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Perspective

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Nutri-Score 2023 update

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In 2023, the algorithm underlying the Nutri-Score front-of-pack label was updated to better align with food-based dietary guidelines (FBDGs) across countries engaged in the system. On the basis of a comparison of FBDGs and literature reviews with the current Nutri-Score classification, modification scenarios were developed and tested in nutritional composition databases of branded products in four countries. The updated Nutri-Score nutrient profile model allows a better discrimination between products, in closer alignment with FBDGs, while the updated algorithm adopts a stricter approach for products that are high in components of concern (including non-nutritive sweeteners) and low in favourable dietary components. The updated Nutri-Score algorithm increases the alignment between the front-of-pack label system and FBDGs, strengthening its potential as a complementary public health tool in an international perspective.

As part of its Farm to Fork Strategy, the European Commission announced that it would propose a European Union (EU)-wide, harmonized, mandatory front-of-pack nutrition label (FoPL) promoting healthier food products and dietary patterns[1,2]. A prominent voluntary FoPL that already exists on the European market is 'Nutri-Score', which provides a graded summary evaluation of the nutritional value of packaged foods and beverages in the form of a colour and letter code—ranging from dark green (A, best nutritional value) to dark orange (E, worst nutritional value). Nutri-Score aims to facilitate the comparison of similar packaged foods or foods eaten on similar occasions in terms of their nutritional value. It was developed by an independent French research group in 2014 and, after a three-year political process, introduced into legislation in France[3,4]. In the following years, several other European countries adopted Nutri-Score as their official FoPL, including Belgium (2018), Switzerland (2019), Germany (2020), Luxembourg (2021), the Netherlands (2023) and Spain (announced in 2018).

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Such a wide adoption highlights the increasing interest in policies raising consumer awareness and facilitating healthier food choices at the point of purchase[5]. Importantly, FoPLs also incentivize food reformulation by manufacturers, which aligns with national strategies to improve the nutritional quality of the food supply[6,7].

Following the adoption of Nutri-Score by several European countries, a transnational governance of all the countries officially engaged (COEN) in the scheme was set up in February 2021 to coordinate and standardize its implementation and future improvements across countries. To this end, two committees were set up: a steering committee, in charge of decisions concerning the overall development and implementation of Nutri-Score, and a scientific committee of independent scientists from each participating country mandated to review and update the algorithm underpinning Nutri-Score, which was originally set in 2015. The primary aim of the scientific committee was to improve alignment of Nutri-Score with national food-based dietary guidelines (FBDGs), to which it is a complementary but independent public health tool, considering the latest scientific evidence on the relevance of nutrition for health.

In its current form, Nutri-Score has already shown a reasonable consistency with FBDGs, assessed in part by discrimination based on nutrient content in different food groups[8–12]. Furthermore, a dietary index based on the Nutri-Score algorithm adequately reflected the nutritional quality of the diet and was associated with healthy dietary patterns, including the Mediterranean pattern[13–15], and major nutrition-related health outcomes in several European populations[16]. While these results demonstrate the public health utility of the Nutri-Score algorithm, the increasing number of countries implementing Nutri-Score made it necessary to re-evaluate the algorithm to ensure alignment with the national FBDGs of the additional European countries now adhering to the scheme and evidence since their implementation on the relation between diet and health.

This Perspective describes the process implemented by the scientific committee to update Nutri-Score algorithm, discusses the main modifications made to it, and presents the resulting Nutri-Score classification in databases of food composition from the different participating countries.

Nutri-Score algorithm

The original 2015 Nutri-Score nutrient profiling model (NS-NPM) is derived from the 2005 British Ofcom algorithm currently implemented for the regulation of advertising to children in the United Kingdom[17–19]. The NPM includes components for unfavourable elements, that is, energy density, saturated fats, sugars and salt, and favourable elements, that is, dietary fibres, proteins (as a proxy for calcium and iron) and 'fruit, vegetables, nuts, legumes and vegetable oils (canola, olive and nut)' content per 100 g or 100 ml of food or beverage. For unfavourable elements, 0 to 10 points are allocated to each component, adding up to a maximum of 40 points. Then, points for favourable elements (0 to 5 points for each component) are subtracted, resulting in a theoretical overall combined algorithm range between −15 and +40 points (Supplementary Fig. 1 and Supplementary Note 1). Depending on the score, a Nutri-Score class is allocated (A–E). NS-NPM has separate algorithms for three categories: one main algorithm for general foods, one for fats and oils, and one for beverages (Supplementary Fig. 1 and Supplementary Note 1). Categories were identified based on the specificities of their nutritional composition (for example, high-fat foods, liquid foods) and to ensure the observed variability in nutritional value would be made visible with the NPM.

Process update

In line with its mandate set by the COEN, the scientific committee agreed on a transparent methodology and applied modifications to the algorithm based on scientific knowledge, independent of the steering committee or outside stakeholders (including the food industry). The process update of the 2015 NS-NPM is presented in Supplementary Note 2.

The scientific committee reviewed the FBDGs in each COEN and compared the food group-specific advice with the current Nutri-Score classification, identifying areas for potential improvement. Literature reviews on the association between food groups, nutrients or components, and health outcomes were conducted (for example, relationship between consumption of different types of oil and cardiovascular diseases or cancer). On the basis of their results, the scientific committee aimed to increase the discrimination of products based on their levels of nutrients of concern, with a specific focus on fish, bread, vegetable oils, sugary or salty products, and various types of beverage. In particular, the priorities were to improve discrimination between fish with and without added nutrients of concern and to ensure a more favourable classification of fish without added nutrients of concern. For bread, the priority was to discriminate between wholegrain and refined grain. For vegetable oil, the priority was to discriminate according to the level of saturated fatty acids. Finally, a more adequate discrimination between sugary and salty products with high versus low sugar or salt and a less favourable classification of high-sugar and high-salt products was defined as a priority. These areas were set by expert consensus based on the importance given in current FBDGs and the deviation between the current and potential optimal classification. Details of the priority areas and specific aims of the modifications are presented in Supplementary Information.

Then, scenarios for modifications were developed and tested in specific target food groups for each component of the profile. For example, wholegrain and refined grain products were selected and tested as specific target food groups for modifying the dietary fibre component. When available, regulations on food information to consumers (FIC) were taken into account to define reference points, that is, the starting point or reference value from which the scale was determined. For example, the starting point of the fibre scale was set at 3 g per 100 g, which is the reference value of the 'source of fibres' claim. For each component, the best scenario was selected based on expert consensus following comparison of the relative performance of the various scenarios developed. The performance was applied to several national databases to cover the widest possible range of foods. Thresholds for classes of Nutri-Score (A–E) were set based on the distribution of the combined algorithm with modified components. The impact of the modified classification on products was tested with four national databases of market products from Belgium (Nutritrack database[20] $N = 24{,}390$ products), France (Observatoire de la Qualité de l'Alimentation (OQALI)[21] and Open Food Facts database[22], $N = 51{,}765$ products), Germany (Mintel Global New Product Database and the German product monitoring database[23] $N = 19{,}172$ products), and the Netherlands (Dutch branded food database[24], $N = 33{,}915$).

2023 Nutri-Score

The updated 2023 NS-NPM is presented in Fig. 1. Detailed information on the modification process is available in Supplementary Note 3 and Supplementary Tables 1–3. The categories of the algorithm were modified, with nuts and seeds being incorporated in the fats and oils category, and milk-, fermented milk- and plant-based beverages included in the beverages category.

The maximum number of points changed from 10 to 15 for sugar and from 10 to 20 for salt. This addressed the algorithm's relative imbalance in the weight attributed to fats by the algorithm due to their higher load in the energy density component compared with sugars and salt. Hence, high-saturated-fat products have now reached 20 points (10 points for energy plus 10 points for saturated fats), as do high-sugar products (5 points for energy plus 15 points for sugars) and high-salt products (0 point for energy plus 20 points for salt). Point allocation in the components was also modified to increase strictness and alignment with EU regulations on FIC and health claims[25,26] (for example, for salt,

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2023 Nutri-Score update

Main algorithm for general foods

Points N				Points P		
Energy	Sugars	Saturates	Salt	Proteins[a]	Fibres	Fruits, vegetables and legumes
0 points ≤335 KJ 10 points >3,350 KJ	0 points ≤3.4 g 15 points >51 g	0 points ≤1 g 10 points >10 g	0 points ≤0.2g 20 points >4 g	0 points ≤2.4 g 7 points >17 g	0 points ≤3 g 5 points >7.4 g	0 points ≤40% 5 points >80%
335 KJ per point	3.4 g per point Rounded to the nearest integer >10	1 g per point	0.2 g per point	2.4 per point Rounded to the nearest integer >10	1.1 g per point	Nonlinear attribution

[a]For meat products: maximum 2 points

Sum of points N

<11
or cheese
Final nutritional score
Points N
–
Points P

≥11
Final nutritional score
Points N
–
(Points Fibres + Points Fruit, vegetables and legumes)

Final nutritional score	
Min to 0	A
1 to 2	B
3 to 10	C
11 to 18	D
19 to Max	E

Fats, oils, nuts and seeds

Points N				Points P		
Energy from saturates	Sugars	Saturates/fats ratio	Salt	Proteins	Fibres	Fruit, vegetables and legumes[b]
0 points ≤120 KJ 10 points >1,200 KJ	0 points ≤3.4 g 15 points >51	0 points <10% 10 points ≥64%	0 points ≤0.2g 20 points >4 g	0 points ≤2.4 g 7 points >17 g	0 points ≤3 g 5 points >7.4 g	0 points ≤40% 5 points >80%
120 KJ per point	3.4 g per point Rounded to the nearest integer >10	6% per point	0.2 g per point	2.4 per point Rounded to the nearest integer >10	1.1 g per point	Nonlinear attribution

[b]Oils from the ingredient list are included

Sum of points N

<7
Final nutritional score
Points N
–
Points P

≥7
Final nutritional score
Points N
–
(Points Fibres + Points Fruit, vegetables and legumes)

Final nutritional score	
Min to –6	A
–5 to 2	B
3 to 10	C
11 to 18	D
19 to max	E

Beverages

Points N					Points P		
Energy	Sugars	Saturates	Salt	Non-nutritional sweetener	Proteins	Fibres	Fruit, vegetables and legumes
0 points ≤30 KJ 10 points >390 KJ	0 points ≤0.5 g 10 points >11 g	0 points ≤1 g 10 points >10 g	0 points ≤0.2 g 20 points >4 g	Presence	0 points ≤1.2 g 7 points >3.0 g	0 points ≤3 g 5 points >7.4 g	0 points ≤40% 6 points >80%
Nonlinear allocation	Nonlinear allocation	1 g per point	0.2 g per point	4 points	0.3 g per point	1.1 g per point	Nonlinear attribution

Final nutritional score
Points N
–
Points P

Final nutritional score	
Water	A
Min to 2	B
3 to 6	C
7 to 9	D
10 to max	E

Fig. 1 | Nutri-Score updated algorithm for general foods, fats, oils, nuts and seeds, and beverages. N points refer to points attributed to unfavourable nutritional elements and P points refer to (negative) points attributed to favourable nutritional elements.Credit: Logo Nutri-Score, Santé publique France 2017.

the point allocation scale was set at 3.75% of the 6 g FIC regulation reference value). The maximum points for proteins increased from 5 to 7, except for red meat, for which the maximum was limited to 2 points. Oils and nuts were removed from the ingredients qualifying for the 'fruit, vegetables and legumes' component. In the fats, oils, nuts and seeds category, the energy component was modified to include energy derived from saturated fats, allowing for an increased discrimination of products based on saturated fat content. For beverages, the 2023 algorithm included a new unfavourable component for non-nutritive sweeteners (NNS) considering elements from FBDGs and literature reviews not to promote beverages containing NNS, in particular to children. Four points were allocated to the NNS component, corresponding to the number of points necessary for a shift by one class of Nutri-Score. In addition, the sugars and energy components were modified to allow for adequate discrimination of both water- and milk-based beverages. Water remained the only A-rated beverage.

Impact on food classification

The current and updated classification of a selected number of food groups are presented in Table 1, including data from Belgium, France, Germany and the Netherlands. Detailed information for other food groups is available in Supplementary Tables 4 and 5. Overall, the 2023 updated algorithm met most objectives for priority areas of improvement set by the scientific committee, while maintaining the structure, scope and efficiency of the NS-NPM as well as strengthening the alignment between Nutri-Score and FBDGs.

A number of targeted products identified as priority groups by the scientific committee reached a more favourable classification: plain fatty fish and vegetable oils with a limited amount of saturated fatty acids (such as canola, nuts, olive oil and high-oleic sunflower oils), and unseasoned nuts and seeds. The classification of hard cheeses with a low salt content was also improved.

The 2023 updated algorithm better discriminated products according to their sugar content, with a shift in distribution of high-sugar products such as confectionery and sweetened breakfast cereals towards less favourable ratings. The same was observed for high-salt products. Products with low levels of favourable dietary constituents, such as dietary fibre or iron and calcium (for which the protein component is a proxy), were consistently shifted towards less favourable ratings (for example, prepared meals or refined cereal products). Discrimination between wholegrain and refined grain breads was increased, that is, that breads were shifted from a distribution in two classes of the Nutri-Score to three classes based on fibre and salt content, with only wholegrain bread with high levels of fibre remaining in the A category. Plain pasta or rice made from whole or refined grains remained in the A category.

The classification of beverages in the current and updated Nutri-Score is presented in Table 2 (for details, see Supplementary Table 6). The 2023 updated algorithm classified plain skimmed and partially skimmed milk as B considering that only water is allowed to be graded A as a beverage, and enhanced discrimination of milk-based beverages by their sugar content, with those containing added sugars classified as D or E. For water-based beverages, increased discrimination was observed by levels of sugars, with very low-sugar beverages (that is, <2 g per 100 ml) reaching the B category while most high-sugar beverages were maintained in the E category. Conversely, introduction of a component for the use of NNS, shifted beverages containing NNS towards less favourable classifications, reaching the C category at best.

Challenges and opportunities

The 2023 update of Nutri-Score maintained the general structure of the algorithm based on a limited number of food categories (that is, main algorithm; fats, oils, nuts, and seeds; and beverages). The number of specific categories to be included in NPMs depends on the type of food discrimination being sought (for example intra-group discrimination versus inter-group discrimination) and the regulation for which it is used[27].

Across-the-board models use the same criteria to rate foods equally. While they allow for a comparison of the nutrient composition of foods across food groups (for example, fruit and vegetables versus meat products), they may be limited in their ability to highlight within-group differences (for example, canned vegetables with or without added salt or sugar). Category-specific models such as the 'Choices system' are tailored to emphasize the nutritional differences within a food group[28]; however, as they rank foods from 'less healthy' to 'healthier' within each category, these models carry the risk of minimizing the relative importance of different food groups within a healthy diet. For example, having specific categories for sugary snacks on the one hand and fruit and vegetables on the other hand would lead to ranking products in each of these categories as 'favourable' or 'unfavourable', while FBDGs do not place them at the same level. In addition, category-based systems may require more subjective decision-making, as references for specific categories may be scarce. The NS-NPM, with a limited number of categories, aims at reaching a balance for both inter- and intra-group differentiation[27], but the limited number of categories also poses a challenge when updating the algorithm, as any modification would affect the scoring of multiple food groups.

Overall, some limitations persist in the 2023 updated algorithm. While an increased discrimination between wholegrain and refined grain breads was obtained, this was not the case for pasta and rice. While some additional modifications to the NS-NPM would have potentially overcome this limitation (such as the introduction of wholegrain ingredients to the 'fruit, vegetables and legumes' component), the balance between the added complexity to the system and the gains obtained for a very specific category of products was considered too complex to proceed forwards. A similar conclusion on this specific group was drawn in the revision of the Health Star Rating system in Australia, which relies on a similar NPM[29]. This decision was also influenced by the absence of an EU-wide definition of 'wholegrain'[30].

Another limitation of the algorithm is due to the available information on the nutritional declaration pertaining to sugars. The current and updated versions of the algorithm rely on a component for total sugars, as it is the only available information on the back-of-pack, according to the FIC regulation. However, from a public health perspective, added sugars or free sugars are more relevant for health outcomes than total sugars[31]. A study performed on the Health Star Rating system algorithm found that the use of added sugars rather than total sugars would allow for a higher discrimination between 'core' (that is, key food groups for a healthy diet) and 'discretionary' foods (that is, foods to be limited in the diet)[32]. However, the inclusion of specific proxy components of naturally occurring sugars (for example, a component for fruit as in the NS-NPM or a specific algorithm for dairy, as in the Health Star Rating system) may partially overcome this limitation.

Other NPMs have incorporated a large number of components, including micronutrients or ingredients of interest (for example, wholegrain or refined grain ingredients, red and processed meat, and so on)[33–36]. The Food Compass model, for example, evaluates foods based on 56 attributes over 9 domains, including vitamins, minerals, phytochemicals as well as ingredients (including 10 forms of ingredients such as seafood, yogurt or plant oils) and processing elements (including Nova classification for the level and purpose of processing, fermentation, frying and several types of additive)[33]. The inclusion of more elements within a NPM may allow for a more precise evaluation of foods and beverages in association with health outcomes. The addition of elements outside of the actual nutritional value, such as additives or level of processing, may allow for incorporation of more dimensions of the foods, with a holistic approach. However, the computation of such extensive systems requires either access to detailed information from the manufacturer or imputation from available elements. From a nutritional perspective, the addition of multiple micronutrients that usually

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Table 1 | Current and updated classification in Nutri-Score for selected food groups from the general category and fats, oils and nuts

	Nutri-Score (%)					Nutri-Score (%)				
	Current algorithm (2015)					Updated algorithm (2023)				
	A	B	C	D	E	A	B	C	D	E
Belgium										
Wholegrain bread	64	28	6	2	0	41	44	12	3	0
Mixed grain and refined grain bread	16	57	18	9	0	7	25	55	13	1
Breakfast cereals	31	10	37	20	2	24	8	32	31	5
Wholegrain pasta	98	2	0	0	0	98	2	0	0	0
Refined grain pasta	74	5	12	10	0	71	5	12	12	0
Solid and semi-solid cheese	0	0	2	91	8	0	0	8	86	7
Sauces—used cold	5	10	38	35	12	5	5	35	29	26
Candy, sweet sauces	5	12	16	54	12	5	12	5	37	40
Nuts, plain	63	23	8	6	0	83	5	5	7	0
Nuts, not plain	14	17	66	1	2	16	3	73	5	2
Seeds	44	42	14	0	0	65	8	21	0	6
(Vegetable) fats and oils	0	0	23	72	5	0	40	51	4	5
France										
Wholegrain bread	77	20	3	0	0	21	38	40	1	0
Refined grain bread	27	55	15	3	0	5	8	78	8	1
Breakfast cereals	16	12	46	25	1	10	4	35	44	6
Wholegrain pasta	100	0	0	0	0	100	0	0	0	0
Refined grain pasta	98	1	1	0	0	84	14	1	1	0
Solid and semi-solid cheese	0	0	5	93	2	0	0	19	78	3
Sauces—used cold	0	0	12	68	20	0	0	2	67	31
Fatty fish	8	20	24	47	1	20	16	13	41	10
Candy, sweet sauces	0	7	12	62	19	0	6	4	11	79
Nuts, plain	66	24	10	0	0	70	22	8	0	0
Nuts, not plain	6	14	75	4	0	5	6	66	18	5
Seeds	45	8	27	19	0	77	3	5	10	5
(Vegetable) fats and oils	0	0	63	29	8	0	60	31	1	8
Germany										
Wholegrain bread	78	22	1	0	0	37	52	11	0	0
Mixed grain and refined grain bread	53	39	7	1	0	8	20	61	10	1
Breakfast cereals	50	10	30	10	0	37	9	28	24	1
Wholegrain pasta	100	0	0	0	0	98	2	0	0	0
Refined grain pasta	98	2	0	0	0	88	10	1	0	0
Fatty fish	20	23	19	38	0	35	13	10	30	11
Nuts, plain	52	28	20	0	0	63	36	1	0	0
Nuts, not plain	2	11	72	15	0	6	31	38	25	0
Seeds	0	24	66	10	0	62	28	3	7	0
(Vegetable) fats and oils	0	0	68	21	11	0	15	73	0	11
The Netherlands										
Wholegrain bread	98	1	1	0	0	89	8	2	1	0
Mixed grain and refined grain bread	51	40	9	1	0	14	25	57	3	0
Breakfast cereals	37	14	39	10	0	26	11	35	25	3
Wholegrain pasta	98	0	2	0	0	98	0	0	2	0
Refined grain pasta	99	1	0	0	0	84	15	1	0	0
Solid and semi-solid cheese	0	0	0	87	12	0	0	1	93	6

Table 1 (continued) | Current and updated classification in Nutri-Score for selected food groups from the general category and fats, oils and nuts

	Nutri-Score (%)					Nutri-Score (%)				
	Current algorithm (2015)					Updated algorithm (2023)				
	A	B	C	D	E	A	B	C	D	E
Sauces—used cold	1	5	22	49	23	1	1	16	43	39
Fatty fish	2	13	23	62	1	6	16	13	63	3
Candy, sweet sauces	5	10	5	71	10	4	8	6	13	69
Nuts, plain	34	56	10	0	0	54	20	20	6	0
Nuts, not plain	1	26	70	2	0	6	9	69	16	1
(Vegetable) fats and oils	0	0	12	81	7	0	57	36	0	7

Data for Belgium, France, Germany and the Netherlands were obtained from the Nutritrack[20], OQALI[21] and Open Food Facts[22], Mintel Global New Product Database[23] and Dutch branded food databases[24], respectively.

coexist within the same foods may lead to a form of double counting (for example, the 'fruit and vegetables' component used as a proxy for certain vitamins), with the risk of giving more weight to elements for which evidence is more limited. From a policy perspective, this may constitute a risk, as the feasibility of implementing such systems in the current legal environment would be somewhat compromised by the lack of available information in the nutrient declaration or absence of consensus definitions to rely on (for example, wholegrain ingredients). Nutri-Score as an FoPL was developed as a transparent tool for consumers, in accordance with the FIC regulation, and as such includes components within the boundaries of available information. While it may be considered a constraint to the system, one of its strengths relates to the capacity of third parties (that is, consumer organizations, app providers and so on) to calculate and provide information to consumers even for products not displaying Nutri-Score, thereby ensuring its wider dissemination. Moreover, considering the inherent correlation between nutrients within a product, some components of the algorithm may act as proxies for multiple nutrients. The 'fruit and vegetables' component, for example, may act as a proxy for vitamins, minerals or secondary plant metabolites present in these ingredients. This has been confirmed at the individual diet level by correlations between a more favourable Nutri-Score dietary index (based on the current algorithm assigned to consumed foods) and more favourable intakes of vitamins, minerals and various types of fatty acid[13,15].

Adding information to the nutritional declaration in the EU FIC regulation would enable to potentially include free or added sugars or a common definition for wholegrain within the algorithm. This would allow for a subtler discrimination between products, and tailor reformulation through more meaningful modifications. These elements could be added to a future update of the algorithm. This timeline needs to be defined by the steering committee of Nutri-Score.

The 2023 NS-NPM also introduced the presence of NNS in beverages as a new component, classified as an unfavourable element, in addition to a strict approach for sugars. While NNS are generally considered safe by food safety agencies, some concerns have emerged as to the potential long-term effects of moderate consumption levels on health[37,38]. In line with this, the International Agency for Research on Cancer recently (that is, published after the Nutri-Score beverage report) classified aspartame as possibly carcinogenic to humans (group 2B) based on limited evidence[39]. These elements raise concerns regarding the promotion of beverages with NNS, in particular for more vulnerable populations such as children and the potential use of NNS as a replacement for sugars by manufacturers. The integration of the component highlights the precautionary approach of the scientific committee in this instance. Importantly, as the level of evidence regarding adverse health consequences of beverages with NNS is low compared with the level of evidence for sugar-sweetened beverages, the magnitude of the new component was set at the minimal number of points, ensuring a shift by one category only (that is, 4 points). Notably, Mexico has already introduced a front-of-pack warning label for the presence of NNS in foods and beverages[40], thereby limiting their promotion and discouraging their introduction by manufacturers to replace sugars. Indeed, greater use of NNS in replacement for sugars has been observed following the introduction of FoPLs[41,42]. Future evaluation of the impact of this change on product reformulation will be required to monitor the relative use of sugars versus NNS in beverages in the future.

Finally, the NS-NPM components are consistent with the nutrient and non-nutrient components identified by the European Food Safety Authority (EFSA) as elements of public health concern in the EU, which could be included in a nutrient profiling systems for the purpose of a harmonized FoPL[2]. EFSA's recommendations to the European Commission identified saturated fat, sodium and added/free sugars as nutrients with excess intakes, and dietary fibre and potassium as nutrients with inadequate intakes in the EU population[2]. EFSA mentioned that energy could be included, as a reduction in energy intake is of public health importance for Europeans. With the exception of potassium, all components are within the NS-NPM model.

Just like the Nutri-Score 2015 algorithm has been extensively validated, this newly updated version will also need to undergo a similar process. In the Netherlands, an analysis of the updated NS-NPM by the Health Council supported its adequacy to complement FBDGs[43]. In addition to analyses at the food level, comparison studies would help to ensure that the updated model is more predictive of nutrition-related health outcomes, thereby highlighting the increased potential of the model in contributing to the prevention of non-communicable diseases. The overall structure of categories has been preserved, so that consumers' understanding of the score is not altered.

Conclusion

The 2023 update of the NS-NPM has improved the ability of Nutri-Score to discriminate foods and beverages based on their nutrient composition and to act as a complementary tool to FBDGs in nutritional policies, supporting the adoption of healthier dietary patterns. It relied on transparent and evidence-based processes, ensuring that Nutri-Score algorithm remains up to date with the most recent evidence relating nutrition to health[44,45]. Dimensions included in the algorithm such as processing and sustainability could be expanded once sufficient scientific evidence is available. The implementation of this updated algorithm within the framework of Nutri-Score's transnational governance will need to address the issues of assisting companies during the transition period, informing and raising awareness of the consumers about the changes, and updating regulations with the EU. Given the number of countries for which FBDGs were assessed for updating Nutri-Score, the algorithm could be considered for use in a harmonized and mandatory FoPL at the EU level.

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Table 2 | Current and updated classification in Nutri-Score for selected beverages

	Nutri-Score (%)					Nutri-Score (%)				
	Current algorithm (2015)					Updated algorithm (2023)				
	A	B	C	D	E	A	B	C	D	E
Belgium										
Milk-based beverages	39	58	3	0	0	0	5	28	32	35
Colas without NNS	0	0	0	0	100	0	0	0	0	100
Colas with NNS	0	87	4	9	0	0	0	91	0	9
Soft drinks with fruits without NNS	0	0	12	16	72	0	1	23	28	49
Soft drinks with fruits with NNS	0	2	34	51	13	0	0	2	61	36
Lemonades, tonic waters and bitters without NNS	0	0	0	11	89	0	0	11	64	25
Lemonades, tonic waters and bitters with NNS	0	22	20	50	8	0	0	42	13	45
Fruit juices	0	74	23	3	0	0	71	24	5	0
France										
Skimmed milk	39	61	0	0	0	0	100	0	0	0
Partially skimmed milk	28	72	0	0	0	0	98	2	0	0
Whole milk	4	94	2	0	0	0	6	87	4	3
Milk-based beverages	6	88	6	0	0	0	0	25	28	47
Colas without NNS	0	0	0	0	100	0	0	0	0	100
Colas with NNS	0	30	49	10	12	0	0	79	2	19
Soft drinks with fruits without NNS	0	0	4	12	84	0	1	7	26	66
Soft drinks with fruits with NNS	0	2	58	28	14	0	0	59	7	34
Lemonades, tonic waters and bitters without NNS	0	0	0	5	95	0	0	0	50	50
Lemonades, tonic waters and bitters with NNS	0	21	24	46	9	0	0	41	13	46
Fruit juices	0	5	54	15	26	0	4	49	20	26
Fruit nectars	0	0	2	11	87	0	0	2	30	68
Germany										
Skimmed milk	100	0	0	0	0	0	100	0	0	0
Partially skimmed milk	68	28	3	0	0	0	97	3	0	0
Whole milk	0	98	2	0	0	0	2	94	2	1
Milk-based beverages	7	35	19	4	35	0	2	10	24	64
Colas without NNS	0	0	0	0	100	0	0	0	11	89
Colas with NNS	0	54	32	14	0	0	0	83	14	3
Soft drinks with fruits without NNS	0	0	3	52	44	0	2	46	16	35
Soft drinks with fruits with NNS	0	2	33	51	15	0	0	25	51	25
Lemonades, tonic waters and bitters without NNS	0	0	1	21	79	0	0	17	40	43
Lemonades, tonic waters and bitters with NNS	0	22	56	21	1	0	0	70	28	2
Fruit juices	0	14	62	19	5	0	14	61	19	6
Fruit nectars	0	0	2	9	88	0	1	5	16	79
The Netherlands										
Skimmed milk	100	0	0	0	0	0	100	0	0	0
Partially skimmed milk	64	36	0	0	0	0	99	0	0	1
Whole milk	3	97	0	0	0	0	3	97	0	0
Milk-based beverages	35	65	0	0	0	0	9	26	30	35
Soft drinks (with fruit) without NNS	0	0	1	33	66	0	0	31	23	46
Soft drinks (with fruit) with NNS	0	2	16	30	51	0	0	13	13	75
Fruit and vegetable juices	0	10	76	12	2	0	8	76	13	3

Data for Belgium, France, Germany, and the Netherlands were obtained from the Nutritrack[20], OQALI[21] and Open Food Facts[22], Mintel Global New Product Database[23] and Dutch branded food[24] databases, respectively.

Data availability

Belgium: the Belgian Nutritrack branded food composition data can be shared by Sciensano upon reasonable request. France: raw data from Oqali is provided at https://www.oqali.fr/en/public-data/data-basis/. Details and how to use the Oqali data are given at https://www.oqali.fr/donnees-publiques/faq/. The Open Food Facts data used in the study are available on their website (https://world.openfoodfacts.org/, accessed on November 2021). OpenFoodFacts is an open collaborative database of food products marketed worldwide, licensed under the Open Database License (ODBL). The Ciqual database is freely available on the Ciqual website (https://ciqual.anses.fr/). Germany: the Global New Product Database (GNPD) by Mintel is a commercially available database; relevant data from the Product Monitoring Database of the Max Rubner-Institut are complemented by purchased data from the consumer research institute GfK. Thus, data from both sources cannot be shared with external persons/institutions. The Netherlands: the Dutch branded food database is not open access, therefore not publicly available.

Code availability

The code used to generate the results is available upon request from the corresponding author exclusively for the purposes of undertaking academic, governmental or non-profit research.

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Author contributions

B.M. and E.T. contributed equally to this study and share first co-authorship. C.J. coordinated the study, acted as Chairperson for the Scientific Committee of Nutri-Score and drafted the original paper. She is the guarantor. C.J. and B.S.; B.M., C.K. and H.H.; E.T. and E.S.; S.V. collected and analysed data from databases in France, Germany, the Netherlands and Belgium, respectively, for the study. All authors participated in the review of the literature and participated equally in the interpretation of results, decision-making process for the scientific committee and critically revised the paper for important intellectual content. All authors have read and agreed to the published version of the paper.

Competing interests

B.M., E.T., H.A., J.W.J.B., A.E.B., T.B., P.D., M.-N.F., M.G.S., E.I., F.R.-A., S.V. and C.J. are members of the Scientific Committee of the Nutri-Score.

Additional information

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