NUTR-HIA

IMPROVING NUTRITION LABELLING IN PORTUGAL HEALTH IMPACT ASSESSMENT

FINAL REPORT

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Nutr-HIA

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Contents

Abbreviations and acronyms	7
Sumário executivo	8
Executive Summary	11
1. Background	13
2. Methods	16
2.1 Health impact assessment	16
2.2 Health Impact Assessment of a nutrition labelling initiative in Portugal	16
Steering committee	18
Engagement of key stakeholders	18
3. Results	19
3.1 Systematic literature review	19
3.2 Perspectives of citizens, experts and stakeholders	20
3.2.1 Participants' characterization	20
3.2.2 General perspectives about FOP-NL systems as a health policy	20
3.2.3 Perspectives of citizens, experts and stakeholders about FOP-NL systems	21
3.3 Nutritional information on Food Packaging Survey	21
3.3.1 Telephone Survey	21
3.3.2 Web-based Survey	25
4. Discussion	31
5. Conclusions and recommendations	33
6. References	35

Figures

Figure 1. Front-of-package nutrition labeling schemes introduced globally. 15
Figure 2. Mixed-methods approach to inform HIA. 17
Figure 3. Why reading information on food labels? 24
Figure 4. Importance given to food label information 24
Figure 5. Acceptability of different FOP-NL 27
Figure 6. Confidence interval (95%) of percentage of correct food choices on bases of different FOP-N 29

Tables

Table 1. Brief description and examples of types of FOP-NL 14
Table 2. Stakeholders participating in the HIA 18
Table 3. Sociodemographic and general health status characteristics of participants involved in the survey. 22
Table 4. Frequency of reading information that is available on food labels when buying food products 23
Table 5. Understanding nutritional information available on food labels 25
Table 6. Percentage of correct food choices on basis of different FOP-NL, across sub-groups of the sample (n=357) 28
Table 7. Association between the type of FOP-NL and choice of healthiest product using logistic regression mixed models in univariate and multivariate analyses (n=357) 29
Table 8. Association between FOP-NL and choice of healthiest product using logistic regression mixed models (people who go shopping once per week or less) 30
Table 9. Association between FOP-NL and objective understanding using logistic regression mixed models in univariate and multivariate analyses (people who have up to 9 years of school). 30

Abbreviations and acronyms

%GDA	Guidelines Daily Amounts
BMI	Body Mass Index
DALY	Disability-Adjusted Life Years
DGS	Directorate-General of Health
EIPAS	Integrated Strategy for Healthy Eating Promotion
EU-SILC	European Statistics on Income and Living Conditions
FMUL	Faculty of Medicine of the University of Lisbon
FOP-NL	Front-Of-Package Nutrition Labelling
HIA	Health Impact Assessment
HSR	Health Star Rating
IAN-AF	National Food and Physical Activity Survey
INSEF	National Health Examination Survey
IPH	Institute of Public Health in Ireland
ISAMB	Environmental Health Institute, Faculty of Medicine of the University of Lisbon
NCD	Noncommunicable diseases
NS	Nutri-Score
OR	Odd Ratio
PNPAS	National Program for Promotion of Healthy Eating
TL	Traffic Light label
WHO	World Health Organization

Sumário executivo

Enquadramento

A evidência científica mostra que os consumidores têm dificuldade em interpretar a informação nutricional obrigatória que está presente nos rótulos dos produtos alimentares. De acordo com um estudo realizado na população portuguesa, foram observadas dificuldades na interpretação desta informação em cerca de 40% dos inquiridos. Para colmatar este problema, diversos países têm vindo a adotar diferentes modelos de rotulagem nutricional simplificados tendo em consideração a evidência científica disponível para cada contexto nacional. A utilização de modelos de rotulagem nutricional simplificativos é considerada como uma das melhores opções para promover escolhas alimentares saudáveis e consequentemente para a prevenção e controlo das doenças crónicas na população.

Em Portugal, não existe ainda qualquer recomendação por parte do Estado no sentido de adotar um modelo específico de rotulagem nutricional simplificada. Contudo, diferentes operadores económicos no mercado nacional têm vindo a adotar e utilizar diferentes sistemas de rotulagem simplificada. Esta proliferação de diferentes sistemas num mesmo espaço geográfico pode dificultar ou até confundir os consumidores no momento da sua escolha. Por outro lado, podem estar a ser adotados sistemas de rotulagem simplificada de menor efetividade na promoção de escolhas alimentares mais saudáveis junto dos consumidores Portugueses.

Tornava-se por isso necessário avaliar o impacto de diferentes sistemas de rotulagem nutricional simplificativos (FOP-NL) relativamente ao seu contributo para promover escolhas alimentares mais adequadas e potencialmente para promover hábitos alimentares saudáveis. O objetivo final deste trabalho é de contribuir com evidência científica para uma tomada de decisão mais informada no que diz respeito à recomendação por parte do governo Português para a utilização de um modelo de rotulagem nutricional simplificado.

Métodos

Para dar resposta a este objetivo, foi realizado, em parceria com a Organização Mundial da Saúde (OMS), um Health Impact Assessment (HIA), enquanto um método de avaliação dos potenciais impactos para a saúde de uma determinada medida ou programa de intervenção.

No contexto deste HIA, foram utilizados diferentes métodos para a recolha de informação,: 1) uma revisão sistemática da literatura sobre os diferentes modelos de FOP-NL e o seu impacto nas escolhas alimentares; 2) grupos focais e entrevistas a peritos, partes interessadas e com responsabilidades (*stakeholders*) e cidadãos, com o objetivo de avaliar as suas opiniões quanto à efetividade da FOP-NL relativamente à capacidade dos consumidores obterem, interpretarem e usarem a informação nutricional; 3) um inquérito telefónico com o objetivo de caracterizar as perceções, opiniões e a utilização da rotulagem nutricional pela população portuguesa; este inquérito incluiu uma componente de recolha de informação *online*, através da qual se avaliou, subjetiva e objetivamente, o desempenho de quatro sistemas de rotulagem nutricional distintos: semáforo nutricional (TL); *Guideline daily amounts* (%GDA) (percentagem relativa à dose de referência), *Nutri-Score* (NS) e *Health Star Rating* (HRS). A avaliação do desempenho dos diferentes sistemas de rotulagem nutricional foi realizada através de um exercício online no qual se simulou a escolha de alimentos no momento de compra. Este exercício contemplou diferentes cenários de escolha com recurso aos quatro diferentes modelos de rotulagem nutricional, bem como uma situação de controlo (sem recurso a modelos de rotulagem nutricional simplificados).

Resultados

1. Revisão sistemática da literatura

A revisão sistemática da literatura sugere que a inclusão de sistemas de FOP-NL promovem melhores escolhas alimentares do que a não inclusão de FOP-NL nas embalagens dos produtos. Contudo, a evidência proveniente dos estudos analisados não é consistente quanto à superioridade, comparativamente aos outros, de um sistema específico de FOP-NL na promoção de escolhas alimentares saudáveis.

2. Grupos focais e entrevistas

Houve consenso sobre a relevância da utilização dos FOP-NL como uma estratégia de saúde pública, bem como da necessidade de o Governo português fazer uma recomendação para a adoção de um sistema único/exclusivo de FOP-NL nos géneros alimentícios pré-embalados comercializados em Portugal.

Foi reconhecido que a implementação de um sistema de FOP-NL deve ser acompanhada de um programa de educação alimentar que promova o conhecimento acerca desse sistema, bem como do correto uso do mesmo. Foi também reconhecida a necessidade de prever e implementar uma estratégia de monitorização do impacto desta medida.

A maioria dos participantes considera que a utilização de um sistema de FOP-NL não deve ser considerada obrigatória. Os representantes do setor da indústria alimentar mostraram preocupação face aos custos e à logística inerentes à implementação de um FOP-NL e, considerando relevante o envolvimento do setor nos processos de reflexão e decisão sobre qualquer política de FOP-NL.

3. Inquérito individual (telefónico e on-line)

Todos os sistemas de FOP-NL avaliados neste estudo se associam a uma maior probabilidade de os cidadãos escolherem um produto alimentar mais saudável, quando comparados com a inexistência de modelos de FOP-NL.

Quando expostos ao TL, 72,3% dos participantes selecionaram corretamente o produto alimentar mais saudável, tendo obtido a maior proporção de respostas certas, seguido do HSR (70,9%), do % GDA (70,0%) e do NS (62,2%), em comparação com 34,2% para a condição experimental em que nenhum sistema de FOP-NL estava presente.

A probabilidade de os participantes escolherem um produto alimentar mais saudável, quando algum dos diferentes modelos de rotulagem nutricional estava presentes, foi cerca de três a cinco vezes superior, comparativamente à situação em que nenhum sistema de FOP-NL estava presente. Comparativamente ao NS, o TL parece ter tido um melhor desempenho no que diz respeito à sua capacidade de promover escolhas alimentares adequadas (ainda que o desempenho do NS não tenha sido significativamente diferente do desempenho dos restantes sistemas de FOP-NL analisados neste estudo).

Conclusões e recomendações

Os resultados deste estudo reforçam a necessidade de o Governo Português emitir uma recomendação para a adoção de um modelo de FOP-NL específico, sendo esta necessidade, bem como a sua relevância como medida para a promoção da saúde, consensual entre as várias partes interessadas, incluindo consumidores, peritos, instituições representantes dos setores da indústria alimentar e distribuição e autoridades nacionais com competências na área da alimentação e da defesa do consumidor.

A avaliação subjetiva e objetiva do desempenho dos diferentes modelos de FOP-NL mostram de forma clara, a mais-valia da sua presença nas embalagens dos produtos alimentares, uma vez que se associa a escolhas alimentares mais saudáveis. Apesar de, para a população portuguesa, o semáforo nutricional parecer ser o modelo que melhor permite aos consumidores fazer escolhas alimentares saudáveis, os resultados obtidos para o desempenho dos restantes modelos de FOP-NL sugerem que todos eles apresentam o potencial de contribuírem para escolhas alimentares mais saudáveis.

Assim, na sua tomada de decisão, o Governo português deve considerar os sistemas FOP-NL já adotados em Portugal, mas também os sistemas que estão a ser adotados por outros países, nomeadamente naqueles que apresentam relações comerciais relevantes com Portugal.

As preocupações expressas com o algoritmo de classificação de alguns sistemas FOP-NL (por exemplo, NS) devem ser tidas em consideração. Previamente à adoção de qualquer modelo deve ser definida uma estratégia para minimizar estas preocupações, incluindo por exemplo o teste da sua adequação aos produtos alimentares portugueses.

Por último, a estratégia de implementação de um modelo FOP-NL deve prever um programa de educação alimentar à população, bem como a avaliação da extensão da sua adoção e da sua efetividade nas decisões de compra e no padrão alimentar e de saúde da população. Deve também considerar-se a realização de um HIA retrospetivo para avaliar o impacto dessa estratégia de política alimentar após cinco anos da implementação.

Executive Summary

Background

Scientific evidence shows that mandatory nutrition declaration can be difficult to understand by consumers. According to a previous study conducted in the Portuguese population, 40% of Portuguese consumers did not understand the nutrition information presented on food labels. To face this misunderstanding, several countries have implemented consumer-friendly front-of-pack nutrition labelling based on the scientific evidence available for their national contexts. The use of interpretative front-of-pack nutrition labels (FOP-NL) is considered one of the best options to promote healthy food choices and consequently to prevent and control non-communicable diseases.

In Portugal, a Government-endorsed policy on interpretative nutrition labelling is not yet implemented. However, several national economic operators from the food sector are already using different FOP-NL. The coexistence of multiple nutrition labelling systems in food products in Portugal in an unregulated way can be not favorable for the consumer understanding and, the FOP-NL systems used by the different food industry operators can not be the most adapted for the Portuguese consumers.

Thus, there is a need to evaluate the impact of different FOP-NL in terms of their contribution to promote better informed food choices and promote healthy food habits. The final goal is to provide scientific evidence that could support a set of evidence-based recommendations that can be used by policymakers' decision concerning the implementation of a proper approach on nutrition labelling.

Methods

This project, with the supervision of the World Health Organization (WHO), was developed according to the Health Impact Assessment (HIA), a study methodology that is used to identify potential key impacts for people's health of a given regulation, service or program.

Using the HIA methodology and with the support of the WHO, this study includes different methods for data collection: 1) a systematic literature review was first performed to identify recommendations for interpretative nutrition labelling; 2) focus groups and interviews were conducted aiming to characterize experts, stakeholders and citizens' opinions about the effectiveness of an interpretative front-of-package nutritional labelling for improving consumers' ability to obtain, interpret, and use the information of FOP-NL; 3) a telephone survey was also performed aimed to characterize Portuguese perceptions, opinions and use of food and nutrition labelling. This survey had a web-based component, intended to evaluate the subjective and objective performance of four FOP-NL systems: Traffic light label (TL), Guideline daily amounts (%GDA), Nutri-Score (NS) and Health Star Rating (HSR). The assessment of the utility of FOP-NL systems for adequate food choices was done throughout an online-based food-selection task, according to different FOP-NL schemes' scenarios (also comparing with a no-nutritional label situation).

Results

1. Systematic literature review

The literature review suggested that all FOP-NL systems promote better food choices than when no FOP-NL is presented. However, the evidence is not consistent regarding the superiority of a specific FOP-NL system regarding the effectiveness for the promotion of healthier food choices.

2. Focus groups and interviews

There was a consensus about the relevance of FOP-NL as a public health strategy and about the need of a Government-endorsed policy on FOP-NL.

It was recognized that a nutrition education program should be associated to the implementation of a FOP--NL system, addressing and promoting knowledge and skills for the correct use of such (specific/unique) implemented FOP-NL, as well as, the need to design an evaluation program for the impact of FOP-NL.

The majority of participants defended the idea that the use of FOP-NL should not be considered as mandatory and the stakeholders from food industry were concerned about costs and logistics related to the implementation of FOP-NL, considering the relevance of their involvement in the reflexion and decision processes regarding any FOP-NL policy .

3. Telephone and online survey

The exposure to a FOP-NL (no matter which one) was associated with a significantly higher probability of choosing the healthier product (when asked for selecting the healthiest food package from a set of three alternatives), when compared to the no-nutritional label situation.

When exposed to TL, 72.3% of participants reached the correct answer, followed by HSR and %GDA (70.9% and 70.0%, respectively), and NS (62.2%), compared to 34.2% for the no-nutritional label experimental condition.

The probability of participants answer correctly in each of the four FOP-NL choice scenarios was three to five times higher than with the control condition, but these results did not differ significantly between themselves. The effect of NS differed significantly (i.e., significantly less effective) from the effect of TL as a nudge for adequate food choices (NS is not significantly different from the other FOP-NL systems).

Conclusions and recommendations

The results of this study showed the need of a Government-endorsed policy on FOP-NL, being consensual among citizens, experts and stakeholders as a relevant and adequate strategy for health promotion.

All of the FOP-NL systems evaluated in this HIA were associated with a higher probability of promoting the choice of a healthier product, comparing to not being presented with a FOP-NL. Besides the fact that TL seems to perform better as a prompt for adequate food choices, the results about the performance of the other FOP-NL systems suggest the potential of all of them to contribute for healthier food choices.

The success of a FOP-NL policy would benefit from the active involvement of all relevant actors (health authorities, stakeholders, citizens), from a nutrition education program to promote a better knowledge and an adequate use of the endorsed FOP-NL system, and from a monitoring program to evaluate its effectiveness as a public health promotion policy.

The Portuguese Government should also consider the FOP-NL systems already adopted in Portugal and also those adopted by other countries with higher levels of food trade with Portugal.

The concerns expressed with the algorithm used by some FOP-NL systems (e.g., NS) should be analyzed and eventual recommendations to improve it should be considered. Moreover, more information about its validity for classifying a basket of food products commercialized in Portugal is needed to test its suitability to Portuguese food products.

The implementation of a FOP-NL system should include a strategy for the communication of the endorsed FOP-NL system, as well as an evaluation program of the policy implementation, focusing on the impact on food choices, food patterns and on the population health. A retrospective HIA to evaluate the impact of this food policy strategy after five years of implementation should also be considered.

1 Background

Noncommunicable diseases (NCD's) are increasing worldwide, accounting for more than 70% of all deaths globally (1), and for more than 40% of global premature deaths (under age 70). NCD's are also a leading cause of years of life lost across countries.

Many public health policies addressing NCD's are considering the need to intervene on modifiable risk factors and, more specifically, on dietary habits. One strategy that has been used to promote healthy dietary behaviors is nutrition labelling, the inclusion of a description of the nutrient content in the food package with the intention to orient consumers in food selection. European Union regulation No. 1169/2011 defined as mandatory the use of the nutrition declaration on the back-of-package of commercialized foods, i.e. the indication of absolute quantities of nutrients (e.g. saturated fat, sugar, salt and trans-fat) by 100g or 100 ml. Interpretive front-of-pack nutrition labels (FOP-NL) were allowed to be used but only as a voluntary (for the industry) additional form of expressing information in an easy-to-use way for consumers.

Evidence suggests that mandatory (already implemented) nutrition declaration can be difficult to understand by consumers, whereas the adoption of voluntary FOP-NL can, potentially, help consumers identifying healthier options. The WHO European Food and Nutrition Action Plan 2015-2020, for example, considered consumer-friendly front-of-pack nutrition labelling as an important policy measure to help consumers making healthier food choices which necessarily has a reflection in the consumption of better products. Moreover, FOP-NL effect can be reflected not only in healthier food choices but also in encouraging food reformulation operated by food industry as a consequence of this policy implementation.

In the last few years, several FOP-NL schemes have proliferated among food industry operators (Table 1 and Figure 1). This diversity of FOP-NL schemes is a natural effect of the absence of specific regulation for this health/nutritional communication tool.

To face the proliferation and use of different FOP-NL systems in an unregulated way, several European countries' governments or authorities of the food sector endorsed the adoption of one single system by the food industry operating in their territory.

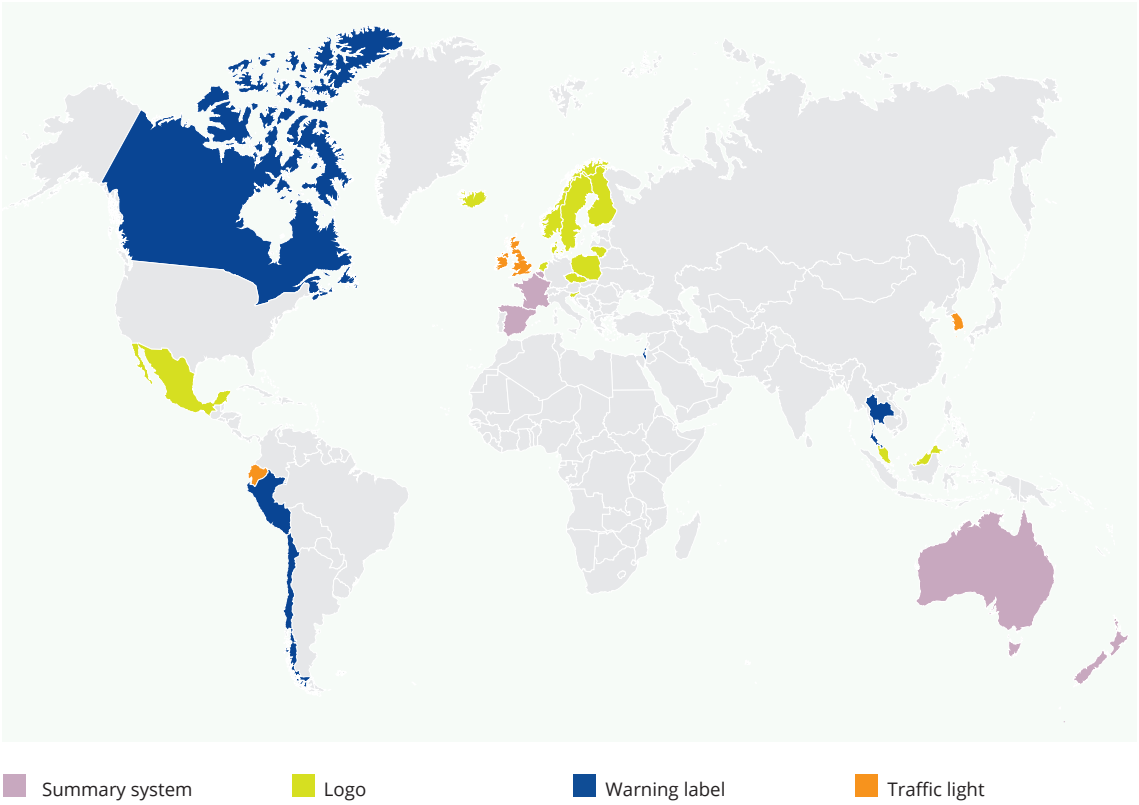
In Portugal, the Integrated Strategy for Healthy Eating Promotion (EIPAS), in articulation with the National Program for Promotion of Healthy Eating (PNPAS), proposed a set of policy proposals in this area, including the incentive to the use of FOP labelling schemes to ease food choices at the point-of-purchase, as well as some guidelines for food industry operators. Notwithstanding this effort to regulate the activities on this matter, several FOP schemes are already being used by different stakeholders in the food market. For example, following the adoption of the Traffic Light FOP-NL system by the United Kingdom, one Portuguese distribution operator introduced this scheme in its own brand products. Other distribution operators in Portugal have adopted different schemes, such as a modified traffic light system (i.e. Nutri Pass) or monochromatic schemes based on guidelines daily amounts. Since the beginning of this year (2019), another distribution operator has included Nutri-Score in its brand products. As a result, Portugal has now multiple nutrition labelling systems available in food products, whereas a government-endorsed policy on interpretive nutrition labelling is still lacking.

Table 1. **Brief description and examples of types of FOP-NL.**

FOP-NL types	Description	Examples		
		Name	**First country to adopt** (year of adoption)	**Other countries where it has been used**
Endorsement logos	Combines nutritional and other food-related criteria to give an overall assessment of absolute "healthfulness" of a product, with positive evaluative judgement. Represents a "stamp" of "health-related quality" (2,3)	**Keyhole:** Green circle with a white keyhole identifying healthy products; First adopted in Sweden	Sweden (1989)	Denmark, Iceland, Norway, Lithuania
Nutrient-specific warning label	Provides information about the excessive quantity of an individual nutrient, above a pre-established threshold. Represents an indicative "stamp" of a negative judgement (2,3)	**Warning labels:** Text symbols indicating that an individual nutrient is above a pre-established threshold	Chile (2012)	Peru and Venezuela
Nutrient-specific interpretive label	Provides information about the quantity (with the indication of a low, medium or high interpretive coding system) of a set of individual nutrients (2,3)	**Traffic light:** Using green (low), yellow (medium) or red (high) as indicative of the quantity of each of a set of nutrients composing the food product	United Kingdom (2013)	
Summary indicator system	Combines criteria to give an overall assessment of relative "healthfulness" of a product, with both positive and negative evaluative judgement (2,3)	**Nutri-Score:** Scale of five levels (also using colors, from green to red) classifying an "overall healthiness" of a food product	France (2017)	Belgium, Spain

This diversity of existing FOP-NL systems is not an optimal ground for three reasons. Firstly, having so many different schemes makes it more difficult for authorities to control the accuracy of the information conveyed in each FOP-NL to the consumers. Secondly, it does not contribute to the establishment of a supportive environment, promoter of healthy food choices, which is the primary goal of FOP-NL. In fact, a previous WHO report referred that 40% of Portuguese consumers did not understand the nutritional information on food labels, a result that is even worse between those with low educational level (60%) (4). Finally, it is not possible to implement studies to assess the impact of a given FOP in consumers' literacy, food choices and, at long-term, health.

Figure 1. **Front-of-package nutrition labeling schemes introduced globally.**



The discussion about which may be the best FOP-NL system is acting as a barrier to define and implement a FOP-NL policy. Despite the movements that have been made, scientific evidence is still lacking about the easiness to interpret FOP-NL systems and about the impact of different FOP-NL systems on the understanding of food products' healthiness and on food choices. Moreover, it is well-known that social and physical environments (both at the individual and community level) where people live in have an important influence in on their health and well-being. Therefore, an analysis of which determinants of health can impact the implementation of a given policy or plan such as nutrition labelling, and which subpopulation groups may be most affected, is also needed.

This report describes the main findings of a prospective health impact assessment (HIA) of different interpretive FOP-NL schemes in terms of their potential to contribute to more informed food choices and, potentially, to healthier food habits in the Portuguese population. In addition, it was analyzed if FOP-NL's impact varied according to different socioeconomic groups. The main goal of this HIA was to create evidence that could support a set of evidence-based recommendations that can be used by policymakers' decision concerning the implementation of a proper approach on nutrition labelling that could promote health gains, mitigate negative health impacts and reduce/prevent health inequalities.

Specific objectives of the project were:

1. To identify, through a literature review, recommendations for interpretive nutrition labelling, considering the cultural and socioeconomic diversity of communities

2. To characterize, through focus groups and interviews, opinions from Portuguese experts, stakeholders and citizens about the effectiveness of interpretative front-of-package nutrition labelling for improving consumers' ability to obtain, interpret, and use information regarding food products

3. To provide information about the performance of specific FOP-NL systems for enabling adequate (healthy) food choices in the Portuguese community

2 Methods

2.1 Health impact assessment

As referred, this project is a prospective HIA of a food nutrition labelling initiative in Portugal. HIA is commonly defined by the European Centre for Health Policy (5) as "A combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population." This methodology can support the evaluation of the potential impact of policy or initiatives on people's health and well-being. Even though HIA is not considered a decision-making tool per se, it is used to inform and influence decision-making or policies.

The involvement of stakeholders – citizens, experts and organizations – is a key strategy of a HIA, as all these social actors have contextual knowledge that can leave to the provision of relevant insights about the potential impact of the proposed policy. Furthermore, they can also contribute to the identification of population subgroups that might be more affected by a policy initiative, thus anticipating the need to include particular details in the proposal that can lead to increased health gains and reduced social inequalities.

There are several types of HIA methods (6) (prospective, retrospective or concurrent), depending on the development stage of the policy or the time and resources available. The HIA described in this report is a prospective one.

As stated by WHO (7), a HIA follows specific pre-defined procedures, alongside several stages:

01 Screening
Identification of the potential health implications of the policy to determine if an HIA is required

02 Scoping
Identification of key health issues and public concerns to be considered in the assessment

03 Appraisal
Evaluation, based on the available evidence, of potential health gains and losses as a result of the intervention and identification of strategies to mitigate health impacts

04 Reporting
Drawn of conclusions and definition of recommendations to mitigate negative impacts on health, and to enhance potential gains

05 Monitoring and evaluation
Monitoring of the real impacts on health of the intervention

2.2 Health Impact Assessment of a nutrition labelling initiative in Portugal

This prospective HIA was carried out between June 2018 and March 2019 and was supervised by the World Health Organization. The process was informed by data collection to provide the best scientific evidence available.

It was decided that a mixed-methods approach would be used to inform HIA, with a systematic literature review, focus groups with experts (e.g. from nutrition, health promotion or health communication areas) and citizens, in-depth interviews with key stakeholders (including large surface supermarket and multinational food companies' stakeholders) and a survey with consumers.

For each component, specific objectives were defined as presented in Figure 2.

Map evidence about impact of FOP-NP on consumer's food choices and anayse if FOP-NL's impact varies according to different socioeconomics groups	**Systematic literature review**
Characterize opinions about the effectiveness of an interpretative FOP-NL for improving consumers ability to obtain, interpret, and use information of FOP-NL	**Focus groups & interviews**
Characterize attitudes and behaviors regarding interpretative nutrition labels and evaluate the impact of several pre-identified FOP schemes on nutricional quality of chosen food products	**Telephone & web-based survey**
Collect data regarding the health status, data on food consumption of the Portuguese population, in particular at high-risk groups, as well as the socioeconomics characteristics	**Community profile**
Collect data regarding the policy context in terms of nutricion labelling	**Policy analisys**

SYSTEMATIC LITERATURE REVIEW. For the systematic literature review, it was decided to follow the guidelines proposed by the Preferred Reporting Items for Systematic Reviews and Meta-AnalysesPRISMA-Equity 2012 Extension (PRISMA-E) and the PROGRESS-Plus framework. The search was performed in four electronic databases (Cochrane Library, PubMed, Scopus and Web of Science) to identify peer-reviewed papers describing longitudinal studies evaluating the effect of FOP-NL schemes on consumers' food choices. No publication-period or language restrictions were applied.

FOCUS GROUPS. For this component, a minimum of five focus groups were considered necessary, two with experts from different areas (e.g. from nutrition, health promotion and health communication areas) and three with citizens (with different ages, educational level and social-cultural backgrounds). The topics of discussion regarded: concerns about food choice, use of nutrition labels, interpretive labelling systems (comparing different ones) and the potential impact of interpretative nutrition labels on food packages as a food-choice determinant.

INTERVIEWS. Individual in-depth interviews with stakeholders were also considered as most relevant for the understanding of the pros and cons of FOP-NL systems. The topics explored stakeholders' perceptions about the determinants, obstacles and facilitators for implementing interpretative nutrition labels, as well as their perspectives on the impact of food choice and related-behaviours.

TELEPHONE AND WEB-BASED SURVEY. Finally, a survey included a random sample of the adult Portuguese population (between 18 and 64 years old). The survey included a first component, with telephone interviews, conducted on February and March 2019. The generation of phone numbers followed a random process. The data collection used a Computer-Assisted Telephone Interview (CATI) system. The survey entailed also a

second component, web-based, targeted to the respondents of the first part, aimed to evaluate the impact of different pre-identified FOP-NL schemes on the selection of food products according to their perceived nutritional quality. For this, five food-choice scenarios were designed with three products packages, one of them with a healthier nutritional profile than others. Consumers were presented in each choice scenario with a FOP-NL system or with a no-nutritional label (control) condition and asked to choose the healthiest food product. The four FOP-NL systems evaluated were: TL, %GDA, NS and HSR. The rationale to include these systems on the analysis was the following:

- TL and %GDA are already used in the Portuguese population by two of the major food retails operators;
- NS is currently endorsed by France, Belgium and Spain health authorities;
- HSR is endorsed by Australian and New Zealand authorities and is a mixed approach of an overall nutrition summary with a set of nutrients-specific assessments.

Steering committee

The steering committee of this prospective HIA was comprised of technicians from the Directorate-General of Health (DGS) and from the Environmental Health Institute (ISAMB) of the Faculty of Medicine of the University of Lisbon.

Engagement of key stakeholders

Stakeholders from different areas were engaged in this HIA process (Table 2), having active participation in the *"Stakeholders' engagement workshop"*, that took place on January 28th, and October 25th 2019.

Table 2. **Stakeholders participating in the HIA.**

Policy-makers **representatives of main policy decision-makers and regulatory entities**	**Academy/research** **representatives of academic and research entities from food and nutrition area**	**Stakeholders** **representatives of main affected groups**
• Ministry of Health • Ministry of Agriculture, Forestry and Rural Development • Directorate-General of Education • Directorate-General of Consumer • Directorate-General of Food and Veterinary Medicine • Food Safety and Economic Authority • Professional Association of Nutritionists	• Porto University Faculty of Nutrition and Food Sciences • National Health Institute Doutor Ricardo Jorge • ISCTE – University Institute of Lisbon	• DECO - Portuguese Association for Consumer Protection • Portuguese Association of Distribution Companies • Portuguese Agrofood Industries Federation

The main objective of the engagement of the stakeholders, was to inform them on the objectives and values of the ongoing HIA, to introduce the proposal for the new policy, to directly and actively involve them in the process, and finally to present and to discuss obtained results. In order to do this, key institutions from several areas of community were selected to represent the food sector, authorities and consumers' association representatives. The position of several stakeholders about the proposed policy was discussed and noted.

3 Results

3.1 Systematic literature review

The goal of this review was to gather evidence on which types of interpretive FOP-NL schemes have been tested on consumers and have been found to be effective in increasing the selection of healthier consumption choices. Several authors, from different countries and with different methodologies, studied the effectiveness of interpretive FOP-NL systems in promoting healthier food choices. A wide range of outcomes related to healthier food choices was identified: the impact on purchase's intention, consumers' perception of healthiness of products, nutritional quality of chosen products, nutrient profile intake, understanding of nutritional content and the effective overall caloric/nutrient intake.

In general, interpretative FOP-NL systems were found to have a beneficial impact on healthier food choices when compared to no-label conditions. The benefits are observed in different outcomes related to healthier food choices, as in perception of products' healthiness (8–11), understanding of nutritional content (8,12), purchase intention (8,9,13), nutritional quality of selected products (12,14–16), and nutrient content (12,14,15).

Despite the evidence of the positive impact of FOP-NL systems on healthier food choices when compared with a no-label condition, no particular system stands out as the most effective, as each system is more helpful in some health-related dimensions but not in others.

Despite the existing evidence of a positive impact of FOP-NL in health food choices, it remains necessary to develop a long-term trial to assess the impact of a FOP-NL on major health outcomes, namely in terms of the impact on the incidence of NCD's and mortality (i.e., more distal outcomes, in terms of causality pathways).

Beside the assessment of the potential health effect of interpretive FOP-NL systems, this HIA focus on the identification and anticipation of health disparities and inequalities resulting from the implementation of a FOP-NL system in Portugal.

When evaluated the effectiveness of FOP-NL, some studies assessed its effect stratified by factors that are known to be predictors of social inequalities. Some of the most common assessed factors of social inequalities were sex, age, education level and socioeconomic status (8,14–16).

Studies have revealed different responses to labelling policy initiatives on pre-packaged products (mandatory or voluntary) among socio-demographic groups of population (17,18). Indeed, recent studies reported mixed results concerning socioeconomic status and education level. Some studies supported that colour-based FOP-NL systems are beneficial in low-income consumers when considering outcomes as food intake or health perception (19,20).

The literature review was unable to clarify the risk of potential social inequities resulting with the implementation of a FOP-NL because there were not enough high-level evidence studies to sustain any hypothesis.

3.2 Perspectives of citizens, experts and stakeholders

The following section of this HIA presents qualitative evidence collected on the pros and cons of FOP-NL systems as stated by Portuguese consumers, experts or stakeholders (through focus groups and individual in-depth interviews).

3.2.1 Participants' characterization

Overall, 31 participants were involved in five focus group: two focus groups with experts (11 experts from different areas: nutrition, health literacy, health communication, health promotion or consumer protection) and three focus groups with citizens (20 participants, in total), between September 19th and October 4th, 2018. Regarding citizens, 12 were men (60%), the mean age was 51 years old and 30% had no more than 12 years of school.

Five in-depth individual face-to-face interviews were made with key stakeholders representing the Portuguese food retail distribution sector, multinational food companies, operating in Portugal, and food regulation authorities. These individual interviews took place between December 26th, 2018 and February 19th, 2019.

3.2.2 General perspectives about FOP-NL systems as a health policy

- There was a consensus (among citizens, experts and stakeholders) about the relevance of FOP-NL as a public health promotion policy and as a policy for health equity promotion.

- The government endorsement of a single/unique FOP-NL system in pre-packaged food products commercialized in Portugal was referred, consensually (i.e., by citizens, experts and stakeholders), as a key point for enhancing the success of this tool as a health and health equity food policy strategy.

- A program of health/nutritional education program (including school curricula) should be associated to the implementation of a FOP-NL system, addressing and promoting knowledge and skills for the correct use of that specific/unique FOP-NL.

- The evaluation of the impact of FOP-NL endorsement on food choices and health gains was considered by experts (participating in focus groups) and interviewed stakeholders as a fundamental component of the policy.

- The majority of participants (i.e., experts on focus groups and interviewed stakeholders from food retail distribution sector, multinational food companies and food regulation authorities) defended the idea that the use of FOP-NL should not be considered as mandatory; efforts should be endorsed to promote the widespread awareness and adoption of the selected FOP-NL system by food industry actors. None of participants defended the compulsory adoption of a FOP-NL on pre-packaged food products.

- Both experts and citizens who participated in the focus groups expressed reservations about the criteria and algorithm that should be used to define the classification attributed by any FOP-NL. In order to increase the perception of transparency, stakeholders proposed the widespread communication of the criteria and algorithm of FOP-NL.

- Stakeholders from food industry were concerned about costs and logistics related to the implementation of FOP-NL by industry, such as branding adaptation costs or potential reformulation costs. Their involvement in the reflexion and decision processes regarding any FOP-NL policy was considered as a most relevant issue.

- Experts (and some citizens) the endorsement of a FOP-NL system should be accompanied by an assessment of its effectiveness in terms of promotion of health literacy gains, healthy habits and, ultimately, health gains.

3.2.3 Perspectives of citizens, experts and stakeholders about FOP-NL systems

- %GDA is considered as a rather "neutral" system, avoiding "pre"-interpreted information using colours or stamps for attributing a "high-low / bad-good" connotation. However, according to participants' (i.e., experts and citizens) perception, groups with a low level of nutritional literacy in general and/or low level of functional health literacy are presumed to get few benefits from this system. Moreover, %GDA can, according to several experts participating in the focus groups, potentially imply more time to process the numeric information it provides, being a relevant obstacle for its systematic use.

- TL is familiar to Portuguese consumers, not only because it is already used in Portugal by one of the major supermarket chains but also because it presents the same colours of road "traffic lights". Both experts and citizens participating in the focus groups reported that TL provides information about specific nutrients, such as nutrients amounts classified with colours, that allows easy and adequate interpretation and use by population groups with low level of literacy or with specific need of information for adequate health management. Some food experts highlighted nevertheless that TL does not allow (or makes it difficult to do) an evaluative summary comparison between products within food categories, based on the colour reference for the ingredients.

- NS offers a simple/immediate summary score, opposing to FOP-NL schemes with more numeric and complex information (e.g., %GDA or TL), implying short reading/interpretation time when shopping. Both experts and citizens participating in the focus groups referred that NS interpretation does not require a high level of health literacy (more specifically, functional health literacy) to make adequate nutritional decisions. Several experts (as well as non-experts) highlighted the idea that this type of FOP-NL enhances equity on vulnerable social groups such as those with low level of literacy. On the other hand, several experts expressed the concern of NS as providing an implicit assumption of "ideal/adequate" food products versus "bad/inadequate" food products, and about the lack of specific information about nutrients amounts that are required for consumers' self-management of a particular disease.

- HSR offers a combination between a summary score of products and more descriptive information for specific nutrients amounts, which can imply less time spent reading this system while providing nutrient-specific numeric information as well. Some participants of the focus groups (both experts and citizens) recognized that HSR can be useful and adequate for groups with low literacy skills or for groups with specific health/disease self-management needs. Still, the use of stars (as interpretative symbols) was not well appreciated by several participants (experts and non-experts), considered as less aligned with our (Portuguese) cultural context.

3.3 Nutritional information on Food Packaging Survey

3.3.1 Telephone Survey

As described previously, a telephone and web-based survey was conducted to assess the knowledge, attitudes and use of food labelling by consumers in Portugal.

As Table 3 shows, the survey sample was homogeneous between men and women regarding age group, country of birth and marital status, despite significant differences were verified on occupation (higher percentages for the "student", "unemployed" and "housekeeper" among women) and educational level (women with more years of formal education than men). No significant differences between women and men were found for the variables: having children or elderly in household, financial well-being of the household and food insecurity. Differences between sexes were found for responsibility for grocery shopping (women assuming more this role than men).

The overall percentage of participants having a diagnosed health problem was statistically higher among women. The prevalence of overweight (pre-obesity and obesity altogether) was more prevalent among men than among women of this sample. Self-perceived health status did not differ between sexes.

Table 3. **Sociodemographic and general health status characteristics of participants involved in the survey.**

		Total[a] (n = 469) n (%)	Women[a] (n = 257) n (%)	Men[a] (n = 212) n (%)	p[b]
Age (years)	**18 - 34**	148 (31.6%)	80 (31.1%)	68 (32.1%)	0.761
	35 - 49	187 (39.9%)	100 (38.9%)	87 (41.0%)	
	50 - 64	134 (28.6%)	77 (30.0%)	57 (26.9%)	
	Mean (SD)	40.6 (11.4)	40.0 (11.2)	41.2 (11.7)	0.297
Country of birth	**Portugal**	429 (91.5%)	230 (89.5%)	199 (93.9%)	0.099
	Other countries	40 (8.5%)	27 (10.5%)	13 (6.1%)	
Marital status	**Single**	141 (30.1%)	72 (28.0%)	69 (32.5%)	0.154
	Married or living together	278 (59.3%)	151 (58.8%)	127 (59.9%)	
	Divorced or separated	43 (9.2%)	28 (10.9%)	15 (7.1%)	
	Widowed	7 (1.5%)	6 (2.3%)	1 (0.5%)	
Education	**Up to 9 year of school**	273 (58.2%)	138 (53.7%)	135 (63.7%)	**0.031***
	More than 9 year of school	196 (41.8%)	119 (46.3%)	77 (36.3%)	
Occupation	**Employed**	382 (84.1%)	198 (80.8%)	184 (88.0%)	**0.017***
	Student	22 (4.8%)	15 (6.1%)	7 (3.3%)	
	Housekeeper	6 (1.3%)	6 (2.4%)	0 (0.0%)	
	Unemployed	27 (5.9%)	19 (7.8%)	8 (3.8%)	
	Retired or pensioneer	17 (3.7%)	7 (2.9%)	10 (4.8%)	
Having a diagnosed health problem	**No**	299 (63.8%)	153 (59.5%)	146 (68.9%)	**0.043***
	Yes	170 (36.2%)	104 (40.5%)	66 (31.1%)	
Self-reported clinical diagnosis(if reporting to have a diagnosed health problem)	**Diabetes (I or II)**	19 (11.2%)	8 (7.7%)	11 (16.7%)	0.083
	Hypertension	49 (28.8%)	26 (25%)	23 (34.8%)	0.224
	Dyslipedemia	42 (24.7%)	27 (26%)	15 (22.7%)	0.717
	Cardiac disease	9 (5.3%)	3 (2.9%)	6 (9.1%)	0.091
	Respiratory disease	28 (16.5%)	15 (14.4%)	13 (19.7%)	0.400
	Gastrointestinal disease	18 (10.6%)	9 (8.7%)	9 (13.6%)	0.317
	Stroke	4 (2.4%)	2 (1.9%)	2 (3.0%)	0.642
BMI (weight/height^2)	**< 25 kg/m^2**	271 (57.8%)	173 (67.3%)	98 (46.2%)	**<0.001***
	overweight (≥25 kg/m^2)	198 (42.2%)	84 (32.7%)	114 (53.8%)	
Self-perceived general health	**Reasonable. Bad or Very bad**	154 (32.8%)	92 (35.8%)	62 (29.2%)	0.139
	Good or Very good	315 (67.2%)	165 (64.2%)	150 (70.8%)	
Households with children	**No**	397 (85.6%)	219 (86.2%)	178 (84.8%)	0.692
	Yes	67 (14.4%)	35 (13.8%)	32 (15.2%)	
Households with elderly	**No**	423 (91.2%)	229 (90.2%)	194 (92.4%)	0.417
	Yes	41 (8.8%)	25 (9.8%)	16 (7.6%)	
Subjective financial well-being of the household	**Difficult or very difficult**	223 (47.8%)	124 (48.6%)	99 (46.7%)	0.341
	Enough for my needs	205 (43.9%)	106 (41.6%)	99 (46.7%)	
	Comfortable or very comfortable	39 (8.4%)	25 (9.8%)	14 (6.6%)	
Food insecurity in the last 12 months	**Yes**	23 (4.9%)	15 (5.9%)	8 (3.8%)	0.391
	No	444 (95.1%)	240 (94.1%)	204 (96.2%)	

		Total[a] (n = 469) n (%)	Women[a] (n = 257) n (%)	Men[a] (n = 212) n (%)	p[b]
Responsible for grocery shopping	Less than once per month	14 (3.0%)	2 (0.8%)	12 (5.7%)	**0.016***
	1 - 3 times per month	51 (10.9%)	28 (10.9%)	23 (10.8%)	
	Once per week	205 (43.7%)	108 (42.0%)	97 (45.8%)	
	Several times per week (not everyday)	165 (35.2%)	97 (37.7%)	68 (32.1%)	
	Everyday	34 (7.2%)	22 (8.6%)	12 (5.7%)	

a. Absolute frequency and the corresponding percentage (for categorical variables) or mean and standard deviation (SD) (for numeric variables)
b. P-value of Chi-square Test (for categorical variables) or t-Test (for numeric variables) for comparing gender
Note: Sample size is not constant due to missing data on some variables or due to filters (e.g., for the variable "self-reported clinical diagnosis").

The frequency of reading the information that is available on food labels when buying food products is presented on Table 4. More than half of participants reported that they never read or only occasionally read this type of information. These percentages were similar between sexes, age groups, educational levels, financial status of household, having or not children and BMI categories.

Table 4. **Frequency of reading information that is available on food labels when buying food products.**

		Never or ocasionally n (%)	Frequently or always n (%)	*p*[a]
Total sample (n=469)		271 (57.8%)	198 (42.2%)	
Gender	Women	140 (54.5%)	117 (45.5%)	0.133
	Men	131 (61.8%)	81 (38.2%)	
Age group (years)	18 - 34	94 (63.5%)	54 (36.5%)	0.161
	35 - 49	107 (57.2%)	80 (42.8%)	
	50 - 64	70 (52.2%)	64 (47.8%)	
Education	Up to 9 year of school	168 (61.5%)	105 (38.5%)	0.058
	More than 9 year of school	103 (52.6%)	93 (47.4%)	
Subjective financial well-being of the household	Difficult or very difficult	25 (64.1%)	14 (35.9%)	0.350
	Enough for my needs	123 (60,0%)	82 (40,0%)	
	Comfortable and very comfortable	121 (54.3%)	102 (45.7%)	
Households with children	No	232 (58.4%)	165 (41.6%)	0.505
	Yes	36 (53.7%)	31 (46.3%)	
BMI (weight/height^2)	< 25 kg/m2	159 (58.7%)	112 (41.3%)	0.705
	overweight (≥25 kg/m2)	112 (56.6%)	86 (43.4%)	

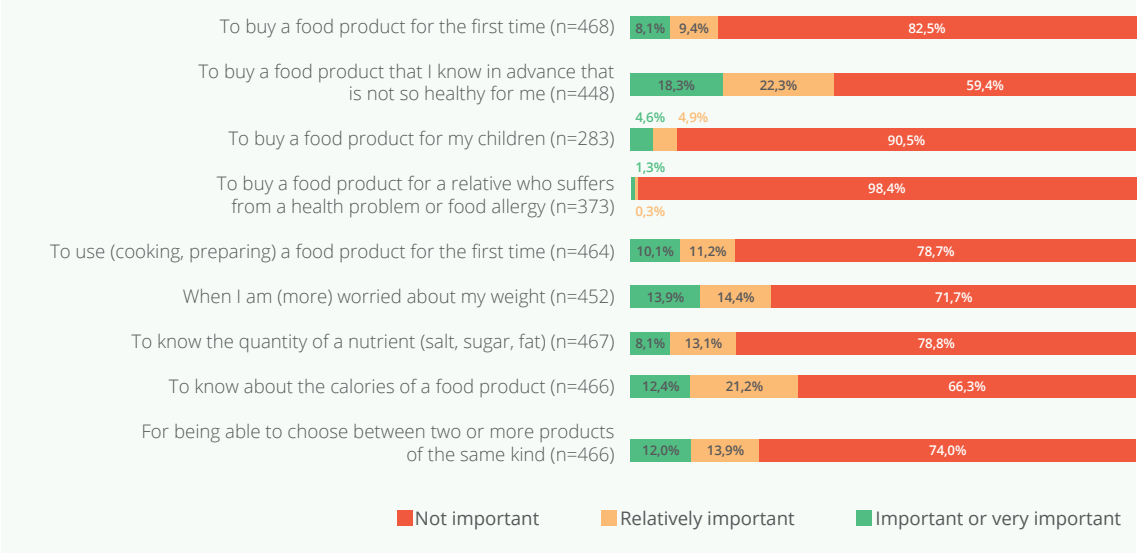
a. P-value of Chi-square Test or Fisher tests.

A relevant number of participants (n=61) reported never reading the information that is available on food labels. The most common reason was "For knowing the food product or brand" (67.2%) followed by "Lack of time" and "It bothers me to have to read this type of information" (52.5% for both) and "The font size is too small to read" (47.5%).

Factors related to the importance of reading information on food labels are presented in Figure 3. The most important factor to read information on food labels was the need to "Buy food for a family member who has a health problem or a food intolerance/allergy" (considered as "important" or "very important" by 98.4% of respondents). Other frequently reported factors (as important or very important) were "Buying food for their children" (90.5%), "When a product is bought for the first time" (82.5%) and "To know the nutrients' amounts"

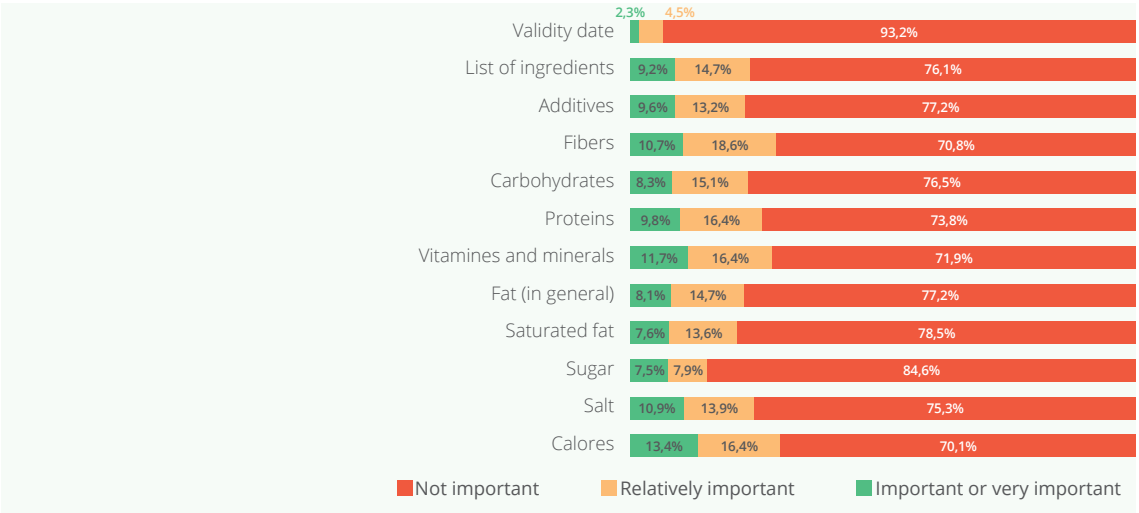
(78.8%). Participants considered to be less important to read food labels when they buy "A food product known as unhealthy from the outset" (18.3%), "When (more) concerned with the control of body weight" (13.9%), "To know about the calories of the food" (12.4%) and "To choose between two or more products of the same kind" (12.0%).

Figure 3. **Why reading information on food labels?**



Several types of food label information were classified by participants as important or very important, as we can see in Figure 4. The labelling information that was most frequently valued as "important or very important" was expiration date (93.2%), followed by sugar (84.6%) and saturated fat (78.5%) amounts. The proportions of importance attributed to sugar, fats (in general) and additives were different across sex, with women valuing this type of nutritional information more than man. Depending on education level, participants attributed different importance to information regarding calories, vitamins and minerals, proteins, fibres, additives and expiration date, being those with fewer years of education the ones who valued the most these types of information.

Figure 4. **Importance given to food label information.**



The product with higher reported use of nutritional information was food for children (e.g., powdered milk, instant cereals, purée) (70.7%) though not many participants have reported buying this type of products (n=147). High percentage of participants reported the use of nutritional information for buying breakfast cereals (69.5%) and yogurts (69.2%). Other products scored above 60%, such as cereals bars (67.5%), cakes and cookies (65.1%), fruit juice (64.1%) and fruit drinks and soft drinks (60.3%). The only product for which nutritional information use was below 40% was bread (31.8%).

Table 5 presents the results of self-reported understanding of nutritional information available on food labels. A higher percentage of self-reported understanding of nutritional information was verified in men (40.6%) and among participants with age between 18 and 34 years (48.0%). Self-report understanding of nutritional information was similar regarding gender, educational levels, self-reported financial status of household, households with/without children and body mass index categories. Significant differences were only observed across age groups, with youngers reporting to have more facility in understanding this information. "Difficult and very difficult" to the understanding of nutritional information was in general reported below 30%. Female participants, with age between 50 and 64, and participants with a difficult or very difficult financial situation had percentages above 30% of self-reported difficulties to understand nutritional information.

Table 5. **Understanding nutritional information available on food labels.**

		Difficult and very difficult n (%)	Relatively easy to understand n (%)	Easy and very easy n (%)	*p*[a]
Total sample (n=469)		127 (27.1%)	167 (35.6%)	175 (37.3%)	
Gender	Women	78 (30.4%)	90 (35.0%)	89 (34.6%)	0.181
	Men	49 (23.1%)	77 (36.3%)	86 (40.6%)	
Age group (years)	18 - 34	31 (20.9%)	46 (31.1%)	71 (48.0%)	**0.001***
	35 - 49	44 (23.5%)	78 (41.7%)	65 (34.8%)	
	50 - 64	52 (38.8%)	43 (32.1%)	39 (29.1%)	
Education	Up to 9 year of school	79 (28.9%)	87 (31.9%)	107 (39.2%)	0.136
	More than 9 year of school	48 (24.5%)	80 (40.8%)	68 (34.7%)	
Subjective financial well-being of the household	Difficult or very difficult	13 (33.3%)	15 (38.5%)	11 (28.2%)	0.494
	Enough for my needs	49 (23.9%)	73 (35.6%)	83 (40.5%)	
	Comfortable and very comfortable	65 (29.1%)	78 (35.0%)	80 (35.9%)	
Households with children	No	108 (27.2%)	141 (35.5%)	148 (37.3%)	1.000
	Yes	18 (26.9%)	24 (35.8%)	25 (37.3%)	
BMI (weight/height^2)	< 25 kg/m2	76 (28.0%)	99 (36.5%)	96 (35.4%)	0.609
	overweight (≥25 kg/m2)	51 (25.8%)	68 (34.3%)	79 (39.9%)	

a. P-values are based on chi square or Fisher tests.

3.3.2 Web-based Survey

As described previously, participants of the telephone survey were asked to complete a web-based questionnaire which was filled in by 357 participants.

When participants were asked if they already knew the FOP-NL that was shown in the online questionnaire (%GDA, TL, NS, and HSR) the most frequently reported and already-known scheme was the %GDA (83.5%), followed by TL (82.6%). Percentage of respondents who reported to have already seen NS or HSR was much lower: 16.2% and 14.3%, respectively.

Subjective evaluation (i.e., preferences and opinions about) of different FOP-NL was assessed adapting the questionnaire of Chantal and colleagues (21). This questionnaire assessed dimensions related to "liking",

"awareness and trustworthiness" and "perceived cognitive workload". The item "easy to identify", belonging to the original questionnaire, was not considered for this survey.

Comparing the different FOP-NL presented to participants, preference for TL (score close to or above 50%) was observed in the majority of items. The results are presented in Figure 5.

Considering the "liking" items of subjective evaluation of FOP-NL, TL was declared to be the most preferred FOP-NL (52.4%) and it was considered as useful to choose healthy products by 51.3% of respondents. The TL was also the label that participants wanted to see the most on front of packages (45.7%), followed by NS (17.9%), %GDA (16.8%), and HSR (11.5%). When asking about the least appreciated label, the NS came first, followed by HSR, %GDA, and TL.

Regarding the "awareness and trustworthiness" items, the TL label was considered as the label which most contributed to provide the needed information (50.2% of the respondents); it was also declared as the most trustworthy (47.6%), and the one which provided the most reliable information (51.0%).

About the "perceived cognitive workload" items, the TL was the most likely to be found as easy and quick to understand (50.4% and 48.2% of the respondents, respectively).

Over half of the participants (58.8%) reported that none of the presented labels made them uncomfortable. The highest proportion of discomfort was observed for the NS (15.7%) and the lowest for the %GDA (6.2%).

When assessing the percentage of participants that selected the healthiest food product within three alternatives, the lowest percentage of correct answers was observed on the choice scenario with a no-nutritional label condition (34.2% of correct answers). All the choice scenarios with a FOP-NL scored better than this control condition. Indeed, all the four FOP-NL systems scored over 60% of correct answers, varying between 72.3% of correct answers when presented TL on food products' packages and 62.2% when NS was presented. Confidence intervals of the percentage of correct answers by FOP-NL are presented in Figure 6.

When analyzing per sub-groups, significant differences were observed for TL, %GDA and HSR across age groups, being respondents with age between 50 and 65 the ones with the lowest percentage of correct answers. This difference across age groups was not observed for NS.

The percentages of correct answers were also statistically different across groups according to the level of education of participants. The group of participants with more than nine years of school had the highest percentage of healthiest choice with TL as FOP-NL (89.5%). Despite not significant, it was observed a tendency for difference in the proportion of correct answers according to the level of education when using %GDA to choose the healthiest product.

NS was the only FOP-NL without differences within subgroup analysis.

Probabilities of correct answers were calculated using logistic regression models and odds ratio (OR) (Table 7). Crude OR were calculated to the following variables: FOP-NL, gender, age group education level, subjective financial well-being of the household, households with/without children, BMI categories, self-perceived general health, food insecurity, responsibility for grocery shopping and understanding of nutritional information.

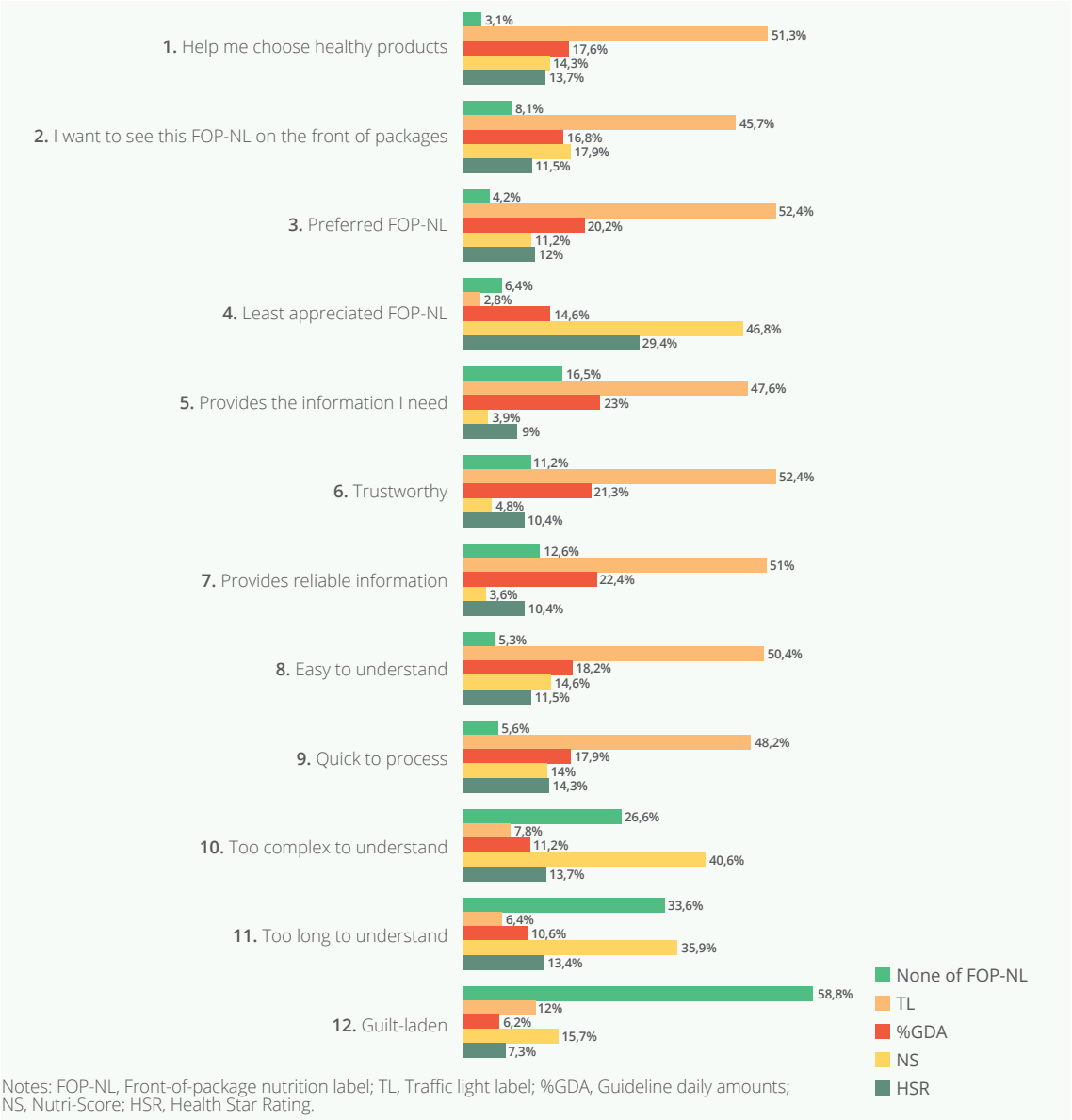
Differences on the probability of answering correctly were observed on categories of the variables: FOP-NL, age group and self-reported understanding of nutritional information. Other variables were not associated with the correct answer of the healthiest product on choice scenarios.

After adjusting for variables associated with the increasing of correct answers, and when compared to a no--nutritional label condition, the presence of any of the studied FOP-NL increased the probability of participants to choose the healthiest product, being TL the system that increased this probability the most, above three to five times higher than the control condition. When compared to a no-nutritional label situation, the highest increase of correct answers probability was verified with the presentation of TL on food products, followed by HSR and %GDA both with similar odds ratio. The increasing of correct answers probability attributed to NS when compared to a no-nutritional label control condition was also more than three times.

The group of participants with age between 50 and 64 registered worse results when compared to those with age between 18 and 64, lowering for almost half the probability to answer correctly.

Before adjusting the effect of variables, the groups that self-reported relatively ease of understanding, as well as easy and very easy of understanding nutritional information verified an increment of 44% and 30%, respectively, on the probability of choosing the right answer. However, after the adjustment of variables, the probability of answer correctly was only statistically significant among participants that self-reported relatively easy to understand nutritional information.

Figure 5. **Acceptability of different FOP-NL.**



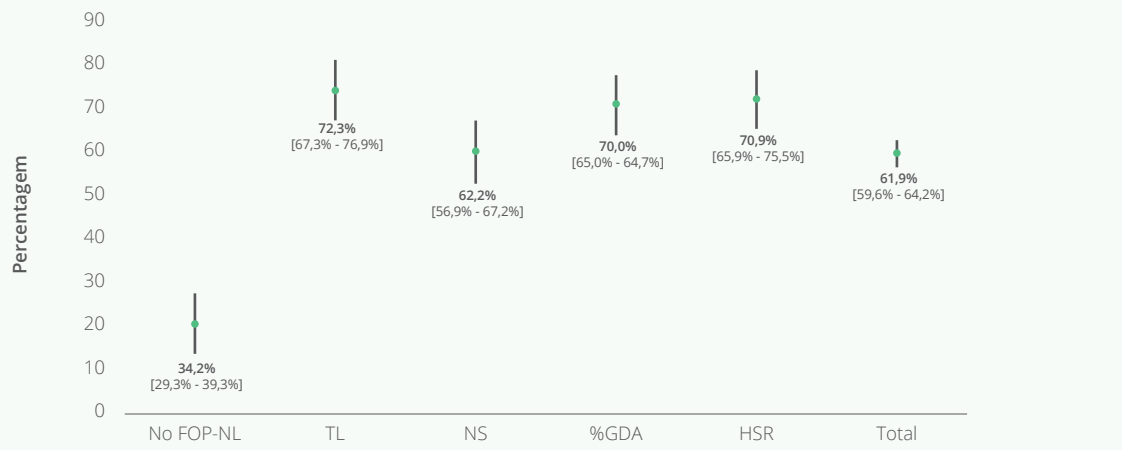
Notes: FOP-NL, Front-of-package nutrition label; TL, Traffic light label; %GDA, Guideline daily amounts; NS, Nutri-Score; HSR, Health Star Rating.

Table 6. **Percentage of correct food choices on basis of different FOP-NL, across sub-groups of the sample (n=357).**

		No FOP-NL n (%)	p[a]	%GDA n (%)	p[a]	TL n (%)	p[a]	HSR n (%)	p[a]	NS n (%)	p[a]
Total of correct answers		122 (34.2%)		250 (70.0%)	<0.001[b*]	258 (72.3%)	<0.001[b*]	253 (70.9%)	<0.001[b*]	222 (62.2%)	<0.001[b*]
Need more info to answer		179 (50.1%)		46 (12.9%)		37 (10.4%)		52 (14.6%)		92 (25.8%)	
Already seen this FOP		-		298 (83.5%)		295 (82.6%)		51 (14.3%)		58 (16.2%)	
Gender	Women	70 (36.3%)	0.373	139 (72.0%)	0.417	146 (75.6%)	0.125	135 (69.9%)	0.726	119 (61.7%)	0.828
	Men	52 (31.7%)		111 (67.7%)		112 (68.3%)		118 (72.0%)		103 (62.8%)	
Age group (years)	18 - 34	48 (39.3%)		93 (76.2%)		94 (77.0%)		92 (75.4%)		80 (65.6%)	
	35 - 49	52 (33.5%)	0.224	114 (73.5%)	0.002	117 (75.5%)	0.011	115 (74.2%)	0.014	96 (61.9%)	0.521
	50 - 64	22 (27.5%)		43 (53.8%)		47 (58.8%)		46 (57.5%)		46 (57.5%)	
Education	Up to 9 years of school	64 (36.0%)	0.504	116 (65.2%)	0.050	118 (66.3%)	0.013	121 (68.0%)	0.246	113 (63.5%)	0.663
	More than 9 years of school	58 (32.4%)		134 (74.9%)		140 (78.2%)		132 (73.7%)		109 (60.9%)	
Subjective financial well-being of the household	Difficult or very difficult	63 (34.8%)		127 (70.2%)		131 (72.4%)		129 (71.3%)		113 (62.4%)	
	Enough for my needs	51 (33.3%)	0.919	107 (69.9%)	0.982	109 (71.2%)	0.658	107 (69.9%)	0.964	93 (60.8%)	0.824
	Comfortable, very comfortable	8 (36.4%)		15 (68.2%)		18 (81.8%)		16 (72.7%)		15 (68.2%)	
Households with children	No	99 (33.0%)	0.436	207 (69.0%)	0.337	215 (71.7%)	0.621	209 (69.7%)	0.101	187 (62.3%)	0.880
	Yes	21 (38.9%)		41 (75.9%)		41 (75.9%)		44 (81.5%)		33 (61.1%)	
BMI (weight/height^2)	< 25 kg/m2	80 (38.1%)	0.070	148 (70.5%)	0.907	158 (75.2%)	0.150	147 (70.0%)	0.723	130 (61.9%)	0.912
	overweight (≥25 kg/m2)	42 (28.6%)		102 (69.4%)		100 (68.0%)		106 (72.1%)		92 (62.6%)	
Self-perceived general health	Reasonable, Bad or Very bad	39 (37.5%)	0.393	71 (68.3%)	0.703	74 (71.2%)	0.795	72 (69.2%)	0.701	69 (66.3%)	0.337
	Good or Very good	83 (32.8%)		179 (70.8%)		184 (72.7%)		181 (71.5%)		153 (60.5%)	
Responsible for grocery shopping	Less than once per month	3 (37.5%)		5 (62.5%)		6 (75.0%)		3 (37.5%)		6 (75.0%)	
	1 - 3 times per month	10 (29.4%)		23 (67.6%)		22 (64.7%)		27 (79.4%)		19 (55.9%)	
	Once per week	51 (33.1%)	0.639	105 (68.2%)	0.753	113 (73.4%)	0.670	108 (70.1%)	0.241	91 (59.1%)	0.271
	Several times per week (not everyday)	52 (38.2%)		97 (71.3%)		101 (74.3%)		96 (70.6%)		86 (63.2%)	
	Everyday	6 (24.0%)		20 (80.0%)		16 (64.0%)		19 (76.0%)		20 (80.0%)	
Food insecurity in the last 12 months	Yes	5 (33.3%)	1.000	11 (73.3%)	1.000	9 (60.0%)	0.374	10 (66.7%)	0.773	9 (60.0%)	1.000
	No	117 (34.3%)		238 (69.8%)		249 (73.0%)		242 (71.0%)		212 (62.2%)	

a. P-values are based on chi square, Fisher tests or z-score.
b. Comparisons of proportion of correct answers with each FOP-NL vs no-FOP-NL condition.
Notes: FOP-NL, Front-of-package nutrition label; TL, Traffic light label; %GDA, Guideline daily amounts; NS, Nutri-Score; HSR, Health Star Rating

Figure 6. **Confidence interval (95%) of percentage of correct food choices on bases of different FOP-NL.**



Notes: FOP-NL, Front-of-package nutrition label; TL, Traffic light label; %GDA, Guideline daily amounts; NS, Nutri-Score; HSR, Health Star Rating.

Table 7. **Association between the type of FOP-NL and choice of healthiest product using logistic regression mixed models in univariate and multivariate analyses (n=357).**

		Univariate **cOR** (95% CI)	**Multivariate** **aOR** (95% CI)
FOP-NL	No FOP-NL	1	1
	TL	5.02 (3.65 - 6.90)*	5.37 (3.87 - 7.44)*
	%GDA	4.50 (3.29 – 6.17)*	4.72 (3.42 - 6.52)*
	NS	3.17 (2.33 - 4.30)*	3.28 (2.40 - 4.48)*
	HSR	4.69 (3.42 - 6.43)*	5.07 (3.67 – 7.01)*
Gender	Women	1	1
	Men	0.90 (0.74 - 1.08)	0.94 (0.75 – 1.16)
Age group (years)	18 - 34	1	1
	35 - 49	0.88 (0.70 - 1.10)	0.85 (0.66 - 1.08)
	50 - 64	0.52 (0.40 - 0.67)*	0.49 (0.37 - 0.66)*
Education	Up to 9 years of school	1	1
	More than 9 years of school	1.20 (0.99 - 1.45)	1.13 (0.91 - 1.41)
Subjective financial well-being of the household	Difficult or very difficult	1	1
	Enough for my needs	0.87 (0.57 – 1.31)	0.89 (0.55 - 1.43)
	Comfortable or very comfortable	0.83 (0.54 – 1.26)	0.84 (0.53 - 1.33)
Households with children	No	1	1
	Yes	1.27 (0.97 - 1.67)	1.09 (0.81 - 1.47)
BMI (weight/height^2)	< 25 kg/m^2	1	1
	overweight (≥25 kg/m^2)	0.88 (0.73 - 1.07)	0.93 (0.75 - 1.17)
Self-Perceived General Health	Reasonable, Bad or Very bad	1	1
	Good or very good	0.97 (0.78 - 1.19)	0.92 (0.72 - 1.16)
Food insecurity in the last 12 months	Yes	1	1
	No	1.15 (0.72 – 1.84)	1.22 (0.73 - 2.03)
Responsible for grocery shopping	Less than once per month	1	1
	1 - 3 times per month	1.08 (0.54 - 2.17)	0.90 (0.42 - 1.92)
	Once per week	1.15 (0.60 – 2.18)	1.01 (0.51 - 2.03)
	Several times per week (not everyday)	1.29 (0.68 - 2.46)	1.22 (0.61 - 2.46)
	Everyday	1.36 (0.66 - 2.81)	1.31 (0.59 - 2.90)
Understanding of nutritional information	Difficult and very difficult	1	1
	Relatively easy to understand	1.44 (1.13 - 1.84)*	1.36 (1.05 - 1.77)*
	Easy and very easy	1.30 (1.02 - 1.65)*	1.20 (0.92 - 1.56)

a. Multivariate model was adjusted on all analysed variables.
Notes: cOR, crude Odds Ratio; aOR, adjusted Odds Ratio; CI, Confidence Interval; FOP-NL, Front-of-package nutrition label; TL, Traffic light label; %GDA, Guideline daily amounts; NS, Nutri-Score; HSR, Health Star Rating.

Due to the context of Portugal market, where TL and %GDA are already being used for some time (by two of the biggest retail food companies) it could be hypothesized that the previous knowledge and use of both two FOP-NL would have an influence in the probability to select the healthiest product (in consequence of their presence on choice scenarios). To evaluate this hypothesis, the sample was stratified to evaluate the effect of different FOP-NL on participants that go shopping less frequently considering that those had less contact with nutritional information on food package (e.g., nutrition declaration and FOP-NL), compared to those that go shopping more frequently and consequently can have more experience using it. Association between correct answers on food choice scenarios and FOP-NL presented on food products was assessed on participants that go shopping once per week or less. However, the magnitude of associations across systems changed poorly when compared to crude OR observed in the previous model, as presented in Table 8.

It was also hypothesized that participants with less education would respond differently to the presentation of FOP-NL. When stratifying the results to consider only people with nine years of education or less, the magnitude of the association between correct answers and the presentation of each of four systems was higher with HSR on food packages. Generally, the odds ratio of correct answer was lower than those verified in the first model that considered all participants. Results are presented in Table 9.

Table 8. **Association between FOP-NL and choice of healthiest product using logistic regression mixed models (people who go shopping once per week or less).**

		Univariate cOR (95% CI)
FOP-NL	**No FOP-NL**	1
	TL	5.29 (3.43 – 8.14)
	%GDA	4.35 (2.85 – 6.65)
	NS	2.99 (1.98 – 4.52)
	HSR	4.91 (3.20 – 7.53)

Notes: cOR, crude Odds Ratio; CI, Confidence Interval; FOP-NL, Front-of-package nutrition label; TL, Traffic light label; %GDA, Guideline daily amounts; NS, Nutri-Score; HSR, Health Star Rating

Table 9. **Association between FOP-NL and objective understanding using logistic regression mixed models in univariate and multivariate analyses (people who have up to 9 years of school).**

		Univariate cOR (95% CI)
FOP-NL	**No FOP-NL**	1
	TL	3.50 (2.27 – 5.42)
	%GDA	3.33 (2.16 – 5.15)
	NS	3.10 (2.01 – 4.77)
	HSR	3.78 (2.44 – 5.87)

Notes: cOR, crude Odds Ratio; CI, Confidence Interval; FOP-NL, Front-of-package nutrition label; TL, Traffic light label; %GDA, Guideline daily amounts; NS, Nutri-Score; HSR, Health Star Rating

4 Discussion

The increase of the burden of diet-related NCD's urges governments to take action in order to improve dietary habits of population and to prevent it. In line with WHO European Food and Nutrition Action Plan 2015-2020, PNPAS defined the adoption of consumer-friendly front-of-pack nutrition labelling as strategic to promote healthier food choices. This HIA was set up to contribute for such decision: it is therefore a support-decision HIA.

Following the best practices of HIA methodology, stakeholders from several areas were involved. Those who participated in the HIA Workshops recognized the need of endorsement of one single/unique FOP-NL system by government and agreed about the importance of defining a communication strategy accompanying its implementation, together with its monitoring and effectiveness assessment (namely, in terms of food choices at the moment of purchase and, ultimately, on food-related habits). The consensus that was verified in this HIA (among citizens, experts and stakeholders) about the relevance of FOP-NL as a public health promotion policy is considered a facilitator to successfully implement this policy.

Stakeholders from several sectors agreed that the adoption of a FOP-NL system by food retail operators can be an effective strategy to both inform consumers and enhance transparency perception about food products and brands, while promoting manufacturing of healthier food products from producers themselves.

However, European legislation allows voluntary presentation of additional nutrition information on front-of-pack which can originate a selective adoption of this labelling according to the nutritional profile of food products. In consequence, it is expected that food sector operators would adopt this information only in healthier products, at least during the previous years after policy implementation. This self-selective process is an important issue that needs to be taking into consideration when/if implementing an interpretive FOP-NL policy.

FOP-NL has the potential of being a nudge for adequate food choices in point-of-purchase contexts (as well as at the moment of using the food product, already after buying it). A beneficial impact of FOP-NL on perception of products' healthiness and understanding of nutritional content of selected products was found on the studies analysed for this HIA, comparing to a nutrition declaration or a no-nutritional label condition. However, none of evaluated FOP-NL differed consistently from others.

The majority of participants of this HIA who never or occasionally read the information on food labels stated the difficulty to understand it as the main reason for this lack of interaction with nutritional information available on packages . If FOP-NL systems are helpful to make easier interpretation of nutritional information, the endorsement of such a scheme, and consequently is usage among consumers, can have a beneficial impact on Understanding labels, through increasing its knowledge.

A potential negative impact of some FOP-NL is the wrong interpretation of the message conveyed in the FOP-NL code system, eventually conducting to inadequate food choices (e.g., not understanding the FOP-NL as informative of the product's nutritional quality).

More than 75% of surveyed consumers considered important or very important to have access to nutritional information about nutrients amounts, such as sugar, saturated fats and salt, associated to diet-related NCD's. This is an important factor for the decision about which type of FOP-NL to endorse in Portugal. The adoption of a summary system not specifying this specific information may be less well accepted by Portuguese consumers.

A more beneficial impact of FOP-NL on purchase intention, on nutritional quality or nutritional content of consumers' food choices was found on reviewed studies, comparing to the effect of nutrition declaration or of no-nutritional label conditions.

The results of this HIA survey, performed with Portuguese consumers, confirmed this evidence, with participants choosing healthier products when presented with one of the evaluated FOP-NL systems. In line with the literature review, no consistent difference was found between different FOP-NL.

Nevertheless, on subjective evaluation of FOP-NL systems, TL was the one that predominated on Portuguese consumers' preferences; for example, TL came out as being more trustworthy, providing more reliable information, and as the most preferred system for choosing healthier products.

The literature review, as well as several experts and stakeholders consulted during this HIA, stated that nutrition labelling can stimulate the reformulation of food supply (17). Previous studies reported that it acts as an incentive for food manufacturers to change their products, being the main mechanism through which labels have worked to affect the diets of wider populations (17). The endorsement of a FOP-NL system can have a beneficial impact on the reduction, by the industry, of the amount of some nutrients (i.e., sugar, saturated fat or salt), in order to produce and present healthier and better classified products.

The endorsement of a FOP-NL by a specific food industry signifies an investment at production, packaging, and other logistic levels, all of which carrying extra costs during the adaptation period. Moreover, industry may have other costs associated with the implementation of a FOP-NL, such as costs with new processes to be implemented on food production, new methods to analyse product composition and present reliable information, and even new branding of products. These issues should be considered and debated at the moment of defining and endorsing a specific (unique) FOP-NL policy solution for Portugal.

5 Conclusions and recommendations

- This HIA showed that the relevance and beneficence of government endorsement of a unique/single FOP-NL system is rather consensual among citizens, experts and stakeholders.

- Experts and stakeholders defended the importance of accompanying the FOP-NL implementation with an effective educational campaign (promoting adequate health literacy to use properly the FOP-NL) and a monitoring system (allowing the assessment of effectiveness of this health policy, also from a health/nutritional equity perspective).

- All the evaluated FOP-NL systems performed much better than the no-nutritional label conditions and this was observed with a random sample of the Portuguese population (significant higher number of correct choices when asked for selecting the healthiest food package from a set of three alternatives).

- Collected data showed more correct choices, though with no statistically significant differences, using TL system than with other FOP-NL systems (i.e., %GDA, HSR and NS).

- FOP-NL systems already in use by food retail Portuguese operators (TL and %GDA) had a good performance among Portuguese respondents who already interacted with these FOP-NL but, again, the results were very similar to those verified with HSR (less familiar to respondents due to its Australia's provenience) and still not significantly different from NS, a system less known by consumers in Portugal.

- From the interviews with stakeholders, it came out that an important issue to take into account regards the suppliers' logistics and management costs of implementation of the FOP-NL system to be endorsed by the government. Moreover, the trading relationships with other countries of the EU should be addressed when taking the decision about which FOP-NL system to endorse.

We recommend that:

- A FOP-NL system should be endorsed by the Portuguese Government as a relevant and evidence-based public health policy. The decision of which FOP-NL system to be endorsed by the Portuguese Government should also consider the data and conclusions resulting from this HIA (namely, about the pros and cons of each FOP-NL system).

- Moreover, the Portuguese Government should also consider the FOP-NL systems already adopted in Portugal and also by other countries with expression at food trade level with Portugal;

- In order to prevent health inequities, the decision about which FOP-NL system to endorse should consider potential differences of effect in promoting better understanding of food products' nutritional quality and/or better food choices among population subgroups, namely with specific nutritional needs.

- In line with European legislation, the adoption by the food industry may be voluntary. However, rules on the adoption should be defined in order to implement just one unique system and to avoid selective implementation (e.g., an operator interested in the implementation of the FOP-NL system in a food product must implement it in all own commercialized products);

- The concerns expressed with the algorithm of classification of some FOP-NL systems (e.g., NS) should be analysed and eventual recommendations to improve it should be considered. Moreover, more information about its validity for classifying a basket of food products commercialized in Portugal is needed to test its suitability to Portuguese food products;

- A strategy for the communication of the endorsed FOP-NL system addressing and promoting knowledge and skills for its correct use should be defined involving and engaging all interested or affected stakeholders. Consumers or communities in higher risk of inequalities should be identified and receive differentiated education according to their needs.

The evaluation of the policy implementation should also be strategically defined, stipulating the assessment of the extent of endorsed FOP-NL adoption and the effectiveness of its impact on purchasing decisions and overall diets in real-life research scenarios (e.g., interventions comparing nutritional quality of real purchased food products – for example, in hyper/supermarkets – with or without the FOP-NL presented in food packages). Conducting a retrospective HIA to evaluate the impact of this food policy strategy after five years of implementation should also be considered, focusing on food choices in point-of purchase contexts and, ultimately, in food habits (e.g., analysing the Portuguese food balance or household budget survey). The incidence and/or prevalence of diet-related NCD's, mortality by NCD's causes, and eventual inequalities observed among these data are also more distal expected outcomes of this policy and should be considered within a continuous and long-term monitoring assessment system of the impact of this health policy initiative.

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