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The Effect of Nutrition Label Type and Consumer Characteristics on the Identification of Healthy Foods in Finland

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ABSTRACT

Front-of-package (FOP) nutrition labels are gaining importance as healthy eating nudge. As a European Union-wide FOP system is under discussion, it is important to examine the understanding of FOPs in various European countries. This study investigates consumer understanding of four FOPs (Heart Symbol, Keyhole, Nutri-Score, Guideline Daily Amounts) and associated consumer characteristics (age, gender, household income, health interest, unhealthy = tasty belief, environmental concern in food choice) in Finland. In an online experiment, 2428 participants ranked products (yoghurt or granola) according to healthiness first without, then with a randomized FOP. Heart Symbol appeared as the most efficient FOP in nutritional assessment of yoghurts. In granolas, Heart Symbol and Nutri-Score performed equally. FOPs were less helpful for older consumers in both product categories and for men in yoghurts. There is a connection between FOP understanding and consumer attitudes. The results contribute to public policy and food industry in FOP implementation.

Introduction

Following a healthy diet is a principle measure against non-communicable diseases, such as cardiovascular diseases and diabetes (WHO, 2020). In Finland, the population's diet is at a suboptimal level, as many are unable to meet the national recommendations in their dietary choices (Valsta, Kaartinen, Tapanainen, Männistö, & Sääksjärvi, 2018). Requiring front-of-package (FOP) nutrition labels indicating the nutritional quality of food products would encourage Finnish consumers to improve their dietary

choices. FOPs are used to make healthier food choices easier for consumers (Ikonen, Sotgiu, Aydinli, & Verlegh, 2020), as they provide information in a concise form and visible placement on a product's front makes them noticeable, as opposed to nutrition facts panel on product's back (Ma & Zhuang, 2021). FOPs can be considered as a nudging method turning the food environment and choice architecture more favorable to healthy diets (Cadario & Chandon, 2020). To support healthier dietary choices, it is important to study whether different labels are helpful for consumers in Finland in identifying healthier options. In addition, examining consumer characteristics (such as age, gender, household income, health interest, unhealthy = tasty belief, environmental concern) in relation to FOP understanding deepens both conceptual and practical knowledge regarding FOPs and who are most susceptible to front-of-package nutrition information.

As the discussion on the European Union (EU) level harmonization of FOP nutrition label system is ongoing (EC, 2020), it is important to gain a comprehensive view of consumer responses to FOP labels from all corners of Europe. Given the different national nutritional guidelines and labels used in local food markets until now, it is crucial to understand how consumers perceive different labels in various EU countries. This has been addressed by several recent studies, in which different FOPs have been compared in terms of consumer understanding to establish the best option for wide-spread use (Andreeva et al., 2020; Egnell, Talati, Gombaud, et al., 2019; Egnell, Talati, Pettigrew, et al., 2019; Egnell et al., 2020; Fialon et al., 2020; Packer et al., 2021). This body of research underscores the efficiency of Nutri-Score FOP system in helping consumers rank products according to their nutritional quality, including a cross-country comparative study (Egnell, Talati, Hercberg, Pettigrew, & Julia, 2018). In the study, Nutri-Score performed best in all countries and for all food categories tested (pizza, cake, breakfast cereals) in comparison to Health Star Rating system, Multiple Traffic Lights, Reference Intakes, and Warning symbols. However, the performance of Nutri-Score has not yet been studied in the context of Finland, nor has the national Finnish Heart Symbol been studied against other FOP nutrition labels.

Moreover, the role of consumer characteristics in explaining perceptions of FOP labels has been examined less in earlier research, except for Egnell, Ducrot, et al. (2018). For instance, multivariable models have been adjusted by sociodemographic factors, but those factors have either not been the focus of the study, no significant interactions have been found or attitudinal factors relating to FOP understanding have not been investigated (cf. Andreeva et al., 2020; Egnell, Talati, et al., 2018; Egnell, Talati, Gombaud, et al., 2019; Egnell, Talati, Pettigrew, et al., 2019; Egnell et al., 2020; Fialon et al., 2020; Packer et al., 2021).
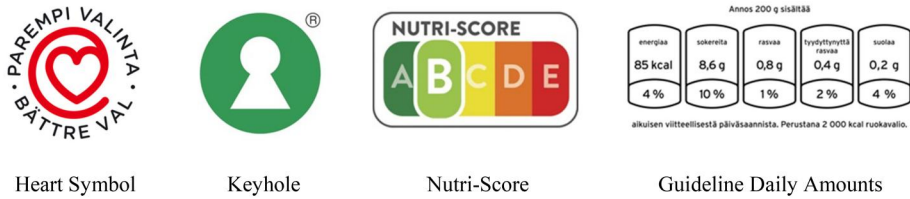
Figure 1. FOP nutrition labels used in the study.

This study provides a conceptual framework for objective understanding of FOPs and examines both the relative performance of different labels and the significance of consumer characteristics to FOP understanding. The empirical examination is made among Finnish consumers with four FOPs used or potentially used in the Finnish market (Heart Symbol, Keyhole, Nutri-Score, and Guideline Daily Amounts [GDA]; see Figure 1). This is done with an experimental online survey investigating the relative ability of consumers to rank a set of products according to their nutritional quality and to identify the healthiest option out of a set of products with different FOPs. Also, the awareness of the labels is considered. Consumer characteristics in relation to FOP understanding examined in this study are age, gender, income level, health interest, unhealthy = tasty belief, and environmental concern in food choice, as the knowledge of their impact on FOP understanding remains limited to date. Examining these factors helps segment consumers with different characteristics and interests in food, and provides information on how to target these groups with the most efficient FOP. The findings will offer theoretical and practical implications regarding FOP understanding and implementation.

In this paper, we first introduce FOP nutrition labels and propose a conceptual framework for FOP understanding. Then, in materials and methods, we present the experimental online survey. In results, awareness of the labels and both direct and interaction effects of FOPs and consumer characteristics on objective understanding are examined. Finally, theoretical and practical implications are discussed.

FOP nutrition labels

FOP nutrition labels are used to guide consumers toward healthier food choices. In recent years, a lot of research has been carried out regarding FOPs. They have focused on comparisons between different label designs (Ikonen et al., 2020), eye tracking (Ma & Zhuang, 2021), effects on product perceptions, purchase intentions and actual food purchases, dietary intakes, and industry responses (An et al., 2021; Anastasiou, Miller, & Dickinson, 2019; Shangguan et al., 2019). Signs of mild positive impact on nutritional outcomes and interest of the food industry to reformulate products to

support consumer health have been found as a consequence of using FOP labels (Anastasiou et al., 2019; Shangguan et al., 2019). Hence, there is potential to provide healthier food to consumers and improve their well-being with a successful implementation of FOPs.

For consumers to use FOPs in their dietary choices, they need to be able to understand FOPs and identify healthier options. Recent studies have discussed what kind of label is the most efficient from the consumer perspective. Ikonen et al. (2020) provide a typology of FOP nutrition labels classifying them broadly into reductive and interpretive labels. According to the authors, *reductive labels* present objective nutrition information about a product without interpretation, whether the product is healthy or not (e.g. GDA), whereas *interpretive labels* offer more evaluation of a product's nutritional content. Interpretive labels can further be divided into *nutrient-specific labels* presenting information about specific nutrients and whether the product scores high or low on these aspects (e.g. traffic-light labels, warning labels, and nutrient content claims) and *summary indicator labels* providing an overall evaluation of a product's healthfulness (e.g. health logos and rating labels). It has been stated, the more interpretive and simplified the label is, the easier it is for consumers to understand (Ikonen et al., 2020; Talati et al., 2016). Time used to interpret nutrition labels in shopping environments is limited, so the labels need to be eye-catching and easy to understand for consumers (Ma & Zhuang, 2021).

In this study, FOPs compared in terms of objective understanding are Heart Symbol, Keyhole, Nutri-Score, and GDA (see Figure 1), FOPs currently in use on food products in Finland or with potential to be in more wide-spread use in the future. Both Heart Symbol and Keyhole represent interpretive summary indicator labels, signaling healthier options rather than providing guidance as what foods to avoid. Nutri-Score is also a summary indicator label but with a grading element (Julia & Hercberg, 2017). GDA, on the other hand, can be considered as a reductive label, merely indicating key nutrient contents without healthiness evaluation (Ikonen et al., 2020).

In Finland, the national voluntary FOP nutrition label Heart Symbol, has been in use since 2000. The symbol is used to mark products that are better choices in their product category regarding fat quantity and quality, sodium, sugar, and/or fiber content. The criteria for the symbol are based on the Finnish nutrition recommendations and they are updated regularly. (Lahti-Koski, Helakorpi, Olli, Vartiainen, & Puska, 2012.) In 2022, there were ∼2000 products on the Finnish market with Heart Symbol, and the label is also used in food service (Sydänmerkki, 2023).

The Keyhole is a symbol used in other Scandinavian countries as well as on some products in Finland, although it has not been marketed in Finland. The label was introduced in Sweden in 1989, in Denmark and

Norway in 2009, and in Iceland in 2013 to help consumers make healthier food choices with less fat, sugar, and salt, and with increased amount of dietary fiber and wholegrain. Guidelines for this voluntary FOP label are based on Nordic Nutrition Recommendations and the criteria vary for each food category. (Livsmedelsverket, 2021.)

Nutri-Score is a label originally launched in France in 2017 (Julia & Hercberg, 2017), now used in a few European countries, including Germany, the Netherlands, and Spain (EC, 2020). The symbol rates all products, not just better choices, according to their nutrient content on a five-point alphabetical and color-graded scale (Julia & Hercberg, 2017). In Finland, Nutri-Score has until now been seen on just a few imported products. Guideline Daily Amounts (GDA), in turn, has been in widespread use during the 2010s, including Finland. This labeling format displays information on fat, saturated fat, sugar, salt, and calorie content of the product (Grunert, Wills, & Fernández-Celemín, 2010).

Conceptual framework

This section lays the ground for our conceptual framework depicting consumer objective understanding of FOPs. As described in the previous section, FOP type plays a role in consumer understanding, but consumer specific characteristics are presumed to have an influence as well. These characteristics considered here are both sociodemographic (age, gender, income level) and attitudinal (health interest, unhealthy = tasty belief, environmental concern in food choice).

Women, younger consumers, and higher educated individuals tend to rank products more accurately according to nutritional quality (Egnell, Ducrot, et al., 2018; Packer et al., 2021). Women use nutrition labels more in comparison to men (Kim, Oh, & No, 2016; Stran & Knol, 2013), as does younger and higher educated consumers in comparison to older and lower educated consumers, according to Kim et al. (2016). However, Lahti-Koski et al. (2012) found that older consumers reported using Heart Symbol-labeled products more, and older adults were more likely to use food labels according to Stran and Knol (2013). It is though important to further understand the individual characteristics of consumers that may drive or hinder adoption of different labels.

Health and nutrition knowledge, as well as interest in healthy eating, have been associated with FOP label and nutrition information use (Cavaliere, De Marchi, & Banterle, 2016; Grunert, Fernández-Celemín, Wills, Storcksdieck Genannt Bonsmann, & Nureeva, 2010; Grunert, Wills, et al., 2010; Roseman, Joung, & Littlejohn, 2018; Sun, Huang, & Chu, 2015). Higher nutrition knowledge helps consumers interpret FOPs (Grunert, Fernández-Celemín,

et al., 2010; Grunert, Wills, et al., 2010) as does higher numeracy and food involvement (Mulders, Corneille, & Klein, 2018). Furthermore, other studies show people with higher health-motivation spending significantly more time looking at nutrition information on food packages compared to taste-motivated people (Turner, Skubisz, Pandya, Silverman, & Austin, 2014; Visschers, Hess, & Siegrist, 2010). This is why we predict higher health interest will lead to better objective understanding of FOPs.

Although the relation of health-orientation to the use and understanding of nutrition information has been documented before, less is known about how other consumer attitudes, such as the perceived health-pleasure trade-off of labeled food products (Bialkova, Sasse, & Fenko, 2016) or environmental concern in food choice, might affect FOP understanding. Considering these other attitudes helps paint a more multidimensional picture of the consumer characteristics driving or hindering the adoption of FOP labels. It is known that consumer's higher unhealthy = tasty belief reflecting association of healthy food to inferior taste may lead to preference for tastier but unhealthier foods and negative health consequences (Mai & Hoffmann, 2015; Raghunathan, Walker Naylor, & Hoyer, 2006). We predict that perceiving healthy food as less tasty might hinder adoption and therefore also understanding of FOP labels.

Besides health issues, environmental sustainability is a pivotal challenge facing the current food system today. These threats include climate change, land use change, water depletion, and ecosystem pollution (Lindgren et al., 2018; Springmann et al., 2018). The consumer's role in tackling these issues is essential and the interrelations of both health and environmental aspects in consumer behavior need to be examined further (Aschemann-Witzel, 2015). Consumer's environmental concerns may drive the use and understanding of eco-labels (D'Souza et al., 2022; Grunert, Hieke, & Wills, 2014; Siraj et al., 2022), but this may also be the case for FOP nutrition labels. There are already signs of an overlap between healthy and environmentally sustainable eating behaviors among some consumer groups (Van Loo, Hoefkens, & Verbeke, 2017; Verain et al., 2012; Zakowska-Biemans, Pieniak, Kostyra, & Gutkowska, 2019), so it is probable that higher environmental concern in food choice might also be reflected in higher health interest and greater use and understanding of FOP nutrition labels. Sustainability also seems to be somewhat congruent with the perceived healthiness of food products, as conscious consumers may find sustainable products healthier (Verain, Sijtsema, & Antonides, 2016), and consumers evaluate healthy food with a label indicating higher sustainability more favorably (Cho & Baskin, 2018). In the future, the integration of healthy and sustainable eating will become more essential in research as well as in public policy. This integration of sustainable practices into healthy diets is
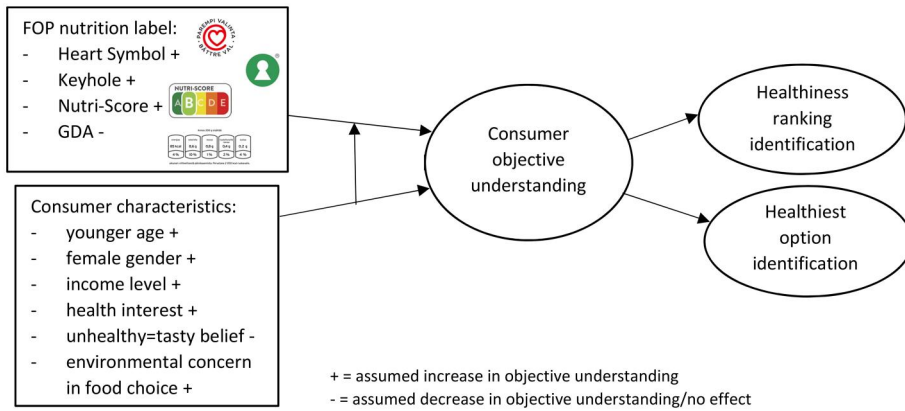
Figure 2. Conceptual framework.

already seen in the introduction of planetary health diet (Willett et al., 2019) and national dietary guidelines for instance in Denmark (Ministry of Food, Agriculture and Fisheries of Denmark, 2021), Canada (Health Canada, 2019), and Sweden (Livsmedelsverket, 2015), as well as in the very recently published Nordic Nutrition Recommendations (Blomhoff et al., 2023). This increases demand for studies covering both healthy and sustainable eating, which is why environmental concerns should be examined in conjunction with health interests more often.

In the conceptual framework presented below (Figure 2), we predict that consumers' objective understanding of the label is affected by both the type of FOP label and consumer characteristics. Younger age, female gender, and higher income level are predicted to enhance FOP understanding as well as higher health interest and environmental concern in food choice. Consumer's higher unhealthy = tasty belief, on the other hand, is assumed to decrease FOP understanding. Consumer characteristics may have both direct and interaction effects with separate FOPs on objective understanding. Consumer's objective understanding of FOPs is manifested in terms of healthiness ranking and healthiest option identification of products, as some FOPs (Nutri-Score and GDA) are able to help in healthiness ranking while others (Heart Symbol and Keyhole) are designed to just distinguish healthier options.

Materials and methods

Sample characteristics

This study was conducted as part of a larger survey investigating several factors influencing food choices. The data were collected via an online survey conducted by a local marketing agency from a consumer panel (Norstat Finland) from 2nd to 16th October in 2020. Electronic consent from the participants was obtained at the beginning of the survey. We

Table 1. Sample characteristics ($N = 2428$).

	N	%	Finnish population, 2019 (%)*
Gender			
Men	1201	49	49
Women	1227	51	51
Age, years			
18–24	247	10	11
25–34	441	18	18
35–44	439	18	18
45–54	415	17	17
55–64	458	19	18
65–74	428	18	18
Place of residence			
Southern Finland	1323	55	52
Western Finland	612	25	25
Northern and eastern Finland	493	20	23
Household yearly income, €			
$\leq$35,000	794	33	
35,001–85,000	926	38	
$\geq$85,001	297	12	
Not willing to disclose	411	17	
Is familiar with each FOP			
Heart Symbol	1622	67	
GDA	1464	60	
Nutri-Score	160	7	
Keyhole	88	4	

*Statistics Finland (2022).

followed the ethical guidelines of the Finnish National Board on Research Integrity TENK (2019). Ethical approval was waived by the University of Vaasa Human Science Ethics Committee. Participants were compensated with points that could be used for redeeming gift cards or donated to charity. The original sample was $N = 2502$. 74 participants were excluded from the analysis due to incomplete responses. The final sample ($N = 2428$; 51% women; aged 18–74 years; $M_{age} = 47$; $SD_{age} = 16$) is representative of the Finnish adult population in terms of gender, age, and region (see Table 1). The sample consists of consumers who do grocery shopping for their household at least twice a month.

Design and stimuli

Test products

Two product categories, yoghurts and granolas, were selected to be used in the online experiment, as they represent typical breakfast products consumed in Finland with varied nutritional contents on the market. To safeguard against the potential confounding effect of brand familiarity, the test products were presented as fictious.

The products were designed to vary by their nutritional profile (fat and sugar contents) based on Finnish dietary guidelines (higher, medium, and lower nutritional quality). Yoghurt versions were strawberry (higher nutritional quality), blueberry (medium nutritional quality), and banana (lower

Figure 3. Example pictures of the test products: yoghurts with Keyhole symbol and granolas with Nutri-Score symbol.

nutritional quality). Granola versions were blueberry (higher nutritional quality), berry (medium nutritional quality), and fruit (lower nutritional quality). Nutri-Score (scores A, B, and C for yoghurts and A, C, and D for granolas) and GDA labels were attached to the three products according to their designed nutritional quality. Heart Symbol and Keyhole were only attached to the product with the highest nutritional quality, according to the labeling standards. Test products were shown to the participants as package pictures (Figure 3) in a randomized order. Participants were able to zoom in on the product pictures. No additional information about the products was available to the participants besides what was seen in the pictures.

Procedure

In this study, we followed the mixed experimental design of Egnell, Talati, et al. (2018). The eligible online experiment participants included 18–74-year-old Finns purchasing groceries for their household at least twice a month. Thus, the study commenced by a screening question regarding the frequency of grocery shopping. The quotas for gender, age, and region were used to ensure that the sample represented the Finnish general population. The first part of the actual survey tackled various food-related issues including attitudes/beliefs in food consumption (see *Measurements* below).

Next, participants completed an objective understanding task involving the four FOPs (see Figure 1) and the two product categories (see Figure 3).
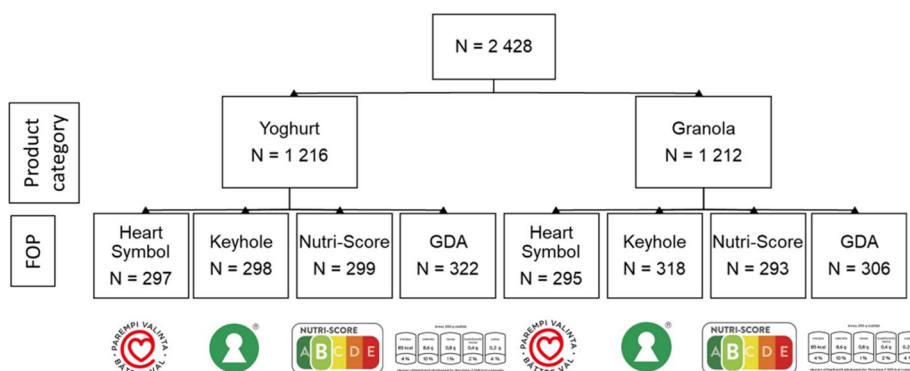
Figure 4. Experimental design. Participants were randomized to evaluate one product category, either yoghurt or granola. First, participants evaluated the products without FOP, then with a randomized FOP.

Participants were randomly assigned to evaluate one of the product categories, yoghurts ($N = 1216$) or granolas ($N = 1212$) (see Figure 4 for experimental design). First, participants were asked to rank the set of three products according to nutritional quality with a question: "Next, we ask you about your perceptions of various products. Which of the following products is the healthiest and which is the least healthy one?" Participants were shown the pictures of the three yoghurt/granola packages without FOP in a randomized order and they completed the evaluation task. After that, participants were asked to repeat the task, now with a randomized FOP (Heart Symbol, Keyhole, Nutri-Score, or GDA) on the package, with a question: "Next, you will evaluate the same products, now with additional package labels. Which of the following is the healthiest and which is the least healthy one?" Participants made the ratings without any additional product or nutritional information apart from the product pictures (first without FOP, then with a randomized FOP). After the evaluation task, participants completed the rest of the online survey including items about awareness of the labels and sociodemographic information.

Objective understanding of a FOP was measured by comparing the results between the initial "no FOP" and the subsequent "with FOP" conditions (within-subject factor). Further, the relative effectiveness of the four FOPs was established by comparing the ranking scores between FOPs within each product category (between-subject factor).

Measurements

Objective understanding
Objective understanding was measured with an evaluation task adapted from Egnell, Talati, et al. (2018), described in the previous section. As opposed to

their study, we measured objective understanding of FOPs in two ways instead of one: by the ability of the respondents to correctly (1) rank the products according to their nutritional quality (*healthiness ranking*) and (2) identify the healthiest option among the products (*healthiest option*). This is due to the fact that the FOPs examined here represent labels both with and without grading: Heart Symbol and Keyhole are designed to indicate options with better nutritional qualities, but they are not able to distinguish between products with less desirable nutritional values, as Nutri-Score and GDA are.

In the *healthiness ranking* approach, the respondents were allocated +1-point score, if they had the entire order of the products correct. If it was partially or entirely incorrect, −1 point was allocated. Points were given for both ranking the products without the FOP (no FOP condition score) and with the FOP (FOP condition score), and the score used as a dependent variable was formed by subtracting the no FOP condition score from the FOP condition score, resulting in a final score of either −2, 0, or +2. In the *healthiest option* approach, the same scoring method was used, with the correct heathiest option leading to +1-point score and the incorrect healthiest option to a −1-point score.

Awareness of the labels

After the objective understanding task, participants were asked to indicate, based on FOP name and picture, how well they knew each label on a 4-point scale: 1 = *very well*, 2 = *quite well*, 3 = *quite poorly*, or 4 = *very poorly*. The scale was reversed for analyses.

Food-related attitudes/beliefs

To limit the response time of the survey to 15 min, each food-related attitude/belief was measured with a single-item claim on a 7-point Likert scale (1 = does not describe my situation/thinking at all—7 = describes my situation/thinking very well). These items were inspired by prior studies (e.g. Mai & Hoffmann, 2015; Roininen et al., 2001; Żakowska-Biemans et al., 2019). In the survey, *health interest* was measured with a reversed single-item claim "Healthiness of food does not interest me much." The item was reversed for analyses. *Unhealthy = tasty belief* was measured with a single-item claim, "I would eat healthier if healthy food tasted better." *Environmental concern in food choice* was measured with a single-item claim "Environmental friendliness is considerably guiding my food choices and food purchases."

Sociodemographic characteristics

At the end of the survey, participants were asked to provide information on gender, age, type of the household, yearly household gross income, place of residence, and occupational status.

Statistical analyses

Ordinal logistic regression analyses were carried out to discover, how well the labels assisted participants to rank the products according to nutritional quality and to identify the healthiest option out of a set of products. GDA was used as a reference category in the models, as it showed no significant effect in the analysis.

Direct effects and interactions by age, gender, income level, and food related attitudes were assessed via individual tests. Those, who were not willing to disclose their yearly household gross income ($N = 411$) were excluded from the income variable.

All statistical analyses were performed using IBM SPSS Statistics version 26. Results were considered significant at the p-value of 0.05.

Results

Awareness of the labels

The Heart Symbol and GDA are the most known FOP labels among Finnish consumers: 67% of the respondents report being at least somewhat familiar with Heart Symbol and 60% report the same for GDA. By comparison, Nutri-Score and Keyhole are less known in Finland with 7 and 4% awareness rates, respectively (see Table 1).

Objective understanding

Healthiness ranking

The percentage of correct answers by FOP and product category is depicted in Figure 5 below. The Heart Symbol increased the number of correct answers in yoghurts by 48.5% points (see Figure 5(A)) and by 14.9% points in granolas (see Figure 5(B)). In yoghurts, the positive change provided by Keyhole was 23.1% points and by Nutri-Score 21.1% points. In granolas, Nutri-Score performed almost as well as Heart Symbol with 14.7%-point positive change in the number of correct answers.

The association between FOP type and the improvement in the ability to correctly rank products according to nutritional quality was measured with ordinal logistic regression and is shown in Table 2. GDA did not increase the number of correct answers in the evaluation tasks, so it was used as a reference category. In the yoghurt category, the Heart Symbol produced the greatest improvement in correct answers, followed by Keyhole and Nutri-Score. When awareness of the labels was controlled for, the effect of Heart Symbol (OR = 19.39; 95% CI: 11.89–31.63; $p = 0.000$) and Nutri-Score (OR = 5.75; 95% CI: 3.49–9.45; $p < 0.001$) was pronounced but the effect of Keyhole diminished (OR = 5.45; 95% CI: 3.32–8.94; $p < 0.001$), causing Nutri-Score to perform slightly better than Keyhole.
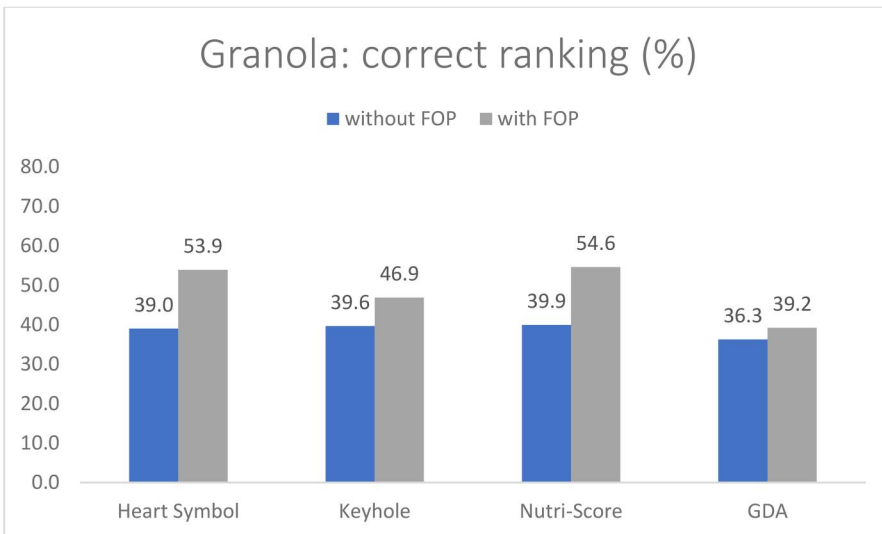
Panel A
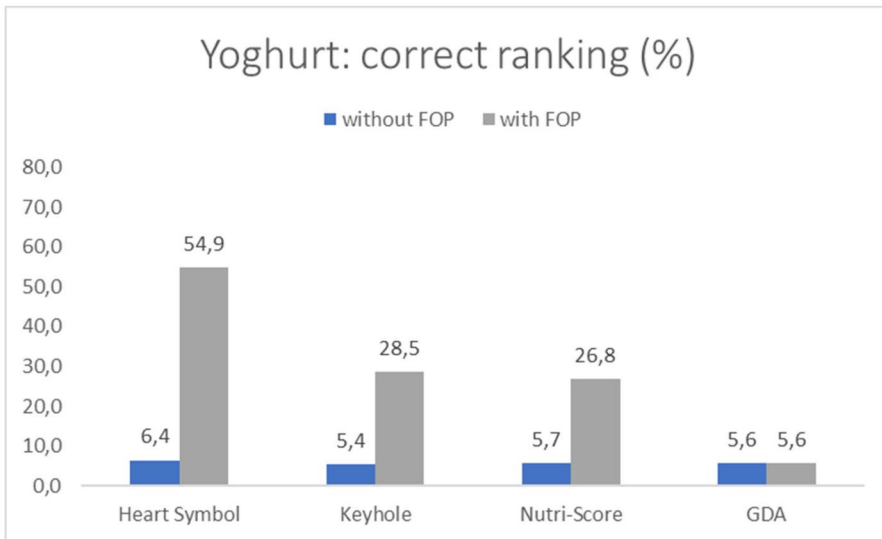
Panel B

Figure 5. Percentage of correct ranking answers by FOP and food category.

Table 2. Association between FOP and the ability to correctly rank products by nutritional quality and to identify the healthiest option ($N = 2428$).

	N	Heart Symbol OR [95% CI]	p	Keyhole OR [95% CI]	p	Nutri-Score OR [95% CI]	p
Healthiness ranking							
Yoghurt	1216	17.53 [10.83–28.36]	<0.001	5.67 [3.47–9.25]	<0.001	5.11 [3.12–8.35]	<0.001
Granola	1212	1.99 [1.34–2.95]	0.001	1.28 [0.87–1.90]	0.211	1.93 [1.30–2.87]	0.001
Healthiest option							
Yoghurt	1216	21.41 [12.97–35.47]	<0.001	6.56 [3.95–10.91]	<0.001	6.20 [3.72–10.32]	<0.001
Granola	1212	2.52 [1.72–3.69]	<0.001	1.26 [0.86–1.85]	0.233	1.63 [1.10–2.41]	0.015

OR: Odds Ratio; CI: Confidence Interval.
The GDA was used as the reference category for the "FOP group" variable in the ordinal logistic regression models.

In the granola category, the improvement rates were lower compared to yoghurts, with the Heart Symbol and Nutri-Score leading to significant improvement in correct answers. Keyhole did not show a significant impact relative to GDA in the granola category. When awareness of the labels was controlled for, the effects remained practically the same.

Healthiest option

The second approach in the objective understanding of the FOPs accounts for the ability to correctly identify the healthiest option out of a set of three products, instead of the whole ranking being correct. The change in the percentages of the correct answers by FOPs is depicted in Figure 6. As in the healthiness ranking evaluation, the Heart Symbol presented the greatest improvement in correct answers, now with even stronger effect (51.2% point improvement in yoghurts and 21.4%-point improvement in granolas). Keyhole increased the share of correct healthiest option answers in yoghurts by 24.2% points and Nutri-Score by 23.1% points, whereas in granolas, Nutri-Score increased the share of correct answers by 12% points.

The impact of the FOPs on the healthiest option identification was tested similarly to the healthiness ranking identification, with ordinal logistic regression using the improvement score as a dependent variable and GDA as a reference category (see Table 2 for results). The Heart Symbol has an even stronger effect here when compared to the first approach. Other results are also in line with the first approach, now with a slightly stronger effect in yoghurts with Keyhole and Nutri-Score, and a slightly smaller effect with Nutri-Score in the granola category. Keyhole did not significantly increase the amount of correct healthiest option responses in granolas.

Here again, when awareness of the labels was controlled for in yoghurts, the effect of Nutri-Score (OR = 6.95; 95% CI: 4.15–11.63; $p < 0.001$) exceeded the one of Keyhole (OR = 6.36; 95% CI: 3.81–10.64; $p < 0.001$). Also, the effect of Heart Symbol was somewhat pronounced (OR = 23.77; 95% CI: 14.29–39.54; $p = 0.000$). In granolas, the effects remained practically the same, when awareness of the labels was controlled for.

The correlations between healthiness ranking and healthiest option scores were $r = 0.96$, $p < 0.001$ for yoghurts and $r = 0.73$, $p < 0.001$ for granolas, indicating a high similarity between the two approaches in the objective understanding of FOPs.

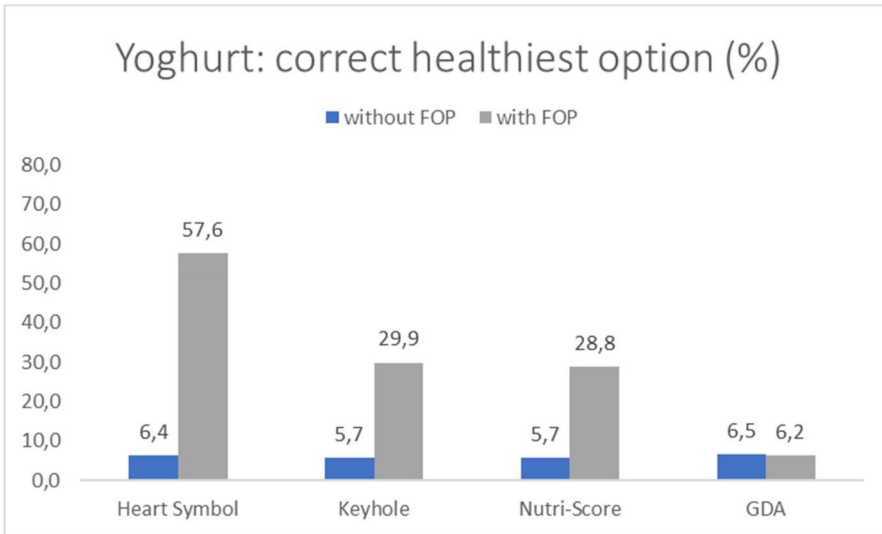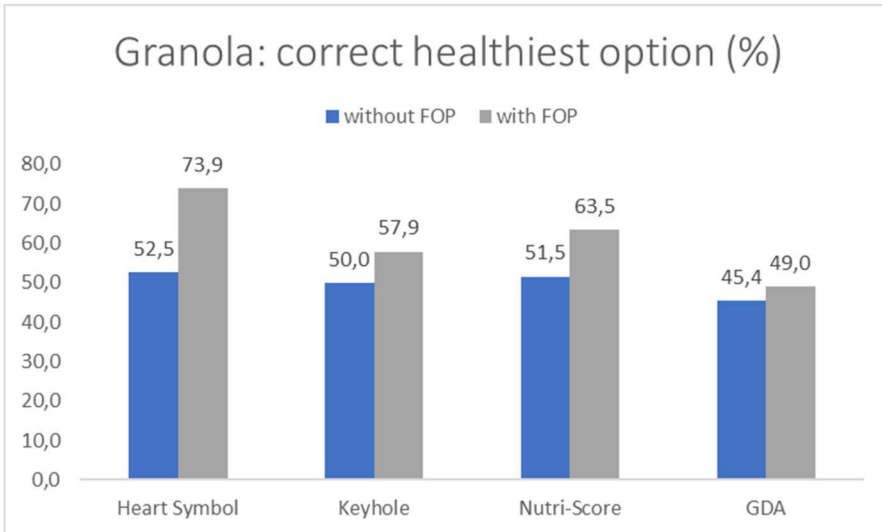### The role of consumer characteristics in determining the effectiveness of FOPs

Direct effects

Age appeared to be a significant factor in all of the healthiness evaluations (see Table 3 for results) with an inverse connection, meaning that FOPs

Panel A

Panel B

Figure 6. Percentage of correct healthiest option answers by FOP and food category.

were less helpful for older participants in discerning the healthiest option or healthiness ranking of the products. Objective understanding scores were lower for men *vs.* women in yoghurt evaluations indicating that FOPs helped women more than men. In granolas, though, there were no direct effects of gender. Income level measured by yearly household income did not demonstrate a significant direct effect on the objective understanding scores.

Health interest was positively related to objective understanding of FOPs in both approaches in yoghurts and in healthiness ranking of granolas. The

Table 3. Direct effects of demographic and food-related attitudinal factors on scores in healthiness identification of products.

Independent variable	Yoghurt healthiness ranking		Yoghurt healthiest option		Granola healthiness ranking		Granola healthiest option	
	OR [95% CI]	p	OR [95% CI]	p	OR [95% CI]	p	OR [95% CI]	p
Age	0.98 [0.98–0.99]	<0.001	0.98 [0.97–0.99]	<0.001	0.99 [0.98–1.00]	0.009	0.98 [0.97–0.99]	<0.001
Gender								
Men	0.68 [0.53–0.88]	0.003	0.66 [0.51–0.85]	0.001	0.92 [0.70–1.21]	0.543	0.92 [0.70–1.19]	0.514
Women (ref.)								
Household income								
≤35,000	0.82 [0.55–1.24]	0.344	0.84 [0.56–1.26]	0.405	1.11 [0.70–1.77]	0.660	1.01 [0.64–1.57]	0.977
35,001–85,000	0.80 [0.54–1.20]	0.281	0.77 [0.52–1.15]	0.209	1.15 [0.73–1.83]	0.542	0.99 [0.64–1.54]	0.974
85,000 (ref.)								
Health interest	1.10 [1.02–1.18]	0.016	1.11 [1.03–1.19]	0.007	1.11 [1.02–1.20]	0.013	1.07 [0.99–1.15]	0.102
Unhealthy = tasty belief	1.03 [0.96–1.11]	0.365	1.04 [0.97–1.12]	0.260	1.07 [0.99–1.15]	0.102	1.08 [1.00–1.17]	0.040
Environmental concern in food choice	1.13 [1.05–1.23]	0.002	1.13 [1.05–1.23]	0.002	1.01 [0.92–1.09]	0.905	1.01 [0.93–1.10]	0.745

OR: Odds Ratio; CI: Confidence Interval.

Main effects were retrieved from separate ordinal logistic regression models. Health interest, unhealthy = tasty belief, and environmental concern variables are scores, with a higher score indicating respondents having higher affiliation with the characteristic.

more health-interested the consumer is, the more FOPs help them identify healthier products. Unhealthy = tasty belief was found to have a positive connection with objective understanding of FOPs in the healthiest option identification of granolas. Environmental concern in food choice was found to be a significant factor in objective understanding of the FOPs in yoghurts, both in the healthiness ranking and in the healthiest option identification, demonstrating FOPs as more helpful for environmentally concerned consumers in yoghurts. The correlation between environmental concern and health interest among participants was $r = 0.15$, $p < 0.001$, but unhealthy = tasty belief was in inverse correlation with both health interest ($r = -0.18$, $p < 0.001$) and environmental concern ($r = -0.16$, $p < 0.001$), as expected.

Tests were also run to investigate relationships between other consumer characteristics (occupational status, geographical location, and type of household) and objective understanding scores (with and without an interaction term with the FOP variable). These results, however, were either non-significant or not valid due to relatively small respondent groups in each sociodemographic category.

Interaction effects

There were some interaction effects found between consumer characteristics and objective understanding of FOPs. Nutri-Score was less helpful for older participants in the yoghurt category ($OR_{healthiness\ ranking} = 0.96$; 95% CI: 0.93–0.98; $p = 0.003$; $OR_{healthiest\ option} = 0.95$; 95% CI: 0.92–0.98; $p = 0.001$). In granolas, there was a significant interaction between Nutri-Score and male gender in healthiness ranking (OR = 3.15; 95% CI: 1.43–6.94; $p = 0.004$) and almost significant interaction in the healthiest option (OR = 2.07; 95% CI: 0.95–4.55; $p = 0.069$) identification indicating that Nutri-Score was more helpful for men in comparison to women in these categories.

Income level in interaction with Heart Symbol was found to be inversely connected to objective understanding in the healthiness ranking of granolas. Using the highest income level (>85,000 eur) as a reference category, the lowest level (≤35,000 eur) respondents were significantly more likely to improve their ranking score in granolas with Heart Symbol (OR = 4.59; 95% CI: 1.19–17.77; $p = 0.027$), and the middle-income level (35,001–85,000 eur) respondents were almost significantly more likely to do so (OR = 3.71; 95% CI: 0.97–14.16; $p = 0.055$).

There were marginally significant interactions between health interest and Nutri-Score in yoghurts ($OR_{healthiness\ ranking} = 1.27$; 95% CI: 0.97–1.65; $p = 0.084$; $OR_{healthiest\ option} = 1.27$; 95% CI: 0.97–1.66; $p = 0.086$) and with Heart Symbol in granolas ($OR_{healthiness\ ranking} = 0.82$; 95% CI: 0.65–1.02;

$p = 0.080$), indicating a slightly more positive effect with Nutri-Score in yoghurts and a slightly more negative effect with Heart Symbol in the healthiness ranking of granolas for health-interested consumers.

Relative to GDA, there were significant interactions with environmental concern in food choice and Nutri-Score ($OR_{healthiness\ ranking}$ = 1.36; 95% CI: 1.03–1.78; $p = 0.028$; $OR_{healthiest\ option}$ = 1.36; 95% CI: 1.03–1.78; $p = 0.03$) and Heart Symbol ($OR_{healthiness\ ranking}$ = 1.33; 95% CI: 1.03–1.72; $p = 0.031$; $OR_{healthiest\ option}$ = 1.33; 95% CI: 1.02–1.73; $p = 0.033$), and marginal interaction with Keyhole ($OR_{healthiness\ ranking}$ = 1.27; 95% CI: 0.97–1.67; $p = 0.087$; $OR_{healthiest\ option}$ = 1.31; 95% CI: 0.99–1.73; $p = 0.057$), indicating these FOPs were more helpful in healthiness identification of yoghurts for environmentally concerned consumers.

Discussion

The aim of this study was to examine the effectiveness of various FOPs among Finnish consumers. The Heart Symbol performed best in both product and ranking categories (healthiness ranking and healthiest option identification of yoghurts and granolas) with the strongest effects in yoghurts, especially in the healthiest option identification. However, Nutri-Score performed almost as effectively as Heart Symbol in granolas. Keyhole performed in yoghurts as effectively as Nutri-Score, but showed no significant effect in granolas. Overall, the effects were greater for yoghurts than for granolas. Based on the results, both product categories benefited from the implementation of FOP labels, excluding the GDA which showed no significant impact on the healthiness evaluation.

Notably, there are differences between the labels that could explain the outcome. Heart Symbol, Keyhole, and Nutri-Score are summary indicator labels, and Nutri-Score also has a grading element. Summary indicator labels have been discovered to be easiest to interpret among consumers (Ikonen et al., 2020), whereas GDA is a reductive label requiring more competence and nutritional literacy in its interpretation.

FOPs were more effective when identifying the healthiest option out of a set of products compared to ranking products according to their nutritional quality. Interestingly, although the Heart Symbol and Keyhole are FOPs designed to indicate only the healthiest option within a product category without ranking less healthy products, they also seemed to improve the healthiness ranking of yoghurts, as the Heart Symbol did for granolas, too. Hence, it is possible that besides the FOP label presented, the flavor of the product contributed to the healthiness evaluation. There are known health benefits of berries, especially blueberries (Basu et al., 2010), which might be reflected in consumers' perception of blueberry as a sign of healthiness.

This might explain the greater share of correct ratings for granolas during the first evaluation task without FOP, as blueberry granola was the healthiest followed by berry and fruit granola. In yoghurts, on the other hand, strawberry flavored version was designated as the healthiest followed by blueberry and banana, which led to greater share of incorrect rankings without FOP. Consequently, the potential and observed efficiency of FOPs were greater for yoghurts, as the correct ranking was not as obvious based on flavors, as it was for granolas. Also, when strawberry yoghurt was indicated as the healthiest with the Heart Symbol or Keyhole, it was relatively easy to figure out the rest of the ranking.

Although in many other studies from Europe, including the UK, the Netherlands, Germany, Switzerland, Italy, and Bulgaria, Nutri-Score seems to be the most efficient label (Andreeva et al., 2020; Egnell, Talati, Gombaud, et al., 2019; Egnell, Talati, Pettigrew, et al., 2019; Egnell et al., 2020; Fialon et al., 2020; Packer et al., 2021), in the context of Finland, the Heart Symbol seems to perform better or as effectively as Nutri-Score in terms of objective understanding. The Heart Symbol is well-known among Finnish consumers compared to Nutri-Score (67 *vs.* 7% awareness rate), as it has been in use since 2000. GDA is almost as well known (60%) as Heart Symbol, thus the awareness of the label does not guarantee effectiveness. Probably, the ease of interpretation of the label in combination with wide familiarity might explain why the Heart Symbol appears as the most effective in terms of objective understanding. Keyhole (4%) and Nutri-Score are both interpretive summary indicator labels but they are less known in Finland. However, the effectiveness of the labels remained practically the same after awareness was controlled for in the analyses, although Nutri-Score performed better in yoghurts after the addition of awareness to the models. This, together with the fact that Nutri-Score performed almost as well as Heart Symbol in granolas, indicates that Nutri-Score is relatively easy to interpret even without familiarity with the label.

Theoretical implications

Besides the performance of alternative FOPs, this study uncovers the significance of consumer characteristics to FOP understanding, the area that is still less examined. In the first part of this paper, we presented a conceptual framework to consumer objective understanding of FOP labels, covering both the influence of FOP label type and consumer characteristics with predicted directions of the outcomes. Our research demonstrates, how individual factors, both sociodemographic and attitudinal, relate to objective understanding of FOP labels. We found that age and gender had a direct effect on the healthiness assessments: FOPs were less helpful for older

consumers in all product categories and for men in the yoghurt category, which is in line with the predicted effects of age and gender. We found significant interactions with Nutri-Score with it being less helpful for older participants in yoghurts but more helpful for men in granolas. Income level did not demonstrate a direct effect but it had an interesting interaction with Heart Symbol, which appeared more helpful for lower income respondents in the healthiness ranking of granolas. The results confirm the findings of Egnell, Ducrot, et al. (2018) who found women and younger consumers to be more able to rank products according to nutritional quality but contradict with Andreeva et al. (2020), whose study with a similar design did not find a connection between improvement in product ranking ability and age, gender or socioeconomic status. Overall, the results are still in line with other previous knowledge of relations in age, gender, FOPs, and healthy eating patterns, described in more detail in the following.

The weaker ability to identify product healthfulness with FOPs among older consumers can be explained by the notion of Grunert, Fernández-Celemín, et al. (2010) and Grunert, Wills, et al. (2010) that even though older individuals have more interest in healthy eating, they have less nutrition knowledge. This may hinder the interpretation of nutrition labels. Kim et al. (2016) found that nutrition labels did not impact nutrient intake among older consumers, and therefore it is crucial to improve the understanding and use of nutrition labels, especially among the elderly. The poorer performance of Nutri-Score among older consumers could partially be explained by the fact that although older age groups in Finland are more likely to use products with the Heart Symbol than younger consumers (Lahti-Koski et al., 2012), they may need more education if they are to adopt a new kind of label.

FOP labels were more helpful for women in yoghurts, which is in line with the known gender differences in healthy food consumption. In Finland, women's diets are closer to dietary recommendations than men's (Valsta et al., 2018), and the prevalence of daily vegetable intake, for instance, was 56% among women compared to 35% among men in 2017 (Kähäri, 2022). Women are generally more concerned with healthy eating (Grunert, Wills, et al., 2010; Wardle et al., 2004), and they are more familiar with FOP nutrition labels (Kim et al., 2016; Lahti-Koski et al., 2012; Miklavec, Pravst, Raats, & Pohar, 2016). Thus, it is recommended to make efforts to increase the familiarity with FOP nutrition labels and healthier products especially among men, since familiarity with food is more salient to men as a food selection motive (Konttinen et al., 2021). In our study, Nutri-Score seemed to help men more in the granola category, probably since men reported being more familiar with the label (results not shown).

It seemed that health interest in food increased the objective understanding of FOP labels, as expected. This positive effect is not a surprise, since

health motivation increases consumers' visual attention to nutrition information and stimulates deeper processing of it (Turner et al., 2014; Visschers et al., 2010). There is also more nuanced evidence around health concepts and labels: in a UK study by Grunert, Wills, et al. (2010), interest in healthy eating affected label use, whereas nutrition knowledge related to understanding nutrition information on FOP. Roseman et al. (2018), in turn, found in the US that personal attitude toward healthy eating was not associated with FOP label use, but selecting food for health reasons was. However, our study found a positive correlation between health interest and FOP understanding. Also, marginal interactions were found with Nutri-Score in yoghurts (positive effect) and with Heart Symbol in granolas (negative effect). These tentative results show that there are differences in FOP understanding between different formats and product types also among consumers with higher health interest in food.

Our study provided evidence that environmental concern in food choice has an effect on FOP understanding. Environmentally concerned consumers' rating scores improved with FOPs in yoghurts, where Nutri-Score and the Heart Symbol were the most helpful. This may be explained by these consumers being more motivated in searching for information and environmental labels on food packages (D'Souza et al., 2022; Grunert et al., 2014; Siraj et al., 2022), which may give them a higher ability to interpret food labels in general. The results may also reflect the integration of healthy and environmentally sustainable eating in consumer attitudes: a significant overlap has been found between involvement in healthy and sustainable eating among European consumers (Van Loo et al., 2017; Verain et al., 2012; Żakowska-Biemans et al., 2019). Both of these aspects are also considered in the new Nordic Nutrition Recommendations (Christensen et al., 2020), and environmental sustainability as part of dietary guidelines will have an impact on national food and health policies of the Nordic countries in the future (Norwegian Directorate of Health, 2022).

Study limitations

There are potential limitations in the study design. First, due to the restricted questionnaire length, we studied only two product categories, yoghurts and granolas. Second, the flavors of the products seemed to have an effect on the baseline healthiness evaluations which was reflected in the final ranking scores. In addition, the flavors presumably helped participants identify healthiness ranking of the three products even with a summary indicator FOP attached merely to the healthiest option. This created a potential confounding effect emphasizing the effect of Heart Symbol and Keyhole in yoghurts, where the flavor cues and FOP effects were more

pronounced. However, the products used were the same in all FOP catego-ries, and thus it was possible to compare the relative objective understand-ing of the labels. Third, there are potential limitations regarding the measures used: it would have been beneficial to measure food-related atti-tudes more comprehensively with a higher number of items. Income level was measured merely at the household level.

Future studies and practical implications

The objective effectiveness of FOPs was investigated in this study, but not how the labels affect product images beyond healthiness or whether con-sumers would actually purchase labeled products. Thus, further research is needed on how nutrition information affects product related attitudes, such as taste perceptions, purchase intention, and emotions attached to products with varying health images, as there may be variation depending on whether the product category with FOP or health claim is generally per-ceived as healthful or less healthful (Bialkova et al., 2016; Profeta, 2020) or classified as processed or unprocessed food (Egnell et al., 2021).

Furthermore, future studies should focus on how labels are used and inter-preted in real life commercial settings. Despite recognizing or understanding nutrition labels, most consumers still do not use them when making food choices (Grunert, Fernández-Celemín, et al., 2010; Kim et al., 2016). According to an extensive ($N = 10,795$) recent study on Finnish consumers' food selection motives, price, sensory appeal, and convenience appear as rela-tively more salient food selection criteria than healthiness (Konttinen et al., 2021). Indeed, Rantala et al. (2022) found an intervention with Heart Symbol not affecting food choice or consumption in a Finnish workplace cafeteria setting and Potter et al. (2023) showed how Nutri-Score did not influence the healthiness of purchases in an experimental online supermarket.

To improve the dietary intake of the population, a closer look at different consumer segments and their perceptions of labels needs to be taken. Also, common beliefs, such as unhealthy = tasty intuition or low general health interest may hinder the adoption of healthier food products (Mai & Hoffmann, 2015). One way to tackle this challenge could be promoting deliciousness and hedonic appeal of healthier foods instead of nutritious-ness, especially for people with lower socioeconomic status (Boles, Turnwald, Perry, & Crum, 2022; Turnwald & Crum, 2019).

It is suggested that national differences in the perception of FOP nutrition labels should be considered in the policy decision making regarding the EU level nutritional label system. In Finland, the Heart Symbol appears as the most efficient label, although Nutri-Score seems to have almost as much impact. The relatively lower performance of Nutri-Score could partially be

explained by the lower awareness rate of the label. Educating consumers about the new label should be ensured if Nutri-Score becomes the dominant FOP in Europe. When implementing nutrition labels, it is especially recommended to take older consumers and men into consideration, as FOPs seem to be less helpful for these groups. Besides the implementation of FOP nutrition labels, the food industry needs to be committed to the reformulation of food products to offer more nutritious options to consumers.

Based on our results, a label integrating both the health and sustainability qualities of products could be one future direction of FOP development (see Bunge et al., 2021). This would be helpful for consumers already valuing both of these qualities and for the overall promotion of diets better for both humans and the planet.

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Ethical approval

According to Finnish legislation and TENK guidelines, the ethical review was not required for this study (statement by University of Vaasa Human Science Ethics Committee).

Disclosure statement

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