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# Comparative understanding and preference of Nutri-Score and NutrInform Battery in a sample of Spanish consumers

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**Background:** Interpretive front-of-pack labels (FoPLs) are supported by World Health Organization as an important policy tool to promote healthy diets. At present, various FoPLs formats co-exist in the European Union (EU). However, as part of the Farm to Fork strategy published in 2020, the European Commission stated that it would propose a single mandatory FoPL. The aim of this study was to analyze Spanish consumers' preference and objective understanding of Nutri-Score and NutrInform, two FoPLs that are currently the subject of debate in the EU. **Methods:** In a representative sample of 1026 Spanish adults (50% women, mean age ± SD = 46 ± 14 years), objective understanding was assessed by asking participants to identify the healthiest food products in three food categories (breakfast products, breakfast cereals and added fats). The preference dimensions were tested by asking participants about the perceived helpfulness of the FoPL in discriminating the nutritional quality of food products (subjective understanding) and their overall assessment of the FoPL's ease of use, informativeness, trust and liking (perception). **Results:** In terms of objective understanding, Nutri-Score was significantly associated with an increase in consumers' ability to identify healthier food products across all food categories compared with NutrInform [OR (odds ratio) = 19.1 [14.2–25.7], $P < 0.0001$]. On the preference dimension, Nutri-Score was perceived as significantly easier to use and was more liked than NutrInform (standardized principal component analysis dimension, respectively, 0.32 ± 1.58 vs. −0.29 ± 1.66, $P < 0.0001$ and 0.080 ± 1.18 vs. −0.072 ± 1.17, $P = 0.039$). **Conclusions:** This study provides new evidence to support Nutri-Score in comparison with NutrInform in Spanish consumers, on both objective understanding and preference aspects.

## Introduction

In 2017, Spain was the country with the highest life expectancy in the European Union (EU) with an average age of 83.4 years.[1] However, this position is threatened by the increasing rates of obesity among children and adults.[2–4] A well-balanced diet and adequate levels of physical activity, while limiting sedentary lifestyle, are crucial in preventing obesity and chronic diseases. The 2018 report from the World Health Organization Europe identified nutrition labelling as cost-effective policy tool to support healthy diets.[5] In order to guide consumers' choices towards healthier foods while encouraging manufacturers to improve the nutritional quality of their products, front-of-pack nutrition labels (FoPLs) have been implemented in the European region.[5] In May 2020, as part of the Farm to Fork strategy, the European Commission stated that it would propose the adoption of a single harmonized mandatory FoPL in 2022.[6]

At present, two main types of FoPLs co-exist in Europe: interpretive formats that convey an evaluation on the nutritional value of a food[7] and non-interpretive formats that reproduce part of the information available on the back-of-pack without additional interpretation.[7] The Nutri-Score is a summary, graded, colour-coded FoPL which was designed by academic researchers and the French Public Health Agency.[8] It was adopted in France in 2017 and since 2021, six other countries including Spain officially committed to an European coordination in order to facilitate the use of the Nutri-Score.[9] Parallel to the gradual adoption of the Nutri-Score in the EU, Italian ministries in collaboration with local public health institutions and professional unions launched a non-interpretive FoPL termed NutrInform Battery, officially adopted by the country in October 2020.[10,11]

Although Spain announced its intention to adopt Nutri-Score, some concerns have been raised regarding the Nutri-Score's application on traditional products and its consistency in regard to the Mediterranean Diet guidelines, with for instance the Nutri-Score's classification of olive oil.[12–14] These issues were raised mainly by food and agriculture trade associations but the debate also emerged

in the scientific community.[15] Discussions on FoPLs in Europe and particularly in Mediterranean countries call for additional studies including NutrInform, on consumers' food choices and FoPL understanding. While Nutri-Score has been scientifically validated by numerous studies and on several dimensions,[16] to date, the three studies testing NutrInform compared with Nutri-Score focused on subjective understanding only.[17–19] They suggested that NutrInform was preferred by consumers and notably that it was more helpful than Nutri-Score to understand the product's nutrient composition. While subjective understanding—a preference measure—covers 'the extent to which consumers think they have understood what is being communicated and the meaning they attach to the perceived label information' according to Grunert *et al.*,[20] objective understanding—a performance measure—tests whether consumers act upon the information provided in alignment with the scope of the FoPL set by its developers.[20] As these two dimensions are likely to differ, it seemed important to fill the gap on the comparison of the objective understanding of Nutri-Score and NutrInform among consumers. Tasks in the form of ranking/selecting products that are considered 'healthier' are an established way of testing objective understanding.[20] The aim of this study was to compare Spanish consumers' reactions to Nutri-Score and NutrInform, testing preference through subjective understanding and perception as well as objective understanding of the FoPLs. A randomized experimental design including several tasks for each dimension tested was used.

## Methods

### Population

The present study was conducted on a total of 1026 Spanish adults recruited in 2021 through an international ISO accredited web panel provider (Pureprofile), applying quotas for sex (50% of women), age and educational level to ensure representativeness of the Spanish general adult population based on 2020 census data.[21] The protocol of the study was approved by the Research Ethics Committee (CEIm) of the Institut d'Investigació Sanitària Pere Virgili (IISPV), Reus, Spain.

### Experimental tasks and analysis

The first section of the questionnaire assessed participants' sociodemographic characteristics and previous experience with Nutri-Score and NutrInform, whether and how they had heard of these labels.

Participants were randomly assigned to either Nutri-Score ($n = 486$) or NutrInform Battery ($n = 540$), with a minimization procedure to balance between groups. To improve understanding of how to use each FoPL and to aim at reproducing real-life conditions where the implementation of a FoPL ideally is accompanied by large-scale communication campaigns, participants had access to an information note about the FoPL they were randomly assigned to (see Supplementary Information). The understanding of the information note was evaluated through seven statements which were either correct or false. Participants had to reply through a four-points Likert scale going from 'totally disagree' to 'totally agree' with an 'I don't know' option available to allow participants to express some degree of certainty. The four-points Likert scales were converted into a binary outcome with one-point allocated when the answer was considered correct. A mean grade out of seven was calculated for both groups. Comparisons between FoPLs were carried out using a Welch's *t*-test.

Then, for each of the three food categories of breakfast products, breakfast cereals and added fats, participants were shown seven/eight products with the matching FoPL positioned below the food packaging image. A zoom function was available to ensure readability. Back-of-pack information was not available to participants.

The effects of the FoPLs on participants were analyzed from two main perspectives: Part A, which assessed the objective understanding of the FoPLs, a prerequisite aligned with effects on purchase and Part B, which measured participants' relative preference for one of the labels by comparing the perception and the perceived helpfulness (as a measure of subjective understanding) of Nutri-Score and NutrInform.

For 'Part A—Objective Understanding', participants had to select the three products they thought had the 'best nutritional qualities' per food category (three-product task), putting in the first position the one they considered having the highest nutritional value (one-product task). In the case of Nutri-Score, the three correct products corresponded to the ones with the highest gradings within the category (A-grade being the highest one). In the case of NutrInform, the three correct products were defined considering the percentages displayed in each battery on the label (except total fat). The products to favour per food category were the ones with the lowest sums of 'battery' percentages for a portion of the product. Indeed, daily intakes for energy, saturated fats, sugars and salt are considered as maximum values that should not be exceeded.[22] Rankings of products could therefore vary and correct answers were adapted according to the FoPL considered (Supplementary Information). This was done in order to ensure an equitable assessment of labels that do not rely on the same information. In the end, for the one-product task, per food category, the score obtained by the participant was either 0 point (wrong answer) or 1 point (correct answer). For the three-product task (only in breakfast products and breakfast cereals categories), each participant could obtain a score ranging from 0 point up to 3 points depending on the number of correct products selected regardless of their ranking. Multivariable ordinal logistic models were used to assess the associations between the ability to choose the three correct products (three-product task) or select the expected product in the first position (one-product task) with Nutri-Score compared with NutrInform (reference). Models were adjusted for sex, age, presence of children in the household, self-reported level of nutrition knowledge, self-reported diet quality and understanding of the information note after checking statistical significance at the $P < 0.20$ level in bivariate models. Statistical analyses were carried out using the full sample of participants for all food categories combined (as a sum of one-product tasks scores only) and by individual food category.

In addition, participants were asked about their perceived helpfulness of the FoPL per food category ('Part B1—perceived helpfulness') assessed through the statement: 'this FoPL helps me differentiate the nutritional quality of products'. Participants had to select an answer among a four-point Likert scale going from 'totally disagree' to 'totally agree' with an 'I don't know' option available. The four-point Likert scale was converted in a score ranging from −2 (strongly disagree) to +2 (strongly Agree) with a 0-score allocated to 'I don't know' answers. A mean score per food category and per FoPL was calculated. Statistical differences between mean scores of both FoPLs were evaluated through Welch's *t*-test.

Perception questions ('Part B2—Perception') were asked after objective understanding tasks to avoid priming effects and to ensure participants could rely on their previous experience manipulating the labels in food selection. Thirteen statements, identical in both randomized groups, were submitted to participants and then grouped into four different dimensions: ease of use; capacity to inform and trust and liking (Supplementary Information).

Statements were assessed on a Likert scale from 1 (strongly disagree) to 9 (strongly agree). Means and standard deviations were calculated for each 13 statements and per FoPL as a preliminary analysis. Each perception dimension was summarized by a principal component analysis (PCA) and the first PCA dimension was retained for the next analyses after checking it accounted for an acceptable level of variance (above 60%). Comparisons of perception dimensions between FoPLs were carried out using Standard *t*-tests. Sensitivity analysis was performed removing participants answering with 'neither agree nor disagree' to all perception statements (Supplementary Information).

Finally, participants were asked to choose which FoPL they would prefer based on the presentation of both labels affixed on cookies

('Part B3—Comparative Preference'). Of note, this is the only instance in which participants were shown both labels at the same time, and had access to the label tested in the other randomization arm. Analyses considered whether participants preferred the FoPL to which they were initially assigned. Multivariable logistic regressions models were fitted to assess the associations between 'preference towards the FoPL they were assigned to' and the randomization group, using NutrInform group as reference. The models were adjusted for sex, age, having children, self-reported level of nutrition knowledge, self-reported diet quality and previous experience with the label.

All statistical tests were bilateral and a *P*-values below 0.05 were considered significant. All tests were conducted using R Software (version 3.4.4, R Foundation, Vienna, Austria).

## Results

The present study included 1026 participants, 50% were men, the average age was 46 years old (SD = 14) and 38% had a university degree (Table 1).

Regarding 'Part A—Objective understanding', for all three food categories and both tasks, participants in the Nutri-Score group had higher percentages of corrects answers (Supplementary Information). In the task of identifying the product with the highest nutritional value (one-product task), for breakfast products, 76% of participants in the Nutri-Score group correctly answered compared with 29% for NutrInform. With breakfast cereals, there was 76% vs. 33% of correct answers for Nutri-Score and NutrInform groups, respectively. Regarding added fats, 93% of participants answered correctly in the Nutri-Score group compared with 26% in the NutrInform group.

When they had to select the three breakfast products with the highest nutritional values (three-product task), 82% of participants in the Nutri-Score group identified them correctly compared with 10% of correct answers in the case of NutrInform. Regarding breakfast cereals, 82% vs. 54% of participants answered correctly for Nutri-Score and NutrInform, respectively.

Being in the Nutri-Score group was always associated with significantly higher odds of identifying the correct products compared with the NutrInform group (Table 2). The highest odd ratios were observed for breakfast products, three-product task [odds rato (OR) = 20.7 [15.1–28.6], $P < 0.0001$] and for added fats, one-product task (OR = 37.2 [24.9–57.6], $P < 0.0001$). When we combined the scores of participants for putting in the first position the correct product across all three food categories (one-product task), Nutri-Score performed better than NutrInform: OR = 19.1 (14.2–25.7), $P < 0.0001$.

Regarding results on the first two preference tasks (Table 3), 'Part B1—Perceived helpfulness', participants found Nutri-Score significantly more helpful than NutrInform in discriminating the nutritional quality of breakfast cereals only (respectively, 88% vs. 81% replied 'strongly agree' or 'somewhat agree' and $P < 0.01$, data not tabulated). However, when considering the variability of the four-point Likert scale, participants exposed to Nutri-Score were significantly more confident of its capacity to help them differentiate the nutritional quality of products in the first two food categories compared with NutrInform (respectively, $1.32 \pm 1.00$ vs. $1.14 \pm 1.02$ and $P < 0.01$ for breakfast products; respectively, $1.33 \pm 1.00$ vs. $1.00 \pm 1.03$ and $P < 0.0001$ for breakfast cereals). For added fats, the difference between the two groups was not significant.

For 'Part B2—Perception', the Nutri-Score was perceived as significantly easier to use than NutrInform ($0.32 \pm 1.58$ vs. $-0.29 \pm 1.66$, $P < 0.0001$) and was more liked ($0.080 \pm 1.18$ vs. $-0.072 \pm 1.17$, $P = 0.039$). Differences between labels were not significant in the other two perception dimensions (capacity to inform and trust).

**Table 1** Individual characteristics of participants and context ($n = 1026$)

| | Nutri-Score group ($n = 486$) | | NutrInform group ($n = 540$) | |
|---|---|---|---|---|
| | ***N*** | **%** | ***N*** | **%** |
| Sex | | | | |
| Men | 250 | 51 | 265 | 49 |
| Women | 236 | 49 | 275 | 51 |
| Age categories, years | | | | |
| 18–34 | 115 | 24 | 132 | 24 |
| 35–54 | 213 | 44 | 241 | 45 |
| 55–80 | 158 | 33 | 167 | 31 |
| Educational level | | | | |
| No university degree | 301 | 62 | 334 | 62 |
| University degree | 185 | 38 | 206 | 38 |
| Presence of children (≤13 yo) in the household | | | | |
| Without children | 327 | 67 | 360 | 67 |
| With children | 159 | 33 | 180 | 33 |
| Self-estimated diet quality | | | | |
| Unhealthy diet | 66 | 14 | 99 | 18 |
| Healthy diet | 420 | 86 | 441 | 82 |
| Self-estimated nutrition knowledge | | | | |
| Poor knowledge of nutrition | 284 | 58 | 306 | 57 |
| Good knowledge of nutrition | 202 | 42 | 234 | 43 |
| Did you hear about Nutri-Score before? | | | | |
| If yes, what you heard was? | | | | |
| No | 210 | 43 | 239 | 44 |
| Neutral | 64 | 13 | 84 | 16 |
| Negative | 31 | 6 | 56 | 10 |
| Positive | 181 | 37 | 161 | 30 |
| Did you hear about NutrInform before? | | | | |
| If yes, what you heard was? | | | | |
| No | 247 | 51 | 285 | 53 |
| Neutral | 60 | 12 | 67 | 12 |
| Negative | 6 | 1 | 9 | 2 |
| Positive | 173 | 36 | 179 | 33 |
| Understanding of the information note[a] | Mean grade = 3.91 ± 2.38 | | Mean grade = 2.86 ± 1.44 | |

a: The consumer's ability to correctly answer seven questions about the information note (grade out of seven).

**Table 2** Associations between Nutri-Score (ref. NutrInform) and the capacity to identify products with best nutritional qualities ($n = 1026$)

| | One-product task | | Three-product task | |
|---|---|---|---|---|
| | OR [CI] | *P*-value | OR [CI] | *P*-value |
| Breakfast products | 6.82 [5.12–9.12] | **<0.0001** | 20.7 [15.1–28.6] | **<0.0001** |
| Breakfast cereals | 5.54 [4.18–7.38] | **<0.0001** | 3.05 [2.28–4.07] | **<0.0001** |
| Added fats | 37.2 [24.9–57.6] | **<0.0001** | – | – |
| Overall | 19.1 [14.2–25.7] | **<0.0001** | – | – |

The multivariable logistic regression models were adjusted for sex, age, presence of children in the household, self-estimated diet quality, self-estimated nutrition knowledge level and understanding of the information note grade. CI: 95% confidence interval; OR: odds ratio; boldface indicates statistical significance ($P < 0.05$); '-': for added fat, participants had to select only one product (due to a more limited difference in nutrient composition in this particular category), as a result the overall objective understanding for the three-product task could not be assessed.

**Table 3** Results of perceived helpfulness by food category and overall perception ($n = 1026$)

| | Nutri-Score ($n = 486$) | NutrInform ($n = 540$) | |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | *P*-value |
| Perceived helpfulness[a] | | | |
| Breakfast products | 1.32 ± 1.00 | 1.14 ± 1.02 | **0.0053** |
| Breakfast cereals | 1.33 ± 1.00 | 1.00 ± 1.03 | **<0.0001** |
| Added fats | 1.06 ± 1.19 | 0.92 ± 1.09 | 0.066 |
| Perception[b] | | | |
| Ease of use | 0.32 ± 1.58 | −0.29 ± 1.66 | **<0.0001** |
| Capacity to inform | 0.10 ± 1.75 | −0.091 ± 1.70 | 0.074 |
| Trust | 0.086 ± 1.64 | −0.077 ± 1.56 | 0.10 |
| Liking | 0.080 ± 1.18 | −0.072 ± 1.17 | **0.039** |

SD, standard deviation; boldface indicates statistical significance ($P < 0.05$).

a: The reported helpfulness of the FoPL in discriminating the nutritional quality of products in each food category (the Likert scale was converted in a score from −2, strongly disagree to +2, strongly agree).

b: Mean coordinates of participants on the first PCA dimension of each perception dimensions, standardized variable.

Finally, for 'Part B3—Comparative Preference', being in the Nutri-Score group increased significantly the odds of preferring the FoPL of that group for the two final questions (OR = 2.18 [1.68–2.84], $P < 0.0001$ for comparative preference—ease of use and 2.68 [2.06–3.50], $P < 0.0001$ for comparative preference—speed of use, Table 4).

**Table 4** Association between Nutri-Score (ref. NutrInform) and the probability to prefer the FoPL of your group ($n = 1026$)

| | OR [CI] | *P*-value |
|---|---|---|
| Comparative preference—ease of use[a] | 2.18 [1.68–2.84] | **<0.0001** |
| Comparative preference—speed of use[b] | 2.68 [2.06–3.50] | **<0.0001** |

The multivariable model was adjusted for sex, age, presence of children in the household, self-estimated diet quality, self-estimated nutrition knowledge level and having heard negative statements about Nutri-Score before. CI: 95% confidence interval; OR: odds ratio; Boldface indicates statistical significance ($P < 0.05$).

a: Between the Nutri-Score and NutrInform nutrition information labels, which one makes it easier for you to assess the differences in nutritional quality between these products?

b: Which label would you like to see on food packaging to help you quickly find the product with better nutritional quality?

## Discussion

In the present study, Nutri-Score performed better than NutrInform for all objective understanding tasks, in all food categories. This is consistent with previous findings on Nutri-Score vs. Reference Intakes, a scheme similar to NutrInform, in Spanish consumers.[23,24] Indeed, NutrInform is a non-interpretive scheme with the same features as the Reference Intakes, the only addition being that of the battery. Interpretive and coloured FoPLs have been shown to be easier to use for consumers, and to lead to healthier and quicker food choices.[5,25–29]

This study also showed that the objective understanding of Nutri-Score vs. NutrInform was higher in breakfast products (different recommended portion sizes) compared with breakfast cereals (same recommended portion size for all products). Indeed, consumers find it difficult to compare nutritional information when products have different recommended portion sizes.[30–32] Moreover, the use of portion as the reference amount in the NutrInform label compared with 100 g for the Nutri-Score could potentially make foods appear more healthful than they actually are as in the case of a small portion, the indicative portion size may not represent what the consumer would ultimately eat (e.g. portion size set for one biscuit when more are actually consumed).[33,34] Even when participants had to select the same product for both FoPL conditions (one-product task, breakfast cereals), more participants selected the expected answer (oat flakes) with Nutri-Score compared with NutrInform (OR = 5.54 [4.18–7.38] and $P < 0.0001$). This could be due to a lack of understanding of how to use NutrInform in a choice situation compared with Nutri-Score (understanding of the information note was significantly lower for NutrInform: 2.86 ± 1.44 vs. 3.91 ± 2.38, $P < 0.0001$). The battery symbol could also be seen as counterintuitive to participants as 'lower-charged batteries' are expected to be preferred in the use of NutrInform while this would warn towards a 'refuel' in electronic devices. Yet, Mazzù *et al.*[17] suggested that the battery symbols in the NutrInform label were not confounded by the analogy to the battery symbols on electronic devices among Italian consumers.

Focusing on added fats, as it is one of the main subjects of controversy in Spain with the case of olive oil,[35] Nutri-Score and NutrInform seem to promote different choices for consumers. With Nutri-Score, olive oil had the best grade (Nutri-Score C) among the seven vegetable oils included in our study. In the case of NutrInform, saturated fat content was the only visual parameter allowing participants to discriminate between the vegetable oils. In the experimental task, rapeseed and sunflower oil had lower saturated fat contents compared with olive oil (respectively, 0.8 and 1 g for a portion of 10 g compared with 1.6 g per 10 g for olive oil). We can suggest that NutrInform tends to promote added fats with lower saturated fat content whereas with Nutri-Score, olive oil, walnut oil and rapeseed oils have the highest grades among added fats. Results of our study showed that 89% of participants selected olive oil in the one-product task in Nutri-Score group compared with 57% in the NutrInform group (data not tabulated). While critics of Nutri-Score in Spain and Italy argued that Nutri-Score would have a negative impact on the consumption of olive oil, while it is the recommended oil within dietary recommendations, our study shows that Nutri-Score seems to direct more participants towards olive oil compared with NutrInform. A similar study in Italy showed that, with Nutri-Score, participants had a higher intention to purchase olive oil than with NutrInform.[36] These results would tend to confirm the alignment between Nutri-Score and food-based dietary guidelines in Mediterranean countries compared with NutrInform Battery.

Regarding preference between the two FoPLs, Nutri-Score was perceived as more helpful than NutrInform to differentiate the nutritional quality of breakfast products and cereals and as easier to use and more liked in general. The only study in Spain[18] that investigated the

perception of NutrInform compared with Nutri-Score found contrasted results. Although the study had several similarities, NutrInform performed significantly better than Nutri-Score on all perception dimensions ('comprehensibility, help-to-shop and complexity'), except for 'liking', whereas in the current study, Nutri-Score was perceived as significantly 'easier to use' and more 'liked' than NutrInform. These differences in results could be explained by authors' decisions on selection and regrouping of perception statements. For instance, in Mazzù *et al.*, some statements focused on the FoPL capacity to inform consumers on the nutrient composition of foods specifically: 'This label helps me to understand the product composition', 'This label helps me to understand different nutritional values' or 'The label is rather extensive'. The two other studies conducted by Mazzù *et al.*[17] and Baccelloni *et al.*[19] on NutrInform also focused on preference measures and similarly to the previous study[18] found that NutrInform was perceived better than Nutri-Score.

Perception analyses should therefore be considered carefully considering the variability of approaches leading to inconsistent results.[17–19] While the stated objectives of Nutri-Score and NutrInform differ (e.g. Nutri-Score is not designed to provide detailed information on the nutritional composition of the product), the overarching goal of a FoPL is primarily to support consumers in making healthier food choices.[6] If perceived parameters of FoPLs such as the ease of use can be a good marker to discriminate between FoPLs, the measure of objective understanding of FoPLs in food choices situations is necessary as it is likely to differ from preference. For instance, a recent study comparing Nutri-Score with three other FoPLs (Multiple Traffic Light, Warning Label and Positive Choice tick) found that Nutri-Score resulted in the highest objective understanding but not the highest preference,[37] highlighting the importance of testing FoPLs on objective understanding tasks.

In our study, if we compare the results of objective understanding with perceived helpfulness measuring the extent to which participants 'think' they have understood the FoPL,[20] some differences can be noted between the two. In the breakfast cereals category, 88% of participants in the Nutri-Score group thought that Nutri-Score was helpful in discriminating products and 76% identified the correct product in the objective understanding task. For the same food category, 81% of participants in the NutrInform group found NutrInform helpful but only one-third of participant identified the correct product in the objective understanding task. In the added fats category, although there was no significant difference in terms of perceived helpfulness between Nutri-Score and NutrInform, 93% vs. 26% of participants, respectively, identified the correct product (one-product task). These findings highlight the fact that subjective understanding and perception outcomes should be interpreted carefully as they are not objective measures by definition. Individual preferences, even if they can affect the use of a FoPL, do not appear to inform about the objective understanding of FoPLs.

Strengths of this study include the use of Spanish population quotas in order to ensure potential generalizability of findings at country level as FoPL policies affect the entire population. However, the characteristics of individuals responsible for household food purchases may differ. Moreover, this is the first study to compare Nutri-Score and NutrInform on the objective understanding dimension including an assessment of subjective understanding and perception in Spanish consumers. Some limitations in our study should be acknowledged. The fact that Nutri-Score had been implemented in some Spanish brands prior to our questionnaire could have improved familiarity with the label compared with NutrInform. Nevertheless, univariable statistical models showed no significant association between having heard about Nutri-Score and objective understanding of the FoPLs. Concerning NutrInform, 48% of participants declared having heard about NutrInform before the survey, although this label was not displayed on pack at the time of the survey, signaling confusion with the Reference Intakes format. This result highlights the similarity between the two FoPLs and supports the contention that NutrInform Battery should not be expected to perform differently than Reference Intakes (that have been on display voluntarily since 2005). In this study, this potential confusion was clarified following the information note explaining in details NutrInform to participants assigned to this FoPL. Finally, this study was based on an online questionnaire, excluding by definition some real-life parameters that are known to influence the evaluation of the nutritional quality of food products. Nevertheless, we chose to use pictures of products that could be found in Spanish supermarkets instead of mock packages.

This study brings new insights in the discussion on FoPLs especially in the frame of the Farm to Fork Strategy supported by the EU that should come forth with a proposal for a mandatory FoPL in the comming months. With the objective to guide consumers towards healthier food choices, this study shows that on all objective understanding tasks and for all the food categories tested, Nutri-Score significantly outperformed NutrInform. Future studies should assess performance of Nutri-Score vs. NutrInform in different food categories and in food purchasing situations.

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## Consent for publication

Written informed consent has been obtained from the subjects to publish this article.

## Authors' contributions

M.F., C.J., J.S., N.B., S.H., P.G., and L.N.: conceptualization. M.F., C.J., J.S., N.B., S.H., P.G., and L.N.: methodology. C.J., J.S., N.B., S.H., P.G., and L.N.: validation. M.F., C.J., S.H., P.G.: formal analysis. M.F.: writing—original draft preparation. M.F., C.J., J.S., N.B., M.T., S.H., P.G., B.S., E.K.-G., M.D.-T., N.K., and L.N.: writing—review and editing. C.J., S.H., and P.G.: supervision. C.J.: project administration. C.J.: funding acquisition. All authors have read and agreed to the published version of the manuscript.

## Ethics approval and consent to participate

The protocol of the study was approved by the Research Ethics Committee (CEIm) of the Institut d'Investigació Sanitària Pere Virgili (IISPV), Reus. Informed consent was obtained from all subjects involved in the study.

## Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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## Conflict of interest

J.S. declares that he is a non-payed member of International Danone Institute and member of the Institute of Danone, Spain. J.S. and N.B. declare that their institution received funds from Danone SA for the purposes of scientific and technical consulting but not for conducting this study. M.F., P.G., E.K.-G., M.T., M.D.-T., B.S., S.H., L.N. and C.J. declares no conflicts of interest.

## Key points

- Online controlled trial on 1026 Spanish adults randomized between Nutri-Score and NutrInform.
- Nutri-Score is perceived as easier to use and is more liked compared with NutrInform.
- Nutri-Score better helps participants identify healthier food products than NutrInform.
- European Commission should consider results of this study in its decision on a harmonized Front-of-Pack Label public health policy.

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