

## CONTRIBUTION OF NUTRIENT PROFILE MODELS TO THE PROMOTION OF HEALTHY EATING ENVIRONMENTS: PROFILING SNACKS

Worldwide, governments and health organizations increasingly recognize the importance of using objective methods for policy and regulatory purposes. Nutrient Profile Models fit this purpose through the implementation of measures to reduce access and exposure to unhealthy food, while enabling consumers to identify healthier food choices.





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Public Health ESDN has the mission of promoting the role of dietitians in Public Health and supporting people to prevent disease through healthy and sustainable food choices across Europe, to support dietitians in developing evidence-based practice, tools and research in the field of Public Health Nutrition and Dietetics.

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## INTRODUCTION

Worldwide, governments and health organizations increasingly recognize the importance of using objective methods to distinguish between different foods according to their nutritional quality, both for policy and regulatory purposes. <sup>1,2</sup>

Nutrient Profile Models (NPM) fit this purpose through the implementation of educational and restrictive measures in order to reduce access and exposure to unhealthy food, while enabling consumers to identify healthier food choices, as low rate of food literacy has been described as a causal factor for negative consumer behavior within the food system. <sup>3</sup>

Thus, NPM may be helpful across a range of public and private settings, including schools, health centers, the workplace, hospitals, long term care facilities (home care services, community based services) and others where healthy eating environments are expected to be promoted and, consequently, policies to be developed accordingly. <sup>2,3</sup>

NPM are also a valuable tool for ensuring consistency between the food environment and potential health gains. <sup>3,4</sup> Strategically increasing access to healthier food choices through increasing supply, with affordable and visible options, can facilitate the selection of healthier foods and beverages, making them more likely to be chosen. At the same time, providing consumers with nutritional information about healthier point-of-sale options can also influence their decision. <sup>4</sup>

NPM can help to create health-promoting eating environments, in several settings as <sup>3</sup>:

- ▲ Helping to define guidelines and regulations for food supply in school, health centers, workplaces, hospitals, etc.
- ▲ Identifying unhealthy foods and define recommendations for the availability of products according to their nutritional value in school meals, canteens, or vending machines
- ▲ Evaluating and monitoring food environments
- ▲ Contributing to a better understanding of the messages conveyed
- ▲ Promoting appropriate eating attitudes and behaviors
- ▲ To define recommendations for the availability to users, staff and visitors.

## NUTRIENT PROFILE MODELS APPLIED TO HEALTHY SNACKS

Snacks are available in most settings (schools, hospitals, long term care and recreational facilities, workplace, public institutions, etc.) with various forms of food supply such as bars, canteens or vending machines. <sup>5</sup>

Nutrient profile models can be very useful for classifying snacks and regulating the access and exposure to those that are unhealthy and so contribute to promoting healthy eating environments, while facilitating food literacy for consumers. <sup>5-8</sup>



## ▲ Defining Snacks

There are several difficulties involved in the definition of snacks as the definition can be both objective and subjective including criteria such as time, energy content, type of food, and location of consumption, or a combination of several of these factors. For instance, some countries consider snacks as food or drinks consumed between main meals, others attribute a caloric value, and some others, like Mexico, suggests that snacks are usually foods that children can consume by themselves and are easy to prepare.<sup>9</sup>

A review study discussing various definitions and presentations of snacks in the current literature and snack patterns in different areas of the world, proposes that snacking corresponds to the “intake of food or caloric drinks between regular meals, usually sold as packaged convenience products, containing most of the times health and nutrition claims and the size of the portion being consumed often determined by the size of the unit e.g., a cereal bar”.<sup>10</sup>

Although the semantics of the term “eating times” may seem trivial, an individual's definition of an occasion to eat a snack can be associated with eating away from home or work at a particular time of day and according to its availability. Snacking can also be defined as food eating in the absence of hunger, or even a real meal such as breakfast, lunch or dinner, can be considered a snack. Snacking is sometimes defined as a small meal/eating occasion but very rarely the definition of snacking includes an energy value (when available <5-15% of total daily energy intake or <150 kcal).<sup>9-14</sup>

A distinction has been observed in terms of the nutritional composition between mid-morning and mid-afternoon snacks, as they may play different roles in the diet. The mid-morning snack may be intended to maintain a sense of satiety and should be easily digestible and not excessively rich in calories. On the other hand, individuals may select the timing and the energy content of a mid-afternoon snack according to the duration of the afternoon.<sup>15</sup>

It is still unclear whether snacking has a positive or negative impact on nutrition and health. This is perhaps a result of the lack of a scientific and consensus definition on what constitutes a snack for either children or adults.<sup>9</sup> However, taken into account that snacking is still an eating occasion, even if the impact of frequent eating on health remains unknown, choosing healthful snacks could contribute to promoting nutrient-dense and health-promoting diets.<sup>10</sup> The inclusion of 1-2 snacks in the daily pattern alleviates the potential digestive and metabolic overload caused by fewer heavier meals and might contribute to meet recommendations for nutrients like dietary fibre, minerals and vitamins and food groups consumption frequency.<sup>15</sup>

A review that compared multiple guidelines of snacking, found that guidance was typically targeted at children and at the general population. In this review, “fruits, vegetables and juices” were the most frequent recommendations, followed by “starchy food” (such as bread, whole grains, crackers, oatcakes, rice, yams, potatoes, pasta, and plain popcorn), “dairy products (milk, cheese or yogurt), “combination of food groups” (like vegetables and dip or dairy, fruit and dairy, or starch and dairy, such as cheese sandwich) and “others foods” (included unsalted nuts or seeds). It is noticeable that variability exists between and within countries, and between different age groups, depending on the organizations that commissioned the recommendations.<sup>9</sup>





Some organizations recommend “snacks to promote” and others focus instead on “foods to limit”. In “foods to limit”, specific foods are identified such as confectionery and chocolates, or characteristics of foods to avoid like foods high in fat, sugar, salt, or saturated or trans-fat or ultra-processed foods. However, no quantitative benchmark was provided to define whether a food would be “high” or “low” in a particular nutrient. <sup>9</sup>

The most frequent rationale suggested snacking as a way to contribute to energy or nutrient intake, followed by rationale related to dental health. Current leading advice suggest that children should consume snacks between main meals in order to meet their nutritional requirements. <sup>15</sup> Therefore, recommendations relating to growth and development, such as for improving school performance and avoidance of choking were only aimed at children, while recommendations relating to reduced risk of disease, improve glycemic management, and rationale for foods to limit or avoid as snacks were targeted at adults. Importantly, heterogeneity is observed on the specific rationale of the recommendations depending on geography. Some countries were more likely to focus on reduced consumption of salted snacks in the context of controlling blood pressure, while others focus on salt and trans fatty acids as cardiovascular risk factors. Although global recommendations refer snacks in the context of overweight and obesity, regional World Health Organization (WHO) recommendations allude to the role of snacks in underweight individuals as well. <sup>9</sup>

The basis of most recommendations remains unclear i.e., if they were based on consumption surveys, published studies, or expert opinions. Most countries recommend consuming 2 snacks per day, but recommendations also varied from none to 3 and 4 snacks per day. <sup>9</sup> Although many organizations recommend fruits, vegetables, nuts and dairy as snacks, consumers may see it as a way to reward themselves, instead of the true value of snacks as a complement to the diet. A review identified hunger, location, culture, distracter and hedonic eating as the main motivations to snack. <sup>10</sup>

Eating preferences for snacks vary slightly in different parts of the world. In the United States, for example, “chips, candies, nuts and sugary drinks” are popular snacks <sup>16,17</sup>, while in Canada <sup>18</sup> preferences are popcorn and cookies. In Mexico, Brazil, China, Oman and France, fruits are one of the most common snacks.<sup>19-21</sup> In France, in addition to fruit, cookies, candy and cereal bars are popular, while in Finland the same foods are consumed as snacks and as meals, with no distinction. <sup>21,22</sup> Drinks like milk, soda, coffee and tea were among the top 5 snacks for all age groups in Mexico.<sup>20</sup> Sweetened coffee and sugary drinks were considered 2 of the 5 main snacks in Brazil.<sup>19</sup> Coffee is also one of the top 3 favorite snacks in Greece, and soft drinks are a popular snack in France.<sup>10</sup>

### ▲ Snacks labelling

Given the special nature of these foods and beverages, and their potential contribution to the daily total intake of energy, saturated fats, added sugar and salt, the choice of foods eaten as snacks is an area of public health concern. Thus, dietary guidelines in many countries mention snacks <sup>23,24</sup> and try to raise consumer’s food literacy by recommending healthier snack options to better address nutritional deficiencies and avoid overeating, suggesting not only a varied choice of foods to optimize the intake of essential nutrients, but also defining the appropriate portion sizes in terms of energy consumption. Therefore, informing consumers through front-of-pack nutrition labelling and health and nutrition claims are possible ways to promote population



health. The nutrient profile model within the framework of the European regulation of nutrition and health claims are not yet defined <sup>25</sup>, which makes it difficult for the consumer to have appropriate information regarding the claims and the whole nutritional value of the food. Terms such as "natural", "nutritious" or "healthy" and images that indicate healthy options or health benefits are wrongly used, especially for marketing purposes. <sup>26-30</sup>

Either front-of-pack nutrition labelling or nutrition and health claims can be accurately used by integrating nutrient profile models. In the "Farm to Fork Strategy" launched by the European Commission, the setting of nutrient profiles aims to avoid a situation where nutrition and health claims would mask the overall nutritional status of a food, which could mislead consumers when trying to make healthy choices. <sup>26</sup>

Also, in the framework of the Farm to Fork Strategy, harmonized mandatory front-of-pack nutrition labelling has been proposed and the extension of mandatory origin or provenance indications to certain products are considered. The impact on the single market and new ways to provide information to consumers through other means including digital, to improve the accessibility of food information in particular for visually impaired persons needs to be explored. The Commission will also examine ways to harmonize voluntary "green claims" and to create a sustainable labelling framework that covers, in synergy with other relevant initiatives, the nutritional, climate, environmental and social aspects of food products. <sup>26</sup>

To objectively assess the "nutrition value" of different foods and meals, different approaches have been suggested to quantify and score products based on nutrient density using NPM.<sup>31</sup>

#### ▲ Using NPM to establish recommendations on healthy snacks

Health-promoting snack analysis can be an important area for collaboration among the the food industry, dietitians and policy makers in order to develop NPM-based recommendations.

A study in Australia compared two NPMs for snack evaluation: the Ofcom Nutrient Score (Ofcom NP) and the Health Star Rating (HSR).<sup>31</sup> The Ofcom NP model attributes negative points to food components that should be avoided (sugar, sodium, saturated fat and total energy) and subtracts points for food components that should be favored (fruits, vegetables, nuts, fibre and protein). A lower score indicates a healthier food product, setting a value greater than 4 points as a cutoff for less healthy food. This model is used in the United Kingdom to regulate child-friendly advertising of unhealthy foods and was also the basis for the development of the Australian Health Star Rating (HSR) system by the Food Standards Australia New Zealand and other rating systems such as Nutri-Score. HSR uses the same underlying formula as Ofcom NP, but with different and extended cutoffs and specific cutoffs introduced for different food categories. The HSR system is used to calculate the number of Health Stars, which can be displayed on the front of the package voluntarily by food manufacturers. The characteristics of the snacks usually consumed by the Australian population, include: caloric value per 100 gr; nutrients; scores based on both NPMs; and portion size (small, being 50% of the large size). Table A provides some suggestions for healthy snacks alternatives by using nutrient profile models. <sup>31</sup>



NPM can be based on 100 kcal, 100 g and on serving sizes. Expressing nutrient content of foods per 100 kcal allows for ready comparisons with guidelines and between products. However, foods with low energy content will be scored disproportionately high by virtue of their low energy density. Expressing nutrient content per portion enables one to relate to the quantity of food typically consumed. However, there are no standardized serving size for different food groups in the EU. NPM calculated per 100 g or 100 mL are consistent with nutrition labeling regulation in the EU, but typical serving sizes deviate very significantly from 100 g, in particular for snacks that are supposed to be small portions of foods. Differences in water content is another problem within this type of model because it can easily influence calculations of nutrient content expressed on a weight/volume basis. However, this disadvantage can be overcome by including adjustments for oils and spreads on one hand, and for beverages on the other.<sup>32</sup>

Table A. Characteristics of the snacks (N=20) evaluated by experts and lay participants for the sorting task. Ofcom Nutrient Profile Score, Health Star Rating (HSR) scores and Health Stars were calculated according to the nutrition information per 100g derived from the AU food database (AUSNUT).

Snack	AUSNUT Food ID	Small Portion (g)	Large Portion (g)	Energy (kJ/100 g)	Saturated Fat (g/100 g)	Total Sugar (g/100 g)	Sodium (mg/100 g)	Fruit, Vegetable and Nuts (%)	Fiber (g/100 g)	Protein (g/100 g)	HSR	Health Stars	Ofcom NP Score	Ofcom Category
Carrot	13A11671	80	160	133	0	5	38	100	4	0.8	-12	★★★★★	-9	healthy
Apple	06D10559	90	180	239	0	11.9	1	100	2.3	0.3	-8	★★★★★	-6	healthy
Rice cake	02C10116	25	50	1683	0.62	0.3	118	0	4.4	8.6	-3	★★★★★	-4	healthy
Mixed nuts	11B10240	40	80	2642	4.03	3.9	4	100	7.6	19	-14	★★★★★	-4	healthy
Natural yoghurt	09C20042	120	240	241	0.19	5.9	84	0	0	6.6	-3	★★★★★	-3	healthy
Toast slice	02B10754	25	50	1247	0.79	2.3	520	0	7.4	13.2	-7	★★★★★	-2	healthy
Dried fruit	06E10091	30	60	1247	0.08	68.5	78	100	5.6	2	3	★★★	2	healthy
Flavoured yoghurt	09C10095	120	240	401	2	11.6	60	20	0.1	4.7	2	★★★	2	healthy
Peanuts (roasted, salted)	11B10201	30	60	2667	9.18	4.4	335	100	6.2	25.1	-6	★★★★	4	less healthy
Muesli bar	12C10415	25	50	1713	3.42	23.6	128	20	7.7	6.3	6	★★★	9	less healthy
Muffin	02E10477	90	180	1516	1.84	25.9	343	10	1.4	4.8	12	★★	12	less healthy
Potato chips	10D10155	25	50	2233	6.8	2.2	415	0	3.5	4.7	13	★★	12	less healthy
Nut bar	12C10531	30	60	2248	10.57	20.7	21	70	8.4	15.7	9	★★	13	less healthy
Protein bar	02C20379	30	60	1811	6.97	9	203	0	1.4	34.2	13	★★	13	less healthy
Ice cream	09D10212	40	80	788	7.16	18.4	48	0	0	3.7	13	★★	13	less healthy
Lollies	12C10423	50	100	1350	0	50.6	110	0	0	5.3	16	★	15	less healthy
Carrot cake	02E10440	100	200	1582	4.02	30	336	10	1.5	4.3	16	★	15	less healthy
Popcorn	10D10135	20	40	2115	12.6	0.6	645	0	8.5	9.1	16	★	18	less healthy
Chocolate biscuits	02C20284	25	50	1841	8.38	23.9	308	0	1.9	6.2	20	★	19	less healthy
Chocolate	12C10407	20	40	2206	18.76	54.6	68	0	2.3	7.6	31	◇	23	less healthy

Notes: Ofcom NP: Ofcom Nutrient profile score. HSR: Health Star Rating Score. ★ equals 1 health star; ◇ equals 0.5 health stars.



Given the proliferation of NPM worldwide, a 2018 study took a systematic approach to assist health professionals and policy makers in selecting an appropriate model when setting food policy using NPM.<sup>4</sup> Included models had to meet the following inclusion criteria: a) be developed or endorsed by government agencies or intergovernmental organizations; b) allow the evaluation of individual food items; c) have nutritional criteria available to the public. Of the 387 potential NP models eligible by the authors, only 78 met the inclusion criteria. Of these, 29 may be applied in public health scenarios.<sup>4</sup> The application of each model represents the purpose for which it was built. Each model is associated with only one primary application.<sup>78</sup> An additional application represents one that is specified in the source reference of a model in addition to its primary application e.g., a model primarily meant for front-of-pack food labeling and also has reformulation as an additional application. For a given model, the number of additional applications could range between 0 and 5. Figure A provides further details on the possible applications of the models and specific model numbers associated with each one.<sup>4</sup>

One main difficulty of developing policies to restrict food marketing to children is the challenge of classifying foods for which marketing should be restricted. For this purpose, a NPM was developed by WHO to be applied in Europe.<sup>33</sup> This is a category-specific model and therefore considered easier to adapt or modify than models based on scoring along-the-board. The WHO Europe NPM has a total of 17 food categories and all of them cover total fat, saturated fat, total sugars, and salt. Energy and non-sugar sweeteners are included in certain categories. This model expresses nutrient content per 100 g or 100 mL, which might be adapted for snacks with specific cut-offs.<sup>32</sup>

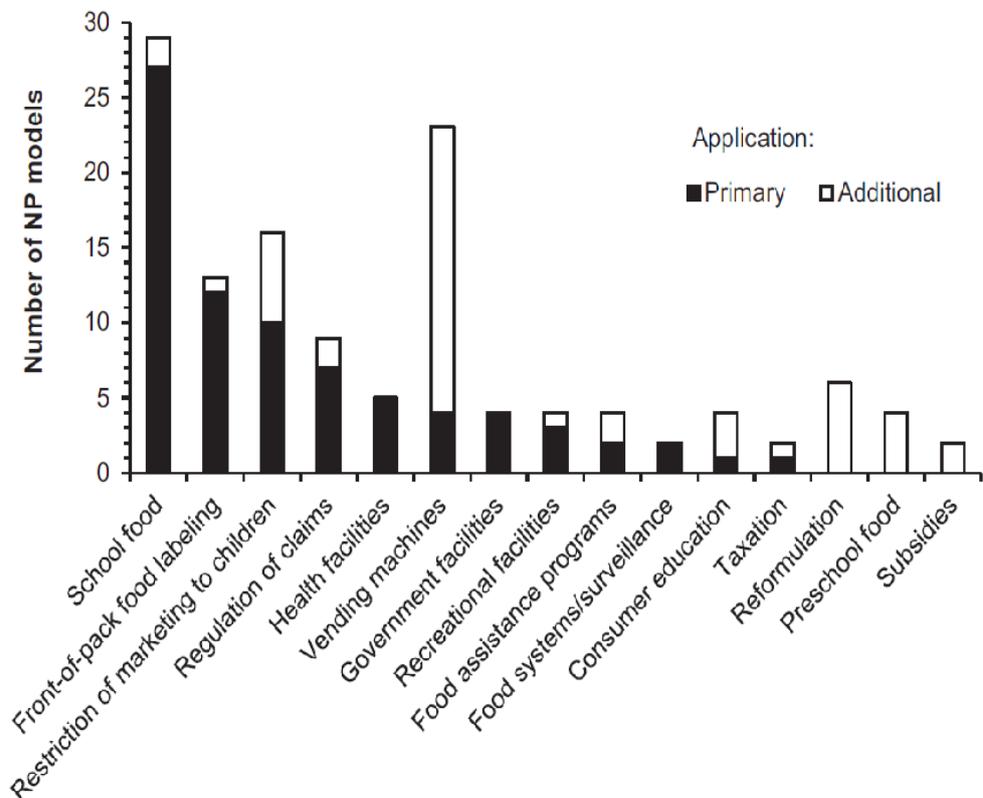


Figure A - Possible applications identified for NP Models. Adapted from Labonté M, et al. Nutrient Profile Models with Applications in Government-Led Nutrition Policies Aimed at Health Promotion and Noncommunicable Disease Prevention: A Systematic Review. 2018.

The potential opportunities to extend the application of NPM on snacks are described according to its location eg public health institutions, schools and preschools. Vending machines, found in most settings, provide opportunity for better nutrient profiling to be applied and influence and improve snacks supply.

## APPLICATIONS IN PUBLIC HEALTH INSTITUTIONS SUCH AS HOSPITALS AND HEALTH CENTERS

Health institutions are considered to be an ideal place to offer healthier food choices, as they allow the reinforcement of guidance provided by health professionals. Good nutrition is a key requirement in these institutions, not only to help patients recover from illness, but also to ensure a healthy diet for visitors and staff. For this reason, WHO has created the concept of the Health Promoting Hospital that recognizes health promotion as a core quality dimension of hospital services.<sup>34</sup>

Despite this, several studies across the world have shown that the range of food available across health institutions is still quite unhealthy. In order to address this situation, many countries have worked to set standards for food for patients, staff and visitors, by changing food availability in bars, cafeterias, buffets,



kiosks and vending machines in hospitals and other health facilities.<sup>34,35</sup> These nutrient profile-based guides, both provide a list of foods that should not be available at health care institutions and a range of products to be included. They can also provide nutrition information as menu labelling or guide patient nutrition services.

Of 12 possible primary applications identified in the 78 NP models included in the 2018 systematic review<sup>4</sup> :

- ▲ 5 consist of food standards/requirements in health facilities - Nova Scotia Food and Beverage Nutrient Criteria, Province of Nova Scotia<sup>36</sup>; Healthy Food Environments pricing incentives nutrient criteria<sup>37</sup>; Scotland nutritional standards for hospital foods: Food in Hospitals<sup>38</sup>; Healthy food and drink choices for staff and visitors in South Australia Health Facilities<sup>39,40</sup>; and Queensland Health's A better choice – Healthy Food and Drink supply strategy<sup>41,42</sup>.
- ▲ 4 set standards for vending machines - Healthier choices in vending machines in British Columbia public buildings<sup>43</sup>; Nutrition Environment Measurement Survey-Vending (NEMS-V) traffic light system<sup>44,45</sup>; Wales—health-promoting vending guidance in hospitals<sup>46</sup>; and Nemours Health and Prevention Services (Delaware's public health department) "Go, Slow, and Whoa" model<sup>47</sup>.
- ▲ There are 19 more in which vending machines are presented as an additional application and, of these, 3 have food standards/requirements in health facilities as a primary application.<sup>4</sup>

In general, all NPM applied to health facilities are summary indicator systems that both limit and encourage nutrients or food components, with a classification as output.<sup>4</sup>

The **Nova Scotia Food and Beverage Nutrient Criteria (Canada)** was designed to support healthy eating policies and facilitate healthy food environments. The NPM works with percentages of maximum, moderate and minimum nutrients and limits a total of nine nutrients/food components - energy, total fat, saturated fat, other fats, added fat, total sugars, free/added sugars, total sodium/salt and added sodium/salt - and encourages two - whole grain and fruits, vegetables, nuts and legumes (FVNL) as shown in Table B.<sup>36</sup>

The **Healthy Food Environments Pricing Incentives Nutrition Criteria NPM (North Carolina –USA)** aims to increase the availability, visibility and accessibility of healthy foods and beverages for employees, volunteers, and visitors on hospital campuses. The intervention includes: pricing policy to encourage purchase of healthier foods, marketing techniques and education of staff and visitors about healthy foods. This model limits eight nutrients/food components - energy, cholesterol, total fat, saturated fat, trans fat, total sugars, free/added sugars and total sodium/salt - and encourages 1 - FVNL (Table B).<sup>37</sup>

The **Scotland nutritional standards for hospital foods (UK)** are designed to make sure that the foods and beverages that are served and sold support an environment for good health. It limits three nutrients/food components in total - total fat, saturated fat and free/added sugars - and encourages two - energy and



protein. According to this model, all snacks provided to patients in hospitals must be capable of providing a minimum 150 kcal and must include fruit as a choice. Since this NPM only applies to food offered to hospital patients, all these recommendations are based on their dietary needs (Table B).<sup>38</sup>

Some of the NPM intended to be applied to health facilities, specifically the **South Australia**<sup>39</sup> and the **Queensland (Australia)**<sup>40</sup> focus on a categorization of food and drinks based on their nutritional value, in a total of three categories: green (best choices), amber (select carefully) and red (select rarely/limit). Both NPMs limit a total of four nutrients/food components - energy, saturated fat, total sodium/salt and maximum serving and/or package size - and encourage one - fibre (Table B).<sup>39-40</sup>

The top three nutrients to limit considered across the standards are saturated fats, energy and total sodium, whereas the top components to encourage are fibre, FVNL, energy, protein and whole grain. Concerning the reference amounts in all five NPM, most presented per serving, per 100 g/ml or the presence of a component in a product and/or its position in the ingredient list (Table B).<sup>4, 37-42</sup>



Table B. - Characteristics of the NPMs with health facilities as a primary application (n=5) according to specific nutrients and food components included, considered reference amounts/other units and base information for recommendations

		Nova Scotia (Canada) Food and Beverage Nutrient Criteria * 36	Healthy Food Environments pricing incentives, USA** 37	Scotland nutritional standards for hospital foods *** 38	South Australia Health Facilities +39	Queensland (Australia) Health's A better choice ++ 41
Nutrients and food components to limit	Energy	Y	Y		Y	Y
	Cholesterol		Y			
	Total fat	Y	Y	Y		
	Saturated fat	Y	Y	Y	Y	Y
	Trans fat		Y			
	Fat (other)	Y				
	Added fat	Y				
	Total sugars	Y	Y			Y
	Free/added sugars	Y	Y	Y		
	Total sodium/salt	Y	Y		Y	Y
	Added sodium/salt	Y				
	Max. serving or/and package size				Y	Y
Nutrients and food components to encourage	Energy			Y		
	Protein			Y		
	Fibre				Y	Y
	Whole grain	Y				
	F&V, nuts, pulses	Y				
Reference amounts / units	Per 100g				Y	Y
	Per 100ml		Y		Y	Y
	Per serving	Y	Y	Y	Y	Y
	Presence or position in the ingredient list	Y	Y	Y		
	% of weight / quantity	Y				
	Max. serving or/and package size				Y	Y
% of carbohydrates	Y					

Base information for recommendations: \* Nutrient richness of food and beverages (categorization by "Maximum; Moderate and Minimum nutrition"). \*\* North Carolina Prevention Partners dietary guidelines. \*\*\* Dietary needs of hospital patients. + Nutritional value of food and drinks (categorization by "best choices", "select carefully" and "select rarely/limit"). ++ Nutritional value of food and drinks (categorization by "best choices", "select carefully" and "select rarely/limit"). Y: Yes



With the same goal, namely the promotion of healthier food choices, the **National Center for Chronic Disease Prevention and Health Promotion** released a guide that promotes healthier food and beverage environments in hospitals for employees and visitors. This guide consists of a described step-by-step process for conducting environment assessments, which can help determine the availability of healthier options within hospitals. Once the scans have been conducted, collected information and data can then be used to develop strategies to promote healthier choices. <sup>34</sup>

## APPLICATIONS IN VENDING MACHINES

Regarding the models intended solely for vending machines, it is important to firstly evaluate the overall healthfulness of the products available, so that interventions and policies can then be targeted at improving food availability in context. According to international research vending machines, including the ones located at health care institutions and schools, have been identified as a source of unhealthy products characterized as energy-dense and nutrient-poor. The orientations given by NPM for vending machines vary between models. <sup>36, 43-48</sup>

The British Columbia (Canada) <sup>43</sup> and Iowa (USA) <sup>44</sup> models are based on the categorization of food and beverages according to specific nutrient criteria. For the **British Columbia model - Healthier Choices in Vending Machines in Public Buildings Policy**, the nutrient criteria define the minimum nutritional standard for prepackaged food and beverages and unprocessed vegetables and fruit allowed in vending machines in Public Buildings. <sup>43</sup> The **Iowa model - Nutrition Environment Measurement Survey-Vending (NEMS-V) Traffic Light system** codes food and beverages and aims to provide a minimum of 30% of foods and beverages as healthy options. <sup>44,45</sup>

The **Model Welsh Health Promoting Hospital Vending Guidance (UK)** is based on health promoting advice supported by a 5 point “charter”: 1) Good for your health - all foods and drinks supplied from vending machines must be the healthier option within its product range; 2) Safe for your teeth - foods and drinks supplied / sold from vending machines must not be damaging to dental health; 3) Safe to eat and drink - methods of storing and handling food and drink supplied from vending machines should comply with a food safety management plan, based on principles of HACCP (Hazard Analysis and Critical Control Points); 4) Promoting good health - branding on vending machines must support health promoting messages; 5) Hospitals leading the way - Healthy vending in hospitals will support the concept of the Health Promoting Hospital. <sup>46</sup>

The **Model Nemours Health and Prevention Services from Delaware's Public Health Department (USA)** is based on the categorization of food and beverages by nutrient density as: “GO” - foods and beverages are the healthiest options for the amount of calories they contain, eat these foods and drink these beverages most often, almost anytime; SLOW” - foods and beverages have added sugar or fat that makes them higher in calories, they should only be consumed sometimes, several times a week at most;



and “WHOA” - foods and beverages are the highest in sugar and fat and the least healthy, they should be consumed just once in a while.<sup>47</sup>

As in the case of the NPM with health facilities as a primary application, all 4 models regarding vending machines also have their own characteristics concerning nutrients to limit and/or encourage and reference amounts/units used (Table C).<sup>43-47</sup>



Table C - Characteristics of the NPM with vending machines as a primary application (n=4) according to specific nutrients and food components included, considered reference amounts/other units and base information for recommendations.

		Healthier Choices in Vending Machines (British Columbia, Canada)* 41	Nutrition Environment Measurement Survey-Vending (Iowa, USA)** 42,43	Welsh Health Promoting Hospital Vending Guidance (Wales)+ 44	Nemours Health and Prevention Services (Delaware, USA)++ 45
Nutrients and food components to limit	Energy	Y	Y		Y
	Total fat	Y	Y	Y	Y
	Saturated fat	Y	Y	Y	Y
	Trans fat	Y	Y		Y
	Fat (other)		Y		
	Added fat				Y
	Total sugars	Y	Y		Y
	Free/added sugars	Y	Y	Y	Y
	Added sweeteners	Y	Y		
	Total sodium/salt	Y	Y	Y	Y
	Added sodium/salt				Y
	Added flavouring/ seasoning/additives		Y		
	Fried foods				Y
Maximum serving or/and package size	Y			Y	
Carbonation			Y		
Nutrients and food components to encourage	Protein	Y			
	Fibre				Y
	Whole grain	Y	Y		Y
	Fruit, vegetables, nuts, pulses	Y	Y	Y	Y
	Milk/dairy-based content		Y		
	Calcium and Vitamin D	Y			
	Water		Y		
Reference amounts / units	Small serving size		Y		
	Per 100g / 100ml			Y	
	Per other pre-specified amount (g or ml)	Y			
	Per serving	Y	Y	Y	Y
	Per % of total fat	Y			
	Presence and/or position ingredient list	Y	Y	Y	Y
Maximum serving or/and package size	Y			Y	

Base information for recommendations: \* Minimum nutritional standard for prepackaged food and beverages and unprocessed vegetables and fruit allowed in vending machines in Public Buildings. \*\* Codification of food and beverages as whether they are consistent with the *Dietary Guidelines for Americans* or not. + Health promoting advice supported by a 5 point “charter”. ++ Categorization of food and beverages by nutrient density. Y: Yes



As mentioned previously, there are also three NPM intended to be applied in healthy facilities that have vending machines as an additional application which include specific policies for these food supply areas. The **Queensland Health's A better choice** requires that all foods and drinks categorized as "red" are totally removed from vending machines.<sup>40</sup> In contrast, the **Healthy food and drink choices for staff and visitors in South Australia Health Facilities model** only requires that 20% of "red" foods and drinks are removed from vending machines.<sup>38</sup> According to these models, respectively, marketing or advertising should only be applied to "green" foods and beverages and those categorized as "red" should not be promoted at all.<sup>39-41</sup>

It is also important that all NPM should take into account the purpose of their use as definitions may be different depending on the age and other characteristics of the population. For example, health institutions serve a diverse population and therefore, food services need to provide suitable foods for individuals across the life-course according to their differing nutritional needs.<sup>48</sup>

## APPLICATIONS IN SCHOOLS AND PRESCHOOLS

Dietary studies suggest that snacks can contribute up to a quarter of a child's total daily energy intake playing a critical role both in childhood nutrient intake but also in the prevention of childhood obesity.<sup>49</sup> Guidelines suggest that energy intakes from snacks (or light meals) should be 5-15 % of the daily energy intake per occasion, with no difference in guidance on energy for children and the general population.<sup>9</sup>

An overview of the guidelines identified by population groups in various countries shows that the quantitative recommendations from countries in the European region tend to provide percentage ranges for energy intake from snacks for the general population, children or both, while those from Asia and South American regions listed caloric values aimed at the general population. A recommendation from the European region provided specific quantitative guidance for nutrients for children specifically listing approximate values for protein, fat, and carbohydrate in grams for morning (3,25 g; 2,8 g; and 24 g) and afternoon snacks (7,0 g; 60 g; and 41;0 g). Currently, high fat/calorie and low nutrient foods remain abundantly available in many schools through *à la carte* services in the cafeteria, school stores, and vending machines in Europe.<sup>9</sup>

Major differences exist in school environments, school policies, food supply and actions to improve the dietary behavior of students to prevent overweight and obesity. Also, the ways of optimizing the school food supply integrating environmental, health, economic, and cultural dimensions of diet sustainability, are very different in Europe.<sup>50-52</sup> Recognizing the diversity of geographical, cultural and even situational factors that influence the design and implementation of healthy eating programs in schools, reinforces the need to base interventions on nutritional profile models, to ensure that the final policy is realistically designed, sustainable and will contribute to prevent childhood obesity.<sup>25</sup>



35 % of the NPMs identified in a systematic review have the main primary purpose to regulate School food standard/requirements. These results advocate that one of the government's priorities is to establish school food standards or guidelines based on objective nutritional criteria. <sup>4</sup>

After-school programs (ASP) provide adult supervision for students immediately after school and incorporate snacks, homework help, cultural and recreational activities. The snacks provided during an ASP represent an important part in a child's daily nutrient intake, as they are served between lunch at school and before dinner at home, but usually those snacks contain more than the recommended total energy, and typically they are also low in nutrient density, with fruits being offered as a snack option less than 1 serving/d and vegetables almost entirely absent from snack menus. <sup>48</sup> To address these unhealthy trends, state and national level organizations have developed policies and/or standards designed to improve the nutritional quality of the snacks served in ASP. However, the success of policies in galvanizing desired changes appears to have fallen short, concluding that stronger efforts are needed. <sup>53</sup>

Also in preschools, the quality of snack food options provided is not appropriate, since the snacks available frequently include sweet and salty foods. It is estimated that preschool children are consuming only one third of a serving of fruit and one quarter of a serving of vegetables per day. <sup>54</sup>

As major differences exist in the provision of school and preschool meals throughout European school systems, the European Network of Health Promoting Schools (ENHPS) operates within the European region to integrate health promoting school policy into wider health and educational sectors. Also, the programme for Nutrition and Food Security in the European Region developed by WHO in 2006, suggested that local partnerships would form a key aspect of school food and nutrition policy. Even though, it is very difficult for schools to avoid vending machines stocked with the usual high-sugar or high-fat products, although they could be used to sell healthier options like water, milks, 100 % juices and low-fat snacks. <sup>54</sup>

Of 12 possible primary applications identified in the 78 NP models included in the systematic review, 27 consist of school food standards/requirements and none of them set requirements for pre-school food as primary application. <sup>4, 55</sup>

Of the 27 models primary related to school foods, four have food standards in pre-schools presented as an additional application: Fuelled 4 Life, from New Zealand <sup>56</sup>; Costa Rica School food regulations <sup>57</sup>; Right Bite for schools and preschools, from South Australia <sup>58</sup>; and Alberta Nutrition Guidelines for Children and Youth, from Canada. <sup>59</sup>

Another model - **Guidelines for Food & Beverage Sales in British Columbia Schools** <sup>60</sup> - embraces several additional applications, besides nutrients to be limited/encouraged, such as limiting the sale of sugar substitutes, supporting healthy eating in the classroom (classroom celebrations and rewards), decreasing or eliminating bottled water by promoting tap water.





The orientations given by NPM for schools and pre-school vary between models, not only concerning the nutrient categories to be limited/encouraged, but also the types of reference amounts/other units considered and base information for recommendations (Table D). A minimum (3) and maximum (12) number of nutrients to be limited has been established, with the top three to be limited being total fat, total sodium and saturated fats. Concerning nutrient categories to be encouraged, the number should be between one and 14, with the top three nutrients/food components considered being fibre, fruits, vegetables, nuts and legumes (FVNL) and whole grains. Nutrients or foods such as cholesterol, naturally occurring sugars and added flavoring/seasoning are poorly referred to in the models.<sup>54,55</sup>

The **Food and Beverage Classification System** was developed in 2007 by the Ministry of Health of Wellington, New Zealand, to support schools and early childhood education (ECE) services in providing healthy food and beverages for students and attendees and also encourage those settings to use available supports and resources to improve their food and physical activity environment. This model “**Fuelled 4 Life**” is a Nutrient Specific System that includes 11 nutrients/food components to limit and two to encourage.<sup>56</sup>

The **Costa Rica School food regulations** are endorsed by the Ministry of Health and regulate canteens and tuck-shops in public schools to only sell and advertise foods consistent with the messages of the dietary guidelines. It includes seven nutrients/food components to limit but none to encourage.<sup>57</sup> **Right Bite for schools and preschools assists South Australia Governmental** schools and preschools to select food and drinks to promote healthier eating. Food and drink are classified according to their nutritional value, into three categories - the Right Bite Food and Drink Spectrum (green, amber and red), a visual guide that shows where certain foods fit with healthy eating. It only includes one nutrient/food to encourage and three to limit.<sup>58</sup>

The **Alberta Nutrition Guidelines for Children and Youth** addresses more nutrients and food components to limit and encourage which makes it the most complete model since it provides more information about its recommendations. This model also specifies conditions for some nutrients and foods, such as “total fat” and “added fat”: depending on the food category, only foods with naturally occurring fat are permitted (i.e., foods with added fat are not allowed).<sup>59</sup>

**Guidelines for Food & Beverage Sales in British Columbia Schools, from Canada**<sup>60</sup> includes 10 nutrients/food components to limit and four to encourage, but only considers “per serving” as its reference amount/unit.<sup>60</sup>

Cholesterol and other fats were not mentioned in any of these models as a criterion to limit, although energy, saturated fat and total sodium/salt were mentioned by almost all of them.<sup>4</sup>

Other models, such as the **Greek school canteen policy**<sup>61</sup>; **Scotland nutritional requirements for food and drink in schools**<sup>62</sup>; and **England requirements for school food regulations**<sup>63</sup>, do not consider energy as a criterion.

Tabla D. Characteristics of 8 NPM used for school and pre-school food standards/requirements according to specific nutrients and food components included, considered reference amounts/other units and base information for recommendations.

		Fuelled 4 life, New Zealand * <sup>56</sup>	Costa Rica School food regulations ** <sup>57</sup>	Alberta Nutrition Guidelines *** <sup>59</sup>	Guidelines for British Columbia Schools+ <sup>60</sup>	Right Bite, South Australia ++ <sup>58</sup>	Greek school canteen policy <sup>61</sup>	Scotland nutritional requirements for food and drink in schools <sup>62</sup>	England requirements for school food regulations <sup>63</sup>
Nutrients and food components to limit	Energy	Y	Y	Y	Y	Y			
	Total fat	Y	Y	Y <sup>β</sup>	Y		Y	Y	Y
	Saturated fat	Y	Y	Y	Y	Y	Y	Y	Y
	Trans fat	Y	Y	Y	Y		Y		
	Added fat	Y <sup>α</sup>		Y <sup>β</sup>					Y
	Total sugars	Y	Y	Y	Y				
	Free/added sugars	Y		Y	Y			Y	Y
	Total sodium/salt	Y	Y	Y	Y	Y	Y	Y	
	Added sodium/salt	Y		Y					Y
	Maximum serving or/and package size	Y				Y <sup>Ω</sup>			
Nutrients and food components to encourage	Energy								
	Protein			Y	Y			Y	
	Fibre	Y		Y <sup>ξ</sup>		Y	Y	Y	
	Whole grain				Y		Y		Y
	Fruit, vegetables, nuts, pulses	Y					Y	Y	Y
Reference amounts / units	Milk and dairy						Y	Y	Y
	Per 100g	Y	Y			Y	Y	Y	Y
	Per 100ml	Y	Y				Y	Y	Y
	Per serving	Y		Y	Y	Y	Y	Y	Y
	Presence and/or position ingredient list	Y	Y	Y	Y				
	% of weight or quantity in a product	Y							
Maximum serving or/and package size	Y				Y				

**Base information for recommendations:** \* Schools as important settings for promoting healthy eating; need to provide criteria for identifying healthy snacks among processed foods. \*\* Classification of food as whether they are consistent with the Dietary Guidelines for Costa Rica or not. \*\*\* Create environments which provides healthy food choices and healthy attitudes about food so that children have access to nutritious foods in school and wherever they go. + Based on tools that enable schools to assess both pre-packaged and freshly made food and beverages, in terms of nutrition standards. ++ Based on a colour spectrum where food better fit according to nutritional value and based on the Australian Dietary Guidelines. Y: Yes. <sup>α</sup>More specifically: added oil. <sup>β</sup> Depending on the food category, the criterion for total fat is sometimes that only foods with naturally occurring fat are permitted (i.e. foods with added fat not permitted). Nuts, seeds and nut/seed butters can also have more fat (naturally occurring, not added) than specified in the criteria for their category. <sup>ξ</sup> Depending on the food category, the criterion for fibre is sometimes that fibre must only be naturally occurring in the food. <sup>Ω</sup> A maximum serving size is specified for beverages.



## CONCLUSIONS

The common nutrients to limit and to encourage at public settings are summarized in the Table E.

*Table E. Common nutrients to limit and to encourage at public settings*

Nutrients and food to encourage	Nutrients and food to limit	Reference amounts/units
Fibre	Energy	Per 100 g
Whole grain	Total fat	Per 100 mL
Fruit	Saturated fat	Per serving
Vegetables	Trans fat	Presence and/or position ingredient list
Nuts	Total sugars	
Legumes	Free/added sugars	
	Added sweeteners	
	Total sodium/salt	

Including NPM in public health policies as a tool to develop/regulate healthier food environments in public settings such as schools, health facilities, government facilities, and settings where vending machines are situated, can help to influence healthier food choice by large numbers of people.

For that purpose, a selection of the NPM that includes nutrients to encourage and nutrients to limit is needed. Most NPM consider nutrients or food components to encourage in their algorithm, particularly in the context of food served in public settings. This is consistent with a view of promoting healthier food environments, in which consumers are encouraged to opt for nutrient-dense snacks in public settings, instead of simply discouraged from choosing nutrient-poor options.

The nutrient density of foods is calculated per reference amount, which can be 100 g, 100 kcal, or serving size. Models based on the 100 g standard have difficulty handling different serving sizes by food group. Models whereby saturated fat, added sugar and sodium are calculated per 100 g of food or beverage, tend to punish energy-dense foods consumed in small quantities (nuts, dried fruit, cheese), while giving favorable scores to sugary beverages of low energy density, unless volume corrections are made. Expressing nutrient content on a per serving/portion basis permits the consumer to directly relate to the quantity of food typically consumed. Although many food products are labelled in this way, there are no standardized serving/portion sizes for different food groups defined at the EU level. Also, serving sizes partly depend on the energy needs of the consumer and therefore serving sizes are difficult to define for some products. Additionally, for small portion foods the serving size has little relation to how much of a nutrient it contributes to the diet if it is consumed on many occasions in a single day. In this context, snacks may be sold as multiserve. This type of retail, with many individual snacks within a large unique package, fails to control the real intake, because consumers are no longer limited to consume only one portion of a snack.

NPMs can have many applications and, therefore, they are designed based on the main purpose for which the model is built for. There are variations in the number and nature of food groups, type of



nutrients to limit and to encourage, and in the number and type of reference amounts considered in various NPM and that occurs not only between models as a whole but also between models built for the same application. The different options available in NPM are suited for different purposes and each have their advantages and disadvantages. For example, it may be appropriate for a model, used to set compositional standards for snacks, to assess only a few number of nutrients. In contrast, a greater number of nutrients are likely to be evaluated for models used for labelling purposes. Nevertheless, there seems to be scope for some design elements to be common across multiple applications, with additional application-specific criteria applying where necessary.

Consequently, the recent proliferation of NPM may lead to confusion, inconsistencies between models, and possibly loss of credibility with regulators, consumers, and researchers.

The adequate selection of a NPM that better fit the purpose to regulate the food environment in a given setting is crucial to avoid inconsistencies between health policies and to facilitate consumers the access to healthy snacks among a wide range of options, since an excessively narrowed-down selection could be a barrier for its success.

## RECOMMENDATIONS

- 1 Different NPMs may benefit different products within the same category. Given the risks associated with proliferation of NPM and the time and cost dispended on development and validation of a new model, **WE RECOMMEND** to either adopt or adapt an existing model, ideally one developed by and authoritative body. Thus, there is urgent need for a **unique system for European consumers that can be adapted for multiple uses** across different settings with the following considerations:
  - ▲ Food composition databases should include a comprehensive coverage for snacks
  - ▲ Choose between across-the board or category-specific NPMs – NPM designed to promote a healthy diet should be category-specific but based on a limited number of defined categories that are applied consistently across all applications. However, food categories must be well explained in order to allocate food in the correct category
  - ▲ Select nutrients to encourage and to limit – In order to promote healthier food environments and NCD prevention. NPM should encourage consumers to opt for nutrient-dense snacks, instead of simply discouraging them from choosing nutrient-poor options. Therefore, NPM should encourage fruit, vegetables, nuts, legumes, fibre, protein, and whole grains and limit saturated fats, energy, added sugars and total sodium/salt
  - ▲ Determine if the basis of calculation is per 100 kcal, 100 g, or serving size - NPM based on the 100 g or 100 mL standard are consistent with food composition tables and nutrition labeling regulation in the EU. Typical serving sizes of snacks deviate very significantly from 100 g, so there is the need to define an energy limit per portion and to establish a format that promotes conscious eating, eg by not selling multi-packs. Additionally, many models do not take into



account the water content and liquid snacks tend to be eaten in large amounts which may promote unconscious energy intake. Yet, this disadvantages can be overcome by including different criteria for solid and liquid snacks or by promoting only water and milk when it comes to drinks, especially for children

- ▲ Decide if the model should apply threshold levels or use scoping and what cutoff numbers should the model adopt – NPM that use scoring systems as their basis are more amenable to adaptation than those that only use thresholds, because once a scoring system is in place, different scoring levels can be adopted to suit different purposes. For choosing the cutoffs, a definition of snacking and snack foods is needed based on the current guidelines and nutrition surveys (see definition of snacks)
  - ▲ Assess the affordability of NPMs – NPMs generally tend to benefit costly foods. So, there is the need to develop a cost analysis. One question of interest is whether product fortification and/or recipe reformulation is a cost-effective way to improve the nutrient density of snacks.
- 2 Based on the last points, we recommend the development of an European framework of a NPM applied to healthy snacks that is fit for children, adolescents, and adults, including those with mental or physical disabilities. This NPM should be implemented in schools, health care facilities, care centers and other public settings.
  - 3 The selected NPM should be flexible and clear, so everybody may be able to recognize its logic and reasoning. One way to do that is through colors or symbols that are easily acknowledged by consumers. The model must also be visibly attractive and be accessible for those with low levels of health and food literacy.
  - 4 One main application of NPMs is in front-of-package nutrition labelling (FOPNL), in order to promote healthy dietary behaviors. Besides having information about a product and a company, it is a powerful technique for communicating with consumers and safeguarding product quality. However, several FOPNL schemes have proliferated among food industry operators and this diversity may not be an optimal ground for three reasons: 1) different schemes may confuse consumers understanding of the nutritional information, which defeats the objective of providing a supportive environment, 2) having many models makes it more difficult for authorities to control the accuracy of the information, 3) it is a great barrier to implement studies to assess the impact of a specific model in consumer's literacy, food choices and long-term health.

Consequently, we recommend the use of a single Nutrient Profile Model based on the criteria described before and use it to harmonize Front of Package in Europe.



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