



Review Article

## Nutrient Profiling: An Approach Promoting Healthy Food Choices

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Received: 16/05/2014

Revised: 16/06/2014

Accepted: 18/06/2014

### ABSTRACT

Over the past few years, there has been a steep rise in the problems of overweight, obesity and other chronic degenerative diseases owing to the intake of unhealthy diets. There is an urgent need for a system that could assist the consumers in making healthy food choices. 'Nutrient profiling' helps in classification of foods according to their nutrient content. There are several nutrient profiling models that have been developed all over the world so far for various purposes like promotion of food to children, regulation of health claims, food certification or even for research purpose based on different criteria. However, there is still need for further research and validation of the models for easy and effective applicability of this concept in promoting healthy diets. Food based strategies aimed at improving public health can be strengthened by nutrient profiling. This paper reviews the concept of nutrient profiling and evaluates the various models in use across the world.

**Key Words:** Obesity, Nutrient profiling, Healthy diets, Food choices, Food based strategies, Public health.

### INTRODUCTION

All developing countries are experiencing dietary and nutritional shifts.<sup>(1)</sup> <sup>2)</sup> There has been a shift in food preferences away from cereals towards meat, fish, eggs and fruits and vegetables. In India, the National Family Health Survey (NFHS)-3 data (2005-2006) has shown that both under- and over nutrition do exist in populations of all income levels; and only about 50% of the population is normally nourished. Among the high income urban population, the prevalence of over nutrition is high. Almost 45% of the adult disease burden in low-income and middle-income countries is attributable to non-communicable

diseases.<sup>(3)</sup> There are many risk factors associated with the prevalence of chronic diseases worldwide and one of the risk factors is unhealthy diet which is due to poor food choices.<sup>(4)</sup> Over the years, many initiatives have been taken by various countries to increase consciousness on banning or limiting the promotion of 'unhealthy' or 'junk' foods. But, few attempts have been made on defining these foods.<sup>(5)</sup> Some nutrient profiling models have been developed to classify foods as 'healthy' and 'unhealthy'.<sup>(6)</sup> They have been used for categorizing foods on the basis of their nutritional composition so as to develop strategies and interventions for

healthy food selection. 'Nutrient Profiling' is one of the approaches besides Nutritional labeling on foods which could help in classification and selection of foods according to their nutritional composition.

#### ***Nutrient Profiling- Concept and Uses***

"Nutrient profiling is the process of categorizing or ranking foods relative to one another according to their nutrient profile". The term "nutrient profile" describes the nutritional composition of a food or beverage.<sup>(7)</sup> However, in a technical meeting held by WHO (World Health Organization)/IASO (International Association for the Study of Obesity) in London, United Kingdom (UK) in 2010, it was discussed that the proposed definition was too simple, and should reflect the aim of categorizing foods based on their "healthfulness". It was also recommended that "classifying" compared to "categorizing" would be more preferable, as a nutrient profile model already takes into account categories of foods.<sup>(5)</sup> Hence, the definition was changed to "Nutrient profiling- as the science of classifying or ranking foods according to their nutrient contents for reasons related to preventing disease and promoting health".<sup>(8)</sup>

The first system for categorization of foods was developed in 1973.<sup>(9,10)</sup> and later called the "Nutritional Quality Index" (NQI) published in a book in 1979. Hansen's NQI used 18 nutrients in 2,000 calories of food as the basis, relative to the RDAs for those nutrients. It was a 'nutrient-by-nutrient profiling system' and made use of individual scores rather than aggregating scores across nutrients to create a composite score for a given food.<sup>(10,11)</sup> Some health agencies including government and other bodies have also developed standards for symbols which food manufacturers can use to label foods as 'healthy'.<sup>(12,13)</sup> Thus, the concept of nutrient profiling is not new, but most of the nutrient profiling models have not been developed

systematically.<sup>(5)</sup> Work in this area conducted more than 3 decades ago, led to the conception of many indices on food quality, nutrient quality profiles, and nutrient-to-nutrient ratios.<sup>(14)</sup>

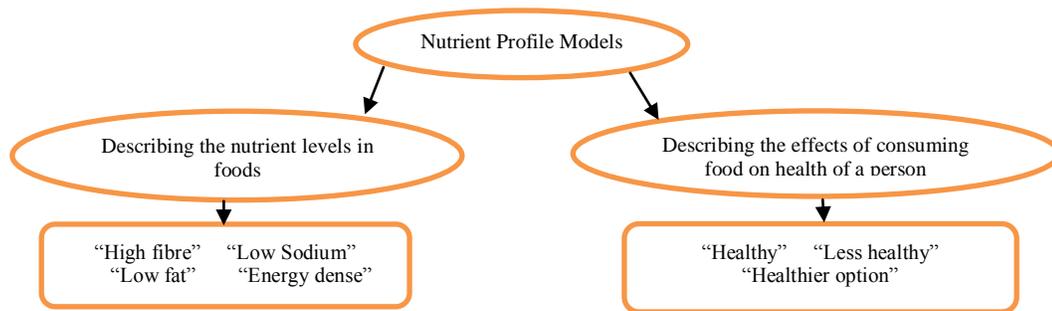
Several nutrient profiling systems have been developed so far and are used for various purposes, that include front-of-pack labeling,<sup>(15)</sup> food service policy,<sup>(16)</sup> nutrition education,<sup>(17)</sup> restriction on food advertising to children,<sup>(18,19)</sup> and the eligibility of foods to bear health claims.<sup>(19-21)</sup> The profiles are generally developed to allow classification of foods as 'healthy' or 'less healthy'.<sup>(20)</sup> A study stated that nutrient profiling helps the consumers to understand the contribution of nutrients in the food and helps them make healthier food choices. It also encourages food manufacturers to develop more healthful food products. Based on the combination of key nutrients relative to calories, the profiles find a number of applications. It could be a valuable tool for the nutrition professionals as it can help them in identifying nutrient dense foods for dietary guidance and nutrition education.<sup>(22)</sup>

"Nutrient density is the relative ratio obtained by dividing a food's contribution to the needs for a nutrient by its contribution to calorie needs".<sup>(23)</sup> Converting the concept of nutrient density into a working system to help consumers achieve a more nutrient-rich diet is the biggest challenge of a nutrient profile design.<sup>(24)</sup> The 2005 Dietary Guidelines for Americans laid emphasis on the quality of individual foods<sup>(14)</sup> rather than on total diets.<sup>(25)</sup> Front-of-pack signpost labeling is gradually being seen as an essential tool in combating unhealthy food choices and improving public health. Thus, much consideration in policy formulation and research is given to nutrient profiling systems so as to determine optimal nutrition criteria. However, the categorization of foods by various systems differs as there is no universally acceptance of systems.<sup>(26, 27)</sup>

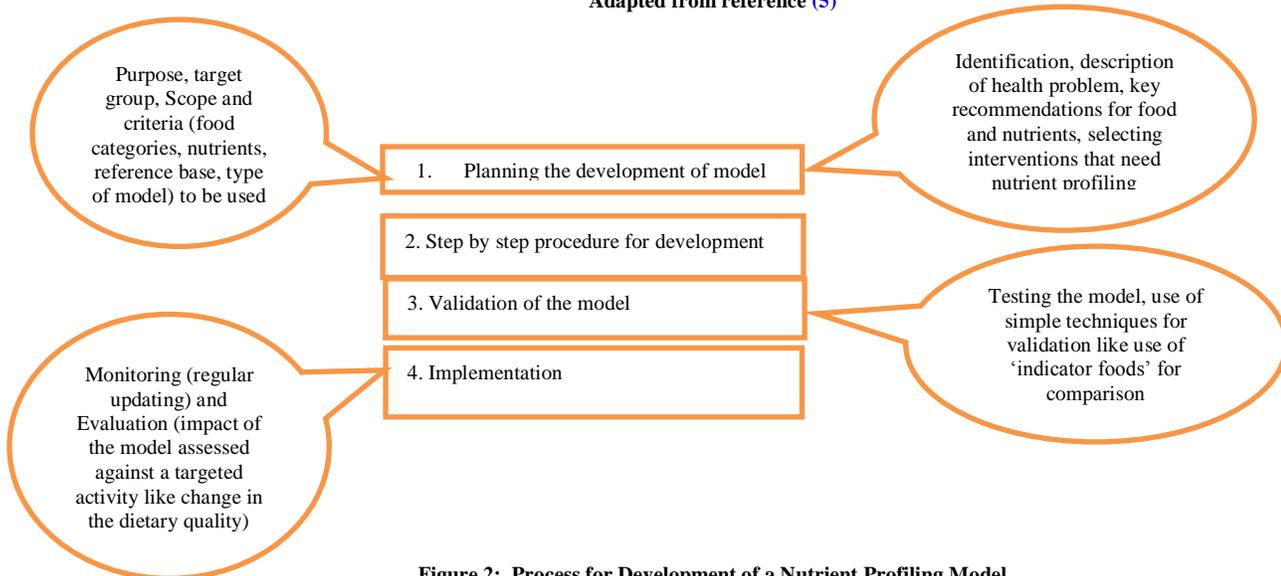
**Model Development Process:** The nutrient profile models have been grouped into two categories-one describing the levels of nutrients in foods and the other describing the effects of consuming food on the health of a person (Figure 1).<sup>(5)</sup> Models tend to differ depending on the purpose for which they have been developed. However they have to fulfill a basic condition; they have to

be developed using a systematic, clear and rational process.<sup>(28)</sup>

Every nutrient profile model involves four stages: Planning, Development, Validation and Implementation (Figure 2).The nutrient profile models for their successful development and implementation should have a clear purpose, should be scientific, systematic, rational, logical and valid.<sup>(29)</sup>



**Figure 1: Two Groups of Nutrient Profile Models**  
Adapted from reference (5)



**Figure 2: Process for Development of a Nutrient Profiling Model**  
Adapted from reference (5)

Criteria for development-Nutrient-profiling models are developed on the following basis:

**A. Nutrients**

1. Models using beneficial/positive nutrients or nutrients to encourage (like vitamin C, Calcium)

2. Models using only nutrients to limit (like total fat, added sugars, sodium) or,
3. Models using some combination of both.

A mixed profiling model may provide a more stable nutrient profile of the food item than focusing only on nutrients to encourage or nutrients to limit.<sup>[19]</sup> Certain indicator nutrients could be included that can help differentiate between the food products within a food group (e.g. iron for meat, calcium or protein for dairy products).<sup>(30)</sup> For instance, calcium as an indicator nutrient could be selected for milk products for differentiating between the calcium rich foods from those that have less calcium. EFSA (European Food Safety Authority) in a report stated that a limited number of nutrients have to be included to avoid complex nutrient profile models. Overall, the selection of nutrients should be appropriate for proper classification of food products in the different food groups and should be determined by their public health importance. The nutrients included were saturated fatty acids, unsaturated fatty acids, sodium, and dietary fibre, the intakes of which did not conform to nutrient intake recommendations in many Member States of the European Union.<sup>(13)</sup>

### ***B. Threshold and Continuous (or Scoring System)***

Threshold systems consider food items that have a nutrient content higher or lower than a stated threshold; nutrient content claims such as “low sodium” use a threshold model. They divide the foods into two or more categories.<sup>(28)</sup> The models used for labeling foods as ‘healthy’ make use of threshold system. Examples of Threshold system are- The Dutch tripartite system by the Netherlands Nutrition Centre.<sup>(31)</sup> The tripartite system classifies food products into 3 groups as- ‘preferable’ having a positive influence on health, ‘middle road/ neutral’ and ‘exceptional’ ones which have a negative influence on health. For products like breads and breakfast cereals, the minimum amount of fibre required to be classified under ‘preferable’ category is 6

grams/100 grams, for ‘neutral’ category is 5-6 grams and for ‘exceptional’ category is less than 5 grams/100 grams. Thus, the classification helps in recognizing favorable and unfavorable choices. The Swedish green ‘keyhole’ from Sweden is based on low fat and fibre rich foods and has been in use since 1989.<sup>(32, 33)</sup>

On the other hand, the Continuous systems compute and assign a score to each food item, which is then used to rank and compare foods. The models based on this system can differentiate between foods high or low in certain nutrients. For example- if we have two products one high in sugar and saturated fatty acids and another one high in sugar but low in saturated fatty acids, then these foods can easily be distinguished and ranked properly using a continuous system by assigning scores to each of the food items based on their nutrient composition.<sup>(28)</sup> The examples of Continuous systems include the Nutritious Food Index (NFI),<sup>(34)</sup> the model RRR (Ratio of recommended to restricted food components) which include protein, fibre, vitamins A and C, calcium and iron as nutrients to recommend and saturated fats, energy, sodium and sugar as nutrients to restrict,<sup>(35)</sup> the model developed by the Food Standards Agency (FSA) of the United Kingdom,<sup>(28)</sup> The Food Profiler,<sup>(36)</sup> and French Food Safety Agency model.<sup>(37)</sup> The ranking/scoring system is used in labeling and also for several other purposes, like developing strategies for new product development,<sup>(38)</sup> and also for regulatory purposes for the evaluation of foods bearing health claims or foods marketed to children.<sup>(39)</sup> This system is also used for regulating the ease of access of certain foods at public establishments like schools, workplaces, hospitals and prisons.<sup>(40)</sup>

### ***C. Reference Base***

per Serving or  
per 100kilocalories (Kcals) or  
per 100grams(g) or

a combination of above

Per 100 g and per 100 Kcals are used as base when the foods are categorized only on the basis of their nutritional quality whereas per serving as a base is used when in addition to the nutritional quality of foods, it also takes into consideration the way food delivers the nutrients. However, defining the serving size becomes a challenging task as it changes with age group. The details of different models using different reference base are documented elsewhere.<sup>(13, 18)</sup>

#### ***D. Category specific and General/Across the board***

There are also nutrient profiles in 'general' and/or 'category specific'. For 'category specific' profile models, food groups like cereals (e.g., breakfast cereals-wheat, rice, bread etc.), milk products (like curd, cheese etc.), meats could have nutrient profiles that are specifically related to the potential of food products in those groups that would affect the balance of the diet. Thus, different diet quality groups could be identified through different food categories and on the basis of these the consumption of healthy or unhealthy diets could be assessed by assigning scores to each food under the specific food categories. The models covered under this category are simple and easily adaptable but have a limitation of difficulty in defining many food groups. These models have different criteria for defining healthiness or unhealthiness of foods under different food categories. The general profile models also called 'Across the board' are made for the foods in general and can have one nutrient profile for all foods. These types of models are mainly used when foods under different categories are to be compared and have the same criteria for defining healthiness or unhealthiness of all food categories. These models do not require defining and managing of individual foods. But, they are

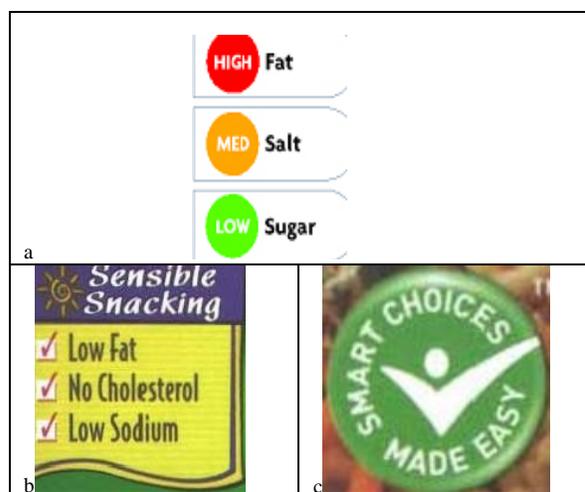
not suited for identification of greater variances in the nutritive compositions of different food groups as that would create a more complex model which could be difficult to adapt.<sup>(18)</sup> It is suggested that nutrient profile systems intended to promote a healthy food intake should be "category specific" and with lesser number of categories to avoid complexity as these help us know the healthier foods within the food groups.<sup>(41)</sup>

#### ***Various Nutrient Profile Models:***

Traditionally, the nutrient adequacy of the diets was evaluated by comparing the nutrient intake with RDAs (Recommended Dietary Allowances). Nutrient Adequacy Ratio (NAR) and Mean Adequacy Ratio (MAR) were the two key measures used to assess diet adequacy.<sup>(25)</sup> But, over a period of time there has been a rise in the independently registered food rating systems, nutrition symbols, and signs displayed on the front of pack of the food products, on shelf tags below the products, or on signage in grocery shops and supermarkets.<sup>(42)</sup> In the United States, a system of nutrient profiling has been used to make shelf labels and front-of-pack symbols to convey the nutritive value of foods to the consumer merely at a glance<sup>(43,44)</sup> and this has been used for many years.<sup>(12)</sup> The use of Nutrient profiling systems reduces the intellectual effort and the time required to process information which is much lesser as compared to more detailed labels. They enable and improve consumer decisions with regard to healthy food selection.<sup>(45)</sup>

A variety of systems have been developed by food manufacturers and retailers with different logo designs(Figure 3) like Smart Spot logo from PepsiCo displaying white check mark inside a green circle with a slogan "smart choices made easy",<sup>(46)</sup> Guiding Stars nutrition navigation program,<sup>(47)</sup> Nestlé's Nutritional profiling system,<sup>(48,49)</sup> Smart Choice Program

displaying a green check mark,<sup>(50)</sup> The Sensible Solution from Kraft foods displaying a green flag with yellow sun.<sup>(51)</sup> All these are front-of-pack labeling schemes aim at facilitating consumers make healthier food choices. About 118 models have been identified so far, of which 63 are meeting the WHO inclusion criteria but only one-third of those have been validated.<sup>(5,52)</sup> Different models have been conceptualized for different purposes which include labeling requirements, regulatory purposes for products to bear a claim, food certification, T.V advertising/marketing of food products to children and few of them developed for research purpose. Table 1 provides a brief description of few of them.



**Figure 3 Different logo designs developed for helping consumers choose foods wisely.**

Source: <sup>a</sup>Traffic light labeling<sup>(30)</sup>

<sup>b</sup>Kraft's sensible solution<sup>(51)</sup>

<sup>c</sup>PepsiCo Smart Spot logo<sup>(46)</sup>

**Table 1: Comprehensive description of some of the Nutrient Profile Models existing so far.**

S.N.	Name of the Model	Country/Organization	Purpose	Across the Board/ Food category specific	Reference Base(per serving/ per 100 g/per 100 Kcals)	Type of Model (Threshold/Scoring)
1.	UK FSA (WXYfm) <sup>(30)</sup>	UK; UK FSA Agency	Promotion of food to children	Across the board	Per 100 g	Threshold and Scoring
2	UK FSA SSCg3d <sup>(7)</sup>	UK; UK FSA Agency	Research purpose for Marketing of food to children	Across the board	Per 100 g	Threshold and Scoring
3.	Dutch Tripartite Netherlands Nutrition Centre <sup>(31)</sup>	Netherland; Netherlands Nutrition Centre	Research purpose	Food Category Specific	Per 100 g	Threshold
4	Disney food Guidelines <sup>(53)</sup>	Disney Corporation	Promotion of food to children	Food Category Specific	Per 100 Kcals	Threshold
5	The Food Profiler <sup>(54)</sup>	Bio Intelligence Service	Regulation of health Claims	Food Category Specific	Per 100 Kcals	Scoring
6	FSANZ model <sup>(21)</sup>	Food Standards Australia New Zealand	Regulation of health Claims	Food Category Specific	Per 100 g	Scoring and Threshold
7	Smart Spot <sup>(46)</sup>	PepsiCo	Food Certification	Food Category Specific	varies with food - per serving or per 100Kcals	Threshold
8	Naturally Nutrient Rich (NNR) Score <sup>(14)</sup>	University of Washington	Research purpose	Across the board	Per 100 Kcals	Scoring
9	NutriMap <sup>(36)</sup>	France; Biointelligence Service	Research purpose	Food Category Specific	Per 100 Kcals	Scoring
10	MyPyramid Food Guidance System <sup>(55)</sup>	USA; USDA Center for Nutrition Policy and Promotion, Alexandria	Research purpose	Food Category Specific	Per Serving	Not Available
11	Overall Nutritional Quality Index (ONQI) <sup>(56)</sup>	USA; Yale University School of Medicine	Research purpose, To develop an algorithm for assessing the overall nutritional quality of foods	Across the board	Not known	Scoring
12	Nutrient for Calorie index <sup>(57)</sup>	USA	Research purpose	Across the board	Complex	Scoring

**Validation of The Models:** Validation/ Testing of the nutrient profile models is the most crucial step for appropriate classification of foods and their eligibility to bear health or nutritional claims. It is an essential step and requires a database of energy and nutrient content of wide range of foods.<sup>(13)</sup> Validation of the models has been done using food modeling at the development stage. The performance of different models is compared but, models developed for different purposes raise the question on how effective the comparison is. Objective systems for validating the profile models are needed which function outside the model.<sup>(18)</sup> Linear programming is also a valuable tool for testing nutrient profile models and validating the concept of nutrient profiling.<sup>(58)</sup> The Daily menu method like Choices Criteria on daily intake of nutrients developed to evaluate the potential effects of nutrient profiling is also a useful means and can have worldwide application.<sup>(59)</sup> In US, the systems have gone through systematic validation to test the accuracy by comparing a system against a single measure or a group of measures.<sup>(29)</sup>

Nutrition Score is one of the simplest and straightforward method which can be used globally and on all food and beverage categories. The selection of nutrients for the Nutrition Score is in agreement.<sup>(15)</sup> Then, there is traffic-light labeling scheme also known as sign post labeling by the Food Standards Agency, UK which aids in quicker comparison among food products and easier selection of healthier options with a criterion of red (high), orange (moderate) and green (low) levels of fat, saturated fat, sugar and salt This system has proven to work better than other scoring or numerical systems or use of dietary allowances for making comparisons.<sup>(60)</sup>

The Nutrient Rich Foods (NRF) Index is another system in use for assessing the nutritional quality of foods by ranking

foods according to their nutrient content.<sup>(24, 43,44)</sup> The NRF 9.3 version is based on the sum of the percent daily values for 9 nutrients to encourage (protein, fiber, vitamins A, C, and E, calcium, iron, potassium; and magnesium) minus the sum of the percentage of maximum recommended values for 3 nutrients to restrict in the diet (i.e., saturated fats, added sugar, and sodium) with all daily values calculated per 100 kcal and capped at 100%. This index can be applied on individual foods as well as total diet.<sup>(44)</sup> But, still further development is needed to identify nutrient rich foods within food groups and across the food groups.<sup>(61)</sup> The UK FSA OfcomWXYfmmodel developed for regulating the advertising of foods on T.V to children in United Kingdom is considered one of the best validated and most appropriate nutrient profile models The model is ‘Across the board’ and uses both threshold and scoring criteria. It includes positive nutrients like energy, protein, fibre, fruits, vegetables and nuts, and saturated fats, added sugar and sodium as negative nutrients. The results obtained are in the form of ‘healthier’ and ‘less healthy’ foods i.e. foods which are allowed to be advertised or not allowed to be advertised to children.<sup>(7, 30,62)</sup>

FSANZ (Food Standards Australia New Zealand) model is a modified and adapted version of the UK FSA model for use to regulate the eligibility of products to bear health claims. In this model, an extra food product category has been introduced to assess the eligibility of edible oils, edible oil spreads, butter and margarine, and cheese and processed cheese with a calcium level of more than 320 milligrams/100 grams. The model has been verified using a database of over 10,000 foods collected from Australian and New Zealand foods.<sup>(21)</sup> The Heart Foundation (HF) Tick 12, a self -funded labeling scheme has been used in New

Zealand and Australia since 1990 to promote healthier food choices. In 2007, a revised form of the HF Tick model was used in order to determine 'healthier' foods qualified for publicizing in the Supermarket Healthy Options trial (SHOP), which was a large (n=1104) randomized controlled trial of the usefulness of discounts on price of the food items and customized nutrition education for improving food purchases in the supermarket.<sup>(63,64)</sup> Both, UK FSA OfcomWXYfm and FSANZ models are considered to be one of the most appropriate and best validated models been developed so far.<sup>(41,62)</sup> A detailed account of various several other nutrient profile models have been described elsewhere.<sup>(12,18,19,28,65,66)</sup> In spite of the differences in the nutrient profile models, they have been shown to associate well with one another.<sup>(6,66,67)</sup> A study has shown a good agreement between foods categorized as healthy by nutrient profiling systems and foods consumed in higher amounts by healthy eaters based on a global index of dietary quality.<sup>(68)</sup>

**Limitations of Nutrient Profiling:** Though this system of classifying foods on the basis of their nutritional composition might help in encouraging the intake of healthier foods but it is not a holistic approach. Nutrient profiling will not be able to solve all the problems related to health of the individuals due to the complex interaction of various factors affecting health. It is not only the nutritional quality that can improve the health but also the frequency of consumption of foods, the portion size, the dietary diversity and many other factors which play a role in the diets of the people. The other limitation of nutrient profiling is that it does not take into account the other non-nutrient substances like phytochemicals, food additives and contaminants. Also, the system does not address the influence of environment, religion and ethnicity on the food

consumption pattern.<sup>(5)</sup> Applying the nutrient intake recommendations which have been established for the overall diet to the individual foods poses an inherent difficulty. Also, not much consideration is being given towards the changes occurring in the nutrient content during cooking/preparation, such as addition of fat, sugar or salt which could adversely affect the diet quality. Transparency in the decisions is also needed to address the limitations of the various systems.<sup>(13)</sup>

## CONCLUSION

This paper presents a comprehensive review on the concept of 'Nutrient Profiling', the criteria, steps involved in the development of a nutrient profile model, validation of the models, the basis of various models, and the limitations of the systems providing a need for future research required in this area. The system of nutrient profiling is multi-dimensional, finding its application in nutritional labeling, for products to bear health claims, food marketing and for regulatory purposes. It could serve as an effective and essential tool for the professionals in the field of nutrition and health care in educating the consumers for making healthy food choices. Nutrient profiling is a practical method for classifying foods as 'healthy' and 'unhealthy' or 'less healthy' and could also support the food based policies directing towards attaining the solutions to the problems of obesity and chronic degenerative diseases. There have been many controversies in using nutrient profile models and in their validation. But, in the context of major nutrients to limit or promote in our diet for a healthy nutrient intake, this method/ technique can be of value. FSA OfcomWXYfm and FSANZ models are considered most appropriate of all the models developed so far. Research at the consumer level is needed so as to link

the nutrient intake data with the feasibility of the models. However, there is still a need for development of a nutrient profile model that is suitable for Asian countries because of special kinds of foods consumed in these countries. Studies are needed in relation to the use of these models and how they can be adapted to the conditions of other countries as well.

#### ACKNOWLEDGEMENTS

We are thankful to the University Grants Commission (U.G.C), India for funding the study.

**Conflicts Of Interest:** The authors have no conflicts of interest to disclose.

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How to cite this article: Arora S, Mathur P. Nutrient profiling: an approach promoting healthy food choices. *Int J Health Sci Res*. 2014;4(7):227-239.

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