International Journal of Nutrition Sciences

Journal Home Page: ijns.sums.ac.ir

ORIGINAL ARTICLE

Knowledge on Front-of-Pack Food Labelling among Adult Urban Population in Puducherry, India

Sriragu Anandhavel, Marimuthu Arthi, Sivaramalingam Janani, Soundarajan Madhumadhi, Surendar Rangasamy*, Jagadeeson Barathalakshmi

Department of Community Medicine, Sri Venkateshwaraa Medical College Hospital and Research Centre, Puducherry, India

ARTICLE INFO

*Corresponding author:
Surendar Rangasamy, MD;
Department of Community Medicine,
Sri Venkateshwaraa Medical College
Hospital and Research Centre,
Puducherry, 605 102, India.
Tel: +91-9894520785
Email: surendar222000@gmail.com

ABSTRACT

Background: Font-of-pack food labelling (FOPL) gives knowledge on the nutritional content of pre-packaged food products. It represents an important role in guiding the consumers towards healthier diets and helps in prevention of diet-related adverse health illness. Nutrition labelling on packed food is an evidence-based informative source and is proposed by World Health Organization (WHO) as a plan to avert the non-communicable diseases. This study assessed the knowledge on FOPL among the urban adult population in Puducherry, India.

Methods: A Cross-sectional study was conducted among 1672 adult population of Urban Puducherry using a quota sampling method among adult Urban population (18 years and above) in Puducherry, India. A pre-designed, semi-structured questionnaire consisted of 3 parts was used to collect the data and for analysis.

Results: Among participants, 51% were male, 35% belonged to middle class, and 53.6% had inadequate knowledge on questions related to Food Safety and Standards Authority of India (FSSAI) regulations.

Conclusion: The Awareness and sensitization on the importance of knowledge about the contents of food labels seem to be necessary to be reinforced for consumers. Further the importance on the habit of reading with understanding the labels for its contents must be presented for the consumers.

Introduction

Food safety is important for overall health and wellbeing (1). Front-of-Pack Food Labelling (FOPL) should be in a format that is understandable and acceptable to all (2). FOPL represents an important role in guiding the consumers towards healthier diets and finally it helps in the prevention of diet-related adverse health illness (3). Though labelling nutritive information for selecting the choice of food is rarely used by Indians because of low literacy, perceiving the text-intensive nutrient information in packed food is difficult (4). So, when the consumer has awareness on FOPL, it will be useful for them on purchasing and consumption of food products (5). FOPLs are a widely deployed tool in marketing and it can influence parental decision-making, impact consumer purchase intentions, consumption intentions, attracting shoppers' attention, be an effective alternative to

marketing communication, building a non-price competitive advantage, comparing and evaluating products, simplifying information processing and increasing the sales and enhance willingness to pay extra for a health food (6, 7).

FOPL might also force producers to improve the nutritional quality of products. Labelling basically contains the details of nutrition contents of the food product packed inside which comprises of two components, i.e., nutrient declaration and supplementary nutrition information (6). In 2018, certain criteria for labelling and display on the front of food packs were highlighted. The Food Safety and Standards Authority of India (FSSAI) laid down the thresholds for sugar, salt/sodium and fats for various food and beverage categories which were in line with the World Health Organization in South-East Asia (WHOSEARO) model. The labels were closely observed for nutrient contents declaration on calories, fat, protein dietary fiber, vitamins and mineral content either as percentage daily value or recommended dietary intake, or per 100 grams or 100 mL or per serving size (8).

Since FOPL is evidence-based information, it will highly decrease the public health issues, as they get aware of it. Therefore, goal of this project was to strengthen the practice of usage of FOPL and to improve the regulation of labelling of nutrition (9). Having these on mind, this study aimed to assess the level of perception on FOPL among adult population of selected villages in Puducherry, India and to determine the association between socio-demographic factors and the awareness about FOPL among the study population.

Materials and Methods

This was a cross-sectional study conducted among the urban adult population of Puducherry District of India for a period of 2 months via quota sampling method. The Sample size was calculated to be 1672, considering the 95% confidence interval, 5% margin of error, 10% non-response rate and each 25% of quota from the adult population. A Pre-designed, Semi-structured questionnaire consisted of 03 parts was used to collect the data. Part A was socio-demographic profile including information about age, education level, monthly income and occupation. Part B was awareness on FOPL included a specific questionnaire enrolling 21 individual items to be asked from participants and to record their responses in a Google form. Part C was questions related to FSSAI regulations. Their answers were recorded in Google form too.

The rationale behind asking this type of questionnaire was to engage the participants and

to appreciate their current knowledge on FSSAI. Data were collected after approval from Scientific Review Committee and Institutional Human Ethical Committee. An informed written consent was obtained from each willing respondent from the house to participate in this study. The adult population (18 years and above) in urban villages of Puducherry, India was visited by house-to-house method. Persons who were able to respond to the questions were asked. The inclusion criteria were to be adult population (18 years and older), living in urban villages of Puducherry, To be able to respond to the questions, and to be willing to give consent for participation. The exclusion criteria were houses which were locked after 3 consecutive visits, and houses without an adult respondent. In statistical analysis, the collected data were statistically analyzed using SPSS software (Version 23.0, Chicago, IL, USA). Mean and standard deviation (SD) were calculated. Chi-square test and Pearson correlation tests were applied to find the association.

Results

Out of the total study participants, 51% were male, 59% were between 18-30 years old, and 8.9% were between 51-60 years (Table 1). About 59.6% of participants had a degree/diploma, 29% were in postgraduate degree, above 04.9% were in higher secondary level, 03.3% had high school degree, 2% were in secondary level and 01.1% had a primary degree (Table 2). Regarding occupation, 22% were unskilled, 21.8% were in clerical/shop/farm related work, 18% were as skilled workers, 11.3% were semi-skilled worker, 11% were at semi-professional jobs, 08.9% were unemployed, and 7% were professional workers. In relation to socioeconomic status, the majority belonged to the middle class

Table 1: Frequency regarding the participants age (n=1672).

Age (Years)	Frequency (%)
18-30	987 (59.0)
31-40	280 (16.7)
41-50	256 (15.3)
51-60	149 (09.0)

Table 2: Distribution of participants in relation to educational level (n=1672).

Educational level	Frequency (%)
Primary school	19 (01.1)
Secondary school	32 (02.0)
High school	56 (03.3)
Higher secondary	82 (05.0)
Degree/Diploma	997 (59.6)
Post graduate degree and above	486 (29.0)

(35%), 29% to lower-middle class 15.3% were in lower class, 14.4% in the upper-middle class and only 06.3% belonged to the upper class. Regarding marital status, 50.3% were married, 43.7% were unmarried, while 03%, 02% and 01% were widow/widower, divorced and separated respectively (Table 2).

It was shown that 66% of participants knew about packaged food items to have food pack labelling, 67% thought the food package labelling to be useful for consumers, 59% remembered the information on food package labels, 47% responded about the packed foods to be unhealthy, 59% found that the nutritional information displayed the food package labels, and 55% believed the food labels could alert them. About 58% of study participants responded that the food labels were carefully designed to help attracting the customers and could induces them to purchase the product, 57% realized that the front of package label could guide the consumers towards healthier diets and 56.5% had heard about labelling in food industry (Table 3).

The majority of the participants (83%) said that they consume packed food, 75% knew packed processed foods to cause many health issues, 64% were aware that packed food had high salt, sugar, and fat content. About 67% were familiar with a health rating system for foods, 54% had information on health rating system to be based on salt, sugar, and fat content, 79% were not informed that the symbol for non-vegetarian food symbol to be changed, 57% opted the food package labels to be legible and noticeable, 54% were conscious about FSSAI act and 78% were not aware of any emergency number for FSSAI; whereas 84% did not know about FSSAI mobile applications (Table 4). Also, knowledge of health impact about the contents of packed processed foods has been demonstrated in Figure 1. The participants' responses regarding their understanding levels in relation to food labels were illustrated in Figure 2. The participants' knowledge on information about food package label was also exhibited in Figure 3. The distribution based on reasons for packed processed foods preference was shown in Figure 4.

Around 53.6% of participants had inadequate knowledge on FSSAI regulation, and 59% of participants of age group 18-30 years reported an adequate knowledge on FOPL. A statistically significant knowledge was seen among 76% of people who had attained higher secondary school education and also a statistically significant of professionals (51%) and unskilled workers (69%) had adequate knowledge about the FOPL. About 84% of participants belonged to upper class and had an adequate knowledge; whereas 73% of participants in

Table 3: Distribution based on awareness about front pack labelling of foods (n=1672).

Question	Yes (%)	No (%)	I do not know (%)
Do you know that the packaged food items come with food pack labelling?	1110 (66.0%)	96 (06.0%)	466 (28.0%)
Do you think these food package labelling is useful for consumers?	1116 (67.0%)	123 (07.0%)	433 (26.0%)
Do you remember the information present on food package labels?	987 (59.0%)	369 (22.0%)	316 (19.0%)
Do you think packed foods are healthy?	568 (34.0%)	789 (47.0%)	315 (19.0%)
Does the nutritional information displayed in food pack labelling helpful?	985 (59.0%)	290 (17.0%)	397 (24.0%)
Have you seen this health rating system in food package labels?	1112 (66.5%)	450 (27.0%)	110 (06.5%)
Does these food label alerts you?	913 (55.0%)	387 (23.0%)	372 (22.0%)
Does the carefully designed food label help in attracting the customers and induces them to purchase the product?	961 (58.0%)	103 (06.0%)	608 (36.0%)
Does the front of package label guide the consumers towards healthier diets?	954 (57.0%)	293 (18.0%)	425 (25%)
Have you heard about ISI in food industry?	946 (56.5%)	249 (15.0%)	477 (28.5%)

Table 4: Participants' attitudes about front pack labelling of food (n=1672).

Question	Yes (%)	No (%)
Do you consume packed food?	1381 (83.0%)	291 (17.0%)
Do you know packed processed foods cause many healthy issues?	1255 (75.0%)	417 (25.0%)
Do you know a packed food has high content of salt, sugar, fat?	1069 (64.0%)	603 (36.0%)
Do you know there is a health rating system for food?	1120 (67.0%)	552 (33.0%)
Do you know health rating system is based on salt, sugar, fat?	897 (54.0%)	775 (46.0%)
Are you aware that the symbol for Non-vegetarian food symbol has been changed?	359 (21.0%)	1313 (79.0%)
Are the food package labels legible and noticeable?	960 (57.0%)	712 (43.0%)
Have you heard about FSSAI act?	896 (54.0%)	776 (46.0%)
Do you know the emergency number for FSSAI?	365 (22.0%)	1307 (78.0%)
Do you know about the FSSAI mobile app?	260 (16.0%)	1412 (84.0%)

the lower middle and 56% in the lower class reported inadequate knowledge. There was statistically significance correlation between marital status and knowledge level (Table 5).
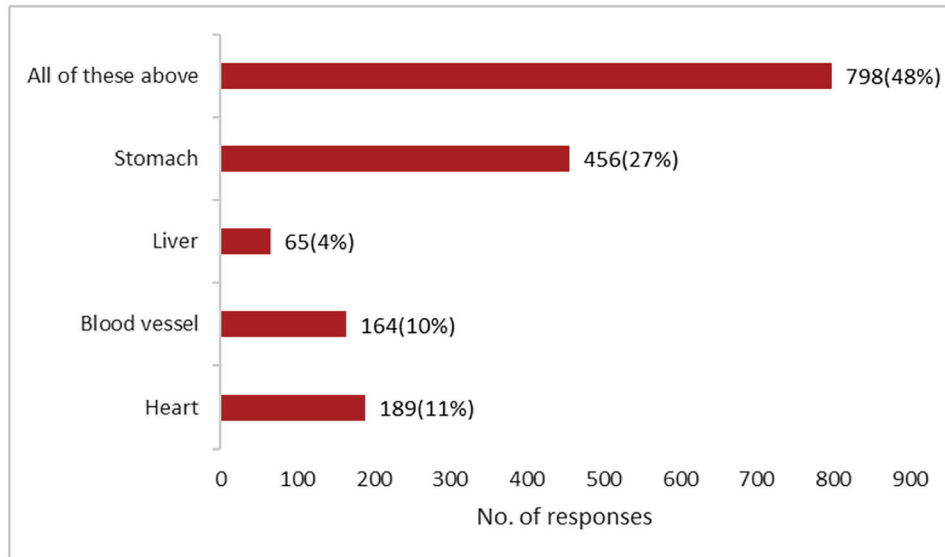

Figure 1: Distribution based on knowledge on health impact regarding the contents of packed processed foods (n=1672).
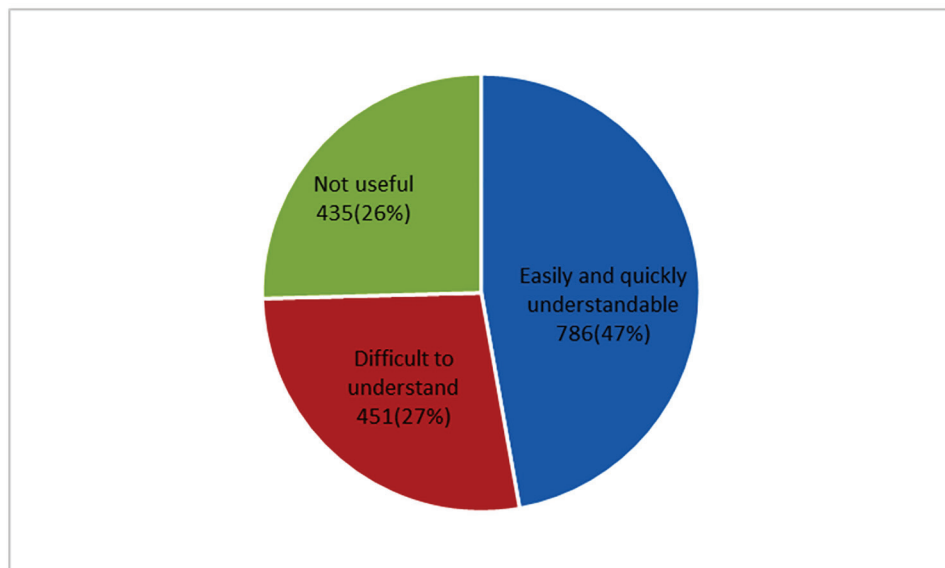

Figure 2: Participants' responses on understanding level of information in food labels (n=1672).
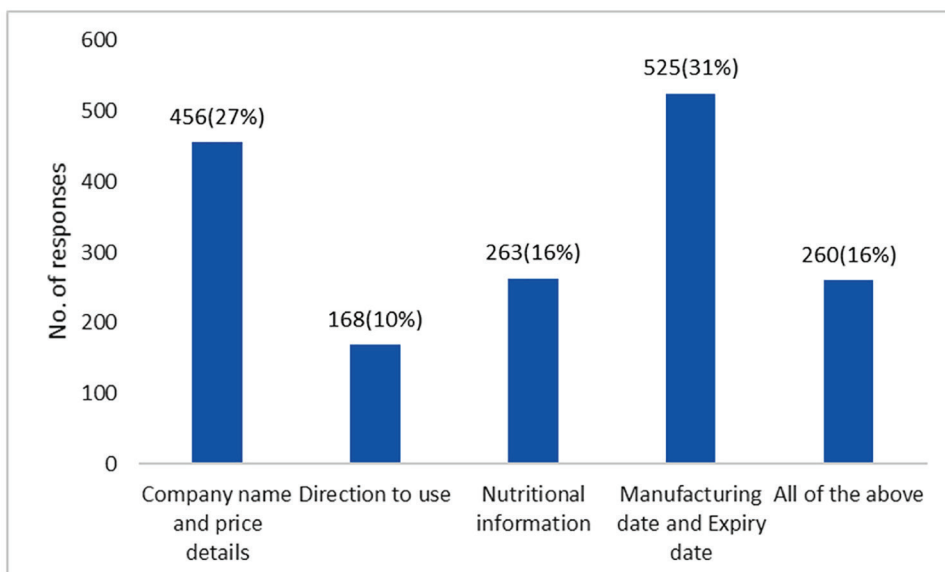

Figure 3: Participants' knowledge on information about food package labels (n=1672).
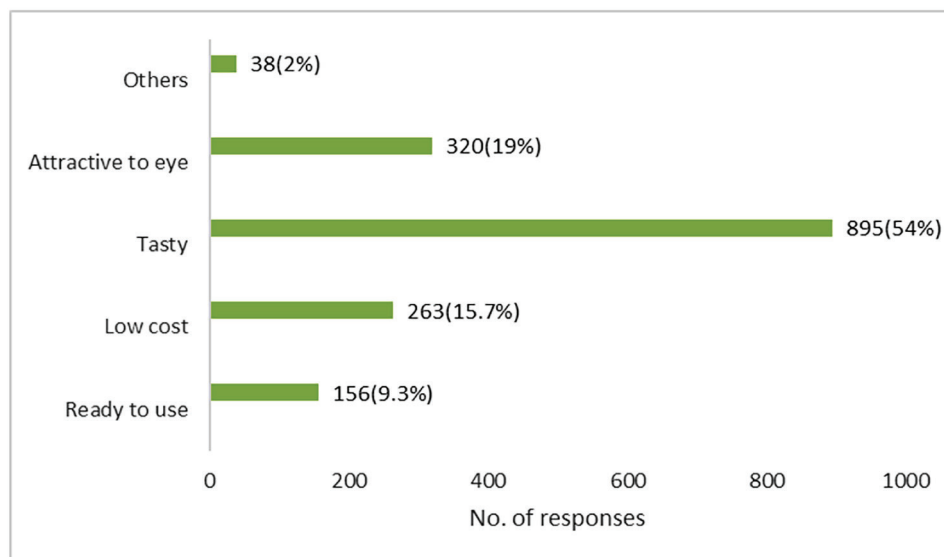
Figure 4: Distribution based on reasons about packed processed foods preferences (n=1672).

Variable	Adequate knowledge	Inadequate knowledge	*P* value
Table 5: Association between socio-demographic factors and the awareness on front-of-pack food labelling among the study population (n=1672).			
Age (Year)			
18-30	586 (59%)	401 (41%)	<0.01*
31-40	96 (34%)	184 (66%)	
41-50	49 (19%)	207 (81%)	
51-60	45 (30%)	104 (70%)	
Gender			
Male	380 (45%)	471 (55%)	0.14
Female	396 (49%)	425 (51%)	
Educational level			
Primary	08 (42%)	11 (58%)	<0.01*
Secondary	19 (59%)	13 (41%)	
High school	39 (70%)	17 (30%)	
Higher secondary	62 (76%)	20 (24%)	
Degree/ Diploma	345 (35%)	652 (65%)	
PG degree and above	303 (62%)	183 (38%)	
Occupation			
Professional	59 (51%)	56 (49%)	<0.01*
Semi professional	41 (22%)	144 (78%)	
Clerical/shop/farm	121 (33%)	245 (67%)	
Skilled worker	115 (39%)	183 (61%)	
Semiskilled worker	101 (53%)	89 (47%)	
Unskilled worker	253 (69%)	116 (31%)	
Unemployed	86 (58%)	63 (42%)	
Socio-economic status			
Upper class	89 (84%)	17 (16%)	<0.01*
Upper middle class	180 (75%)	61 (25%)	
Middle class	263 (45%)	317 (55%)	
Lower middle class	132 (27%)	357 (73%)	
Lower class	112 (44%)	144 (56%)	
Marital status			
Unmarried	359 (49%)	373 (51%)	<0.01*
Married	356 (42%)	486 (58%)	
Separated	18 (90%)	02 (10%)	
Divorced	26 (72%)	10 (28%)	
Widow/Widower	17 (40%)	25 (60%)	
Total	776	896	

*p value <0.01 to be statistically significant.

Discussion

Nutritional ingredients were shown to have a pivotal role affecting the health status of a population that even may lead to food avoidance (10-12). So nutritional labelling on the front of packed food is appreciated by World Health Organization (WHO) across all countries as a policy to fight against chronic nutrition-related diseases (2, 8). A study by Bhattacharya *et al.* showed over half of the consumers with perception about FOPL in India (50.1%) were 18-29 years old (5). Similarly, our study revealed that the majority (59%) of respondents were between 18 and 30 year old. It may be due to young adults choosing more packed food because of its likeable taste. Egnell *et al.* in theirs study found that half (50%) of the study respondents with understanding about FOPL were female (3). In contrast, our study showed most participants were male (51%) that may be due to their busy lifestyle.

The current study illustrated that undergraduates (59.6%) and postgraduates (29%) were the major participants when compared with primary school participants. Similarly, a study of Bhattacharya *et al.* demonstrated that 46% of study participants were graduates, followed by 17% as postgraduates (5). It may be because of a lack of time to prepare food in their hectic schedule. Our study revealed that unskilled employers (22%) were more in comparison with professional ones (7%). We also found that middle-class (35%) respondents were the majority participants in comparison to the upper class individuals (6.3%), because they were commonly read food labels when purchasing and consuming packaged foods to see manufacturing/expiry date and price details. E.g., foods supplemented with probiotics can be beneficial in balancing gut and overcoming many diseases (13, 14).

Bhattacharya *et al.*'s report described that most of the respondents (95%) were aware of the pack food labelling, and participants (88.6%) accepted information in the food label to be helpful; while half (55.4%) of the respondents considered packaged foods to be healthy (5). Our study portrayed that 66% of study participants knew the packaged food items came with a label, 67% imagined the label on food package to be useful for consumers, 59% remembered the information that was present on food package labels, 59% explained that the nutritional information displayed in food pack labelling was helpful. In contrast, Bhattacharya et al.'s report mentioned that about 47% of participants responded the packed foods to be unhealthy that may be due to health consciousness thought (5).

A study conducted in Europe by Van Kleef *et al.* exhibited that nutritional information presented on front of a product can allow the consumers to compare the food products and make quick decisions regarding its purchase (15). In our study, about 57% of respondents encouraged the FOPL since it guided the consumers towards healthier diets. Bhattacharya *et al.* reported that more evidence-based researches are necessary regarding the knowledge and perception of people on FOPL to lay a foundation to formulate laws and policies in relation to the FOPL to attract the customers to purchase a healthier product (5). Therefore, FOPL can be a design element to wisely reflect the packaging design (16).

A study by Croker *et al.* suggested the significant impact of sugar, calories, saturated fat and sodium on household purchases (17). Most of our participants (64%) consumed packed food with knowledge to contain high sugar, salt, fat that can affect the health status. They consumed packed food because of being tasty and attractive to eye. Similar study by Singh *et al.* in a field experiment in rural and urban areas of 6 states (Assam, Delhi, Gujarat, Odisha, Karnataka, Uttar Pradesh) in India demonstrated that all FOPLs helped consumers identify unhealthy packaged products that were high in sugar, sodium and saturated fat (18). Our results recommended that the warning label in front of packed food could help consumers get aware about packaged foods and drinks that were high in amount of nutrients of concern and could cause a stronger impact on policy makers and consumers' purchasing behaviors.

Health symbols can be effective for consumers when they buy products with a front-of packed food. We indicated that 66.5% of participants had seen the health rating system in food package labels; while the symbols in labels on the packed foods could alert them (55%). Hutton *et al.* conducted a study in South Africa and found that consumers preferred the FOPL system presented as a symbolic color or a symbol alone. They suggested standardization of FOPLs too (19). Similarly, in our study, many customers expected warning labels to be present as food labels for judging the packed-processed food to prevent themselves from non-communicable diseases like diabetes, hypertension, stroke, and cardiovascular diseases. Most of our study participants were able to perceive the warning symbol/symbols present in FOPL; but their understanding was less and their knowledge on quality symbols was also low. Saha *et al.* have also noticed the need to provide education on different aspects of labeling information to promote label use worldwide (20).

About 27% of our participants believed that nutrition information on labels was difficult to understand.. Bandeira *et al.* conducted astudy in Brazil and identically reported warning FOPL models

(octagon, triangle and circle) to have a superior performance to be understood when compared to the traffic light (21). Aguenaou *et al.* performed a study across a group of Moroccan consumers and demonstrated that Nutri-Score to be the most effective and incentive criterion for manufacturers to reformulate their products (22). Our findings revealed a significant association between age and awareness on food labels. Earlier studies have also suggested that as increase in age can lead to a decrease in use of food labels (23, 24). Since, older people have less understanding on nutritional labels sas reprted before revealing that nutritional labelling became more stricter with increasing age (25-27).

We also found that a significant association between occupation and awareness on food labels where unskilled workers consumed the maximum packaged foods and beverages when compared to the semi-professional employers that may be due to the busy life style of the employees. A study report by Fard *et al.* showed an association between a higher education level and consumption of a healthier diet (28). Similarly, our research findings denoted to a significant association between educational level and awareness on food labels. Though the education level among consumers was high, their knowledge to interpret the food label was still low.

Vemula *et al.* in India found that 90% of food consumers across different age groups looked for food labels, while the majority (81%) searched for the manufacturing or expiration date (4). In our study, most of respondents (31%) were following the manufacturing or expiration date too and seldom peeped at nutritional information (16%) that may be due to inadequate knowledge about food labels. Grunert *et al.* realized that 17% of the shoppers read food labels and their understanding about nutritional information was limited and consumers were not also knowledgeable with the terminologies on the food labels (29).

Highly educated consumers reported reading and understanding food labels to be easier in comparison to those having lower educational levels (30). Similarly, our study revealed that educated participants found information in food labels to be understandable; where 47% answered to be understandable and 26% responded not to be useful. The majority of our respondents mentioned that they remembered the information on labelling of packed food; but the consumers had wrong perceptions about food labels regarding their food items and it could result in ill-health issues for the consumers. The information in relation to the nutritional content of any packaged food is important as they can allow the consumer to make the right decision before purchasing the product (31).

In our study, 59% of participants answered that the nutritional information displayed in food pack labelling was helpful suggesting that warning labels on front of packaged foods and beverages could indicate excessive salt, sugar or fat contents. Many consumers were interested in front-of pack nutritive content-related information and they preferred more specific front-of-pack information about salt, sugar and fat contents. Therefore, our study strongly suggested that nutritional labelling on the front of the packed food is mandatory and should give knowledge about nutritional information present in food label. Our study participant's responses about knowledge on health impact of the contents of packaged foods can affect all vital organs such as heart, liver, stomach, and blood vessels. Our participants were aware about health issues but their knowledge on FOPL was still low and due to lack of knowledge, it may lead to irreversible body organ damages (32-34).

The Food Safety and Standards Authority of India works under the Ministry of Health and Family Welfare, Government of India strongly established regulations about the food safety in India (35). Arokiaraj *et al.* suggested that FSSAI should take the steps to apply and proceed for license and registration for food businesses. FSSAI rules and regulations should be strictly implemented all over India and properly monitor the activities of food business operators to fulfil the FSSAI standards in future. The consumers should have knowledge on what they are consuming and should be aware about the quality of ingredients in the food outlets (35).

The limitations of this study were that the literature had very few articles and an additional point that was noted during the data collection was that the respondents were not willing to answer the questions, though they were aware of the answers which could have been on a gross population like State or National level. Our study was not able to be done like that due to the limited study duration factor. As this present study reveals that the knowledge of study participants on questions related to FSSAI regulations is inadequate, it may be due to obstacles in enforcement, lack of understanding and rapidly evolving food industry outlook.

Conclusion

The Awareness and sensitization on the importance of knowledge about the contents of food labels seem to be necessary to be reinforced for consumers. Further the importance on the habit of reading with understanding the labels for its contents must be presented for the consumers. The policymakers

should act as a decision-making tool for national regulatory authorities to use the findings to decide which labelling system would dominate in the country to be a mandatory nutrient declaration.

Authors' Contribution
The conception or design of the work: SA, MA, SR, JB; The acquisition, analysis, or interpretation of data for the work: SA, MA, SJ, SM, SR; Drafting the work or reviewing it critically for important intellectual content: SA, MA, SR; Final approval of the version to be published: SR.

Conflict of Interest
None declared.

References

1   Flores ARC, Angbengco JMC. Assessment of Knowledge, Attitude, and Practices of Food Handlers on Food Safety in Selected Tertiary Hospitals in Metro Manila, Philippines. *Int J Nutr Sci*. 2024;9:39-47. DOI: 10.30476/IJNS.2024.100091.1265.

2   Momeni M, Riasatian M, Karimian Z, et al. Improvement of Snack Choices among Children by TrafficLight Food Labeling Education Employing Jigsaw Method. *Int J Nutr Sci*. 2025;10:22-29. DOI: 10.30476/ijns.2025.100348.1278.

3   Egnell M, Talati Z, Hercberg S, et al. Objective Understanding of Front-of-Package Nutrition Labels: An International Comparative Experimental Study across 12 Countries. *Nutrients*. 2018;10:1542. DOI: 10.3390/nu10101542. PMID: 30340388.

4   Vemula SR, Gavaravarapu SM, Mendu VV, et al. Use of food label information by urban consumers in India - a study among supermarket shoppers. *Public Health Nutr*. 2014;17:2104-14. DOI: 10.1017/S1368980013002231. PMID: 23965761.

5   Bhattacharya S, Bera OP, Shah V. Consumers' Perception About Front of Package Food Labels (FOPL) in India: A Survey of 14 States. *Front Public Health*. 2022;10:936802. DOI: 10.3389/fpubh.2022.936802. PMID: 35910921.

6   Shangguan S, Afshin A, Shulkin M, et al. Food PRICE (Policy Review and Intervention Cost-Effectiveness) Project. A Meta-Analysis of Food Labeling Effects on Consumer Diet Behaviors and Industry Practices. *Am J Prev Med*. 2019;56:300-314. DOI: 10.1016/j.amepre.2018.09.024. PMID: 30573335.

7   Nasimi N, Mohammad Hosseini M, Mohammadi Nasrabadi F, et al. Nutritional Traffic Light Knowledge and Food Choices: A Cross-Sectional Study at Purchase Point. *Int J Nutr Sci*. 2024;9:299-307. DOI: 10.30476/ijns.2024.100342.1273.

8   WHO: Global Strategy on Diet, Physical Activity and Health, Resolution of the Fifty Seventh World Health Assembly WHA57.17, 2014.

9   Jones A, Neal B, Reeve B, et al. Front-of-pack nutrition labelling to promote healthier diets: current practice and opportunities to strengthen regulation worldwide. *BMJ Glob Health*. 2019;4:e001882. DOI: 10.1136/bmjgh-2019-001882. PMID: 31908864.

10   Mehrabani D, Masoumi SJ, Masoumi AS, et al. Role of Diet in Mesenchymal Stem Cells' Function: A Review. *Int J Nutr Sci*. 2023;8:9-19. DOI: 10.30476/IJNS.2023.97788.1221.

11   Hedayati A, Homayuon M, Mobaracky A, et al. Lithium Chloride, Ketogenic Diet and Stem Cell Transplantation in Treatment of Bipolar Disorder. *Int J Nutr Sci*. 2024;9:80-82. DOI: 10.30476/IJNS.2024.99601.1250.

12   Mehrabani D, Vahedi M, Eftekhari MH, et al. Food Avoidance in Patients with Ulcerative Colitis: A Review. *Int J Nutr Sci*. 2017;2:189-195.

13   Masoumi SJ, Mehrabani D, Saberifiroozi M, et al. The effect of yogurt fortified with Lactobacillus acidophilus and Bifidobacterium sp. probiotic in patients with lactose intolerance. *Food Sci Nutr*. 2021;9:1704-1711. DOI: 10.1002/fsn3.2145. PMID: 33747481.

14   Azad A, Ranjbaran AR, Zareshahrabadi Z, et al. Protective effects of the probiotic bacterium streptococcus thermophilus on candida albicans morphogenesis and a murine model of oral candidiasis. *Iran J Med Sci*. 2021;46:207-217.

15   van Kleef E, van Trijp H, Paeps F, et al. Consumer preferences for front-of-pack calories labelling. *Public Health Nutr*. 2008;11:203-13. DOI: 10.1017/S1368980007000304. PMID: 17601362.

16   Savov R, Tkac F, Cheben J, et al. Impact of Different FOPL Systems (Nutri-Score vs. Nutrinform) On Consumer Behaviour: Case Study of the Slovak Republic. *Amfiteatru Economic J*. 2022;24:797-816. DOI: 10.24818/EA/2022/61/797.

17   Croker H, Packer J, Russell SJ, et al. Front of pack nutritional labelling schemes: a systematic review and meta-analysis of recent evidence

relating to objectively measured consumption and purchasing. *J Hum Nutr Diet*. 2020;33:518-537. DOI: 10.1111/jhn.12758. PMID: 32364292.

18 Singh SK, Taillie LS, Gupta A, et al. Front-of-Package Labels on Unhealthy Packaged Foods in India: Evidence from a Randomized Field Experiment. *Nutrients*. 2022;14:3128. DOI: 10.3390/nu14153128. PMID: 35956305.

19 Hutton T, Gresse A. South African consumer perception of five front-of-pack label formats. *J Consum Sci*.2020; 5:126-39.

20 Saha S, R Vemula S, Mendu VV, et al. Knowledge and practices of using food label information among adolescents attending schools in Kolkata, India. *J Nutr Educ Behav*. 2013;45:773-9. DOI: 10.1016/j.jneb.2013.07.011. PMID: 24021455.

21 Bandeira LM, Pedroso J, Toral N, et al. Performance and perception on front-of-package nutritional labeling models in Brazil. *Rev Saude Publica*. 2021;55:19. DOI: 10.11606/s1518-8787.2021055002395. PMID: 33978115.

22 Aguenaou H, El Ammari L, Bigdeli M, et al. Comparison of appropriateness of Nutri-Score and other front-of-pack nutrition labels across a group of Moroccan consumers: awareness, understanding and food choices. *Arch Public Health*. 2021;79:71. DOI: 10.1186/s13690-021-00595-3. PMID: 33957970.

23 Balasubramanian SK, Cole C. Consumers' Search and Use of Nutrition Information: The Challenge and Promise of the Nutrition Labeling and Education Act. *J Mark*. 2002;66:112-27. DOI: 10.1509/jmkg.66.3.112.18502.

24 Kim SY, Nayga RM Jr, Capps O Jr. The effect of food label use on nutrient intakes: an endogenous switching regression analysis. *J Agric Resour Econ*. 2000;25:215-31. DOI: 10.22004/ag.econ.30831.

25 Andrews JC, Netemeyer RG, Burton S. The Nutrition Elite: Do Only the Highest Levels of Caloric Knowledge, Obesity Knowledge, and Motivation Matter in Processing Nutrition Ad Claims and Disclosures? *J Public Policy Mark*. 2009;28:41-55. DOI: 10.1509/jppm.28.1.41.

26 Govindasamy R, Italia J. The influence of consumer demographic characteristics on nutritional label usage. *J Food Prod Mark*. 2000;5:55-68. DOI: 10.1300/J038v05n04_04.

27 Coulson NS. An application of the stages of change model to consumer use of food labels. *Br Food J*. 2000;102:661-8. DOI: 10.1108/00070700010362031.

28 Fard NA, Morales GDF, Mejova Y, et al. On the interplay between educational attainment and nutrition: a spatially-aware perspective. *EPJ Data Sci*. 2021;10:18 DOI:10.1140/epjds/s13688-021-00273-y.

29 Grunert KG, Fernández-Celemín L, Wills JM, et al. Use and understanding of nutrition information on food labels in six European countries. *Z Gesundh Wiss*. 2010;18:261-277. DOI: 10.1007/s10389-009-0307-0. PMID: 21124644.

30 Singla M. Usage and understanding of food and nutritional labels among Indian consumers. *Br Food J*. 2010;112:83-92. DOI: 10.1108/00070701011011227.

31 Osei MJ, Lawer D, Aidoo, R. Consumers' use and understanding of food label information and effect on their purchasing decision in Ghana; a case study of Kumasi metropolis. *Asian J Agric Rural Dev*. 2013;2:351-65. DOI: 10.22004/ag.econ.197981.

32 Karimdavijani S, Ahmadi A, Askarpour M, et al. Association between the Quality and Diversity of Diet and the Risk of Colorectal Cancer. *Int J Nutr Sci*. 2025;10:244-252. DOI: 10.30476/ijns.2025.103703.1338.

33 Makhtoomi Z, Alijani S, Shateri Z, et al. The Association between Low-Carbohydrate Diet Score and Conventional Risk Factors of Cardiovascular Diseases in Iranian Adult Population: A Cross-Sectional Study. *Int J Nutr Sci*. 2025;10:253-260. DOI: 10.30476/ijns.2025.103550.1335.

34 Babajafari S, Taghdir M, Rostami H. The Association between Macronutrient Quality Index and Global Dietary Quality Score with Metabolic Syndrome among Iranian Male Staff Population. *Int J Nutr Sci*. 2025;10:39-47. DOI: 10.30476/ijns.2025.102413.1318.

35 David A, Kumar CG, Jeganathan GS. Impact of Food Safety and Standards Regulation on Food Business Operators. In: International Conference 2022- Entrepreneurship and Sustainability in the Digital Era At: Assumption University of Thailand. 2022.