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Nutrient profiling for regulatory purposes

Mike Rayner
Nuffield Department of Population Health, University of Oxford, Oxford OX3 7LF, UK

In this paper, I first provide definitions of nutrient profiling and of a nutrient profile model. I set out the purposes of nutrient profiling: both general and specific. I give two examples of nutrient profile models that have been developed for regulatory purposes by the Food Standards Agency (FSA) in the UK and the WHO for its European Region – the UK FSA/Ofcom and the WHO-Euro models – and compare the way the models are constructed and function, how they have been developed, the extent to which they have been tested and validated and their use in regulation. Finally I draw some conclusions about the future use of nutrient profiling for regulatory purposes. I argue that its full potential has yet to be realised and give some reasons why. I pose some urgent research questions with respect to nutrient profiling.

Nutrient profiling: Food regulation: Food marketing

Nutrient profiling can be defined as 'The science of classifying or ranking foods according to their nutritional composition for reasons related to preventing disease and promoting health'[1]. It can be used for a variety of purposes both regulatory and non-regulatory. Here I focus on regulatory purposes and the term 'foods' in the present paper should be taken to include non-alcoholic beverages.

Nutrient profiling is based on two assumptions: firstly that a person's health is affected by the healthiness of their diet and secondly that the healthiness of a diet is, in turn, affected by the healthiness of the foods that compose that diet.

Of course a person's health is affected by more than their diet, and the adjective healthy as applied to a diet is therefore short hand for promotes health. A diet that promotes health is one that also reduces the risk of disease. A diet cannot, in and of itself, be healthy: it is only individuals and groups of people that can be healthy or not.

Similarly the healthiness of a diet is affected by more than the healthiness of the foods of which it is composed. There are many possible ways of defining healthy as applied to a food. It is easier to say what a healthy food is not than what it is. For example a healthy food is not just one that is likely to contribute to a healthy diet. On this basis salad dressing would be classified as healthy but only for the reason that salad dressing is generally eaten in combination with salad vegetables that are also likely to be part of a healthy diet. My preferred definition for a healthy food is 'a food that, when consumed, makes the total diet more healthy'. This has the corollary that the greater the contribution to the healthiness of diets the more healthy the food is. For my reasons for this preference see a previous review[2].

Nutrient profiling is operationalised by nutrient profile models; algorithms, which convert the levels of nutrients and other components of foods into classifications or scores. The classifications generated by nutrient profile models are many and various. They range from the simple such as low in fat to the more complex such as healthy.

Some nutrient profile models generate scores, which enable foods to be ranked for their healthiness. Scores are useful for certain applications of nutrient profiling such as food labelling schemes, which require more than a simple binary classification such as healthy and not healthy. Note that the latter is not the same as unhealthy. Most labelling schemes acknowledge that foods cannot simply be classified as healthy and unhealthy but that there are many foods, which are better classified as intermediate between healthy and unhealthy.

Abbreviation: FSA, Food Standards Agency.

Corresponding author: Professor M. Rayner, email Mike.rayner@dph.ox.ac.uk

Nutrient profiling can be used for deciding the healthiness of foods in a variety of situations both regulatory and non-regulatory[3]. The regulatory applications of nutrient profiling can be classified using the '4Ps' of Marketing Theory into those related to the composition (Product), Promotion, availability (Place) and Price of foods. So, for example, nutrient profiling can be used to decide how foods should be reformulated in order to increase their healthiness (Product), which foods should not be advertised to children (Promotion), which foods should be made available in a school vending machine (Place), which foods should be subject to health-related taxes (Price), etc.

Ideally nutrient profiling should not be used for deciding upon the healthiness of diets. The healthiness of a diet is not only determined by the healthiness of the individual foods of which it is composed but the quantities in which those foods are consumed and how they are combined. For example a diet where only one type of vegetable is consumed will (all else being equal) be less healthy than a diet where a variety of vegetables is eaten even if the healthiness score of the single vegetable is higher than the average healthiness score of the variety of vegetables.

This means that nutrient profiling should generally not be used for providing dietary advice. When providing dietary advice, the aim is to provide guidance about foods in the context of how they are consumed and how they can combine to create a healthy diet. In this situation, the context provides crucial information, which a nutrient profile model does not use in its calculations. Some nutrient profile models do not even take account of the serving sizes in which foods are consumed and serving sizes clearly need to be taken into account when providing dietary advice. It is almost impossible for nutrient profile models to take account of the frequency and combination in which foods are eaten.

It should be noted, however, that nutrient profile scores and classifications are sometimes aggregated to generate scores for two or more foods. Aggregated classifications have been used for regulatory purposes such as when deciding upon advertisements for foods where more than one food is featured and aggregated scores have been used for non-regulatory purposes such as monitoring the healthiness of its customers' shopping baskets by a retailer[4] and assessing the healthiness of companies' product portfolios[5]. Perhaps the most pressing need with regard to nutrient profiling is to determine which of the existing models have most validity. The process of validation uses empirical evidence to confirm whether a tool, in this case a nutrient profile model, provides a sufficiently accurate measure of the phenomenon it is designed to capture; in this case the healthiness of foods. Studies of the validation of nutrient profile require the aggregation of model scores and/or classifications[6].

Nutrient profiling for regulatory purposes

Nutrient profiling is essential when there is a need to regulate the marketing of foods for health reasons. This regulation can be compulsory (e.g. imposed through government legislation) or voluntary (e.g. self-imposed by an individual food manufacturer).

One example of such regulation concerns the advertising of foods to children. It is increasingly recognised that most of such advertising is for foods that are unhealthy and that it encourages children to consume less healthy foods than they would do otherwise. In the light of this recognition regulators need either to restrict the techniques used for food advertising to children or to ban that adverting completely. This can either be for all foods advertised to children or just for the advertising of unhealthy foods. When adopting the second option regulators have turned to using nutrient profiling to decide which foods should and should not be advertised.

In some rare instances regulators have sought to decide which foods should not be advertised without a nutrient profile model but with little success. This failure is because it is simpler to score or classify the healthiness of foods on the basis of their nutritional composition than by other characteristics of foods, which affect or correlate with their healthiness, such as the food group to which the foods belong, their degree of processing, etc.

There are now many different nutrient profile models that have been developed for regulatory purposes[7]. The UK Food Standards Agency (FSA)/Ofcom model and the WHO-Euro model are two of the most well-known nutrient profile models developed for the regulation of food marketing to children but there are others that might be discussed. The UK FSA/Ofcom model and the WHO-Euro model were developed by public bodies but nutrient profiled models for the regulation of food marketing to children have also been developed by non-governmental organisations, individual food companies, consortia of food companies, etc. A well-known example of a model developed by a consortium of food companies is that developed for a voluntary initiative aimed at reducing the marketing of unhealthy food to children: the EU Pledge[8].

Here I discuss the UK FSA/Ofcom model and the WHO-Euro model to illustrate both similarities and differences in the way nutrient profile models are constructed and function, how they have been developed, the extent to which they have been tested and validated and their use in regulation. Others have sought to compare models e.g. with a view to deciding which model is best for a regulatory purpose[9]. Generally conclusions about the best model among a set have been made on a number of bases including the nutrients involved, their overall strictness, etc.

The UK Food Standards Agency/Ofcom nutrient profile model

The UK FSA/Ofcom model was one of the first nutrient profile models developed for regulating the marketing of foods to children. By 2004 the FSA in the UK had concluded that much food marketing was detrimental to children's health and had agreed an Action Plan to

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'press for action to address the imbalance in television advertising of food to children'[10].

In 2004 the FSA commissioned the British Heart Foundation Health Promotion Research Group, at the University of Oxford, to carry out analyses to help inform the development of a nutrient profile model for marketing restrictions and such a model was developed between 2004 and 2005. In April 2007, the media and communicators regulator, Ofcom, introduced regulations to prohibit the advertising of foods defined as unhealthy by the nutrient profile model, the UK FSA/Ofcom model, during children's programmes and programmes for which children under the age of 16 years form a disproportionate part of the audience.

The UK FSA/Ofcom model uses a scoring system which balances the contribution made by nutrients and other food components that are important for a healthy diet (protein, fibre and fruit, vegetables and nuts) with that of components people should eat less (energy, saturated fat, sugars and salt). For a full description of the model see technical guidance published by the UK Government Department of Health[11].

The development of the UK FSA/Ofcom model took place in three stages and involved the testing of more than 50 prototype models. The first stage involved the development of a prototype model called Model SSCg3d[12]. During this stage it was agreed that the model should use a scoring system, should involve food components both to be encouraged and discouraged, etc. The second stage, following a consultation exercise with a range of stakeholders, resulted in a new model with a slightly different set of nutrients to Model SSCg3d (total sugars instead of free sugars, protein instead of iron, calcium and *n*-3 fatty acids, etc.). This model was called Model WXY[13]. The third stage, following a subsequent but shorter period of consultation, this time, in particular, with the UK Government Scientific Advisory Committee on Nutrition, led to the creation of the final model (Model WXYfm)[14] here called the UK FSA/Ofcom model.

In the development of the UK FSA/Ofcom model various prototypes were compared with each other using sets of indicator foods, some of which were pre-categorised as healthy or unhealthy with reference to food-based dietary guidelines. Comparisons were made between models using a combination of statistical tests and more subjective assessments by a small expert group consisting of academic nutritionists and representatives from industry, consumer organisations and public health bodies[12–14].

Two prototype models were also compared using an on-line survey of professional nutritionists in the UK. The survey asked the nutritionists to assess forty foods for their healthiness. The forty foods were randomly drawn from 120 different food products representative of the UK diet. The professionals' ratings were compared with the ratings obtained from the prototype models. UK FSA/Ocom scores showed a close correlation with the professional ratings[15].

Subsequent to the adoption of the model by Ofcom, the British Heart Foundation Health Promotion Research Group has continued to investigate the validity of the model. The group has, in particular, showed that people in the UK who have unhealthy diets consume more of their energies in the form of foods defined as unhealthy by the model[16]. It has also shown that diets with a greater proportion of foods classified as unhealthy by the model are associated with a greater prospective risk of all-cause mortality and other health-related outcomes but the relationship was found to be complicated[17]. There was a clearer relationship when the variety in individuals' diets was taken into account[18]. A group of French researchers have taken these analyses forward and shown that a higher diet quality score (based on the average UK FSA/Ofcom scores of the foods of which diets are composed) is associated with a lower prospective risk of weight gain, metabolic syndrome, cancer and CVD[19–22].

The development of the model did not end with its adoption by Ofcom. In 2007 the FSA established an independent panel to review the model. The review panel endorsed all the major features of the model[23] and in 2009 the FSA board confirmed that the model was generally scientifically robust and fit for purpose and agreed that there was no need to modify the model for the time being[24]. In October 2010 technical support for the model was transferred from the FSA to the UK Government Department of Health and in 2016 the Department decided upon another review of the model in the light of new recommendations on sugar and fibre from the Scientific Advisory Committee on Nutrition[25].

The UK FSA/Ofcom model has been modified by other bodies around the world for a variety of regulatory purposes including regulating the advertising of foods to children (in Ireland) health claims on food packages (in Australia, New Zealand[26] and South Africa), front-of-pack supplementary nutrition information (in Australia, New Zealand[27] and potentially France[28]). In the process of adapting the model for different purposes and contexts various changes have been made to the model, some of which are probably improvements.

The WHO-Euro nutrient profile model

The WHO began to be interested in nutrient profiling in about 2009 and this culminated in a technical meeting in London in October 2010[29]. The aim of that meeting was to review a technical manual designed to help WHO member states develop their own nutrient profile models. The manual was subsequently field-tested in South Africa, Thailand, Canada, Norway, Slovenia and the United Arab Emirates but has never been published.

In 2010 WHO issued guidance to member states on the marketing of foods to children, as endorsed by the Sixty-third World Health Assembly in that year[30]. However, a 2013 report, from the WHO European Regional Office indicated that few countries in the European Region had implemented such restrictions[31]. One of the obstacles to policy development identified by member states was the challenge of classifying foods

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for which marketing should be restricted. Accordingly the WHO European Regional Office, in collaboration with WHO Headquarters, resolved to develop a nutrient profile model for member states to use for restrictions on the marketing of foods to children[32] and a model, the WHO-Euro model, was published in 2015[33].

The WHO-Euro model first divides foods into twenty categories and then employs different thresholds within categories to decide which foods within those categories are suitable for marketing to children. These thresholds are for energy, fat, saturated fat, total sugars, added sugars, non-energetic sweeteners and sodium.

The development of the WHO-Euro model began with a technical meeting in Copenhagen in December 2013. The meeting involved representatives of member states and external experts and initially involved reviewing existing nutrient profile models used for marketing restrictions in Europe. Four models developed or endorsed by European governments were identified from Denmark, Norway, the UK and Ireland. Following this review it was agreed that a new model based on the Danish and Norwegian models should be developed and that this new model should differ as little as possible from the original models. A draft of the model was discussed at a meeting of the European Network on Reducing Marketing Pressure on Children in March 2014. And a revised draft model was tested by member states of the European Region in the subsequent months. The final version of the model, issued in 2005, incorporated the results of this testing[32].

This testing involved applying the model to ten country-specific food composition databases each of approximately 200 foods commonly consumed by and/or commonly advertised to children. This testing was mainly done to identify practical problems with applying the model. There has been, as yet, no systematic attempt to test the validity of the model with respect to healthy diets, or prospective health outcomes, as there has been for the UK FSA/Ofcom model.

The WHO-Euro model has yet to be incorporated into any regulation to control the marketing of foods to children but some European countries are considering doing so. There are, of course, other barriers to the introduction of such regulations besides the lack of a nutrient profile model.

Meanwhile the WHO-Euro model has been adapted by other WHO regional offices for use by other WHO regions: the Eastern Mediterranean Region and the Western Pacific Region. The model developed by the WHO Eastern Mediterranean Regional Office, the WHO-EMRO model has yet to be published but the model developed by the WHO Western Pacific Regional Office, the WHO-WPRO model, has recently been issued[34]. The Pan American Health Organization (the American equivalent of the European Regional Office of the WHO) has also recently published a nutrient profile model, the WHO/PAHO model, for a range of regulatory purposes but this model differs substantially, both in the way it is constructed and in the way it classifies foods, from the other WHO regional models[35]. For example The WHO/PAHO model is much stricter than the other regional models.

Differences and similarities between the UK Food Standard Agency/Ofcom and WHO-Euro nutrient profile models

The successful development of the UK FSA/Ofcom and WHO-Euro nutrient profile models demonstrates that it is possible to come to an agreement on a model for regulating the marketing of foods to children. In the case of the UK FSA/Ofcom model by government institutions in the UK for use nationally and in the case of the WHO-Euro model by the WHO for use internationally.

However the algorithms for the models look very different. The UK FSA/Ofcom model involves scoring all foods and drinks on an equivalent basis (although drinks are treated slightly differently from foods when it comes to classifying whether the products are unhealthy or not) whereas the WHO-Euro model uses thresholds within twenty food categories.

Despite differences in the way the two models are constructed, they agree on the way most foods should be classified. Both models agree, for example, that most confectionery, sugary drinks, sugary breakfast cereals and salty snacks should be classified as unhealthy and thereby unsuitable for advertising to children and that most fresh fruit, fresh vegetables, high fibre breads and breakfast cereals should be classified as not unhealthy and thereby suitable for advertising to children.

But the two models do classify some foods differently. For example the UK FSA/Ofcom model classifies both orange juice and diet cola as suitable for advertising to children whereas the WHO-Euro model does not, and the UK FSA/Ofcom model classifies olive oil as unsuitable for adverting to children while the WHO-Euro model classifies does not. Moreover the WHO-Euro model is somewhat stricter than the UK FSA/Ofcom model, i.e. the WHO-Euro model classifies more foods as unsuitable for advertising to children than the other model. For instance: of a representative sample (n 1992) of packaged foods available for purchase in July/August 2013 in the UK, Slovenia, Germany, Spain and the Netherlands, 47 % could have been advertised to children under the UK FSA/Ofcom model but only 32 % under the WHO-Euro model[35].

The reasons for the difference in the way the UK FSA/Ofcom and WHO-Euro models are constructed are mainly historical. Most of the models that have been proposed and/or adopted for the regulation of food marketing, including models used by the food industry such as the EU Pledge model, have been multi-category models with thresholds within categories. Such models are easier to understand than those using only one or a few categories together with scoring. They can also take implicit account of food components that need to be discouraged or encouraged without setting explicit thresholds for those components. Models with multiple categories and thresholds within categories are therefore more popular in some quarters.

Models that rely on dividing foods into categories do, however, have their drawbacks. The main problem is that food categorisation is not simple and that most systems that have been used for nutrient profile models are less than satisfactory. Based on the precedent of the

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nutrient profile mode developed by the Norwegian Government the developers of the WHO-Euro model considered that the best way of defining categories for their model was to use the Harmonised Commodity Description and Coding System, a multipurpose international product nomenclature system developed by the World Customs Organization[32]. But even this method has it downsides; it is not user-friendly nor is it freely available without paying a subscription. To avoid the need for food categories, the developers of the UK FSA/Ofcom model sought to develop a model with just two categories; foods and non-alcoholic beverages. It is noteworthy that those who have sought to improve the model have added additional categories and there are good nutritional reasons for this[36].

For both the two nutrient profile models the process of development took a considerable amount of time, even once it had been agreed that there was a need for a model. In the case of the UK FSA/Ofcom model the process involved much consultation with stakeholders, particularly with the food industry, whereas for the development of the WHO-Euro model, governments of WHO member states were consulted, but the food industry was not. Perhaps for this reason the UK FSA/Ofcom it is less strict than the WHO-Euro model. The UK FSA/Ofcom model took longer to develop than the WHO-Euro model because it was developed from scratch rather than being based on models that had already been developed and indeed used in practice.

The UK FSA/Ofcom model has found general acceptance in many quarters, not just among regulators, but also among researchers, non-governmental organisations, etc. It is also used for its primary purpose in the UK and, in a modified form, for regulatory purposes in other countries. This is because the model is relatively simple to use, relies on generally available compositional information, has been quite extensively validated and can and has been adapted for other applications besides marketing regulations. It remains to be seen whether the WHO-Euro model achieves similar acceptance and use. It is not yet used for any regulation to control the marketing of foods and it will be less easy to adapt for applications besides marketing regulations.

Choosing between the two models (and indeed others) when, for example, developing regulations on the marketing of food to children in a country which does not have such regulations, will depend on a variety of considerations. The source of the model will clearly be important and for this reason models developed by the WHO may be more acceptable than other models.

The future of nutrient profiling for regulatory purposes

Nutrient profiling has already proved useful for certain regulatory purposes, particularly for regulating the marketing of foods to children, both on a compulsory basis but also on a voluntary basis by the food industry. But in practice regulations involving nutrient profiling remain rare and nutrient profiling's potential has not yet been fully realised.

An increase in the number of countries implementing regulations on the marketing of foods to children seems likely given, for example, clear WHO support for such measures. But in practice most of such regulation has been concerned with advertising rather than other marketing methods. Nutrient profiling has sometimes been used to control the availability of unhealthy foods in schools, with or without the use of compositional criteria for school meals.

Nutrient profiling can, of course, be used to control the marketing of foods to adults as well as children. One regulatory purpose for which nutrient profiling has long been recognised as potentially useful is in restricting the use of spurious health-related marketing claims for foods. Indeed the term 'nutrient profiling' for foods gained currency with a 2003 proposal from the European Commission for a European Union regulation on nutrition and health claims[37] in which it was suggested that a nutrient profile model should be used to decide which foods can bear health and nutrition claims.

The Regulation was published in 2006 and came into force in July 2007[38]. It stated that, 'By 19 January 2009, the Commission shall… establish specific nutrient profiles and the conditions, including exemptions, which shall be respected for the use of nutrition and health claims on foods and/or categories of foods'. However the Commission has failed to abide by the Regulation in this respect. It seems progressively unlikely that it ever will although a few other jurisdictions have developed a nutrient profile model for regulating health claims (in the case of Australia and New Zealand a model based on the UK FSA/Ofcom model[26]). If the Commission were to develop a nutrient profile model it is likely that this would be more widely used for regulatory purposes than just the regulation of health claims.

Nutrient profiling has long been used in the provision of health-related food labelling including (i) front-of-pack supplementary nutrition information in the form of, for example, traffic-light labelling (as in the UK) or health star rating (as in Australia and New Zealand) and (ii) health logos such as the Nordic keyhole logo (as in Sweden, Norway and Denmark) etc. But there is no general agreement, on an international basis, which of these many forms of health-related food labelling are most useful to consumers, both with respect to the optimal underlying nutrient profile model or the format for that labelling. In practice, government-developed health-related food labelling schemes involving explicit nutrient profile models remain quite rare[39] although labelling claims about the healthiness of foods are common[40].

A relatively new use for nutrient profiling that has emerged in recent years is in deciding which foods should be taxed for health-related reasons. Health-related taxes for food are becoming increasingly popular as a means for reducing the consumption of unhealthy foods. These health-related taxes normally have an underlying nutrient profile model, however rudimentary. For example the sugary drinks tax proposed for the UK has a rather simple nutrient profile model which first distinguishes sugary drinks from all other products and then has two thresholds for sugar content to define 'very high sugar' sugary drinks to which the highest tax rate will apply, and 'high sugar' sugary drinks to which a lower tax rate will apply[41]. It is arguable that the nutrient profile models that are used to decide which

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foods should be taxed on health grounds should take account of more nutrients than just sugar. The regulatory uses of nutrient profiling discussed in this section do not exhaust its many potential uses explored more extensively elsewhere.

Conclusions

Although nutrient profiling is clearly useful for some regulatory purposes, its potential is only very slowly being realised. There are a number of reasons for this.

Nutrient profile models will only be developed once there is a perceived need. For example the need for nutrient profiling in regulations aimed at restricting the advertising of unhealthy foods to children is now generally recognised. Conversely the value of nutrient profiling is not generally acknowledged when devising health-related food taxes even though health-related taxes implicitly involve nutrient profiling.

But another factor hindering the development of nutrient profiling is the lack of interest among nutrition researchers, perhaps because of the persistence of the myth that there is no such thing as a healthy food only a healthy diet. But there are also other reasons. Nutritional practitioners seem mainly concerned with the provision of dietary advice in which nutrient profiling has little, if any, part to play. But given the enormity of the global challenge of diet-related ill health and the growing recognition that improvements in diets will only come about if the marketing of food is regulated, then this situation should and will surely change.

If nutritionist were to become more interested in nutrient profiling then there is a large number of urgent research questions related to nutrient profiling and in particular its regulatory use. These include: (1) How can we decide between nutrient profile models when selecting a model for a new regulatory use? In particular which models provide the most accurate measure of the phenomenon they are designed to capture, i.e. the healthiness of foods; (2) Can we develop ways of deciding how strict a nutrient profile model should be for any given application; e.g. should a model developed for marketing restrictions classify the majority of foods as suitable for advertising to children or unsuitable? (3) Can the same nutrient profile model be used for different applications; e.g. can a model developed for marketing restrictions be used for deciding which foods should be taxed? (4) Do nutrient profile models need to take account of current diets; e.g. should a model developed for marketing restrictions in a developed country be used for such restrictions in a developing country where the burden of diet-related diseases is substantially different?

None of these questions can be answered satisfactorily at the moment. It is about time they were.

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Conflict of interest

The author was closely involved in the development of the UK FSA/Ofcom and WHO-Euro nutrient profile models described in the present paper and his research centre received funding from the UK FSA to carry out analyses in connection with the development of the UK FSA/Ofcom model.

Authorship

The author is solely responsible for the views expressed in the present paper.

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