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Article

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IMPACT OF DIFFERENT FOPL SYSTEMS (NUTRI-SCORE vs NUTRINFORM) ON CONSUMER BEHAVIOUR: CASE STUDY OF THE SLOVAK REPUBLIC

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Abstract
Undoubtedly, the proportion of the obese population has increased significantly in recent decades. Using FOPL (front-of-pack labelling) with clear nutritional information could also be helpful in eliminating this problem. The main aim of this contribution is to analyse the effects of using nutritional FOPL on consumers' choices. The analysis was based on the research, while 1000 respondents were asked to choose the desired product variant in three categories – cereals, yoghurts and protein bars without FOPL and with FOPL on their package. Two of the most discussed FOPL systems in the EU (Nutri-Score and Nutrinform) were analysed. Changes in consumer choice were analysed using non-parametric statistics, multiple correspondences, and correlation analysis. The results showed that both FOPLs affect the consumer in all products. The effects of FOPL resulted in choosing the best product (for cereals from 47% to 49%; for yoghurts from 28% to 31%; for bars from 28% to 42%) and improved consumers´ choice. There are differences in effects between Nutri-Score (NS) and Nutrinform (NI). NS seems to be a more effective system because it has a stronger positive impact on consumers´ choices. For cereals, the selection improved by 18% (NS) vs. 15% (NI), for yoghurts by 17% (NS) vs. 13% (NI), and for bars 28% (NS) vs. 20% (NI). The results among different product categories were not consistent. Consumers' attitudes toward a healthier diet can be improved using nutritional FOPL.

Keywords: Front-of-Pack labelling, food choice, healthy diet, health perception, nutrition, Nutri-Score, Nutrinform

JEL Classification: I12, M31, M38, Q13

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Introduction

While the whole world is currently facing the COVID-19 pandemic, less attention is paid to another global "pandemic" called obesity. COVID-19 and obesity are two pandemic diseases that the world is currently facing. Both activate the immune system and mediate inflammation (Brandão et al., 2020; Gammone and D'Orazio, 2021). Both crises are linked together (Brandão et al., 2020; Gammone and D'Orazio, 2021), as obese people are at greater risk of becoming hospitalised than healthy living humans. Obesity leads to poorer vaccination success, the emergence of more virulent virus strains, and obese people carrying more infectious viruses (Luzi and Radaelli, 2020). An unhealthy diet determines obesity that could be eliminated by support systems such as labelling systems on the front of food packages.

Manufacturers are increasingly adopting health symbols, which translate overall product healthiness into a single symbol (Maesen et al., 2022). Even if there is no single unique solution to encourage healthy food choices (Grandi et al., 2021), FOPL (Front-of-Pack Labelling) makes nutrition information accessible to all consumers, thus supporting healthy food choices (Alonso-Dos-Santos et al., 2019). Deren et al. (2021) recommend the FOPL system as a mandatory labelling requirement for packaged foods marketed in European countries as an element of a broader obesity prevention strategy. The establishment of means to support nutritional labelling is encouraged via a FOPL, which facilitates consumers' comprehension and improves their choices (Medina-Molina et al., 2021). FOPL is a source of important nutrition information that consumers can easily understand, but its ability to nudge consumers toward healthier choices is more limited (Ikonen et al., 2020). FOPL appears to be an effective tool that can quickly inform consumers about nutritional value (Hawley et al., 2013) because it provides nutrition information in more understandable formats (El-Abbadi et al., 2020). Using FOPL allows consumers to check the nutritional value of pre-packaged foods and is becoming a strategically important managerial and marketing topic. FOPLs are a widely deployed tool in marketing (Hamlin and McNeill, 2018), and it can influence parental decision-making (Bui et al., 2013), impact consumer purchase intentions (Newman et al., 2016) as well as consumption intentions (Payne et al., 2014), attract shoppers' attention (Dubois et al., 2021), be an effective alternative to marketing communication (Nikolova and Inman, 2015) build a non-price competitive advantage (Newman et al., 2016; Lim et al., 2020), compare and evaluate products (Newman et al., 2016), simplify information processing (Hauff, J., 2022; Maesen et al., 2022) and increase sales (Maesen et al., 2022), and enhance willingness to pay extra for a health food (Marozzo et al., 2020). FOPL might also force producers to improve the nutritional quality of products (Hersey et al., 2013).

Many international organizations (WHO, FAO, UN, and others) recommend the application of FOPL to food, even though there is no consensus on the method and design of FOPL. On the one hand, we can notice many existing FOPL systems (e.g., Nustri-Score, Nutrinform, Nutri RepereRepair, Nutri-Couleurs, Guideline Daily Amounts, Stop Sign labels, Multiple Traffic Lights, Health Star Ranking, Reference Intakes, Warning symbol). Still, on the other hand, the question remains of which FOPL system should dominate. Consensus across countries will be very difficult to achieve, as political, cultural, economic, and social factors (El-Abbadi et al., 2020) and strong lobbying influence nutrition labelling. Currently, professional and political discussions at all levels focus on which system will prevail in EU countries. Although many studies focused only on a single FOPL system, not many have compared FOPL systems (e.g., Engell et al., 2018; van der Bend and Lissner, 2019; Engell

et al., 2020; Andrews et al., 2021; Carruba et al., 2021; Dubois et al., 2021; Mazzu et al., 2021). A more detailed list of comparative studies can be found in Temple (2020). The current study makes two main contributions to the literature. First, this study advances knowledge on the effects of FOPL on consumer behaviour and shows the significant impact of FOPL on consumer decision-making and purchase behaviour.

Andrews et al. (2021), who revealed the dominance of the Stop Sign label over the Traffic Light label in key brand attitudes and purchase intentions, but not in the accuracy of nutrition use, suggest testing the effectiveness of other FOP systems such as Nustri-Score and Nutrinform. Dubois et al. (2021) discovered that FOPL Nutri-Score is more effective than its immediate follower Nutri-Couleurs in France, while Temple's (2020) findings put Nutri-Score in 3rd position after Warning labels and MTL. Werle et al. (2021) concentrated on the FOPL Nutri-Score 3C to 5C comparison. They revealed that the 5C nutrition label is superior to the 3C nutrition label because it provides more information that helps consumers discriminate the products' healthiness (Werle et al., 2022). We build on this study and compare the effectiveness of two simplified, evaluative FOPL systems: Nutri-Score and Nutrinform. These two FOPL systems are the subject not only of political but also of academic clashes. When Carruba et al. (2021) discovered the supremacy of Nutrinform FOPL over the Nutri-Score, Touvier et al. (2021) complained to the editor-in-chief and challenged Carruba's team results. While Engell et al. (2018) and Deren et al. (2021) strongly recommend Nutri-Score in the EU because it is consumer-friendly, interpretative, and easy to understand, Mazzu et al. (2021) found the prevalence of Nutrinform over Nutri-Score in consumer information understanding. They suggested making further comparisons of these two FOPL systems. Based on this, we can state that comparing two main FOPL systems according to consumer perceptions presents this study's second main theoretical contribution. This study presents the effective FOPL form for product promotion according to consumer preferences.

Solving this FOPL dilemma in Slovakia presents the main practical contribution of this study. According to Fábryová (2020), more than 63% of Slovaks over 15 years suffer from obesity in Slovakia. This puts Slovakia in the last place in the EU. Most European countries are around 50% of the adult population. For example, in Switzerland, the prevalence rates of overweight and obesity are 41.6% and 13.9%, respectively (Bochud et al., 2017).

For this reason, the National Action Plan for Obesity Prevention for 2015-2025 focuses on strengthening activities to combat obesity. It sets a goal to reduce the obesity rate of the population from the current 16.9% of obese people in the entire population of the Slovak Republic to 15.8% (NAP, 2014). Central European countries can also apply these results due to similarities in consumer behaviour. Moreover, we have found only one study (Mazzu et al., 2021) in which a sample other than from a west European country (Romania) was researched. The results shed light for policymakers, food enterprises, and marketing practitioners on the possible managerial applications of food labelling.

To sum up, the main purpose of this study is to provide evidence that FOPL influences consumer behaviour toward a nutritionally better food choice that, in turn, helps to reduce obesity and to decide which of the most discussed FOPL systems (Nutri-Score and Nutrinform) has a stronger impact on consumer choices. The constancy of the FOPL system preferences will be confirmed in three food categories (cereals, yoghurts, and protein bars). The paper is structured as follows—first, a literature review on the FOPL systems and their impact on consumer behaviour. Next, a conceptual framework with hypotheses is outlined in

the methodological section, including the sample, operationalisation of variables, and analytical methods. Subsequently, we present the research results and discuss our framework's theoretical and practical implications. Finally, we highlight the main conclusions and limitations and suggest possible avenues for future research.

1. Review of the scientific literature

The essence of FOPL is that consumers choose more nutritious foods with more positive properties (Becker et al., 2015; James et al., 2015). FOPL has a significantly stronger impact on consumers' perceptions than nutrition claims (Franco-Arellano et al., 2020). An educational communication campaign with a correct communication style may increase the effect on purchase behaviour (Bollinger et al., 2022). Consumers associate greater product quality with absence-focused FOP claims if an appeal is framed as prevention-focused rather than promotion-focused benefits (Ku and Chang, 2021).

1.1. Nutrition information and consumer behaviour

Understanding consumer behaviour is an important factor in market success. Consumer behaviour includes knowledge of how people make purchasing decisions, what they choose to buy, and why (Muniady et al., 2014). Marketing managers try to understand customer behaviour and then use the knowledge in formulating marketing strategies. Several factors influence the consumer in his purchasing decisions. The main factors can be divided into the following groups: cultural, social, personal, economic, and psychological (Gajjar, 2013). Price and quality are the factors that have the greatest impact on consumer behaviour (Dapkevičius et al., 2009; Cristo et al., 2017), and health symbols are more effective for products with lower priced products and private label products (Maesen et al., 2022). However, nutritional value plays an important role in food (Dewettinck et al., 2008). The results of the quality perception analysis demonstrate the importance of health and sensory considerations in selecting foods that have approximately the same weight (Grunert, 2006). Although the often illegible and invisible values of the food ingredients on the back of the package represented compliance with legislative standards on food labelling, they did not serve the purpose of changing the population toward healthier food. Especially when nutrition labels are not among the most watched elements on the packaging (van Herpen and van Trijp, 2011). Some studies have criticized the effectiveness of nutrition labels on the back. They concluded that it is an inadequate tool, and consumers do not pay attention and do not examine components of the title (Dumoitier et al., 2019).

Providing nutrition information is a good way to change the mind of customers to choose a healthier product. Mandatory nutrition labels on all packaged foods can be used to compare fares. However, such food labelling can be considered inadequate, as consumers do not notice or even ignore it. Studies suggest that labels on the back can be confusing and difficult to interpret and, therefore, their use in fast shopping is very low (Cowburn and Stockley, 2005; Jones and Richardson, 2007). Shoppers typically spend only a few seconds researching labels (Sanjari et al., 2017), so FOPLs airfoils must be simple and clear at a glance (Temple, 2020). Considering these limitations of current nutrition labelling, FOPL has been recommended as a useful tool to meet the goals of reducing obesity and chronic diseases. FOPL systems seem to be a promising intervention to improve the quality of dietary intake (Emrich et al., 2012).

Evidence shows that FOPL can change consumer behaviour towards healthier and more nutritionally balanced choices. Any presentation of information in the form of FOPL appears to be beneficial for consumer education and helps to change consumer behaviour positively (Hodgkins et al., 2015). Studies examining the impact of FOPL on product choice have found that using a variety of coloured nutritional scales allows consumers to identify the nutrient content of foods better. Colour traffic lights and aggregate FOPL improve nutritional literacy more significantly than other variations of the label (Maubach et al., 2014;), help in comparing similar products and identifying substances that need to be restricted in the diet, such as fats, sugars, and sodium (Roberto et al., 2012; Freire et al., 2017). A favourable perception of warning labels on the front was identified in Chile, where research results have led to a better understanding of nutritional values by mothers with young children. This has led to healthier purchasing decisions for their families (Correa et al., 2019).

In contrast, FOPL focused on the daily amounts of the respective components had the least impact compared to other FOPL systems (Julia et al., 2015; De la Cruz-Gongora et al., 2017; Talati et al., 2017). Bix et al. (2015) showed that FOPL is a very effective tool that is sensitive to nutritional information. Therefore, it is suggested that the most important must appear on the front of the package. Evidence indicates that well-designed FOPL systems can influence consumers to purchase products and product transformation by manufacturers (Emrich et al., 2012).

Several studies have been published abroad that examined individual FOPL systems to change consumer behaviour. These studies focus mainly on the influence of FOPL on the ability of adults to identify which foods are the healthiest or which foods they choose. The method of food selection was mostly simulated by computer images. However, the results of individual studies are relatively inconsistent (Temple, 2020), so there is a need for ongoing research in this area. However, consistency can be seen in the fact that almost all studies point to a significant effect of FOPL on food choice (Maubach et al., 2014; Watson et al., 2014; Ducrot et al., 2015; Talati et al., 2017; Egnell et al., 2018; Findling et al. 2018). This fact we want to verify also in our research; therefore, the following hypothesis was formulated:

Hypothesis no. 1: Using FOPL with nutritional information will result in a higher choice of the best product (in terms of nutritional quality).

1.2. FOPL systems

Historically, FOPL was first introduced by food companies that wanted to highlight selected positive aspects of their products compared to the competitors (Lupton et al., 2010). Currently, FOPL is a complementary nutrition labelling system that generally expresses nutritional information through a graphic label. Its main advantage is its greater ability to attract attention, especially when coloured (Becker et al., 2015). It provides key nutritional information that usually relates to foods' fat, sugar, salt or calorie content (Carruba et al., 2021). Several FOPL systems have emerged in practice to increase nutrition awareness and the effectiveness of nutrition labelling (Crockett et al., 2018). The individual proposals focus on nutrients and display information on individual particular substances (e.g., fats, sugars, sodium). It is the first alternative to the FOPL design based on nutrient-specific. As an example, we can name GDA (Guideline Daily Amounts) used in Mexico (Temple, 2020); in Britain, a traffic light system based on a nutrient-profiling approach (created by Oxford

University) is implemented, and the Reference Intake label, Daily Intake Guide, and Nutrinform are made in Italy. The second option is the warning labels, which only appear if the product has a disproportionately high content of an undesirable substance. Usually, a simple text statement is used (e.g., high in sugar, high in sodium, high in fats) like in Chile, Brazil, Uruguay, and Canada. This symbol shows a negative component that could be excessively detrimental to the human body (Bucher et al., 2015).

The third alternative is a summary label, which simply expresses a food's health value in one value or expression. Complex FOPL systems are based on sophisticated algorithms for nutritional profiling systems that include both positive and negative components (Hawley et al., 2013). These systems integrate the values of several components into a single score; thus, individual foods can be categorised according to their nutritional composition and compared in terms of nutrition (Lobstein and Davies, 2009). Australia used Tick for heart-healthy approved foods and Health Star Rating; in The Netherlands, the Choices programme is used, France prefers the Nutri-Score system, the US prefers Guiding Stars, and in Sweden, Keyhole was created (Dumoitier et al., 2019). As several FOPL systems exist, specific efforts are being made to standardise them (Goiana-da-Silva et al., 2019). The question remains as to how such a system should look and what the requirements are for it. Although even the best FOPLs that affect consumers appear to be poorly understood, many studies suggest that FOPLs must be constructed on an easy-to-process information basis (Newman et al., 2016; Sanjari et al., 2017). The US Institute of Medicine gave some recommendations for the FOPL system. It would be 1) simple to be well understood without nutrition knowledge; 2) interpretive with guidance rather than information; 3) ordinal with any scale or ranking implemented in the system (Emrich et al., 2012). The proposed system, according to these requirements, does not require special nutrition awareness. According to a US study, coloured labels are more effective at attracting consumer attention (Becker et al., 2015) regardless of the healthiness of the food. An interesting finding is that FOPL-coloured systems influence consumers to choose the healthiest products and reduce the preference for food that is presented as less healthy (Findling et al., 2018) but do not work for items that consumers personally prefer (Aschemann-Witzel et al., 2013). Colour-based labels are the most effective for consumers to rank food according to healthiness, which was also confirmed in French consumers (Julia et al., 2015).

1.3. Effectiveness of different FOPL systems on consumer choice

All systems have their own specific design and use. Therefore, it is understandable that they affect consumer behaviour in different ways. However, does FOPL work on all products? Research on the effectiveness of FOPL has been carried out on various products. A significant Swiss study (Egnell et al., 2020) examined the impact of FOPL on three product categories – pizzas, cakes, and breakfast cereals. Improvement was recorded in the nutritional quality of food choices in all types of products. In another study (Arrua et al., 2017), hamburgers, chicken nuggets, and instant soups were examined. The results indicated the effect of FOPL in helping consumers identify unhealthy products. Ducrot et al. (2015) examined the effectiveness of FOPL on fish dishes, pizzas, dairy products, breakfast cereals, and appetisers. All searched FOPLs were effective in ranking products according to their nutritional quality. But how coherent are these results between products? We found no answer to this question in almost any study. Therefore, another hypothesis was formulated:

Hypothesis no. 2: The effects of FOPL resulting in the choice of the best product (in terms of nutritional quality) are consistent across all categories of searched products.

Research on the effectiveness of FOPL systems worldwide focuses on three research issues. First, they focus on the ability of consumers to identify a healthier product using different FOPL systems (Egnell et al., 2018; Talati et al., 2017; Maubach et al., 2014; Ducrot et al., 2015). Second, they focus on determining the impact of consumers' intentions to buy a healthier product (Roberto et al., 2012; Findling et al., 2018; Goodman et al., 2018; Julia et al., 2015). Third, they focus on whether FOPLs help consumers to reduce junk food consumption (Ang et al., 2019). Regarding these research issues, we formulated the following hypothesis:

Hypothesis no. 3: Using FOPL with nutritional information will improve consumers' choice in terms of nutritional quality.

When we compare the effectiveness of different types of FOPL in identifying healthier products, it is clear that systems based on GDA (Guideline Daily Amounts) worked weaker than other systems. On the contrary, systems based on a colour scheme, such as MTL (Temple, 2020), work very well. Both MTL schemes and HSRs have performed very well in identifying healthier foods (Talati et al., 2017). Similarly, the warning symbol (Arrua et al., 2017). Nutri-Score (Durcot et al., 2015) and NuVal (Findling et al., 2018) can also be included in the category of most effective systems.

Aggregate labels are more effective in influencing consumers when buying healthier products compared to systems that emphasize recommended daily allowances (Hersey et al., 2013). According to research (Ducrot et al., 2015), consumers consider the GDA system the label with the most informative value and the most reliable information. Almost half of the consumers said so. This is significantly more than with other systems (MTL, Nutri-Score). On the other hand, the GDA system has been identified as the least easily identifiable. The Nutri-Score was identified as the system that was most easily recognised. This system has also been recognised as the easiest and fastest to understand. The rationale for these results can be seen in that, while they provide the same information, both MTL and Nutri-Score have a colour expression (Acton et al., 2018). The presence of colour can be considered one of the most important factors in their high efficiency (Lohse, 1997; Temple, 2020). The advantage of comprehensive labels is that consumers need less time to evaluate and understand them. Therefore, they appear to be a more appropriate choice in a shopping environment where quick decisions are usually made (Fuenekes et al., 2008).

As our paper compares the effectiveness of the two most discussed systems in the EU (Nutri-Score and Nutrinform), we will specifically approach their comparison in similar studies worldwide. Their main goal is common: consumers to understand the nutritional quality of food simply and understandably. But the philosophy is different. Nutri-Score is considered a complex system with a graded colour code. It provides information on the relative general composition of a food product (Hercberg et al., 2021). SINU Scientific Board (2021) considers its strengths to be, in particular, recognisability and clear design from a graphic point of view using standard colours; does not repeat the information provided on the back of the mandatory labelling of products; is supported by the number of studies where its effectiveness has been demonstrated; it works effectively, especially with poor eating habits (Dubois et al., 2021). Nutrinform is a scheme that provides non-directive labelling specific to individual nutrients. It is based on the reference leads label with the battery symbol. Battery

amount of energy and nutrients. The battery base is one serving of the product and is reported as a percentage of daily intake (Lorenzoni et al., 2021). Its strength is, in particular, the concept of conversion per portion and high information value (SINU Scientific Board, 2021). The research results suggest that these FOPL systems are predominantly perceived positively (Acton et al., 2018). Comparative studies have already been conducted in many countries, showing a higher ability of the Nutri-Score to positively influence consumer behaviour (Julia and Hercberg, 2017; Egnelli et al., 2018). As the Nutri-Score has been around for a long time, it is understandable that more studies show that it is more effective than the Nutrinform. Due to the inconsistency of the results of research in the world concerning the impact of individual FOPL systems on consumers, the following hypothesis was proposed and researched:

Hypothesis no. 4: The two analysed types of FOPL (NutriScore vs Nutrinform) have a different effect on consumer change.

However, in Slovakia and central Europe, such a study has so far been absent. Therefore, this paper aims to evaluate and compare the impact of two FOPL systems (Nutri-Score and Nutrinform) on consumer choice.

2. Research methodology

The paper's main objective is to study consumers' reactions to provide clear information as a part of FOPL. The survey was conducted during the summer of 2021 and studied the consumer behaviour of 1000 respondents divided into two samples, as the study was devoted to two different nutritional FOPL designs. Part of the methodology can be understood as replicating research realised with partially similar objectives in other European countries (Egnell et al., 2020). The basis for the analysis is created by survey research. The survey examined consumer behaviour in the Slovak food market toward the perception and effects of FOPL aimed at the nutritional composition of food products. A sample consisting of 1000 respondents participated in the survey, while they were divided into two random groups. The design of sub-samples is presented in Table no. 1.

Table no. 1. The profile of the respondents

	Sample - NI	Sample - NS
Gender		
man	31.75%	32.28%
woman	68.25%	67.72%
Age		
18-29	8.81%	8.69%
30-39	14.67%	14.49%
40-49	18.20%	18.16%
50-59	19.12%	19.56%
60+	39.21%	39.11%
Size of municipality		
<5000	22.76%	22.76%
<20000	16.35%	16.55%
<100000	37.24%	36.65%
>100000	23.65%	24.04%

	Sample - NI	Sample - NS
Region		
SK-BL	2.51%	2.46%
SK-TA	4.42%	4.41%
SK-TC	7.14%	6.99%
SK-NI	10.88%	11.19%
SK-BC	13.18%	12.93%
SK-ZI	16.33%	16.28%
SK-PV	21.73%	21.66%
SK-KI	23.81%	24.08%
Education		
ISCED 2	2.81%	2.50%
ISCED 3C	29.61%	30.15%
ISCED 3A/B	41.46%	41.59%
ISCED 5	26.12%	25.76%

The division of respondents was based on evaluating two different approaches to FOPL aimed at the nutritional composition of food products – the first with detailed information about the contents of essential nutrients. On the other hand, the goal of the second one is to show nutritional quality in the simplest possible way. Two mentioned and analysed systems are presented in Figure no. 1.

Figure no. 1. Analysed FOPL designs
Source: Egnell et al. (2018)

The main part of the questionnaire survey consisted of a form component, where respondents were asked to choose one of three versions in three product categories (cereals, yoghurt, and protein bar). It is important to note that these were hypothetical products to eliminate the potential association with the brand's particular effect on the consumer, the respondent. The choice of the first respondents was based on the respondents' preference without providing nutritional information on the packages. Subsequently, the respondents received information on the nutritional composition through one of the two examined labels, which have been placed on the product's packaging. The operationalisation of variables is shown in Table no. 2.

Table no. 2. Operationalization of variables

Variable	Survey question	Measurement
FOPL type	Hidden division	Dichotomous (NS | NI)
Cereal without FOPL	Assuming that you are interested in buying this type of food product, what type would you choose?	3 categories (A | B | C)
Cereal with FOPL		
Yoghurt without FOPL		
Yoghurt with FOPL		
Protein bar without FOPL		
Protein bar with FOPL		

Two approaches evaluated these data. Firstly, we have analysed if FOPL will choose the best product from the nutritional point of view. Using the second approach inspired by Engel et al. (2020), we also consider choosing a better (or worse) alternative to the product selected without influence of FOPL, while the influence score was calculated as follows, while three is for the best outcome from the nutritional side.

The obtained data were analysed using the following statistical tests (XLSTAT, 2021):

- McNemar test to analyse changes in binary paired samples. The McNemar test, also known as a test of difference between two correlated for proportions, is a special case of the Cochran's Q test (in the case where there are 2 treatments). It is used on randomized complete blocks of binary data.

- Pearson Chi-squared test to identify relations between categorical variables. The Pearson chi-square statistic can be used to test the independence of the table's rows and columns by calculating how far the observed table is from the predicted table computed using the identical marginal sums.

- Wilcoxon signed-rank test to analyse if the score is significantly different from 0. The Wilcoxon test is a nonparametric test that allows two matched samples to be compared. Wilcoxon devised a test that takes the extent of the difference between pairs into consideration. Because the sign of the differences is also involved, this test is known as the Wilcoxon signed rank test.

- Mann Whitney U-test to analyse differences between two types of FOPL. The Mann-Whitney test is a nonparametric test that allows two independent samples to be compared. This test can only be used to investigate the samples' relative locations.

- Spearman correlation coefficients to analyse relationships between ordinal variables.

- Multiple correspondence analysis to analyse the relations between changes through product categories and types of FOPL. Multiple correspondence analysis is a technique for investigating the relationship between two or more qualitative variables. Multiple Correspondence Analysis is equivalent to Principal Component Analysis in terms of qualitative variables. One can obtain maps that allow one to visually observe the distances between the qualitative variable categories and between the observations.

The main objective of providing nutritional information as an FOPL should be to convince the consumer to choose the best available food product. According to our research model (Figure no. 2), we have formulated hypotheses (presented in the 'literature review' section).

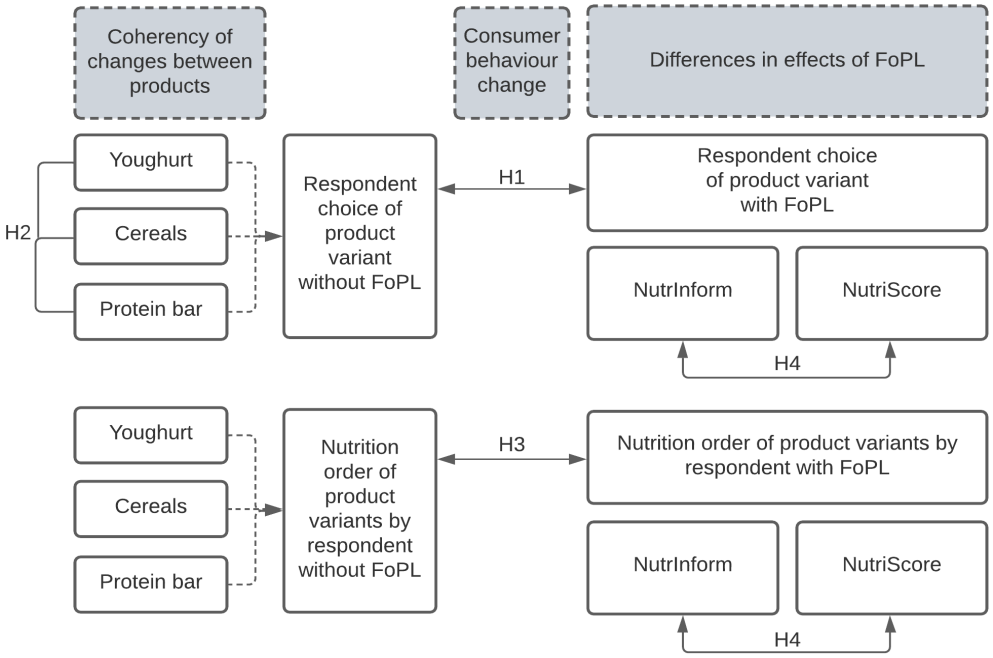

Figure no. 2. Influence of nutritional FOPL on consumer behaviour

The statistical level of significance is interpreted using traditional labelling using asterisks, which are given in parentheses in the test characteristic, whereby:

* significant at $\alpha = 0.05$

** significant at $\alpha = 0.01$

*** significant at $\alpha < 0.01$

3. Results and discussion

In the research, we were interested in whether using FOPL with nutritional information will result in a higher choice of the best product (in terms of nutritional quality) in three selected categories. As can be seen in Figure no. 3, FOPL was helpful mainly in the case of protein bar (from 28% without FOPL vs 42% with FOPL), where we found a significant improvement in selection in the case of both labels (McNemar test, $p<0.001$), which confirms our hypothesis that using FoPL with nutritional information will result in a higher choice of the best product *(Hypothesis no. 1)*. Slight differences were also found in the case of yoghurts (from 28% to 31%) and cereals (from 47% to 49%). A slightly more significant improvement appears when using Nutri-Score.

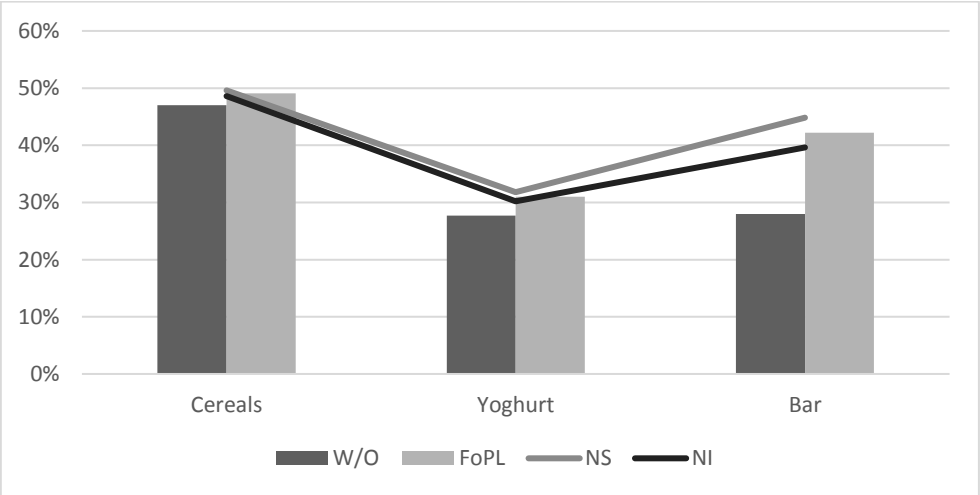

Figure no. 3. Improvement in the selection of products using FOPL

The data above show a comprehensive view of the change in selection concerning FOPL. However, it is important to note that in the change of choice for individual consumers, we can observe its deterioration in addition to the status quo or improvement in choice. As shown in Table no. 3, there are differences between the types of labels in the way of selection changes (Chi-squared test). The Nutrinform label tends to have slightly more consumers without change in selection, while Nutri-Score can be considered a 'changer'. For cereals, the selection improved by 18% (NS) vs. 15% (NI), for yoghurts by 17% (NS) vs. 13% (NI), and for bars 28% (NS) vs. 20% (NI). We can assume that better and, particularly, more intensive communication about the meaning of nutritional FOPL towards consumers will be required.

Table no. 3. Improvement influenced by FOPL type and product

Product	Label	Better	Significance
Cereal	NI	43%	*
	NS	57%	
Yoghurt	NI	40%	***
	NS	60%	
Bar	NI	37%	***
	NS	63%	

When we take a closer look at the relations between changes in product choice influenced by FOPL, we can see that the effects tend to be interconnected among all three product categories, as can be seen from the output of the multiple correspondence analysis shown in Figure no. 4. Following the results above, we can conclude that respondents who were not influenced by one product tend to be the same for another product. There are interconnections between the other two effects, but it looks weaker; therefore we can consider effects of FOPL coherent through all three product categories *(Hypothesis no. 2)*. Furthermore, we can assume that FOPL tends to have a mainly neutral impact in changing consumer behaviour towards choosing the best product variant from a nutritional point of view.

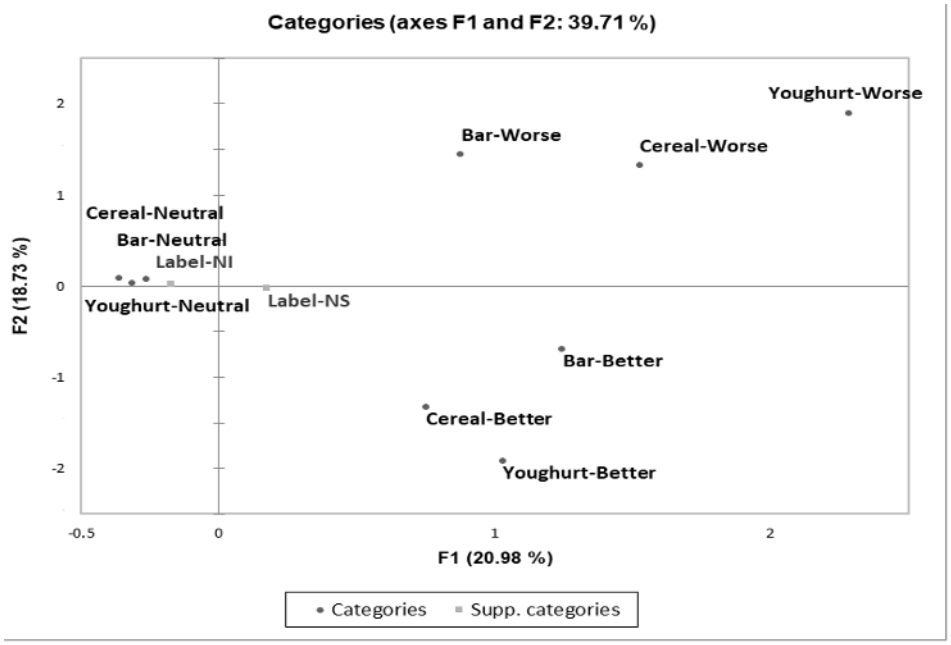

Figure no. 4. Connections in the context of FOPL influence

The analysis described above provides a view that does not consider the fact that the positive effect of the label can be viewed as a change in consumer choice towards the most nutritious product and its shift from the worst to a slightly better option. Therefore, we analysed changes in consumer choice using methodology introduced by Egnell et al. (2020), where variants of products were classified on a 3-point scale, where number 1 represents the worst variant from

the nutritional point of view and three the best one, while the product category score was calculated as a difference between choice with FOPL and without FOPL. As can be seen in Figure no. The 5 average score calculated according to the methodology stated above is positive for both FOPLs in all three products. On the contrary, in the case of cereals (V=7904*** for NS, V=4924* for NI) and a protein bar (V=13606*** for NS, V=7263*** for NI), the average scores are significantly higher than zero at the 5% significance level for both FOPL and in the case of yoghurt for NI (V= 7263***), therefore FOPL with nutritional information will improve consumers' choice in terms of nutritional quality *(Hypothesis no. 3)*, but not consistently.

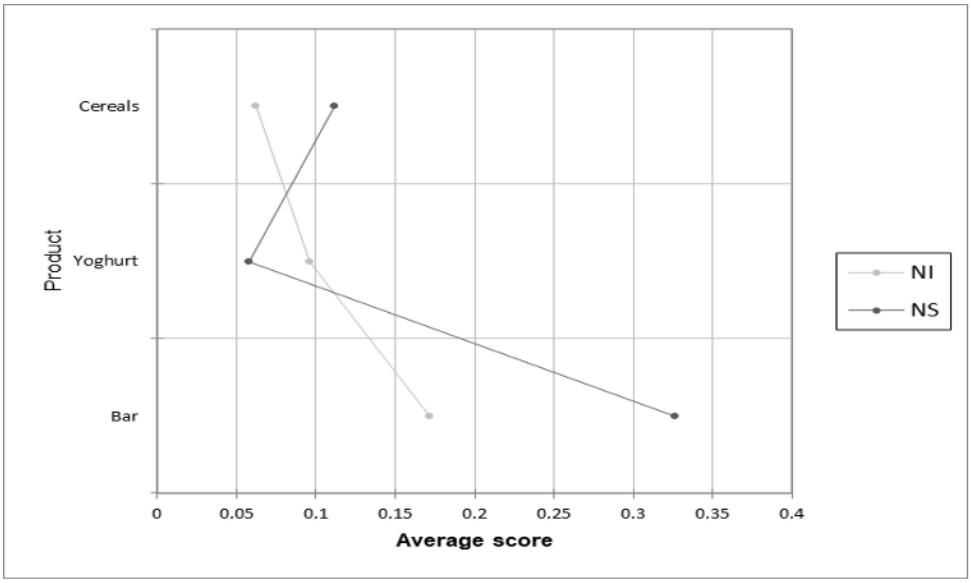

Figure no. 5. Average FOPL influence score

As is obvious from the graphical illustration of the average values, we have found a difference in the effects of different types of FOPL in the case of the protein bar ***(Hypothesis no. 4)***, while Nutri-Score in the case of this product had a significantly stronger positive impact on consumer's choice (U= 114616**). Mora-Garcia et al. (2019) found that providing FOPL (Nutri-Score) increased spending on healthier items by 21%, with no change for less healthy items. However, Folkvord et al. (2021) have found that integrating the Nutri-Score label on food packages did not modify consumers' cognitive responses. According to Hagmann and Siegrist (2020), FOPL leads to greater accuracy in healthiness evaluations. In their study, the Nutri-Score label has the greatest effect on perceived healthiness and is less effective when only displayed on some of the products. Egnel et al. (2020) have examined multiple FOPL types while stated that Nutri-Score has slightly higher effects than the Reference Intakes, followed by the Warning symbols, the Multiple Traffic Lights, and the Health Star Rating system. Furthermore, De Temmerman et al. (2021) suggest using Nutri-Score as the standard front-of-pack label to help combat the increasing obesity pandemic.

Conclusions

This article outlined the results of a study that compared two dominant FOPLs, respectively, Nutri-Score and Nutrinform. The paper has studied the effects of using nutritional FOPL on consumer choice. This research is unique and represents the initial study of the impact of FOPL on conditions in Slovakia and Central Europe. So far, no similar representative research has been conducted on a sample of Slovak respondents. Our research is based on previous studies abroad (Ducrot et al., 2015; Egnell et al., 2018), using a similar data collection methodology. In it, consumers had the opportunity to express their preferences first on products without the FOPL designation and then on products with the FOPL designation. Both systems (Nutri-Score and Nutrinform) examined worked to change consumer behaviour, consistent with many studies conducted in this area around the world (Maubach et al., 2014; Watson et al., 2014; Ducrot et al., 2015; Talati et al., 2017; Egnell et al., 2018; Findling et al. 2018;). The Nutri-Score system clearly dominated in two products (cereals, bars), and the Nutrinform system worked slightly better in one (yoghurt). However, this difference was not significant. We assume that no effect in the case of yoghurts can be caused by the traditional position of natural dairy products on tables of Slovak consumers. Therefore, the transition from high-fat to low-fat yogurt is influenced by regional specificities and it is very difficult to change the customer's decision. In general, the respondents improved their choice towards healthier products. In the category of cereals, their intention was enhanced by 18% (NS) vs 15% (NI), in variety of yoghurts by 17% (NS) vs 13% (NI), and in the category of bars by 28% (NS) vs 20% (NI). This suggests that the Nutri-Score performed better results than the Nutrinform system. This is consistent with the research (Egnel et al., 2018; Dubois et al., 2021), where a significant difference between individual FOPL effects on consumer behaviour in favour of Nutri-Score has been demonstrated.

The findings of this study have implications for marketing theory and practice, as well as for managers and public health policymakers and policymakers. From the perspective of marketing theory and practice, our findings show that FOPL can change consumer behaviour largely for some products and to a lesser extent for others. This finding helps grocery retailers and food manufacturers to prioritise specific product categories. Specifically, this research suggests that managers should start with products where there are too many unhealthy ingredients (for example, sugar, salt, fats, sodium, etc.), such as cereals, sweets, sweetened bars and drinks, dairy products, ready-to-eat meals (soups, sauces, pizza, burgers). As shown in all interaction schemes in the figures, FOPL has a positive effect on consumer behaviour toward more nutritious food, which means that FOPL helps consumers to faster understand and compare information to make a purchase decision. From this point of view, FOPL is a design element that should be wisely reflected in packaging design. This study has confirmed the labelling theory, where FOPL is a more dominant tool in consumer healthy food choices than labelling nutrition on the back of the package (Dumoitier et al., 2019). Marketing communication using the presentation of nutritional values on the backside of products appears to be insufficient. Health symbols are more effective for products with a front-of-pack taste claim (Maesen et al., 2022). Our findings suggest to marketing practitioners the use of FOPL, preferably for healthier food, as nutritional information on the bottom can be confusing and difficult to interpret (Jones and Richardson, 2007).

The results of our study may be beneficial to policymakers who constantly emphasise the importance of a healthy diet and support the elimination of the rise in obesity. FOPL plays an important role in this, as other studies also confirmed that it has a positive effect on the

choice of healthier, more nutritious food (Watson et al., 2014; Hodgkins et al., 2015; Talati et al., 2017; Egnell et al., 2018). In this context, FOPL appears to be an effective tool in the fight against the obesity pandemic. On the other hand, we see space for greater consumer communication and education on nutritional food possessions and their labelling, both as part of public health policies and as social aspects of sustainable consumption. The last implication of policymakers serves as a decision-making tool for national regulatory authorities that can use this study to decide which labelling system will dominate in their countries as a mandatory nutrient declaration.

Despite the good results, this is not immune to limitations, which can stimulate further investigation on the FOPL. First, although this study featured different food categories (cereals, bars, yoghurts), future research may empirically test the other product categories. Second, future research is needed to generalise the results presented using field experiments in supermarkets and real- world data because customers have significantly less time to make purchase decisions under real conditions. Therefore, the impact of FOPL can be even more significant. This research can also be enriched by a qualitative study in real situations using collection using new technologies. These can be a shopping cart with use wherever it is natural to move a shopping cart or a special research vest, which is used to test showrooms, restaurants, or banking premises. It is also possible to use another technology. This digital panel uses biometrics to adapt the content presented and obtain real feedback from people based on facial biometrics and their emotions.

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