

Understanding of the Nutri-Score front-of-pack label by Italian Medical Professionals and its effect on food choices: a web-based study on knowledge, attitudes and practices

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Abstract. *Background and aim.* A growing number of European Countries have adopted front-of-pack nutrition labels (FPNL) in order to assist costumers' alimentary choices, and particularly Nutri-Score. While its acceptance in Italy has been slowed by ongoing debates, we assessed corresponding knowledge, attitudes and practices of a sample of Italian Medical Professionals (MP). *Methods.* A total of 153 MP participated into an internet-based survey by completing a structured questionnaire. While 43.1% reported any knowledge of Nutri-Score, the overall understanding of its conceptual issues was quite low (50.8% after percentual normalization of the knowledge score). Only half of participants acknowledge some usefulness of FPNL, and their acceptance as a guide for nutritional choices was seemingly low (36.6%), being more likely in MP participants from Northern regions (Odds Ratio 9.610, 95% confidence intervals 2.667-34.637), living with children < 14 year or age (3.658, 1.463-9.145), and perceiving some usefulness in FPNL (3.595, 1.381-9.356). In turn, having any knowledge of Nutri-Score and being of male gender were negative effects. *Conclusions.* Nutri-Score is a useful instrument in guiding consumers' alimentary choices, but the actual understanding of its rationale by participants MP was insufficient. Specifically aimed interventions should be tailored in order to cope with a significant share of MP reporting false beliefs and misunderstanding. (www.actabiomedica.it)

Key words: Italian consumers; Nutri-Score; Knowledge, Attitudes, Practices; food choices; front-of-pack nutrition label; nutritional labeling.

Introduction

Nutrition is a global determinant of morbidity and mortality. For instance, around 16% of annual deaths in Italy have been accounted to the dietary risk (1). As a consequence, interventions aimed to instate better dietary behaviors are considered able to prevent non communicable diseases (2). Among the interventions promoted by several National and International

Health Authorities, the implementation of front-of-pack nutrition labels (FPNL) has received a significant international endorsement. Referral to FPNL should encourage healthier food choices in consumers, ultimately urging manufacturers to improve the nutritional quality of the foods they offer (3–5). Even though no single harmonized FPNL scheme exists in the EU-area, a summary five-color indicator of the nutritional content of food products originally implemented in France,

the Nutri-Score, has been adopted by a growing number of European countries (i.e. Belgium, Spain, the Netherlands, Germany, Luxembourg, and Switzerland) (4,5). Following the stipulation by European Commission for implementing a harmonized FPNL before 2022, Italian stakeholders have raised significant criticism towards the otherwise successful Nutri-Score, as it was felt as an instrument that would have disqualified typical Italian food products (3,6). As Medical Professionals have been proven instrumental in implementing appropriate behaviors and practices among their patients (7–9), understanding their knowledge (i.e., the awareness of official recommendations), attitudes (i.e., propensity towards a certain intervention), and practices (i.e., actual promotion of such intervention; collectively: KAP) on FPNL may be particularly useful in the Italian setting.

Materials and Methods

We designed an internet-based survey, with a convenience sampling from a series of Facebook health discussion groups (in total: 10,343 unique users), for a total of 30 days (December 1st to December 30th, 2019). To post the study invitation, the chief researcher contacted the administrators, requesting a preventive authorization to post the link to the questionnaire, including a short description of the aims of the survey. Facebook users who clicked on the invitation text were provided with the full study information, an opportunity to give their informed consent, and a web link to the survey. No personal data such name, IP address, email address, or other personal information unnecessary to the survey was requested, saved or tracked. Because of its anonymous, questionnaire-based observational design, lacking any clinical data, according to the Italian law (Gazzetta Ufficiale no. 76, dated 31/3/2008), a preliminary evaluation by an Ethical Committee was not statutorily required. All participating professionals received a mail outlining purpose, risks, and potential benefits of the study, and including a link to the online questionnaire (Google Forms® platform). No monetary or other compensation was offered to the participants.

The questionnaire encompassed a total of 28 items divided into 5 areas of inquiry (i.e. individual characteristics of the participants; general knowledge status;

attitudes; practices; information sources). Participants were initially requested whether they had any knowledge of FPNL and of Nutri-Score. If the participant denied any knowledge of FPNL, the web form closed and the survey promptly ended. Participants reporting any knowledge of Nutri-Score received a knowledge test encompassing a series of 10 true-false statements covering some misconceptions about FPNL and Nutri-Score. A similar knowledge test had previously been applied in various occupational settings (10–12). A general knowledge score (GKS) was then calculated as the sum of correctly marked recommendations: when the physicians answered correctly, +1 was added to a sum score, whereas a wrong indication or a missing “*don't know*” answer added 0 to the sum score. Participants denying any knowledge of Nutri-Score jumped directly to the following section, on attitudes and practices towards FPNL. Participants were initially asked whether they perceived FPNL as useful. Respondents were then asked to rate a series of 7 statements on FPNL covering their daily practices and their attitudes (i.e. “*Looking for nutritional labels when buying alimentary products*”; “*I think that I will look for nutritional label when buying alimentary product*”; “*I think that I will avoid products with worse nutritional label*”; “*I think that I could change my nutritional habits based on nutritional labels*”; “*At the same cost, I will prefer products with better nutritional labels*”; “*I'm willingly to spend more for products with a better nutritional label*”; “*I'm willingly to spend more time looking for products with a better nutritional label*”). All aforementioned statements were rated through a 5-point Likert scale (i.e., 1 = totally disagree, 5 = totally agree). While perceived usefulness was dichotomized in totally disagree to neutral vs. agree to totally agree, a cumulative Propensity Score was calculated as a sum of the 7 single statements on attitudes and practices, and the resulting score was dichotomized by median value in high propensity vs. low propensity towards FPNL.

A preventive reliability test was performed on GKS through determination of Cronbach's alpha (i.e. 0.796). Association of individual factors, GKS (dichotomized as \leq vs. $>$ median values), and perceived usefulness (somewhat agree vs. somewhat disagree), with the outcome variable of higher Propensity Score was initially evaluated through the Chi² test (with continuity correction). A binary logistic regression analy-

ses was modeled including all factors that, at univariate analyses, were significantly associated with a Higher Propensity Score, calculating adjusted Odds Ratios (aORs) with their respective 95% confidence intervals (95% CI) (SPSS 25, IBM Corp. Armonk, USA). In all calculations, significance level was set at $p < 0.05$.

Results

A total of 209 participants applied for the survey. As 50 of them reported to ignore what a FPNL actually is, and a total of 6 questionnaires were incomplete in the demographic section, as shown in Table 1, our sample eventually included a total amount of 153 Medical Professionals. Therefore, participation rate was 2.0% when calculated on the total potential population, but 73.2% referring to the total of medical professionals applying to the survey. Of them, 50.3% were males. The majority of respondents was < 40-year-old (60.1%), and lived in Northern Italy (74.5%); 49.0% of them reportedly lived with subjects aged 14 years or less, and 38.6% worked as general practitioner at the time of the survey. A total of 43.1% respondents had any knowledge of Nutri-Score, and 27 out of 56 became aware of such instrument only during December 2019.

The GKS was quite unsatisfying: after its normalization in percent values, 66 participants having any knowledge of Nutri-Score obtained a mean score of $50.8\% \pm 20.4$ (median = 47.0%). Interestingly, participants who had their acquaintance with Nutri-Score before December 2019 reported a not significantly higher score than those who became aware of this instrument during December 2019 ($54.3\% \pm 21.0$ vs. $45.8\% \pm 18.8$, $p = 0.090$) Even though the majority of respondents was able to recognize the Nutri-Score among other FPNL (71.2%), being aware of its notation A to E (71.2%) (Figure 1), and acknowledging that displaying Nutri-Score is not mandatory in Italy (68.7%), only 34.8% of them understood that its calculation is not performed by a central authority (i.e. Health Ministry).

In facts, significant uncertainties were reported regarding its calculation. For instance, while 69.7% of participants were aware of the negative impact of the Na⁺ content, only half of them understood that Nutri-Score is calculated on 100 g of the alimentary product,

considering its content as a whole (47.0%), and that a higher content of sugar and fat is associated with a dismal score (47.0%, and 51.5%, respectively). Moreover, a reduced share of participants seemingly knew that Nutri-Score cannot be applied to alcoholic (33.3%) and not-sweetened beverages (28.8%).

Moreover, only 49.7% of participants acknowledged FPNL as useful, and barely 1/3 of them reportedly looked for nutritional labels when buying alimentary products. While the majority of participants reportedly preferred products with better nutritional labels (75.2%), exhibiting some degree of willingness to spend more money for products with a better nutritional label (57.5%), being prone to change usual nutritional habits based on nutritional labels (56.9%), less than half of them was willingly to spend time looking for nutritional labels (49.0%), and researching products with better scores (47.1%). Moreover, only 34.0% of them had any willingness to avoid products with worse nutritional label.

Eventually, higher propensity towards FPNL (Table 2) was negatively associated with male sex (aOR 0.209; 95%CI 0.084 to 0.520), and having any knowledge of Nutri-Score (aOR 0.158, 95%CI 0.061 to 0.410). In turn, coming from Northern Italy, (aOR 9.610, 95%CI 2.667 to 34.637), living with people aged 14 y.o. or less (aOR 3.658, 95%CI 1.463 to 9.145), and perceiving any usefulness of FPNL (OR 3.595, 95%CI 1.381 to 9.356) were associated with higher propensity towards referral to Nutritional Labels.

Discussion

Even though mass-media and significant stakeholders have extensively criticized the Nutri-Score as an instrument able to assist the consumers in their choices, increasing evidences suggest that Nutri-Score is, by far, the best FPNL available to help consumers in the identification of nutritional quality of foods (13–17). Its potential efficacy has been proven also in Italian consumers (6,18), but inception of Nutri-Score labeling by Italian Food Industry for domestic market remains problematic, and some alternatives have been proposed with mixed acceptance either by the general population and stakeholders (18).

Table 1. Characteristics of 153 Medical Professionals participating into the survey on Nutri-Score and front-of-pack nutrition labels (FPNL) (December 2019).

Characteristics of participants	No. = 153
Age (average \pm S.D.)	38.5 \pm 8.7
Age < 40 year (No., %)	60.1%
Gender (No., %)	
	Male 77, 50.3%
	Female 76, 49.7%
Region of origin (No., %)	
	Northern Italy 114, 74.5%
	Central Italy 21, 13.7%
	Southern Italy 18, 11.8%
Living with children, any individual age 14 y.o. or less (No., %)	75, 49.0%
Qualification as General Practitioner (No., %)	59, 38.6%
Any knowledge of Nutri-Score (No., %)	
	No 87, 56.9%
	Yes (before December, 2019) 39, 25.5%
	Yes (during December, 2019) 27, 17.6%
Knowledge test	No. = 66
1. Able to recognize a Nutri-Score label	47, 71.2%
2. Nutri-Score is a label showing the nutritional quality through a note ranging from A to E [TRUE]	47, 71.2%
3. Nutri-Score is calculated on 100 g of the alimentary product, considering only recommended nutrients [FALSE]	31, 47.0%
4. Nutri-Score cannot be applied to alcoholic beverages [TRUE]	22, 33.3%
5. Nutri-Score could be applied to not-sweetened beverages [FALSE]	19, 28.8%
6. At the moment, Nutri-Score is mandatory [FALSE]	46, 69.7%
7. In Italy, Nutri-Score is calculated by Health Ministry [FALSE]	23, 34.8%
8. Higher the sugar content, higher (i.e. worse) will be the Nutri-Score [TRUE]	31, 47.0%
9. Higher the fat content, higher (i.e. worse) will be the Nutri-Score [TRUE]	34, 51.5%
10. Higher the Na ⁺ content, worse will be the Nutri-Score label [TRUE]	46, 69.7%
General Knowledge Score (average \pm S.D.)	50.8% \pm 20.4
Knowledge Score > median value (45.4%)	31, 47.0%
Attitudes towards FPNL (No., %)	No. = 153
1. Looking for nutritional labels when buying alimentary products	51, 33.3%
2. I think that I will look for nutritional label when buying alimentary products	75, 49.0%
3. I think that I will avoid products with worse nutritional label	52, 34.0%
4. I think that I could change my nutritional habits based on nutritional labels	87, 56.9%
5. At the same cost, I will prefer products with better nutritional labels	115, 75.2%
6. I'm willingly to spend more for products with a better nutritional label	88, 57.5%
7. I'm willingly to spend more time looking for products with a better nutritional label	72, 47.1%
Propensity Score (average \pm S.D.)	69.6% \pm 16.5
Propensity Score > median value (71.4%)	56, 36.6%
Perceived Usefulness of Nutritional labels	76, 49.7%

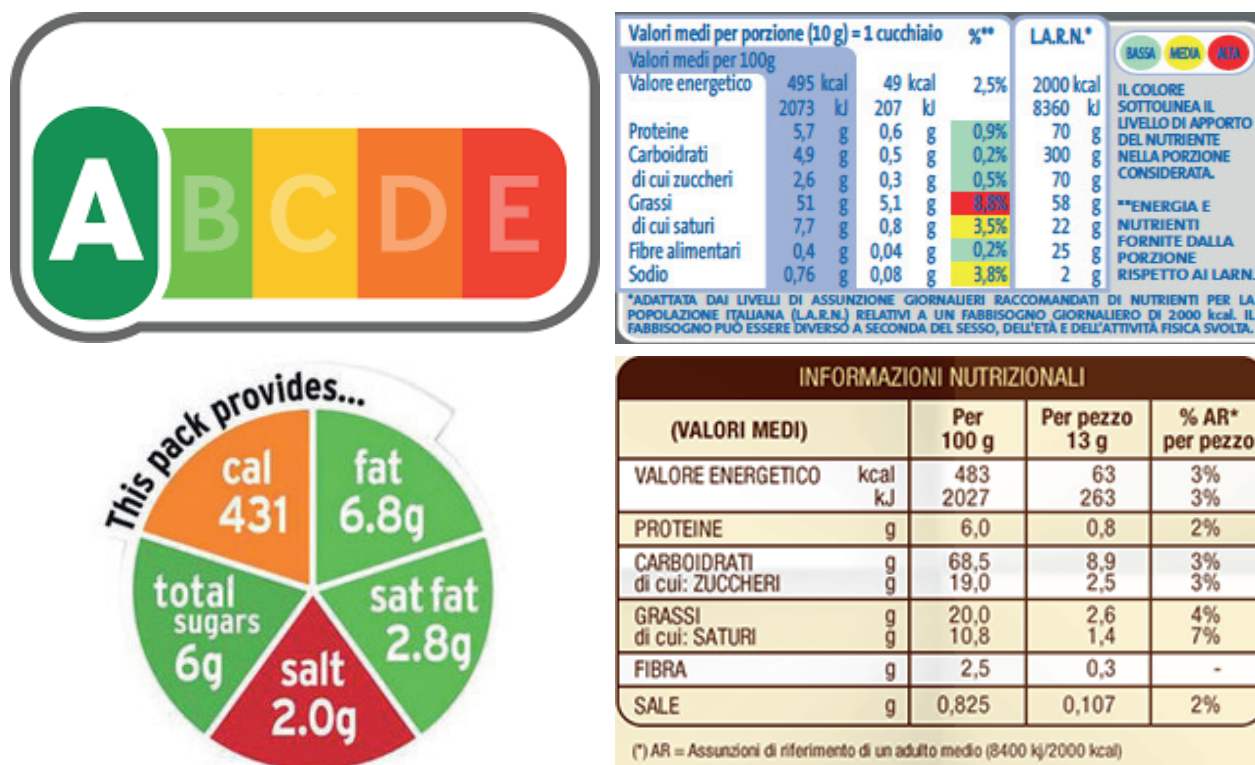


Figure 1. Front-of-Pack nutrition Labels that were presented to the study participants being asked to recognized Nutri-Score labeling (*).

Table 2. Association of individual characteristics of 153 Medical Professionals with high propensity towards referral to front-of-pack nutrition labels (Italy, December 2019). Univariate analysis was performed by means of chi-squares test with Yates correction. All factors that were associated (i.e. p < 0.05) with higher propensity towards the front-of-pack nutrition label (FPNL) were eventually included in a multivariate analysis model that calculated correspondent adjusted Odds-Ratio (aOR) with their respective 95% confidence intervals (95%CI) by means of a binary regression analysis.

	Propensity Towards FPNL		P value	aOR (95%CI)
	High (No./56, %)	Low (No./97, %)		
Male gender	16, 28.6%	60, 61.9%	< 0.001	0.209 (0.084; 0.520)
Age < 40 y.o.	36, 64.3%	56, 57.7%	0.531	-
Coming from Northern Italy	51, 91.1%	63, 64.9%	0.001	9.610 (2.667; 34.637)
Qualification as General Practitioner	24, 42.9%	35, 36.1%	0.511	-
Living with children / individuals aged < 14 y.o.	50, 71.4%	35, 36.1%	< 0.001	3658 (1.463; 9.145).
Knowledge of Nutri-Score	12, 21.4%	54, 55.7%	< 0.001	0.158 (0.061; 0.410)
Higher Knowledge Score*	12, 21.4%	19, 19.6%	0.949	-
Perceived usefulness of Nutritional labels	40, 71.4%	36, 37.1%	< 0.001	3.595 (1.381; 9.356)

* Calculated only on participants having any knowledge of Nutri-Score

Interestingly enough, not only 73.2% of participants had some understanding of FPNL, but 43.1% of them reported any knowledge of Nutri-Score, and the majority of them was actually able to recognize the labeling among other FPNL and its meaning. In other words, Medical Professionals participating into the survey had some degree of familiarity with this

substantially new instrument. However, when dealing with their actual knowledge status, diffuse misunderstandings and knowledge gaps were promptly identified. More precisely, our results hints towards a superficial understanding of this labeling system, with the majority of participants seemingly ignoring how the Nutri-Score is actually determined. In facts, calcula-

tion of the Nutri-Score is a relatively complicated issue (5,19), and diffuse claims on the improper labeling of typical Italian foods rich in fats and sugars (e.g. some cheese, baked products, etc.) might have contributed to the knowledge gaps we identified. Not coincidentally, eventual estimates for knowledge status were higher among respondents having the first acquaintance with Nutri-Score before December 2019 than those reported among participants having a later understanding of this FPNL.

On the other hand, we cannot rule out a sort of social desirability bias. In fact, the implementation of FPNL has been urged by National and International Authorities, and foods otherwise perceived as “healthy” are indeed penalized by Nutri-Score because of their nutrients content, so participants might have felt unpalatable that such a new and highly appreciated instrument discourage their selection (13,15,17). In other words, our data suggest that Medical Professionals may unwillingly deliver among their patients a significant degree of false beliefs and misunderstandings: because of the obvious implications (i.e. lesser confidence in FPNL and improper interpretation of nutritional scores), appropriate informative interventions should be specifically tailored out for Medical Professionals before an extensive implementation of Nutri-score by Italian Domestic Food industry.

As previous studies on healthcare settings have shown that personal attitudes of Medical Professionals are strongly involved in the promotion of health habits among the subjects they assist (20–23), we specifically assessed specific barriers and facilitators towards acceptance of FPNL. We identified two main barriers, represented by male gender (aOR 0.209, 95%CI 0.084 to 0.520), and having a previous knowledge of Nutri-Score (aOR 0.158, 95%CI 0.061 to 0.410). The latter factor may be explained as a consequence of the false beliefs on Nutri-Score that were improperly diffused by Italian media during 2019 (6,18). As suggested by the relatively low acknowledgement of FPNL as useful in guiding better nutritional choices (49.7%), that in turn was among the main positive effectors of FPNL acceptance (aOR 3.595; 95%CI 1.381; 9.356), participants may have been prompted to assume even greater doubts on Nutri-Score. Regarding the effect of the male gender, a possible explanation may be found

among positive effectors, that included living with individuals aged less than 14 years (aOR 3.658, 95%CI 1.463 to 9.145). In other words, rather than being somewhat impaired towards the FPNL, respondents of male gender may be simply less frequently involved in nutritional choices of their family, and particularly when dealing with their offspring. Similarly, also the higher propensity among Medical Professionals from Northern Italy might be explained in terms of a pre-existing behavior, i.e. higher adherence to alimentary tradition in Southern Regions compared to Northern ones, and a subsequently higher reluctance to rely on external guidance in nutritional choices.

Despite its potential interest, our study has some limitations. More precisely, its cross-sectional design prevents us from drawing any causal inferences based on our findings. Second, it shares the implicit limits of Internet-based surveys (24,25). Even though such studies are substantially reliable and cost-effective, they are substantially based on volunteer participants and, therefore, can introduce selection bias. In other words, the final sample may potentially over-represent some sub-groups (e.g., subjects from younger age groups, with a greater literacy, and more accustomed to the internet access), eventually failing to represent the original population. Not coincidentally, while Italian medical population is relatively old (26), the majority of respondents was less than 40-year-old at the time of the survey. Therefore, a significant selection bias cannot be ruled out. Moreover, participating voluntarily could be due to a proactive attitude or greater knowledge about the survey theme, with an eventual over-estimation of the actual understanding of the parent population. In the same way, the fact of not participating could be understood as a negative attitude or a lack of knowledge about the main study theme. Again, as we previously suggested about the results of knowledge test, we cannot rule out that some of the items assessed may have been affected by a significant social desirability bias, with participants reporting the “*socially appropriated*” rather than their authentic behaviors. Another potential shortcoming of our sample was its limited size, as it included only 153 professionals among the over 10,000 potential participants. In this regard, even though social media managers of specific discussion groups usually perform a certain selection of poten-

tial members (e.g., by registering only subjects who receive a specific invitation by the manager; answering to specific “selection” questions; etc.), we cannot rule out that some of the respondents were not actively working as Medical Professional, and particularly as General Practitioners, limitedly or even not fulfilling our initial selection criteria. Eventually, information about Nutri-Score in European Countries is continuously expanding and changing (3,5,6,15–17,19), mirroring its increasing referral by national Governments (6,18), thus even the internal validity of our estimates may dramatically change in the next few years.

Conclusions

In conclusions, study participants exhibited some familiarity on FPNL and particularly Nutri-Score. Unfortunately, their understanding of pros and cons of such instruments was severely flawed by large knowledge gaps, that have the potential to severely impair diffusion of nutritional label systems among the general population. Even though the main effectors of the attitudes towards FPNL were found among individual characteristics of the participants, it is reasonable that inappropriate communication on Nutri-Score by National media in 2019 may have severely impaired its eventual acceptance, stressing the urgency for a more responsible sharing of information by media and stakeholders.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article. The facts, conclusions, and opinions stated in the article represent the authors’ research, conclusions, and opinions, and are believed to be substantiated, accurate, valid, and reliable. However, as this article includes the results of personal researches of the authors, presenting correspondent, personal conclusions, and opinions, parent employers are not forced in any way to endorse or share its content and its potential implications

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