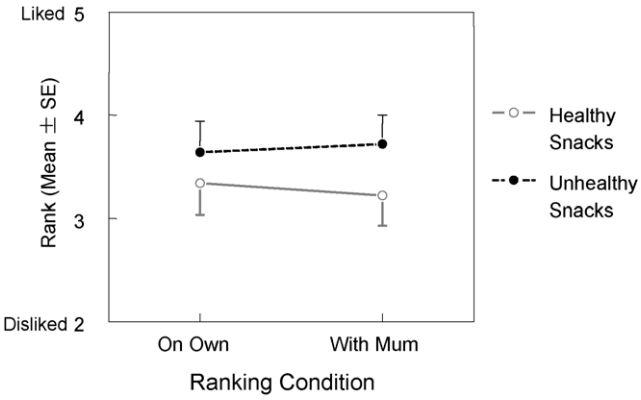

Fig. 1. Snack ranking in children 5 years of age with normal-weight mothers. Figs. 1 and 2 from Vögele et al. with permission [29].

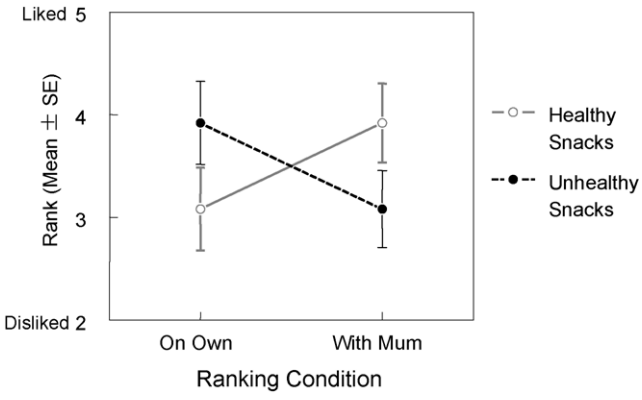

Fig. 2. Snack ranking in children 5 years of age with overweight mothers.

From the perspective of food choices and promoting healthy eating practices, the drivers of impulse decision-making need to be carefully delineated. It is clear that humans are born with certain innate preferences for sugar and fat, as evidenced by early studies with newborns in which distinctive and recognisable facial expressions could be elicited by tasting salty, sour, bitter, and sweet [28]. Nevertheless, there are large inter-individual differences in food preferences.

Impulse decision-making in relation to food choices can also be influenced by learned behaviour (or imprinting), cultural factors (e.g., fried scorpions or fried tarantula legs may be considered a delicacy in some countries, but repulsive in others), and conditioned learning (including conditioned preferences), whereby eating is linked to a certain behaviour such as watching television. Conditioned learning can also occur in a reward setting, as illustrated in a study by Vögele and colleagues, which examined children's snacking preferences in relation to their mother's weight status (overweight or normal-weight) [29]. Children were asked to rank 5 healthy snacks (e.g., raw vegetables or low-fat yoghurt) and 5 unhealthy, calorie-dense snacks (e.g., cookies, potato chips) in both the presence and absence of their respective mothers. As a group, children from normal-weight mothers chose more or less the same snacks with or without the mother being present (Fig. 1). In contrast, children from overweight mothers chose more unhealthy snacks as their preference when the mothers were not there and healthy ones when the mothers were present (Fig. 2).

These findings indicate that the mothers were passing on the message of healthy eating or unhealthy eating, depending on whether they were normal-weight or overweight, to their children at a very early age. Overweight mothers have much more reason to be concerned about healthy eating, and their children's snack food ranking when their mother was present probably illustrates the mothers' attempts to educate their children in healthy eating practices. Nevertheless, the children's ranking behaviour when on their own clearly shows that such rational food choices are replaced by preferences that are driven by other factors.

Collectively, the studies summarised above indicate that eating behaviour does involve a component of reason, but cognitive factors such as information are probably less important for the decision-making process than previously assumed. More importantly, eating behaviour is driven by automatic behaviours (both innate and learned) that occur without awareness, are initiated without intention, continue (once initiated) without control, and operate efficiently or with little effort. Since automatic behaviour dominates our decision-making (including our food choices), simply educating people in what is healthy will not substantially impact their eating practices. Furthermore, when this automatic behaviour is replaced by excessive control, eating disorders may arise.

In summary, it is clear that health promotion messages must be simple, clear and consistent. Early interventions are important to facilitate the psychological processes (e.g., imprinting and learning) that form automatic behaviours. Flexible control is preferable to rigid control—cognitive control is fallible, rigid control increases the risk of all-or-nothing strategies. Pre-conscious processes (intuition, gut-feeling, etc.) largely determine consumer behaviour.

HEALTHY FOODS AND HEALTHY CHOICES: LESSONS FROM FRANCE

V. Azaïs-Braesco

Although considered a country of "good life and good food", France actually has the same kind of relationship with food and health as anywhere else. However, it is fair to say that a French paradox does appear to exist in that the archetypal slender profile of French people occurs against a backdrop of a diet dominated by high-fat foods (rich sauces, red meat, and cheese) and accompanied by significant intake of wine. To understand this paradox, one must consider not only *what* a culture eats but also *how* it eats—in other words, it is important consider the relationship of people with food not simply the food's nutritional composition.

Compared to other western societies, the French eat differently in that they consume most of their food at meal times shared with others, they spend a much longer period of time eating their meals, and they rarely snack between meals

Table 2
Priority nutrition objectives.

Objective	Desired outcome
Increase fruit and vegetable consumption	Reduce the number of low consumers by ≥25% (i.e., 45% of the population)
Increase calcium consumption	Reduce the number of people with a lower than recommended calcium intake, and the prevalence of vitamin D deficiency, by 25%
Reduce the average proportion of lipids in the daily energy intake	Reduce daily energy intake from fats to <35%, and reduce the average consumption of saturated fats by 25% (<35% of total fat intake)
Increase the consumption of carbohydrates	Achieve daily energy intake from carbohydrates of 50% by encouraging consumption of starchy foods, reducing the intake of simple sugars by 25%, and increasing dietary fibre by 50%
Reduce alcohol consumption per capita	Achieve a goal of <8.5 L per year per person (a 20% reduction)
Reduce mean blood cholesterol level (LDL-C)	Achieve a 5% reduction in LDL-C in adults
Reduce the average systolic blood pressure	Achieve a 2–3 mm Hg reduction in adults
Reduce the prevalence of excess weight and obesity (BMI >25 kg/m^2)	Achieve a prevalence rate below 33% in adults and put a halt to the increasing prevalence of excess weight and obesity in children
Increase daily exercise	Achieve a 25% increase in the number of people of all ages doing the equivalent of ≥30 min of moderate exercise at ≥5 times per week (i.e., 75% of men and 50% of women)

LDL-C = low density lipoprotein-cholesterol and BMI = body mass index.

[30]. The differences between the French and Americans in their relationship with food are illustrated by the results of a sociological study of eating habits of French-speaking subjects (French and some Swiss) and English-speaking subjects (the US and UK) [31]. When asked what "eating well" meant for them, Americans immediately mentioned health; in contrast, health came far after pleasure for the French. The study also jokingly referred to the two styles of eating as "the stable" for the US (where individuals could eat anytime of day) and "the Zoo" for the French (where individuals eat at set feeding times). As a consequence, the French pattern of eating contributes to the overall consumption of fewer calories while maximising gustatory enjoyment by engaging all the senses.

To paraphrase Paul Rozin, Professor of Psychology, University of Pennsylvania, Pennsylvania, USA, in the domain of food, French people have created a more pleasant and relaxed pattern of interaction, without paying a health price [32]. This finding may explain, in part, why the prevalence of obesity in France is twice or three times less than that observed in other countries (e.g., the USA). Nevertheless, obesity and diet-related diseases in France, like many other European countries, are steadily increasing, especially in children, and this had led public health authorities to undertake appropriate action to promote better nutrition. However, as noted by Xavier Bertrand, Minister of Health and Solidarity, in September 2006, France's second national nutrition program has attempted to make dietary recommendations while preserving France's culinary heritage.

French Health and Nutrition National Programme (PNNS)

The French National Nutrition and Health Program (PNNS) [33], implemented in 2001, is a government-sponsored collaboration between the public and private sectors with a mission to improve the health of the French population and to reduce risk factors for chronic disease by focusing on nutrition. As summarised in Table 2, the PNNS program proposed nine priority nutritional objectives to improve specific outcomes in the general population.

The key approaches of the PNNS to achieve these goals centre on several strategies: (1) Educate and inform consumers about healthy food choices, particularly with respect to nutrition labelling and consumer guidelines; (2) Identify, treat, and prevent eating disorders, particularly with respect to childhood, adolescent, and adult obesity and undernutrition; (3) Target specific population groups, especially with respect to improving nutrition for different ages, and improve food aid for people in disadvantaged circumstances; and (4) Improve the food supply by partnering with the food industry and agribusiness and formalising commitments to progress as well as creating an observatory of food quality.

With respect to formalising commitments to progress, the French government has given economic operators in the various branches of the food sector the opportunity to develop charters of commitment to nutritional progress, preferably on a joint basis but also individually.

The terms of these charters depend on the specific features of the businesses and products concerned. These commitment charters mainly focus on the nutritional composition of products, the size of portions, communication and advertising (especially targeting children), and the availability of products among disadvantaged populations (actions on prices, etc.). As of October 2008, seven such charters have been accepted and their number is increasing.

It is important to note, that the PNNS does not include nutrient profiling. However, this issue is addressed in France by two systems. The first is the SAIN LIM system proposed

by the French agency (Agence française de sécurité sanitaire des aliments [www.afssa.fr]). This method assesses the favourable or healthy aspects (SAIN) and unfavourable or unhealthy aspects (LIM) of each food, thereby allowing allocation into one of 4 categories: (1) Recommended for health; (2) Neutral; (3) Recommended in small quantities or occasionally; (4) Consumption should be limited. Another system (Nutrimap®) quantifies nutritional assets and weaknesses of foods [34]. However, from the French perspective, a key issue to contemplate going forward is whether or not nutrient profiling, as currently understood, represents a good tool to keep a "relaxed" attitude to food.

IMPACT OF HEALTHIER FOOD LABELLING IN THE UK

P. Scarborough

Front of pack (FOP) nutrition labelling represents one component of the UK Government's broader programme of activities addressing a spectrum of diet-related public health issues. The main objective of FOP labelling is to allow consumers to clearly see and comprehend the levels of key nutrients in foods sold through retails outlets. The UK Government, recognising the political pressure to intervene in the obesity epidemic, developed an informative FOP food labelling system referred to as traffic-lights [13,35]. This system, used by a variety of major supermarket chains, employs a colour coding system of red, amber, or green to indicate whether a food item is high, medium, or low, respectively, in the following nutrients: total fat, saturated fat, total sugars, and salt. In addition, some retailers and manufacturers have developed their own FOP labelling systems, the most notable of which is the percent Guideline Daily Amount (GDA). The GDA system, recommended by the Food and Drink Federation, provides similar nutritional information to the traffic-light system but expresses the calories, sugar, fat, saturated fat, and salt of a particular food as a percentage of the recommended daily allowance.

Studies Assessing the Impact of Labelling Schemes in the UK

Research on how well these two labelling systems can help people achieve a healthier diet in the UK comes from several performance studies, including studies funded by the Food Standards Agency (FSA, a UK government agency) and the European Food Information Council (EUFIC) research, as well as sales data analysis and reviews.

Food Standards Agency Studies

The FSA-funded performance studies represent the most comprehensive evaluation of FOP labelling in the UK and determined how FOP labels (traffic-lights, percent GDA, and single symbols) are understood and used by shoppers. The studies involved a variety of research methodologies, including accompanying shoppers in stores to observe the decision-making processes, in-store and in-home shopping bag audits, and a random survey of shoppers in the UK. In 2005, an FSA-funded project compared the performance of traffic-light and percent GDA schemes and found that the traffic-light labelling performed significantly better than the percent GDA labels at allowing consumers to comprehend nutrient levels [36]. More recently, a study aimed at comparing comprehension of nutritional characteristics and consumer preference found that the optimal FOP labelling scheme was traffic-light labelling system that includes information about GDAs of individual nutrients [37].

In January 2007, the Omnibus survey of consumers in the UK (a regular monthly representative survey of around 2000 consumers) included a section on FOP labelling, and found that only 35% of respondents were aware that GDAs represent maximums for salt, sugar, and fat; in contrast, 76% of respondents correctly associated a red light with a high amount of a nutrient that needed to be reduced. Further, the survey found that understanding of both the percent GDA and the traffic-light labelling was socially patterned, with lower comprehension in less affluent groups [38].

European Food Information Council Study

The Pan-European research projected conducted by EUFIC evaluated consumers' in-store behaviour, understanding of nutrition information on food labels, and nutrition knowledge. The UK component of the study involved a total of 2019 consumers in three major supermarkets (each using a different FOP labelling system: traffic-light system, percent GDA, or a combination of both) in London, Manchester, and Birmingham [39]. Researchers were placed at specific sections (e.g., areas displaying yoghurts, snacks, and ready meals) within the store and observed consumers making their food selections. Researchers then approached consumers, established their interest in survey participation, conducted a brief in-store interview to determine how they used the nutrition labelling, and then asked consumers to complete an in-home questionnaire to retest their knowledge of nutritional labelling. In total, 921 UK consumers completed all sections of the study and returned their in-home questionnaire for analysis.

Results from the in-store research indicated that only 27% of consumers who actually selected food items were observed using nutritional information. When asked, more shoppers indicated that they used the GDA nutritional information system compared with the traffic-light system, although it is not clear whether this was due to preference or difference in availability of the two labelling schemes. Further, with respect to the in-home questionnaire, over 60% of respondents were aware that GDAs represent maximums for salt, sugar, and fat [39]. This value is considerably higher than that reported in the Omnibus survey, which revealed only 35% of respondents were aware of what GDAs represent [38]. Interestingly, the percent GDAs and traffic-light labelling performed equally well at distinguishing between 'healthy' and 'unhealthy' products.

Supermarket Sales Data

The studies reviewed above focused on the ease of use and customer understanding of nutrition information on food

labels but they provide little information on the impact of FOP labelling on actual purchasing decisions. One method of obtaining this sort of insight is by reviewing supermarket sales data. Independent analysis of sales data for several types of sandwiches in the 12 weeks before and after the introduction of Sainsbury's wheel of health FOP labelling system (a traffic-light based approach) revealed a modest 6% increase in sales of a Salmon sandwich with mostly green lights and a substantial 44% decrease in sales of a breakfast sandwich with mostly red lights (personal communication Sainsbury's, October 2007). In contrast, a comparison of sales data 8 weeks before and after introduction of Tesco's percent GDA labelling system, sales of a healthy prawn sandwich (with 2% saturated fats GDA and 34% salt GDA) increased by 46% and sales of an unhealthy prawn sandwich (with 28% saturated fat GDA and 58% salt GDA) decreased by 37% (personal communication Tesco, June 2006). These figures are taken from press releases from the supermarket chains, aimed at promoting the introduction of their new labelling schemes. It is unclear whether the reported differences in sales are directly linked to the introduction of the respective labelling systems or due to other changes in pricing or promotion.

To gain further insight into the impact of FOP labelling on consumer food purchases, an analysis of sales data from 2006 to 2007 was conducted at a major UK supermarket chain with a focus on the initial impact (4 weeks) of introducing traffic-light labelling [40]. Preliminary findings of data obtained for 6 ready meals and 12 sandwiches (items with no price or promotional differences) indicated that the introduction of traffic-light labelling had little impact on sales (0.4% decrease in sandwich category share and a 2.4% increase in ready meal category share). Further, for the 12 sandwiches included in the analysis, the change in sales was not linked to the nutritional quality of the product (i.e., there was no significant difference between the sales performance of 'healthy' and 'unhealthy' sandwiches).

Reviews of Labelling Studies

Two reviews have conducted a useful and valuable literature analysis of research studies evaluating consumer preferences and use of FOP nutrition schemes [41,42]. A European Heart Network review examined data from a total of 10 research projects from 9 countries (conducted from December 2006 to June 2008) on consumer preferences and use of FOP nutrition schemes [42]. Relevant studies were identified by searching literature databases, internet searches, and through the European Heart Network, its members, and contacts. The review concluded that traffic-light labelling was largely helpful for most respondents, provided more information than a single symbol, and appeared to allow consumers to evaluate foods for nutrients of particular public health concern. In contrast, GDAs and percent GDAs by themselves were not well understood by consumers and could be misleading.

A EUFIC-sponsored review of how consumers perceive, understand, like, and use nutrition information on food labels involved analysis of results obtained from 58 research projects (conducted in 2003–2006) from 15 EU countries [41]. Studies for inclusion were identified by detailed search of academic research databases, the Internet, and key informants. The main conclusions of this analysis were that consumers showed widespread interest in the nutrition information on food packages and simplified FOP info was liked and generally understood. However, marked differences in preference among formats were evident and this appeared to be influenced by individual preferences for simple and easy to use labels, a desire to know what the information stands for and how it was derived, and a desire not to feel pressured into certain choices. Of particular interest in this regard was the finding that some consumers regarded traffic-light labelling as too coercive. It is important to note, however, that the reviews provided virtually no insight into how labelling information is used in real-life shopping situations.

In summary, there is a need for more accurate analysis of (a) how people use the different food labelling systems in real-life contexts and (b) the impact of the different food labelling systems on sales of different food categories. Better access to sales data will certainly allow more accurate analyses to be performed. In addition, more information is needed to understand whether labelling is actually helping when it comes to making food choices and deciding which foods are better from a nutritional perspective.

Table 3
Key elements of an ideal food-profiling system.

Based on solid scientific data
Applicable to different socio-economic contexts
Inclusive of all food items
Easy to use
Flexible and adaptable to new scientific discoveries
Able to provide guidelines that are easily understandable by consumers, at the same time leaving a large freedom of choice

Extracted from Visioli et al. [43].

ASSESSMENT OF NUTRITIONAL PROFILES: BEYOND DICHOTOMY

F. Visioli

Evidence is mounting to support a paradigm shift in nutrient profiling towards a much broader system that incorporates factors such as portion sizes and patterns of food consumption during or between the main meals (in addition to the favourable or unfavourable character of each food item). In striving to meet the challenge of incorporating all of the key elements of an ideal food-profiling system (Table 3), a novel method of assessing the nutritional profile of foods has been developed by the Lorenzini Foundation. This method starts with the guiding principle that there are no 'good' or 'bad' foods when the energetic balance is considered overall [43].

Novel Method to Assess the Nutritional Profile of Foods

The Lorenzini method (available online at www.foodprofile.org) is based on the FAO/WHO report on Diet, Nutrition, and the Prevention of Chronic Diseases [44]. The key characteristics of this method are that it: (1)

comprehensively analyses and computes a great range of features of individual food items (macro- and micro-nutrients), (2) distinguishes among eating occasions (i.e., during or in-between the main meals), (3) incorporates portion size as an important contributor to evaluation criteria, (4) allows for rapid modification and great flexibility, thereby suiting individual needs and gastronomic habits, (5) embraces an 'informatics'-based system, simplifying accessibility, calculations, simulations, and updates, and (6) rewards innovation with respect to food product composition (i.e., increased fibre, reduced salt). The system is universally applicable but is currently framed within the typical food culture of Europe.

Between-Meals Eating Episodes

A key aspect of the Lorenzini method is that it takes into account food items that are consumed outside of the main meals (typically mid-morning or mid-afternoon snacks), the so-called between-meals eating episodes (BMEE). This is an important consideration in light of the fact that BMEEs, especially among younger generations, contribute up to 30% of the daily energy intake and 50% of the daily intake of micro-nutrients [45].

The Lorenzini method normalises the portion size rather than the food item per se and, in so doing, takes into account energy-per-portion. In addition, it factors in the portioning and energy load of BMEEs, averaging the scores of portioned energy (mean between energy and portion for a BMEE snack), sodium, fruits and vegetables, and macronutrients. This essentially provides normalisation of foods by calories rather than by weight.

Nutritional Profiling Models

The simplest of the various models proposed by the Lorenzini system is based on the nutritional profile of main meals determined according to the parameters of the FSA [46]. The modified FSA model employs scores that range from 0 to 10 (with scores from 0 to 3.33, 3.34 to 6.66, and 6.67 to 10, indicating low, medium and high nutritional value, respectively) and averages the scores of total energy, saturated fats, simple sugars, sodium, fruits, and vegetables, giving a final value from 0 to 10.

A slightly more elaborate model, depicted in Fig. 3, involves the nutritional profile according to the FSA parameters but now modified by computing the whole macronutrient profile (i.e., FSA Q&Q [quantity and quality]). Other models of progressively increasing complexity are also proposed and these similarly utilise the FSA parameters but also take into account other components such as: (A) macronutrients and the portioning and energy load of BMEEs (Portioning 200), (B) macronutrients and the portioning and energy load of breakfast (Portioning 400), (C) macro- and micro-nutrients and the portioning and energy load of BMEEs (Portioning 200 plus add-on), (D) macro- and micro-nutrients and the portioning and energy load of breakfast (Portioning 400 plus add-on), (E) macro- and micro-nutrients, the glycaemic index (GI), and the portioning and energy load of BMEEs (Portioning 200 plus add-on GI), and finally, (F) macro- and micro-nutrients, GI, and the portioning and energy load of breakfast (Portioning 400 plus add-on GI).

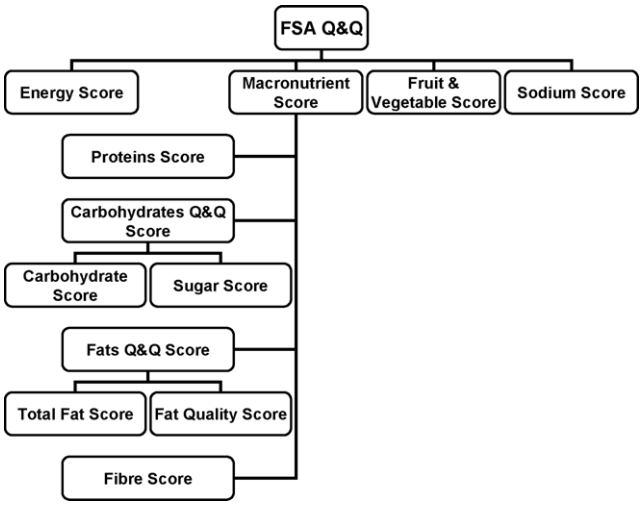

Fig. 3. Nutritional profile according to the parameters of the Food Standards Agency (FSA) but modified by computing the whole macronutrient profile. Reproduced from Visioli et al. [43] with permission of Cambridge University Press.

Real-Life Trial of Lorenzini System of Nutritional Profiling

Although large-scale plans are underway to evaluate the effectiveness and usefulness of the Lorenzini food-profiling model in countries across the EU, an initial assessment has been carried out in a small, pilot study in Parma, Italy. This pilot study assessed the nutritional habits of 161 subjects (72 female and 89 male) and included data collected prospectively in a nutritional diary over a 7-day period (giving a total of 1127 diary days of data). The protocol excluded predefined dietary limits and, as such, the data collected is assumed to represent a bona fide evaluation in a real-life setting. The study employed the Lorenzini algorithm described above and included mean scores (0 and 10 scale) for sodium, sugar, saturated fats, total fat, energy, fruit or vegetables, as well as portion size. A cut off value of 5 was arbitrarily chosen to represent the boundary between low (or "bad") nutrient value (<5) and high (or "good") nutritional value (>5).

Scores of 756 food items (alcoholic beverages excluded) were determined using the extensive nutritional database of the European Institute of Oncology. As shown in Fig. 4, using the Lorenzini system, some food categories such as vegetables, fruits, and fruit juices could be clearly categorised as "good" (i.e., both the means and minimum values were well above the cut off score of 5); however, for the most part, a majority of food categories was neither "good" nor "bad" (e.g., cheese and fats) because the cut off value of 5 fell within the maximum and minimum bounds.

Baseline demographics (Table 4) of the study population indicated a homogeneous cohort of relatively young people within the normal range in terms of height, weight, BMI, and waist circumference.

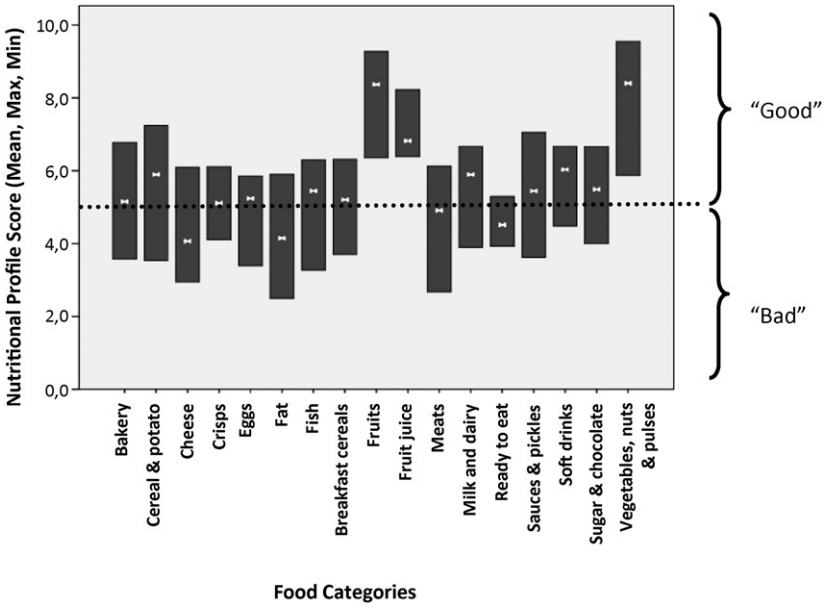

Fig. 4. Distribution of mean nutrient profile scores for different food categories analysed using the nutritional database of the European Institute of Oncology.

A key element of the study was to assess the effectiveness of the Lorenzini model in terms of providing dietary information to consumers to allow them to discriminate among available foods and to achieve health benefits from their choices. The study indirectly assessed potential health benefits by determining how closely each consumer's diet adhered to the dietary recommendations set forth in the Italian guidelines [47]. Thus, the diet of an individual consumer received a score of 1 for each of the following categories: energy from carbohydrate >50%, energy from FAT <35%, saturated fats <33% of total fat, cholesterol <300 mg/day, and fibre >30 g/day. Thus, an ideal diet meeting all of the guideline recommendations would receive a maximum score of 5 and a completely inappropriate diet meeting no recommendations would receive a score of 0. The results showed that a small minority of subjects fully complied with the dietetic recommendations (i.e., their diet received 5 points). On the other hand, 20 subjects followed a completely inappropriate dietetic regimen (i.e., they diet received 0 points). A majority of subjects (100) had a score of 2 or 3 points (i.e., 2 or 3 guideline objectives were regularly attained). Overall, the average score for all 161 subjects was 1.9 ± 1.2 points. The results revealed a good correlation between the mean number of objectives reached and how the Lorenzini model scored foods in terms of tertiles of "bad" food profiles, although this trend was not statistically significant (Fig. 5). A larger study enrolling substantially more patients is needed to provide the statistical power to adequately address this issue.

In summary, the Lorenzini food-profiling system can easily be used to accurately analyse and compute a wide range of features of individual food items. The ability of the model to distinguish between patterns of food consumption (main meals and BMEEs) and to provide a detailed analysis of macro- and micro-nutrients may relieve some of the constraints that consumers perceive during deliberations on their nutrition and health. Preliminary data from a small real-life pilot study suggests that the Lorenzini system may represent a practical and effective means to help consumers follow a healthy, guideline-recommended diet.

Table 4
Baseline characteristics of the pilot study cohort.

	Males	Females	Total
n	72	89	161
Age (years)	37 ± 9	37 ± 7	37 ± 8
Height (cm)	164 ± 6	178 ± 6	172 ± 9
Weight (kg)	61.4 ± 9.3	81.8 ± 13.5	72.6 ± 15.5
BMI (kg/m^2)	22.8 ± 3.3	25.9 ± 3.9	24.5 ± 4
Waist circumference (cm)	83 ± 8	92 ± 11	88 ± 11

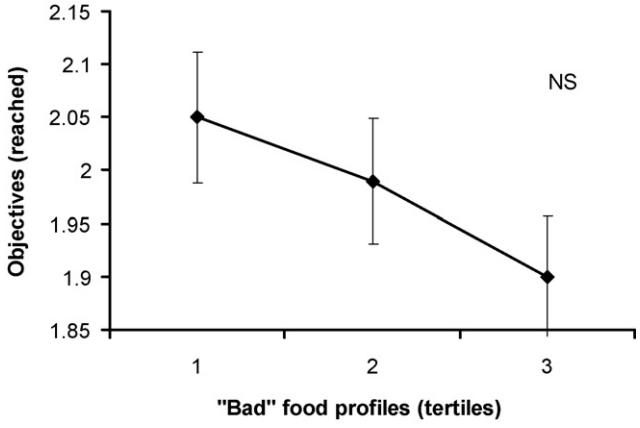

Fig. 5. Relationship between the mean number of objectives reached and the performance of the Lorenzini model in terms of tertiles of "bad" food profiles.

3. Comment

CVD, particularly CHD, creates a substantial healthcare and economic burden and is responsible for more than 4.3 million deaths in Europe alone [48]. According to recent statistics, direct and indirect costs (lost productivity and the cost of informal care) associated with CVD are estimated to be €192 billion in the EU and $431.8 billion ($151.6 billion for CHD) in the US in 2007 [48,49]. In light of these dismal statistics, the logical question arises, "What can we do better?".

According to a recent article by Schroeder in the New England Journal of Medicine [50], an individual's health is linked to five key domains: genetics, social circumstances, environmental exposures, behavioural patterns, and health care. Contrary to popular belief, however, improving health care may actually play a relatively diminutive role when it comes to reducing early deaths. Changing an individual's unhealthy behavioural patterns may yield the greatest opportunity to improve health and reduce premature mortality [50], particularly with respect to smoking, physical inactivity, and obesity resulting from an unhealthy diet. Indeed, a comprehensive literature review found that tobacco (18.1%) and poor diet and physical inactivity (15.2%) were the leading the causes of death in 2000 in the US [51]. The authors noted, however, that poor diet and physical inactivity could soon overtake tobacco as the leading cause of death if current trends continue.

Not only is an unhealthy diet an independent risk factor for CVD and a contributor to development of other CVD risk factors [52], it is also linked to the current world wide epidemic of obesity and diabetes and contributes to a plethora of other diseases such as dental caries, periodontitis, osteoporosis, and complications associated with ageing (e.g., neurodegenerative disorders) [53]. While population changes in dietary habits (as well as life style and physical activity) can have a marked impact on the overall burden of CVD as well as other NCDs, it is important to note that such changes are achieved only by the collective participation and contribution of individuals. While policy changes including legislation and regulation can play an important role in changing behaviour, individuals need more assistance, education, and tools to help them to increase their personal responsibility for their health particularly with respect to diet.

4. Conclusions

A concerted effort is needed from medical and behavioural scientists to address the escalating incidence of diet-related diseases seen across Europe. It is important to recognise that eating takes place in a behavioural, social, and cultural context. Thus, it is important to consider not only the food's nutritional composition but also the relationship of people with food. In this regard, fostering a more enjoyable, relaxed pattern of interacting with food, especially at a young age, may prove especially beneficial. Since automatic behaviour dominates our decision-making process with respect to food choices, excessive regulation alone will likely be insufficient to markedly impact population eating practices. Simple, practical tools are urgently needed to help consumers make healthy food choices in a real-life setting. In this regard, further research on the Lorenzini food-profiling model is necessary to verify its user-friendly approach and its applicability to broader geographic, social, and cultural environments. Such a system may allow a more realistic assessment of the impact of nutritional policy and food product claims based on real-life consumer practices rather than hypothetical modelling techniques. Finally, while this article has focussed primarily on topics relating to healthy foods and healthy choices, the importance of energy expenditure (i.e., physical exercise) should also be considered as an integral component of the broader public health issue.

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