

# Nutri-Score: Evidence of the effectiveness of the French front-of-pack nutrition label

Chantal Julia, Serge Hercberg

## Abstract

France recently decided to implement a newly developed 5 colour Front-of-Pack (FOP) nutrition labelling, “Nutri-Score” to orient consumers towards healthier food choices at the point of purchase and as an incentive for manufacturers to reformulate their products towards healthier compositions. Results of validation studies suggest that the Food Standards Agency nutrient profiling system (FSA-NPS) underlying the Nutri-Score can adequately characterize the nutritional quality of foods, and that an individual score (FSA-NPS dietary index, FSA-NPS DI) based on the FSA score of the foods consumed can adequately summarize the nutritional quality of the diet. Moreover, the FSA-NPS DI is associated with chronic diseases onset. The format of the Nutri-Score appears well-perceived and understood. Finally, the Nutri-Score was associated with a higher nutritional quality of purchases in experimental and large scale trials. Altogether, these elements tend to corroborate the Nutri-Score as an efficient tool in public health nutrition.

**Keywords:** front-of-pack labelling, nutrient profiling systems, validation, public health policies

Since 2001, France has set a public health nutrition policy, the Programme National Nutrition Santé (PNNS, French Nutrition and Health Program) which combines laws, regulations and incentives in the field of nutrition (diet and physical activity) to improve the population’s health status [10, 11]. Following a report by the Minister of Health to the president of the PNNS in 2014 – which included 15 public health measures [6] – the principle of a FOP nutrition label was included in the Health law, enacted in January, 2016 [12]. The Nutri-Score (also known in its former version as the 5-Colour Nutrition label, 5-CNL) was finally selected after comparison tests against several labels proposed by industry or retailers in March 2017, and the EU was notified of the implementation of this label in the following month. This manuscript retraces the elements that led the French health authorities to select the Nutri-Score.

The Nutri-Score/5-CNL relies on the computation of a nutrient profiling system, derived from the United Kingdom Food Standards Agency nutrient profiling system (FSA score) [13–15]. The FSA score is computed taking into account nutrient content per 100g for food and beverages. It allocates positive points for “unfavourable” content: energy (kJ, 0–10 points), total sugar (g, 0–10 points), saturated fatty acids (g, 0–10 points) and sodium (mg, 0–10 points). Negative points are allocated for “favourable” contents: fruits, vegetables and nuts (0–5 points), fibers (0–5

## Background

In order to tackle the growing increase in nutrition-related conditions, government-led strategies and policies have introduced multifaceted interventions aiming at improving the diet in the population [1–5]. Among the variety of possible interventions, Front-Of-Pack (FOP) nutrition labels have received growing attention from public authorities and learned societies [4, 6]. FOP nutrition labels are considered a helpful guidance for consumers towards healthier food choices at the point of purchase [7–9]. Moreover, they are thought to be incentives for manufacturers to reformulate their products towards healthier compositions, which would be materialized on the FOP label.

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points) and proteins (0-5 points). The total from positive (0-40 points in total) and negative (0-15 points) points is computed, yielding a global score ranging from -15 for the most healthy foods (0 positive points and 15 negative points) to +40 for less healthy foods (40 positive points

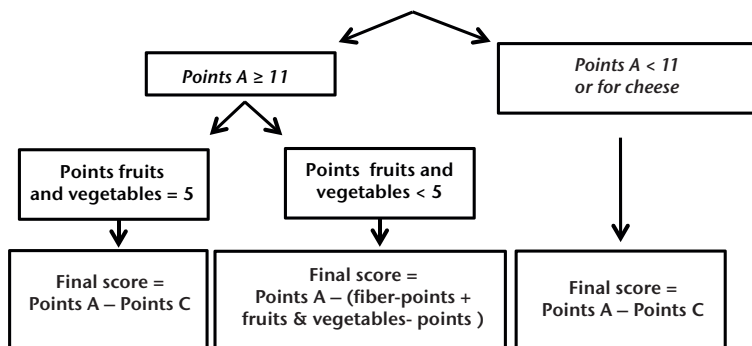
and 0 negative points) (♦ Table 1). From this overall score, five categories of nutritional quality are derived, defining the categories for the Nutri-Score, ranging from 'green' to 'red' (♦ Figure 1). Letters (A to E) were added to colours in order to improve the readability of the label.

The entire scale appears on the label, with the letter/colour corresponding to the product's nutritional quality enlarged. Using the Nutri-Score, whole-grain bread or plain yogurt are classified as Green/A, chocolate-flavored breakfast cereals or jam are classified as Yellow/C, and cho-

1. Attribution of points, based on the content of nutrients and other elements per 100 g of a food/beverage

| Points       | Energy (kJ)                               | Sugars (g) | Specific cut-offs: beverages |            | Saturated fat (g) | Specific cut-offs: fats   |                 | Sodium (mg)                                      | Points  | Fruits, veg (%) | Specific cut-offs: beverages |             |  |
|--------------|---|------------|------------------------------|------------|-------------------|---------------------------|-----------------|--|---------|-----------------|------------------------------|-------------|--|
|              |   |            | Energy (kJ)                  | Sugars (g) |                   | Saturated fat/ Lipids (%) | Fruits, veg (%) |  |         |                 | Fiber (g)                    | Protein (g) |  |
| 0            | ≤ 335                                     | ≤ 4.5      | ≤ 0                          | 0          | ≤ 1               | < 10                      | < 90            | 0  | ≤ 40    | ≤ 40            | ≤ 0.7                        | ≤ 1.6       |  |
| 1            | > 335                                     | > 4.5      | ≤ 30                         | ≤ 1.5      | > 1               | < 16                      | > 90            | 1  | < 40    |                 | > 0.7                        | > 1.6       |  |
| 2            | > 670                                     | > 9        | ≤ 60                         | ≤ 3        | > 2               | < 22                      | > 180           | 2  | > 60    | > 40            | > 1.4                        | > 3.2       |  |
| 3            | > 1,005                                   | > 13.5     | ≤ 90                         | ≤ 4.5      | > 3               | < 28                      | > 270           | 3  | –       |                 | > 2.1                        | > 4.8       |  |
| 4            | > 1,340                                   | > 18       | ≤ 120                        | ≤ 6        | > 4               | < 34                      | > 360           | 4  | –       | > 60            | > 2.8                        | > 6.4       |  |
| 5            | > 1,675                                   | > 22.5     | ≤ 150                        | ≤ 7.5      | > 5               | < 40                      | > 450           | 5  | > 80    |                 | > 3.5                        | > 8.0       |  |
| 6            | > 2,010                                   | > 27       | ≤ 180                        | ≤ 9        | > 6               | < 46                      | > 540           | 6  |         |                 |                              |             |  |
| 7            | > 2,345                                   | > 31       | ≤ 210                        | ≤ 10.5     | > 7               | < 52                      | > 630           | 7  |         |                 |                              |             |  |
| 8            | > 2,680                                   | > 36       | ≤ 240                        | ≤ 12       | > 8               | < 58                      | > 720           | 8  |         |                 |                              |             |  |
| 9            | > 3,015                                   | > 40       | ≤ 270                        | ≤ 13.5     | > 9               | < 64                      | > 810           | 9  |         |                 |                              |             |  |
| 10           | > 3,350                                   | > 45       | ≤ 270                        | > 13.5     | > 10              | ≥ 64                      | > 900           | 10   |         | > 80            |                              |             |  |
|              | 0–10 (a)                                  | 0–10 (b)   | 0–10 (a)                     | 0–10 (b)   | 0–10 (c)          | 0–10 (c)                  | 0–10 (d)        |  | 0–5 (a) | 0–10 (a)        | 0–5 (b)                      | 0–5 (c)     |  |
| <b>Total</b> | Points A = (a) + (b) + (c) + (d) [0 – 40] |            |                              |            |                   |                           |                 | <b>Total</b> Points C = (a) + (b) + (c) [0 – 15] |         |                 |                              |             |  |

2. Final score: -15 to 40 points



3. Attribution of colors

| Foods (points) | Beverages (points) | Color       |
|----------------|--------------------|-------------|
| min to -1      | water              | green       |
| 0 to 2         | min to 1           | light green |
| 3 to 10        | 2–5                | yellow      |
| 11 to 18       | 6–9                | orange      |
| 19 to max      | 10 to max          | dark orange |



Green: highest quality  
 Red: lowest quality

Table 1: Score computation and attribution of the categories for the Nutri-Score/5-CNL

For each component (in columns), points are attributed based on their nutritional composition for 100g. In some food categories, a specific attribution grid for points is used. The sum of points for A components (in red) is drawn. Depending on this sum, the total or part of C components are subtracted, yielding the overall score of the food product. The Nutri-Score is attributed based on this overall score, with specific thresholds for foods and beverages.

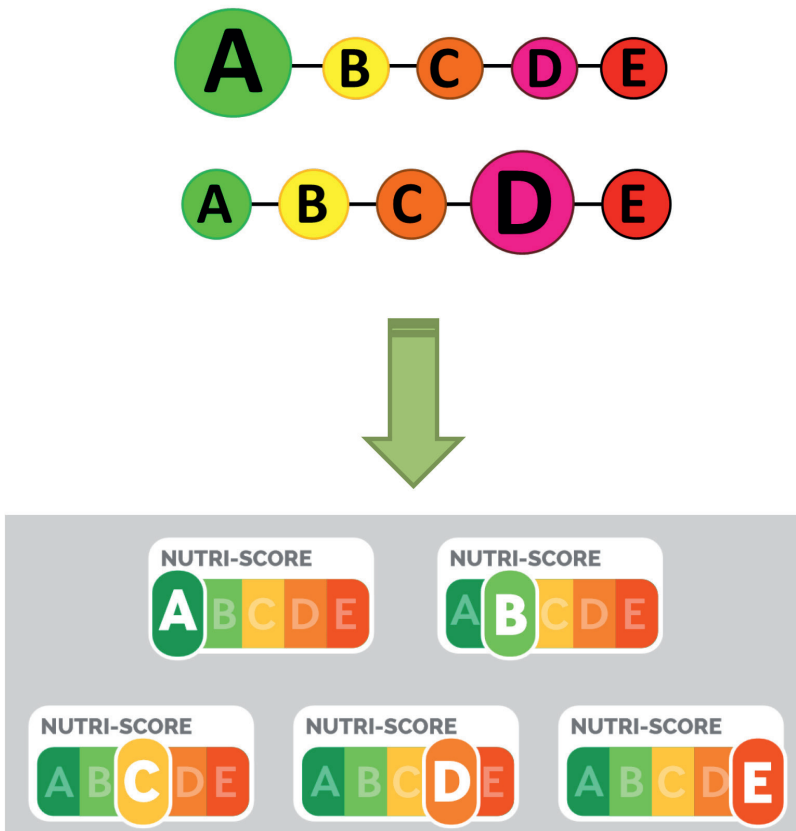


Figure 1: Nutri-Score, and its former graphical format, the 5-CNL

colate biscuits or chocolate spreads as Red/E.

## Application of the FSA score in the French food environment

### Classification of foods

The FSA score was first applied to the French Nutrinet-Santé food composition database [16], which includes generic foods usually consumed in the French diet. This study compared the classification of foods using the FSA score to French food-based dietary recommendations, and assessed whether the FSA score was able to define five categories of nutritional quality of foods. Overall, the FSA score classified foods consistently with nutritional recommendations. While 82.4% of fruit and vegetables were in the first quintile of distribu-

tion, 22% of 'sugary snacks' were in the fifth quintile of distribution. Moreover, the FSA score displayed a large variability within food groups, which allowed for a discrimination of the nutritional quality within a food group. The feasibility and discriminant capacity of the FSA score were confirmed when applying it to a food composition database reflecting foods as sold in France, the Open Food Facts database [17]. However these studies showed that the application of five categories of nutritional quality did not perfectly agree with nutritional recommendations for 3 food groups: beverages, cheese and added fat. These results were further confirmed by a report of the French Agency for Food, Environmental and Occupational Health and Safety, ANSES [18]. The ANSES also proposed a first set of thresholds for the Nutri-Score, based on the quintiles of the distribution

of the FSA score observed in the Observatory of Food Quality (OQALI) database and including more than 12,000 foods and beverages, as sold in France. The French High Council of Public Health (HCSP) was commissioned to precise thresholds defining the 5 colours and to make the necessary adaptation of the FSA algorithm for cheese, added fats and beverages [19], defining the final contours of the Nutri-Score/5-CNL for France. The final thresholds of the Nutri-Score were set in order to increase the discrimination of products within a food category.

Minor modifications to the FSA score algorithm were performed by the HCSP for beverages, cheese and added fats. Modifications consisted in the adaptations of the allocation of points for saturated fatty acids/fats, energy and sugars for beverages and modification of the overall algorithm (taking into account protein) for cheese (♦ Table 1), and allowed for an improvement of the consistency between the 5-CNL/Nutri-Score classification and the French nutritional recommendations. For fats, the updated FSA algorithm allowed to discriminate between vegetable oils rich in n-3 polyunsaturated fatty acids (PUFA) (colza oil classified in Yellow/C vs. Red/E in the original version), vegetable oils low in n-3 PUFA (sunflower oil classified in Orange/D vs. Red/E in the original version) and animal fats (butter, classified in Red/E in both versions). For beverages the updated algorithm discriminated between water (Green/A), artificially sweetened beverages (Light Green/B), fruit juices (Yellow/C), low-sugar soft drinks (Orange/D) and regular soft drinks (Red/E), while in the original FSA score the distribution of beverages was too narrow to allow any discrimination. For cheese, the updated version of the FSA score allowed to take better account of the calcium content of cheese, which is highly correlated to the protein content of cheese.

Finally, the discriminant capacity of the 5-CNL was also confirmed in a

large specific group of foods: breakfast cereals (n = 380) [20], as all types of cereals – and even similar cereals from different brands – were classified in at least three categories of the 5-CNL.

### FSA score as an indicator of the overall quality of the diet at individual level

The FSA score was transposed into an individual indicator aiming at reflecting the overall nutritional quality of the diet, the FSA-NPS DI [21]. As the FSA score of foods, a higher FSA-NPS DI reflects lower nutritional quality of the foods consumed in the overall diet of the individual. The FSA-NPS DI was validated against food consumption, nutrient intake and biomarkers of nutritional status, in three French studies: in a representative sample of the French population randomly selected from the NutriNet-Santé study (n = 4,225) [21], in the French SU.VI.MAX cohort study (n = 5882) [22] and the representative population-based ENNS cross-sectional study (n = 2,754) [23].

In all three studies, higher FSA-NPS DI (reflecting a lower nutritional quality of the diet) was associated with higher consumption of sweet, fatty and salty foods and lower consumption of fruits, vegetables, fish and whole grains [21]. Higher FSA-NPS DI was also associated with higher energy intakes, higher intakes of saturated fats, added sugars and lower intakes of polyunsaturated fatty acids, fibers, vitamins and minerals. FSA-NPS DI was associated with lower levels of LDL-cholesterol and antioxidant biomarkers [22].

### FSA-NPS DI and health outcomes

The prospective associations between FSA-NPS DI and health outcomes were investigated in two large French cohorts: the SU.VI.MAX cohort and the NutriNet-Santé cohort study. The investigated outcomes were cancer (and breast cancer), cardiovascular disease, metabolic

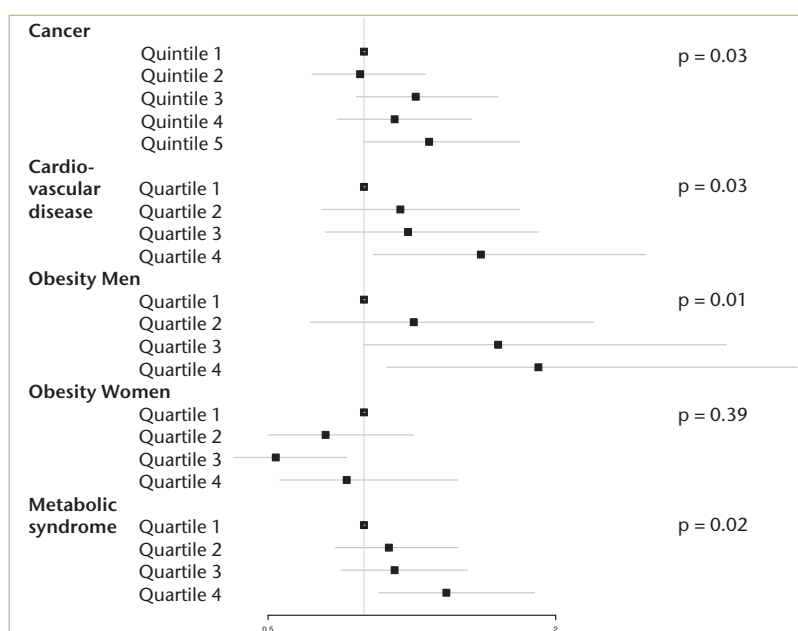


Figure 2: Prospective associations (multivariable odd ratio and 95% confidence interval) between FSA-NPS DI and health outcomes in the SU.VI.MAX cohort study

syndrome and weight gain [24–29]. A synthesis of the observed associations in the SU.VI.MAX cohort is shown in ♦ figure 2. Overall, poorer diets, as expressed by the FSA-NPS DI were associated with a higher risk of developing a chronic disease in both cohorts. Between the Quartile 4 (less healthy diets) and Quartile 1 (more healthy diets) of the FSA-NPS DI, the odds of developing metabolic syndrome were increased by 43%, overweight and obesity in men by 61% and cardiovascular diseases by 40% to 61%. Overall cancer risk was increased by 34% and breast cancer risk by 52% between Quintile 5 and Quintile 1 of the FSA-NPS DI.

### Perception, understanding and use of FOP nutrition labels

#### Objective understanding

The theoretical framework of the effectiveness of FOP labels suggests that perception and understanding are key elements to their impact [30]. These prerequisite were assessed in participants in the Nu-

triNet-Santé cohort study, using self-administered questionnaires [31, 32]. Four formats were compared, each one corresponding to a specific type of FOP label:

- nutrient-specific with numeric information (*Guideline Daily Amount, GDA*),
- nutrient-specific with colour-coded information (*Multiple Traffic Light, MTL*),
- endorsement scheme, which appear only on the more healthy products within a category (*Tick*, similar to the Danish *Keyhole* and the Dutch *Choices*) and
- graded summary systems (*5-CNL*, the former graphical format for the *Nutri-Score*).

The 5-CNL was considered the easiest to identify and the most likely to be found easy and quick to understand. GDAs were considered the least easy label to identify, and the one entailing the heaviest cognitive workload [32]. A second comparative study on the perception of FOP labels showed that the Nutri-Score had the highest support in the population (preferred format on a set of variables for 43% of the sample),

and more particularly in subjects with low adherence to nutritional recommendations [33].

Objective understanding was assessed by asking participants to rate the nutritional quality of three products based on the information provided by the FOP system. Compared to a control situation, all labels significantly increased the likelihood of correctly ranking the products. Overall, the 5-CNL was the most effective label (64.6% of correct answers), followed by the MTL (56.4%), GDA (50.2%) and the Tick (29.4%) labels [32]. The odds of correctly ranking products with the 5-CNL compared to a control situation were particularly high for subjects more at risk of having unhealthy diets: subjects with low educational level increased the odds of correctly ranking products tenfold and subjects with no perceived nutrition knowledge twentyfold [31].

### Use in purchasing situations

The use of the label on consumer purchasing intentions was evaluated in several complementary studies. First, a randomized study with an experimental online supermarket comparatively assessed the impact of four types of labels (5-CNL, MTL, GDAs and Check) in the Nutri-Net-Santé study (n = 11,981). The overall nutritional quality of the shopping cart was measured using the mean FSA score of the selected items, with a lower score indicating a higher overall nutritional quality. As expected, the control situation was associated with the lowest overall nutritional quality of the shopping cart ( $9.34 \pm 2.57$ ). Among the various formats tested, the 5-CNL significantly led to the highest overall nutritional quality of the items in the shopping cart (mean FSA score:  $8.72 \pm 2.75$ , -6.6%) followed by MTL ( $8.97 \pm 2.68$ , -4.0%) and Tick ( $8.99 \pm 2.71$ , -3.7%) compared with the control situation [34]. Notably, no effect was observed in the number of purchased items, or the price of the shopping cart.

An experimental study in a physical experimental supermarket (n = 901) found that the 5-CNL, associated with an explanatory leaflet, was associated with a higher nutritional quality of purchased sweet biscuits. No significant effect was observed for breakfast cereals or appetizers [35].

Two studies using an experimental economy design found that the Nutri-Score was associated to the highest improvement in the nutritional quality of the shopping cart. The first study (n = 255) compared the Nutri-Score to MTL, and Reference Intakes (RIs), while the second (n = 809) compared it to the Health Star Rating system, MTL, SENS (a graded-summary label, using four categories associated with recommended frequencies of consumption, which was proposed by retailers) and a modified version of the Reference Intakes (mRIs) [36, 37]. In both studies, the Nutri-Score performed best at improving the nutritional quality of the purchased items. In the second study, the nutritional quality of the shopping cart was improved by 9.3% for Nutri-Score, 6.6% for the Health Star Rating System and 4.8% for MTL [37]. Moreover, the Nutri-Score performed best in households with the lowest income.

Finally, a large scale trial was performed in 60 supermarkets, 10 for each of four proposed labels (Nutri-Score, MTL, SENS and the mRIs) and 20 controls. The first results showed that the Nutri-Score was associated with the largest improvement in the nutritional quality of purchases, followed by MTL and SENS. Moreover, the Nutri-Score was associated with an improvement in all subgroups of the population (in particular subjects buying discount brands), while with other formats some subgroups deteriorated the nutritional quality of their purchases [38].

### Conclusion

Both the nutrient profiling system and the actual FOP format of the Nu-

tri-Score/5-CNL were validated in various complementary studies. More particularly, the Nutri-Score/5-CNL appears to have a positive impact in disadvantaged populations, as shown in various subgroup analyses.

The adoption of the Nutri-Score in France is voluntary, based on EU regulations. So far, three large retailers and three manufacturers have agreed in a voluntary commitment charter to implement the Nutri-Score. In order to prevent manufacturers from selecting the foods they would label, the charter stipulates the commitment is for all foods in the portfolio. Hopefully, this uptake by large companies will prompt other to follow suit.

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#### Conflict of Interest

The authors declare no conflict of interest.

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