Effectiveness of front-of-pack nutrition labels on consumer behavior: implications for food labelling policy in Indonesia

Efektivitas Label Informasi Gizi dalam mengubah Perilaku Konsumsi Makanan dan Minuman Kemasan: Scoping Review

Maulia Dewi Kurnia Putri[1*], Zahroh Shaluhiyah[2], Ratih Indraswari[2]
[1]Master of Health Promotion, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia
[2]Department of Health Promotion, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia
*Email: mauliaadewii@gmail.com

ABSTRACT

Background: *Non-communicable diseases (NCDs) such as obesity, diabetes, and hypertension have become significant global health challenges. One of the main factors contributing to this problem is the high consumption of packaged foods and beverages with excessive sugar, fat, and sodium content. Nutrition information labels have been identified as an effective strategy to raise awareness and encourage healthier consumption behavior change.*

Objective: *This study aimed to evaluate the effectiveness of various nutrition information labeling systems, including Front-of-Pack Labeling (FOPL) such as Nutri-Score, Nutri-Grade, Health Star Rating, and warning-based labels, in improving consumer awareness, understanding, and consumption behavior.*

Methods: *A scoping review was conducted using thirteen journals selected based on PRISMA guidelines, focusing on awareness, understanding, and changes in consumption behavior.*

Results: *Intuitive visual labels increased consumer awareness by 75% and reduced sugar consumption by 1.51 grams per serving. Warning-based labels reduced purchases of unhealthy products by 17%.*

Conclusions: *Effective nutrition labeling should adopt clear visual formats and be supported by public education. Further policy recommendations include integrating labeling with education campaigns and additional regulations, such as sugar taxes, to strengthen the long-term impact on healthier consumption patterns.*

Keywords: *consumption behavior, front-of-pack labeling, nutrition education, nutrition information label, nutri-grade, nutri-score*

ABSTRAK

Latar Belakang: Penyakit tidak menular (Non-Communicable Diseases/NCDs) seperti obesitas, diabetes, dan hipertensi telah menjadi tantangan kesehatan global yang signifikan. Salah satu faktor utama yang berkontribusi pada masalah ini adalah tingginya konsumsi makanan dan minuman kemasan dengan kandungan gula, lemak, dan natrium yang berlebihan. Label informasi gizi telah diidentifikasi sebagai strategi efektif untuk meningkatkan kesadaran dan mendorong perubahan perilaku konsumsi yang lebih sehat.

Tujuan: Penelitian ini bertujuan untuk mengevaluasi efektivitas berbagai sistem pelabelan informasi gizi, termasuk Front-of-Pack Labeling (FOPL) seperti Nutri-Score, Nutri-Grade, Health Star Rating, dan label berbasis peringatan, dalam meningkatkan kesadaran, pemahaman, dan perilaku konsumsi masyarakat.

Metode: Penelitian ini menggunakan metode scoping review terhadap tiga belas jurnal yang dipilih berdasarkan pedoman PRISMA, dengan fokus pada kesadaran, pemahaman, dan perubahan perilaku konsumsi.

Hasil: Label visual yang intuitif mampu meningkatkan kesadaran konsumen hingga 75% dan menurunkan konsumsi gula hingga 1,51 gram per sajian. Label berbasis peringatan juga terbukti mengurangi pembelian produk tidak sehat sebesar 17%.

Kesimpulan: Pelabelan informasi gizi yang efektif perlu dirancang dengan pendekatan visual yang jelas serta didukung oleh edukasi publik yang komprehensif. Rekomendasi untuk kebijakan lebih lanjut mencakup integrasi label dengan kampanye edukasi dan regulasi tambahan, seperti pajak gula, guna memperkuat dampak jangka panjang terhadap pola konsumsi yang lebih sehat.

Kata kunci: edukasi gizi, nutri-grade, nutri-score, pelabelan depan bagian kemasan, perilaku konsumsi.

INTRODUCTION

The increasing prevalence of non-communicable diseases (NCDs) such as obesity, type 2 diabetes, and cardiovascular diseases has become a serious challenge for global public health. According to a WHO report, over 1.9 billion adults worldwide are overweight, with 650 million of them being obese, and this trend is increasing annually. One contributing factor is the increasing consumption of ultra-processed foods and beverages that are high in sugar, saturated fat, and sodium but low in nutritional value [1]. Therefore, population-based approaches such as nutrition labeling are increasingly prioritized as preventive strategies to promote healthier consumption choices [2].

Front-of-Pack Labelling is one of the key interventions recommended by global health organizations due to its simple and easy-to-understand approach, enabling consumers to quickly recognize a product's nutritional quality without needing to read the full nutrition information table [3]. FoPNL comes in various forms, ranging from numerical labels (e.g., calorie information), interpretive labels (such as Nutri-Score and Health Star Rating), to warning labels (widely implemented in Latin American countries) [4]. Experimental studies have shown that FoPNL is effective in improving nutritional information understanding, influencing consumer perceptions, and directing purchases toward healthier products compared to conventional labels [2].

However, the effectiveness of labeling is greatly influenced by the socio-cultural context, nutritional literacy levels, and the format of the label used. In a meta-analysis by Aitken et al. (2023), it was found that interpretive color- and symbol-based labels are more effective in changing both consumption intentions and behavior compared to numeric-based labels. This finding is supported by a cross-national experimental study by Arrúa et al. (2021), which showed that warning label systems were most successful in reducing purchase intentions for high-sugar products among consumers in middle-income countries [4].

Meanwhile, a study by Jones et al. (2022) evaluating the implementation of the Health Star Rating (HSR) system in Australia and New Zealand revealed that voluntary labeling approaches have limitations. Many manufacturers only apply labels to products that already have good scores, thereby reducing the effectiveness of this policy in the context of mass behavioral change and industry reformulation. On the other hand, Indonesia does not yet have national regulations governing nutrition labeling on the front of packaging, although some manufacturers have started initiatives independently.

Although a number of studies have examined the impact of nutrition labeling, most have focused on only one type of label in a single country or region. No comprehensive studies are comparing various labeling systems across countries and examining the factors influencing their success. Therefore, this study aims to map the effectiveness of

107

various nutrition information labeling systems on the consumption behavior of packaged foods and beverages, while identifying label design elements and sociodemographic conditions that influence the outcomes of labeling interventions.

METHODS
Study design
This study employed a scoping review design based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) by Tricco et al. (2016) and the framework of Arksey and O'Malley[5]. The review aimed to identify and map the effectiveness of front-of-pack nutrition labeling (FoPNL) in influencing consumer understanding and purchasing behavior.

Data source and search strategy
Article searches were conducted in PubMed, Scopus, and ScienceDirect using the keywords: ("front-of-pack labeling" OR "nutrition labeling" OR "food labeling") AND ("consumer behavior" OR "purchasing decision" OR "food choice") AND ("effectiveness" OR "impact").

Eligibility criteria
The inclusion criteria were studies published between 2019–2024, written in English, available in full text and open access, and focused on the effectiveness of nutrition labeling.
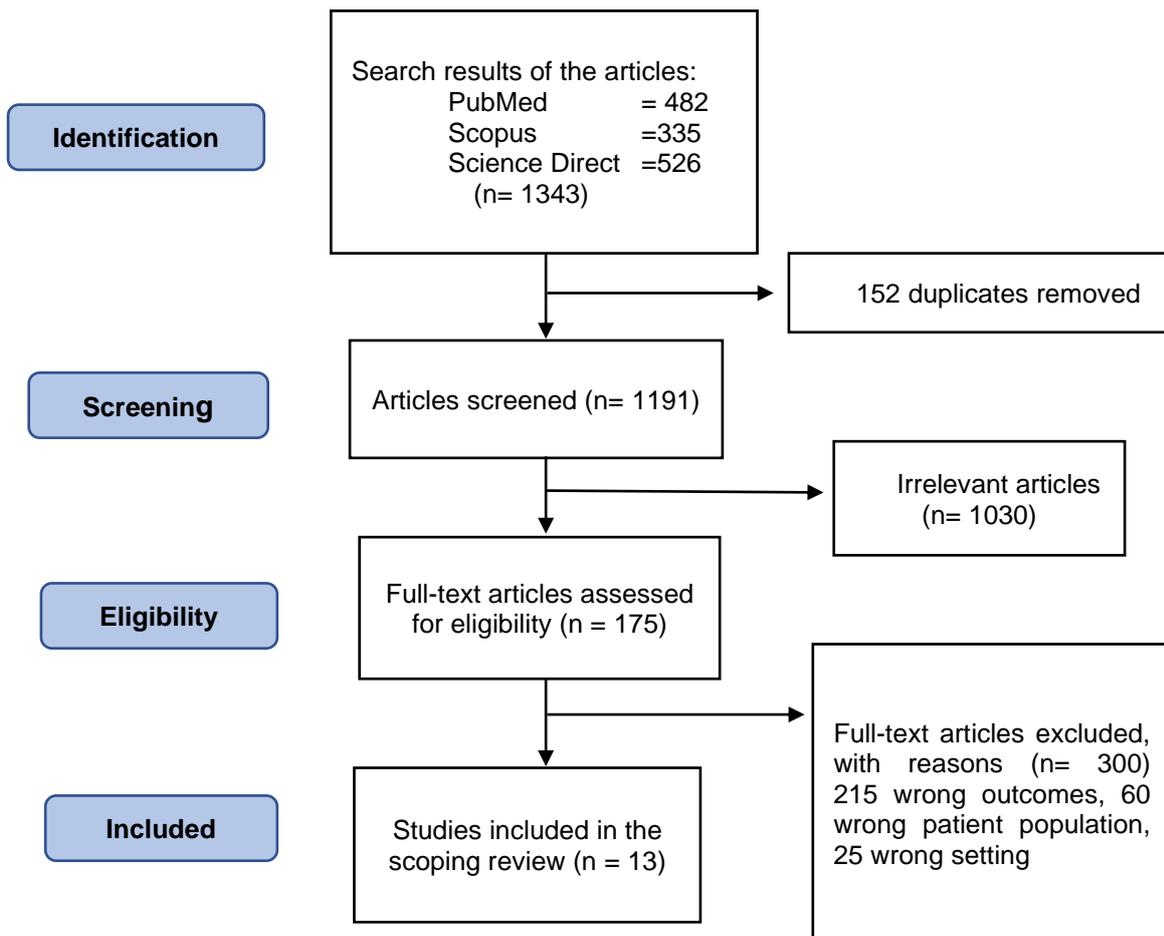

Figure 1. PRISMA Flowchart

Study selection process

The search yielded 1,343 articles; after removing 152 duplicates, 1,191 were screened by title and abstract. A total of 175 full-text articles were reviewed, and 13 studies met the inclusion criteria. The selection process followed the PRISMA-ScR flow diagram (Figure 1), ensuring transparency and reproducibility.

Data extraction

Data extraction was performed independently by two reviewers, focusing on study design, population characteristics, labeling system, and key findings.

RESULTS

The results of this study show that nutrition information labels significantly influence consumer awareness and consumption behavior regarding packaged foods and beverages. Based on the analysis of selected studies from both developed and developing countries, different labeling systems—such as front-of-pack labels (FOPL), Nutri-Score, Nutri-Grade, and warning-based labels—demonstrate varying levels of effectiveness depending on contextual factors such as nutrition literacy, socioeconomic status, and policy support. In developed countries such as France, Canada, and Australia, interpretive systems like Nutri-Score and Health Star Rating have been effective due to higher nutrition literacy and strong regulatory enforcement. Meanwhile, studies from developing countries such as Brazil and Chile reveal that simple, visual, and directive warning labels are more effective in populations with limited literacy and access to nutrition education. For Indonesia, which shares similar socioeconomic and educational characteristics with developing countries, the findings indicate that a simple and visual front-of-pack warning label system—supported by public education and policy enforcement—would be the most feasible and impactful approach. Future research should identify which consumer groups (e.g., lower-income, rural, or young populations) respond best to specific labeling formats, providing evidence to guide national implementation strategies.

Table 1. Data Charting

No	Author(s)/Year/Title	Objective	Method	Result
1	[6]/Taxes and front-of-package labels improve the healthiness of beverages and snack purchases: a randomized experimental marketplace	Examined the combined effect of front-of-pack (FOP) labels and sugar taxes on purchasing behavior.	A randomized controlled experiment was conducted in Canada among 3,584 adults using simulated purchase tasks to test five FOP labeling systems and eight tax levels.	The "high content" FOP label and sugar tax policy reduced sugar, fat, and calorie intake, showing that combined labeling and fiscal interventions can effectively improve the nutritional quality of purchases.
2	[7]/Consumption Trends of Sweetened Beverages in Norway	Analyzed long-term consumption trends of sugar-sweetened and artificially sweetened beverages in relation to socioeconomic status.	A 15-year longitudinal cohort study was conducted in Norway involving 437 participants from randomly selected schools, using repeated food frequency questionnaires.	Over time, sugar-sweetened beverage intake decreased while artificially sweetened beverage use increased, with higher socioeconomic groups showing healthier consumption trends.
3	[8] / "Warning: ultra-processed": an online experiment examining the impact of ultra-processed	Investigated how ultra-processed food (UPF) warning labels influence consumers'	An online randomized experiment was carried out in Brazil with 1,004 adults who viewed products either with	Participants exposed to UPF warning labels better recognized ultra-processed foods and perceived them as less healthy, although

	warning labels on consumers' product perceptions and behavioral intentions	perceptions and purchase intentions.	nutrient-only labels or additional UPF warnings.	their purchase intentions remained largely unchanged.
4	[9]/Modeling the impact of different front-of-package nutrition labels on mortality from non-communicable chronic disease	Modeling the impact of different FOP nutrition labels on mortality from chronic diseases in France.	Macro-simulation in France combining experimental purchase data from 691 participants with dietary data from 81,421 individuals in the NutriNet-Santé cohort, analyzed using the PRIME model.	The Nutri-Score label showed the highest potential to reduce diet-related mortality, followed by the Health Star Rating and Multiple Traffic Lights, highlighting the public health value of interpretive labels.
5	[10]/Objective understanding of the Nutri-score front-of-pack label by European consumers and its effect on food choices: an online experimental study	Compared the effectiveness of the Nutri-Score label with other front-of-pack systems in promoting understanding and healthier choices.	A multi-country online experiment was conducted across 12 European countries with 12,391 participants using ranking and choice tasks before and after label exposure.	Nutri-Score significantly improved consumers' ability to identify nutritional quality and encouraged healthier product choices compared to systems like Multiple Traffic Lights and Reference Intakes.
6	[11] /How pictorial warnings change parents.' purchases of sugar-sweetened beverages for their children: mechanisms of impact	Explored the psychological mechanisms through which pictorial warnings affect parents' beverage purchases for their children.	A randomized controlled trial was carried out in North Carolina, USA, involving 325 parents who completed simulated store purchase tasks comparing pictorial warnings with control labels.	Pictorial warnings reduced sugar-sweetened beverage purchases by 17%, mainly by lowering perceived healthfulness and reducing parents' intentions to buy sugary drinks for their children.
7	[12]/Awareness, use, and understanding of nutrition labels among children and youth from six countries: findings from the 2019 - 2020 International Food Policy Study	Assessed awareness, use, and understanding of nutrition and front-of-pack labels among children and youth.	A multi-country cross-sectional study was conducted between 2019 and 2020 in six countries—Canada, the US, the UK, Mexico, Chile, and Australia—using self-administered online surveys.	Awareness and understanding of front-of-pack labels increased markedly, reaching up to 75% after policy implementation, especially in countries adopting simple and mandatory labeling systems.
8	[13]/Impact of the front-of-pack 5-colour nutrition label (5-CNL) on the nutritional quality of purchases: An experimental study	To evaluate whether the 5-Colour Nutrition Label (5-CNL) improves the nutritional quality of food purchases in supermarkets.	A supermarket experimental study was conducted in France among 901 adult shoppers randomly assigned to three groups (control, 5-CNL; 5-CNL with consumer information). The 5-CNL labeling system was tested on selected food	The 5-CNL with consumer information improved the nutritional quality of purchases for sweet biscuits (FSA score: 21.01 vs 20.23; p = 0.02), showing that interpretive color-coded labels can modestly guide healthier choices when accompanied by educational support.

			categories, and outcomes were measured using the UK FSA nutrient profiling score and label recall.	
9	[14]/Food Labeling - Knowledge among university students in the Lisbon region: An exploratory study	Assessing university students' knowledge of nutrition information labeling and its relationship with demographic factors.	An exploratory cross-sectional study was conducted in Lisbon, Portugal, with 124 university students completing an online questionnaire on labeling comprehension. The study evaluated general nutrition label systems and used a knowledge score (0–8) as the main outcome.	The mean labeling knowledge score was 5.0 ± 1.8, with no significant correlation between knowledge and demographic factors. Findings suggest low literacy regarding food labels and highlight the need for targeted nutrition education interventions among young adults.
10	[15]/Food Front-of-Pack Labelling and the Nutri-Score Nutrition Label Poland-Wide Cross-Sectional Expert Opinion Study	To gather experts' opinions on the effectiveness and suitability of the Nutri-Score system in Poland.	A cross-sectional survey using the CAWI method was conducted among 75 nutrition and health experts across Poland. The study compared Nutri-Score with desirable front-of-pack (FOP) labeling features such as clarity, simplicity, and comparability.	Nutri-Score was found to help compare similar products, but less informative about specific nutrient content. The system needs further improvement and validation.
11	[16]/Consumers' Response to Sugar Label Formats in Packaged Foods: A Multi-Methods Study in Brazil	Tested the effectiveness of different sugar label formats in improving consumer understanding and food choices in Brazil.	A multi-method study was conducted in Brazil, involving five focus groups (n = 32) followed by a randomized online survey with 1,277 adults. The study tested four labeling systems: no label (control), total and added sugar on NIP, FoP octagonal warning, FoP magnifying-glass warning, and high-sugar text embedded on NIP. Outcomes included understanding of sugar content and food choice behavior.	All label formats improved understanding compared with the control. The FoP warning labels, especially the octagonal format, were most effective in enhancing comprehension and reducing the selection of high-sugar foods. The study supports FoP warning implementation to promote healthier purchasing decisions.
12	[17] / A randomized trial to evaluate the impact of Singapore's Nutri-Grade front-of-pack beverage label on food and beverage purchases	To evaluate the effectiveness of Singapore's Nutri-Grade label in reducing sugar and saturated fat from beverage purchases.	A randomized two-arm crossover trial was conducted in Singapore using an online grocery platform (NUSMart). A total of 138 participants completed two shopping sessions (control vs.	The Nutri-Grade label significantly reduced sugar purchased by 1.51 g per serving (95% CI: −2.68, −0.34) but had no significant impact on saturated fat or overall diet quality. Findings suggest Nutri-Grade can

			Nutri-Grade exposure). The Nutri-Grade label rates beverages from A (healthiest) to D (least healthy) based on sugar and saturated fat content.	reduce sugar intake but should be complemented by broader dietary policies.
13	[18]/The impact of interpretive and reductive front-of-pack labels on food choice and willingness to pay	To compare the effectiveness of interpretive (Health Star Rating, Multiple Traffic Light) and reductive (Daily Intake Guide) labels on food choice and willingness to pay.	An online discrete choice experiment was conducted in Australia among 2,069 adults. Participants selected food items (cookies, cereals, pizzas, yoghurts) under varying FOP labeling systems and price levels within a time-limited choice task. Outcomes included food choice distribution and willingness-to-pay (WTP).	The Health Star Rating (HSR) produced the strongest shift toward healthier choices (40% choosing the healthier option) and significantly increased WTP for healthier products. The Multiple Traffic Light had moderate impact, while the Daily Intake Guide showed minimal influence. HSR was viewed as the most effective interpretive label for guiding consumer behavior.

DISCUSSION

Effect of Nutrition Information Labeling on Consumer Awareness

Nutrition information labels have long been recognized as an effective tool to increase consumer awareness of a product's nutritional content. Based on the analysis of the reviewed journals, labels designed with intuitive visual displays, such as Front - of - Pack Labeling (FOPL), Nutri-Score, Nutri-Grade, and pictorial warning labels, show high effectiveness in attracting consumer attention and conveying clear information. This suggests that there is an influence of nutrition information labeling on consumer awareness.

Research by[12] reports that the implementation of visual labeling in some countries has increased consumer awareness by 75%, especially among consumers with low nutritional literacy. The FOPL system used was designed to make it easier for consumers to recognize products with high sugar, fat and salt content through prominent warning symbols. The study also noted that consumers who previously ignored traditional nutrition information tables became more responsive to visual labels that were easier to understand. Also supported by the study[13] in its context of color label systems, it tested the effectiveness of 5-CNL and found that it can improve the nutritional quality of purchases, particularly for sweet biscuit products. The system categorized foods based on nutrition scores using intuitive colors, although the effect varied among product categories.

Another study by[14] in Portugal also highlighted the effectiveness of nutrition information labels in raising awareness among university students. The study found that students' average knowledge of nutrition labels was 5 out of 8 points. Therefore, additional education is needed to strengthen nutrition literacy, especially for groups with lower levels of understanding. In addition, students reported that simpler labels, such as Nutri-Score, helped speed up the decision-making process at the store, compared to more complicated nutrition information tables.

Research[7] in Norway also confirms that visual labels are effective in raising consumer awareness in highly educated groups. However, challenges arise when these labels are applied to lower-educated groups, who still require additional educational

support to maximize their understanding and application. Thus, nutrition information labels not only serve as a communication tool but also require integration with systematic education programs in order to reach different segments of society.[8] highlights that the addition of warning labels to ultra-processed foods (UPFs) has the potential to improve consumers' ability to identify products with high health risks. The study found that labels with clear and direct information, such as warnings about high sugar, salt, and saturated fat content, made consumers more aware of the risks associated with consuming these products. Hence the need for extensive public education and campaigns to amplify the positive impact. This education aims to increase understanding of the dangers of packaged foods and beverages and the importance of a healthy diet. In addition, additional policies such as taxes on unhealthy foods and subsidies for healthy foods and beverages can strengthen the impact of nutrition information labels in driving sustainable consumption change.

Research by[16] in Brazil found that labels with pictorial warnings about sugar content were more effective than traditional information tables in helping consumers identify high-sugar products. Such visual labels have been shown to attract consumers' attention and influence healthier food choices. Visual labels with clear and direct symbols make it easier for consumers, especially those with low nutritional literacy, to make healthier decisions when shopping.[10] says Nutri-Score improves consumers' ability to objectively rank products by nutritional quality. Nutri-Score uses a clear and easy-to-understand color system, with a scale from green (healthiest) to red (less healthy), to help consumers quickly compare the nutritional quality of products. Through this mechanism, consumers are encouraged to choose products with better nutritional content, thus directly contributing to healthier diets and reducing the risk of NCDs such as obesity, diabetes, and heart disease.

This research emphasizes that the success of nutrition information labels depends on several factors, including nutrition literacy, label design, and educational campaigns. Systems that combine a visual approach with detailed information are more effective in reaching low-literacy consumers and increasing long-term impact on healthy eating.

Effectiveness of Nutrition Information Labels in Changing Consumption Behavior

In addition to raising awareness, nutrition information labels also have a significant influence on leading consumers to make healthier food and beverage choices. Research[6] shows that the combination of warning labels and sugar taxes in Canada reduced calorie consumption by 19.8 kcal and sugar intake by 4.7 grams per purchase. These results suggest that a combination of policies involving visual labels and economic incentives can effectively reinforce changes in consumer behavior. In accordance with research[9] shows that the application of Nutri-Score labels has great potential in reducing the risk of non-communicable diseases. Through PRIME simulations, it was found that this system can reduce deaths from nutrition-related diseases by 3.4%. This confirms that nutrition information labels are not only effective in influencing short-term consumption behavior but also have a long-term impact in improving public health and reducing the burden of chronic diseases.

A similar study by[17] in Singapore also reported that implementing the Nutri-Grade system reduced sugar consumption by 1.51 grams per serving. Nutri-Grade, which uses color coding to assess sugar content, is an effective tool in guiding consumers to choose products with lower sugar content. However, the study also noted that the impact on saturated fat consumption was not significant, suggesting that this kind of labeling needs to be combined with additional, more specific educational campaigns to influence different aspects of diet. As per[10], highlights that the Nutri-Score system significantly improves consumers' ability to select products with better nutritional quality. This system

uses color coding from green (healthiest) to red (less healthy), which makes it easier for consumers to distinguish the nutritional quality of products. The results of this study show that the implementation of Nutri-Score in various European countries has reduced the overall consumption of sugar, saturated fat, and calories, and increased the proportion of healthier product purchases. The findings underscore the potential of simple and visual labeling systems to influence consumption habits at the population level.

In addition, the study[11] highlighted the effectiveness of picture labels in reducing the consumption of sugar-sweetened beverages among parents. The study showed that the purchase intention of sugar-sweetened beverages decreased by 17% after the implementation of picture labels. These labels utilize the emotional response evoked by health warning images to trigger a change in perception of the health risks associated with the consumption of unhealthy products.[16] reported that pictorial warning labels were more effective compared to traditional nutrition information panels in identifying products with high sugar content. The study shows that pictorial labels, which often feature prominent warning symbols, are more easily understood by consumers with low nutrition literacy levels. These labels also encourage consumers to avoid products with higher health risks, proving the effectiveness of visual approaches in attracting attention and changing consumption intentions.

This finding indicates that labels that utilize a visual approach have more power to drive behavior change than traditional nutrition information tables that require deeper understanding. However, the long-term impact of these labels requires further research to ensure their sustained effectiveness.

Factors Affecting the Effectiveness of Nutrition Labels

The effectiveness of nutrition information labels in raising awareness and changing consumption behavior depends not only on the label design itself, but is also influenced by various external factors related to consumer characteristics and socioeconomic context. One of the main factors is the consumer's level of education and nutrition literacy. Studies conducted by[14] show that consumers with higher education levels tend to have a better understanding of nutrition information labels than those with low education levels. Low nutrition literacy is often an obstacle in utilizing the information provided by nutrition labels, especially in systems that require more complex interpretation, such as traditional nutrition tables. Therefore, groups with low nutrition literacy need additional support through education campaigns and socialization programs to ensure they can use nutrition information effectively in making consumption decisions.

Labels that use easily identifiable symbols and color coding, such as the Nutri-Score and Nutri-Grade systems, are more effective in attracting consumer attention than complex tables of nutritional information. These visual labels are able to simplify complex information into easy-to-understand terms, making it easier for consumers to make quick decisions when shopping. Clear and attractive label design can also help bridge the nutrition literacy gap in society and expand its impact across different social groups.

Furthermore, culture and socioeconomic status (SES) are also factors that influence the effectiveness of nutrition information labels. Research by Bolt-Evensen et al. (2018) in Norway showed that consumers with higher socioeconomic status tend to respond better to nutrition information labels than those from lower SES groups. Consumers with higher SES typically have greater access to education, health information and healthier product alternatives. In contrast, low SES consumers often face limitations in understanding nutrition labels and accessing healthier food options. This highlights the importance of considering cultural and economic differences in designing inclusive

labeling policies, so that nutrition information labels can be accepted and utilized by all segments of society.

Other influencing factors include consumption habits and shopping patterns. Consumers who are used to reading nutrition information labels before buying products tend to be more responsive to visual labels than those who do not have this habit. However, research from[18] shows that only 7% of consumers pay attention to detailed nutrition information tables when shopping. This strengthens the argument that simpler visual labels have the advantage of attracting attention and providing information that is quickly understood by consumers. Consumers with fast and impulsive shopping habits are also better helped by visual labeling systems that provide information directly and do not require in-depth analysis. Therefore, label design should consider consumer shopping behavior to ensure its effectiveness in influencing purchase decisions.

The last factor is public education support and socialization campaigns. Research by[12] emphasizes that nutrition information labels require ongoing educational support to ensure that all levels of society, especially vulnerable groups such as adolescents and consumers with low literacy, can understand and utilize the information provided by the labels. Socialization campaigns that highlight the importance of reading and understanding nutrition labels can help strengthen the impact of visual labels and expand their influence at the population level. Structured public education also helps to address gaps in understanding across different demographic groups, so that nutrition information labels can be used effectively by all.

Consideration of these factors shows that the effectiveness of nutrition information labeling is strongly influenced by a combination of intuitive label design, consumers' socioeconomic and educational backgrounds, consumption habits, and strong educational campaign support. Therefore, effective nutrition labeling policies should be integrated with broader educational programs and social approaches to ensure long-term impact in raising awareness and encouraging healthier consumption behaviors across society.

Comparison of the Effectiveness Formats of Different Nutrition Labels

The reviewed studies indicate that different front-of-pack nutrition label formats vary in their effectiveness in improving consumer understanding and influencing behavior. Interpretive systems such as Nutri-Score, for example, enable consumers to quickly compare the overall nutritional quality of products through intuitive color-coded scales. [10] Evidence from Poland shows that such systems facilitate rapid evaluation of relative product healthiness, making them particularly useful in time-constrained purchasing environments. However, these formats provide limited detail regarding specific nutrient content, such as sugar or sodium levels, which may restrict their usefulness for consumers requiring more precise dietary information. [15]

In contrast, warning-based labeling systems implemented in countries such as Chile and Mexico offer direct and explicit communication of health risks by highlighting excessive nutrient content. These labels are more effective in prompting immediate risk recognition and guiding quick purchasing decisions, especially among populations with lower nutrition literacy. While interpretive labels support comparative assessment and overall diet quality evaluation, warning labels prioritize clarity and risk signaling. [12]

Taken together, the findings suggest that no single format universally outperforms others; rather, effectiveness depends on communication objectives and user context. Combining visual interpretive guidance with explicit nutrient warnings may represent a more comprehensive strategy for enhancing consumer understanding and encouraging healthier consumption behavior.

Challenges and Opportunities in Nutrition Label Implementation

While nutrition information labeling has proven to be effective, the study also identified several challenges in its implementation. One of the main challenges is the non-uniformity of labeling systems in different countries. The Nutri-Score system, for example, was adopted in Poland but has not been widely accepted in other countries due to differences in policy preferences and standards.

The implementation of nutrition information labeling faces several key challenges, including non-uniformity of formats across countries and a lack of public education. Research[7] in Norway shows that groups with higher socioeconomic status (SES) are more responsive to visual labels than groups with lower SES. More inclusive policies are needed to reach all levels of society.

In addition, research[18] highlighted that only 7% of consumers actually read the nutrition facts table, emphasizing the importance of using easy-to-understand symbols and graphics. A wider public is needed to strengthen the effectiveness of these labels.

Another challenge is the lack of adequate public education to support the use of nutrition labels. Studies show that consumers with low nutrition literacy often misinterpret the information conveyed by labels, reducing their effectiveness. Therefore, a policy approach that combines visual labels with education campaigns is more effective in driving sustainable behavior change.

Developed vs Developing Countries in Nutrition Labelling Research

The reviewed studies demonstrate clear contextual differences between developed and developing countries in the implementation and effectiveness of nutrition labelling systems. In developed countries such as France, Canada, Australia, and Singapore, interpretive front-of-pack labels—like Nutri-Score, Health Star Rating (HSR), and Nutri-Grade—have been successfully implemented within populations that generally possess high nutrition literacy, strong regulatory frameworks, and consistent public health campaigns. These systems effectively influence purchasing decisions because consumers can interpret the color codes, letters, and star ratings with ease. The presence of supportive fiscal measures, such as sugar taxes and product reformulation incentives, further enhances the impact of these labeling policies.

Conversely, in developing countries such as Brazil, Chile, and Mexico, simpler and more directive labelling systems, notably warning labels (e.g., octagonal "High in Sugar/Fat/Salt" symbols), have proven more effective in altering consumer perception and behavior. These countries face challenges such as lower literacy levels, limited access to nutrition education, and economic inequality, which make straightforward and visually striking labels more suitable. Warning labels appeal to intuitive understanding and emotional responses, helping consumers quickly identify unhealthy products without requiring advanced nutritional knowledge.

Given these contrasts, Indonesia shares more contextual similarities with developing nations, particularly in socioeconomic structure, education level, and public health communication capacity. Therefore, the adoption of a simple, mandatory, and visual front-of-pack warning label system, supported by national nutrition education programs, would be more feasible and effective than complex interpretive systems designed for high-literacy populations. This approach ensures inclusivity, enhances public understanding, and aligns with Indonesia's current policy readiness and consumer behavior patterns.

Research Advantage

This scoping review has the advantage of examining various nutrition information labeling systems from different countries with diverse socioeconomic contexts, thereby providing a more comprehensive overview of the effectiveness of various labeling formats, such as Nutri-Score, Nutri-Grade, and warning labels. Additionally, the use of

116

the PRISMA-ScR approach in the review process ensures high methodological transparency and facilitates the replication of future research.

Limitations of the Study

However, this study also has limitations. First, only English-language articles were reviewed, so there is a possibility that important literature in local languages was not accommodated. Second, most of the studies reviewed were short-term experiments, so they do not fully describe the long-term impact of behavior. Third, there is heterogeneity in the methods and indicators between studies, which may affect the overall consistency of the results.

Research Implications

Based on the findings of this study, several recommendations are proposed. From a practical perspective, improving public nutrition literacy through continuous education is essential, particularly for low-literacy groups, to enhance the effectiveness of nutrition labels. Schools, communities, and the media play important roles in expanding educational outreach and helping consumers better understand nutrition information.

From a policy perspective, the Indonesian government is encouraged to adopt a simple, visual, and standardized nutrition labeling system aligned with national public health priorities. Systems such as Nutri-Score, Nutri-Grade, or warning labels may serve as references but should be adapted to Indonesia's socio-cultural context. The implementation of labeling policies should be supported by complementary measures, including sugar taxes, public education campaigns, and incentives for healthier product reformulation, along with strengthened cross-sector collaboration.

Furthermore, future research should focus on the long-term impact of nutrition labels on consumption behavior, as current studies are mostly short-term. More context-specific research in Indonesia is needed, particularly among vulnerable groups such as children, adolescents, and low-income populations, to ensure inclusive and targeted policy development.

CONCLUSION

The results of this scoping review indicate that nutrition labeling—particularly simple, visual, and interpretive systems—plays an essential role in improving public awareness and promoting healthier consumption behaviors. However, its effectiveness depends on nutrition literacy, socioeconomic conditions, and policy enforcement. For Indonesia, adopting a clear and easy-to-understand front-of-pack labeling model, supported by education and fiscal policy, is crucial to ensure nationwide impact. Future studies are recommended to evaluate the long-term behavioral outcomes of labeling implementation and its integration with broader nutrition education and public health strategies.

REFERENCES

[1]   A. Shrestha, K. Cullerton, K. M. White, J. Mays, and M. Sendall, "Impact of front-of-pack nutrition labelling in consumer understanding and use across socio-economic status: A systematic review," *Appetite*, vol. 187, no. November 2022, p. 106587, 2023, doi: 10.1016/j.appet.2023.106587.

[2]   I. Ikonen, F. Sotgiu, A. Aydinli, and P. W. J. Verlegh, "Consumer effects of front-of-package nutrition labeling: an interdisciplinary meta-analysis," *J. Acad. Mark. Sci.*, vol. 48, no. 3, pp. 360–383, 2020, doi: 10.1007/s11747-019-00663-9.

[3]   R. P. Hamlin, L. S. McNeill, and V. Moore, "The impact of front-of-pack nutrition labels on consumer product evaluation and choice: An experimental study," *Public Health Nutr.*, vol. 18, no. 12, pp. 2126–2134, 2015, doi: 10.1017/S1368980014002997.

[4]   A. Jáuregui *et al.*, "Impact of front-of-pack nutrition labels on consumer purchasing intentions: A randomized experiment in low- And middle-income Mexican adults," *BMC*

Public Health, vol. 20, no. 1, pp. 1–13, 2020, doi: 10.1186/s12889-020-08549-0.

[5]   A. C. Tricco, E. Lillie, W. Zarin, K. K. O'Brien, and H. Colquhoun, "PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation," *Ann. Intern. Med.*, vol. 169, no. 7, pp. 467–473, 2018, doi: https://doi.org/10.7326/M18-0850.

[6]   R. B. Acton, A. C. Jones, S. I. Kirkpatrick, C. A. Roberto, and D. Hammond, "Taxes and front-of-package labels improve the healthiness of beverage and snack purchases: A randomized experimental marketplace," *Int. J. Behav. Nutr. Phys. Act.*, vol. 16, no. 1, 2019, doi: 10.1186/s12966-019-0799-0.

[7]   K. Bolt-Evensen, F. N. Vik, T. H. Stea, K.-I. Klepp, and E. Bere, "Consumption of sugar-sweetened beverages and artificially sweetened beverages from childhood to adulthood in relation to socioeconomic status - 15 years follow-up in Norway," *Int. J. Behav. Nutr. Phys. Act.*, vol. 15, no. 1, 2018, doi: 10.1186/s12966-018-0646-8.

[8]   A. D'Angelo Campos *et al.*, "'Warning: ultra-processed': an online experiment examining the impact of ultra-processed warning labels on consumers' product perceptions and behavioral intentions," *Int. J. Behav. Nutr. Phys. Act.* , vol. 21, no. 1, 2024, doi: 10.1186/s12966-024-01664-w.

[9]   M. Egnell *et al.*, "Modelling the impact of different front-of-package nutrition labels on mortality from non-communicable chronic disease," *Int. J. Behav. Nutr. Phys. Act.*, vol. 16, no. 1, 2019, doi: 10.1186/s12966-019-0817-2.

[10]   M. Egnell *et al.*, "Objective understanding of the Nutri-score front-of-pack label by European consumers and its effect on food choices: an online experimental study," *Int. J. Behav. Nutr. Phys. Act.*, vol. 17, no. 1, 2020, doi: 10.1186/s12966-020-01053-z.

[11]   M. G. Hall *et al.*, "How pictorial warnings change parents' purchases of sugar-sweetened beverage for their children: mechanisms of impact," *Int. J. Behav. Nutr. Phys. Act.*, vol. 20, no. 1, 2023, doi: 10.1186/s12966-023-01469-3.

[12]   D. Hammond *et al.*, "Awareness, use and understanding of nutrition labels among children and youth from six countries: findings from the 2019 – 2020 International Food Policy Study," *Int. J. Behav. Nutr. Phys. Act.*, vol. 20, no. 1, 2023, doi: 10.1186/s12966-023-01455-9.

[13]   C. Julia *et al.*, "Impact of the front-of-pack 5-colour nutrition label (5-CNL) on the nutritional quality of purchases: An experimental study," *Int. J. Behav. Nutr. Phys. Act.*, vol. 13, no. 1, 2016, doi: 10.1186/s12966-016-0416-4.

[14]   L. Oliveira, C. Manoel, M. Ribeiro, D. Pedro, C. S. Rodrigues, and C. Rossoni, "Food Labeling - Knowledge among university students in the Lisbon region: an exploratory study," *Biomed. Biopharm. Res.*, vol. 20, no. 1, pp. 25–36, 2023, doi: 10.19277/bbr.20.1.306.

[15]   M. Panczyk, H. Dobrowolski, B. I. Sińska, A. Kucharska, M. Jaworski, and I. Traczyk, "Food Front-of-Pack Labelling and the Nutri-Score Nutrition Label—Poland-Wide Cross-Sectional Expert Opinion Study," *Foods*, vol. 12, no. 12, 2023, doi: 10.3390/foods12122346.

[16]   T. Scapin *et al.*, "Consumers' Response to Sugar Label Formats in Packaged Foods: A Multi-Methods Study in Brazil," *Front. Nutr.*, vol. 9, no. June, pp. 1–14, 2022, doi: 10.3389/fnut.2022.896784.

[17]   S. Shin, J. Puri, and E. Finkelstein, "A randomized trial to evaluate the impact of Singapore's forthcoming Nutri-grade front-of-pack beverage label on food and beverage purchases," *Int. J. Behav. Nutr. Phys. Act.*, vol. 20, no. 1, 2023, doi: 10.1186/s12966-023-01422-4.

[18]   Z. Talati *et al.*, "The impact of interpretive and reductive front-of-pack labels on food choice and willingness to pay," *Int. J. Behav. Nutr. Phys. Act.*, vol. 14, no. 1, 2017, doi: 10.1186/s12966-017-0628-2.