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Research Article
Impact of Front-of-package (FoPTL) Traffic Light Nutrition Labels in the College Students

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Abstract

Background and Objective: Front-of-pack Traffic Light (FoPTL) label have been widely discussed as a tool for guiding consumers with regard to making healthy food purchase choices. Despite the prevalence of these labels, Indonesian studies on the impact of FoPTL label on consumers are extremely scant. As a response, this study aimed to evaluate both the acceptance (liking, attraction and cognitive workload) and the subject's objective comprehension of FoPTL label. **Materials and Methods:** The study employed a pretest-post test quasi-experimental design (control group). Forty college students were invited to participate as the subjects who were divided into intervention group and control group. They introduced to different nutrition labelling formats: FoPTL label (intervention group) and nutrition facts labels (control group). The participants were asked to complete a questionnaire containing 13 questions on the acceptance of nutrition labels (including their liking, attraction and cognitive workload) and 23 questions aimed at measuring their comprehension of the nutrition labels and their ability to identify the health value of a food product from the nutrition labels provided. **Results:** The mean difference between the two groups was analyzed using an independent t-test. The empirical evidence was derived from the results indicated that the FoPTL label had higher acceptance than the nutrition facts label ($p<0.05$). The comprehension test indicated that the FoPTL label had a higher mean difference of correct answers (28.80+12.63) than the nutrition facts label (12.50+20.76). **Conclusion:** FoPTL label were more effective in terms of improving college student consumers' awareness when selecting healthier food products.

Key words: FoPTL label, nutrition fact label, acceptance, comprehension, college students

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Food selection plays a determining role in obesity as a serious and growing health issue throughout the world[1,2]. Studies and research have documented the impact of the use of nutrition labels on the increase of nutrition values such as fiber and assisting in the reduction of caloric intake from sugar, fat, natrium and cholesterol[3-5]. Nutrition labels are viewed as a potentially cost-effective tool in helping to guide consumers' selection behavior, which may be beneficial in preventing nutrition-related diseases such as heart disease, diabetes and cancer[1,2,6-8]. College students are significantly more prone to poor comprehension and attitudes with regard to the reading of nutrition labels. Their progression from adolescence to adulthood is a period marked by changes in their attitudes, routines and preferences. This adaptative phase marks the period in which they begin to make their own decisions regarding food selection[9-11].

Effective nutrition labels provide accurate information aimed at assisting consumers to quickly evaluate the healthiness and attractiveness of food products (liking, familiar, easy to comprehend, affect purchase intention and rated as credible)[12]. Thus, it is possible to measure the effectiveness of nutrition labels by evaluating consumers' level of comprehension and acceptance (including liking, attractiveness and cognitive workload) towards them. Sadly, the average reading behavior and level of comprehension of Indonesian consumers remain low[13,14].

In a bid to both increase consumers' reading behavior and aid their understanding of nutrition labels, in 2007 the UK Food Standards Agency (FSA) developed Front-of-Pack Traffic Light (FoPTL) label. The design characteristics of Front-of-Pack (FoP) label include a color-coded categorisation of the food product's nutritional value center on the three colors (traffic lights) of red (high level), yellow (medium level) and green (low level). The system is based on regulations published by the European Parliament with the most commonly displayed nutrients comprising total fat content, saturated fat, sugar and natrium. By and large, these studies revealed that consumers were more inclined to choose healthier food products using the traffic light (TL) labelling system than other forms of label[6,15]. Furthermore, another study demonstrated the declining consumption of calories, total fat, saturated fat and salt following the introduction of TL nutrition labels[16]. An experimental study conducted by Sonnenberg *et al.*[17] in a hospital canteen in Boston concluded that an intervention based on FoPTL nutrition label led to an improvement in consumers' awareness of the health aspect of the products they purchased[17].

Those consumers who were fully aware of the FoPTL nutrition label tended to buy healthier food products. A similar study was conducted by Seward *et al.*[18] at the canteen of Harvard University. Over the course of the 7 week intervention, they recorded a drop in the sales of those food products with yellow Front of Package (FoP) label (a weekly decrease of 2.2%) and red FoP labels (a weekly decrease of 4.1%) among the intervention group. Moreover, 48% of the college student participants reported a change in their food selection following the FoPTL intervention, with a total of 59% of the college students affirming the usefulness of FoPTL label[18]. Likewise, Hamlin *et al.*[19], in their study conducted among 250 college students in New Zealand, found that the subjects in the nutrition labels intervention group made healthier food purchases than those in the control group[19].

Two another studies on nutrition labelling conducted in New Zealand and Uruguay[20,21]. The first study assessed the impact of the Multiple Traffic Light label and Health Star Rating on the healthiness of consumer food purchases via smartphone application. The second study studied the impact of using FoPTL and The Chilean warning system on the children in grades 4-6 from 12 primary schools. The impact of FoPTL labeling on children's choices was lower than the warning system. Both the study had different tool and the type of subject to assess the consumer nutrition information knowledge and puchase. The principal rationale for the sample selection was the poor reading behavior of nutritional labels. From the total population, only 13.4% who always read nutrition labels before purchasing food products, while 57.5% had poor nutrition label reading behavior.

The study focused on the female college student (aged 18-24) due to women were more likely to read nutrition labels than men[22]. In addition, college students had been found to have a low comprehension rate (44.62) of the nutritional value of food[23]. Another rationale for the sample selection was the ready availability and ease of purchasing packaged products at the numerous supermarkets and shopping centers located around the UI campus area. The present study aimed to assess the FoPTL labels on the attractiveness (comprehension) and acceptance to female college students.

The present study used FoPTL in dummy packages and booklet explaining FoPTL nutrition label for the intervention group and the nutrient information labels for control group. The study had different target, study design and the tools. In addition, a limited number of studies on the effect of FoPTL in campus setting in Asian Region reported. The present studies will add to the list of the Asian studies in the public health nutrition field.

MATERIALS AND METHODS

Population and sample: This study employed a quasi-experimental design on 40 students at UI. The inclusion criteria were as follows: (i) Currently a student at UI, (ii) Female, (iii) Aged between 18 and 24 and (iv) Had independently purchased packaged food products in the last month. To ensure the homogeneity of the sample, women were selected as the research subject for the study. In addition, women were more likely to read nutrition labels than men[22]. Further subject characteristics were (i) Studying the Social Humanities discipline and (ii) No family member working in either the food or health industries. In the first phase, 20 subjects were selected using the Purposive Sampling Method based on the aforementioned inclusion criteria. These 20 subjects formed the intervention group, while the other 20 subjects made up the control group. An ethical review license for this study was obtained from the Faculty of Public Health, UI. All subject should filled the informed consent before participating in the study.

Questionnaire: An analysis was performed of the completed questionnaires containing personal information, answers on reading behavior with regard to nutrition labels, the acceptance of nutrition labels and the participants' comprehension of nutrition labels. The questionnaire used was a modified version of a previously published nutrition knowledge questionnaire[24,25], nutrition labels acceptance questionnaire[2] and nutrition labels comprehension questionnaire[4,12,26]. A trial test of the questionnaire was performed on a different research subject.

Dummy packages: The dummy packages used were fictitious food or drinks packages that incorporated a picture of the food, the packaging weight and nutrition labels. In order to avoid bias, the imaginary brand name used differed from those already found within the market. The food products selected were yogurt, instant noodles and wafers. The products were selected based on a survey of the biggest-selling packaged food products in Indonesia[27].

Label format front-of-pack (FoP): Two commonly used FoP nutrition label were the nutrient-specific and summary labels. Nutrient-specific labels contain information pertaining to several nutrients in the form of, for example, Guideline Daily Amount (% Guideline Dietary Amount (GDA)) and TL indicators. The percentage GDA figures revealed information on the nutritional element content of each serving and the weight (gram) and the Recommended Dietary Allowance (RDA) amounts that represented the requirements for these nutritional elements. The categorization of FoPTL nutrition labels was based on three colors: red (indicating a high level), yellow (for a medium level) and green (for a low level). In principle, FoPTL nutrition labels disclosed information pertaining to the following several nutrients: total fat, saturated fat, sugar, natrium and energy. The level of each nutrient contained within the product in question was displayed according to the relevant color (i.e., red, yellow or green)[28,29].

Traffic light (TL): The design was aimed at educating consumers through the provision of a simple and intuitive expression of a product's nutritional information that they could use to help them make healthier food choices[30]. Each of the TL colors indicated expert recommendations with regard to the total energy and nutrients contained in the product. The three main colors used in the TL design and their meanings put in Fig. 1 as follows[20]:

- **Red:** Food product contains a high level of the ingredients in question-for example, the product was high in fat, had a high salt content, etc. and may therefore contributed to nutrient-related diseases such as diabetes. Red denoted that the food product was fine to eat the food occasionally but that consumers should carefully monitor how often or how much of these products they consume
- **Yellow:** Food product contains moderate levels of the ingredients i.e., fat, saturated fat, sugar and salt nutrients but the level of consumption must still be controlled
- **Green:** Low fat, sugar and/or salt content. The more green light indicators

Booklet: The educational media for teaching consumers how to read nutrition labels comprised two booklets, one

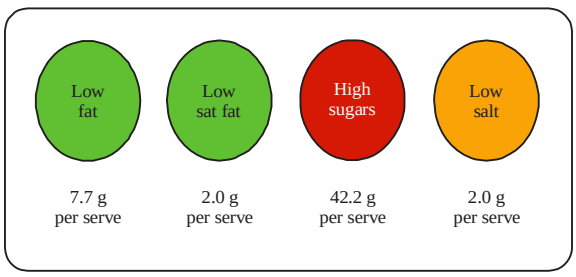

Fig. 1: Design of food of traffic light (FoPTL) nutrition label

explaining FoPTL nutrition label for the intervention group and the other on nutrient information labels for the control group. Both booklets explained the concept of nutrition labels, the composition of the food products and how to read and use the labels, in addition to a brief description of fat, sugar and salt and their impact on health.

Data collection: The study was conducted over a period of three weeks (three meetings) in March-May, 2018 at Faculty of Economic and Business and Faculty of Social and Political Science, Universitas Indonesia at Depok city, West Java province, Indonesia. The study began with the collection of primary data, which included the following: (i) Subject characteristics (age, nutritional status, living allowance), (ii) Nutritional and health knowledge levels, (iii) Nutrition labels reading behavior and (iv) Acceptance and comprehension of FoPTL labels. College students from the Economic and Business Faculty, UI were appointed as the intervention group and looked at FoPTL labels, while students from the Social and Political Sciences Faculty, UI were established as the control group who given the nutrition value information labels. A pre-test was used to assess the subjects' level of understanding of nutritional labels in both groups, with the subjects being required to answer 23 questions regarding their understanding of nutritional labels based on dummy food product packaging. The survey participants had received booklets designed to educate them on how to read nutrition labels and the nutritional content of different foods and beverages. The booklets also provided an explanation of the consequences of eating below or above their recommended nutritional intakes. At the second meeting in week 2, an educational seminar on how to read and use nutrition labels undertaken. At the third meeting in week 3, the subjects were tested on their healthy food selection abilities based on the nutrition labels displayed on the dummy packaging. There were 13 point questionnaires to measure the subjects' acceptance of nutrition labels. Each session lasted for between 15 and 30 min. Questionnaires containing 23 multiple choice questions were distributed to measure the subjects' understanding of nutrition labels. The questions enquired about (i) The categorization of nutritional content and (ii) Food product selection based on the nutritional content disclosed on the label.

Data analysis: Data analysis was performed using SPSS 21.0. A chi-square test was used to obtain the mean value of acceptance in both groups at the end of the intervention. Aside from analyzing the changes and differences, bivariate analysis was recommended to analyze the correlation between the numerical variables. The statistical tests employed in this study were the paired t-test and independent t-test. The paired t-test was utilized to examine the difference in mean between the intervention group and control group at the pre-test and post-test stages. The independent t-test was conducted to investigate the mean difference between the intervention group and control group's acceptance at the pre-test and post-test stages. The criterion for significance was set at 95%.

RESULTS

Data in Table 1 presented the characteristics of the subjects in the intervention group and the control group. Both groups had homogenous characteristics (age, household composition, the frequency of packaged product purchase and knowledge of nutrition). The majority of the subjects lived independently in either a dormitory or boarding house. The research subjects comprised those whose parents' income was in the range IDR 3,000,000-IDR 10,000,000 (for both the intervention group and control group). Moreover, the majority of the subjects spent IDR 259,000 on fewer than 4 purchases of packaging food products. Current findings showed that even-though most of the subjects had a proper level of awareness with regard to health issues, their knowledge and understanding of nutrition remained very shallow. Between the intervention group and control group, the former had a better understanding of nutrition.

The results pertaining to the mean value of the subjects' understanding of nutrition labels before and after the research period were presented in Table 2. The change in the mean difference of the intervention group at the end of study was twice the size of that of the control group (28.8 points vs. 13.05 points, respectively). On the other hand, the intervention group also had a higher acceptance level which covered several aspects, namely liking, attractiveness and perception of cognitive workload. The superiority of the intervention group can also be seen from the average difference in the acceptance of nutrition labels. Further analysis proved the significant difference in the acceptance of nutritional labels between the two groups (Table 3).

Table 1: Characteristic of subjects

	Intervention (n = 20)		Control (n = 20)			
Variables	n	%	n	%	95% CI	p-value
Residence status						
Alone (boarding house)	12	60	11	55	0.350-4.307	0.749
Living with family	8	40	9	45		
Family income						
>IDR 10,000,000	3	15	1	5		
IDR 5,000,000-IDR 10,000,000	8	40	4	20	0.145-8.786	0.113
IDR 3,000,000-IDR 5,000,000	8	40	9	45		
<IDR 3,000,000	1	5	6	30		
Expenditure of buying packaging food product						
>IDR 259,000	7	35	9	45	0.184-2.350	0.519
≤IDR 259,000	13	65	11	55		
Frequency of buying packaging food product						
>4 times	7	35	8	40	0.224-2.912	0.744
≤4 times	13	65	12	60		
Health perception						
Good	16	80	14	70	0.400-7.340	0.465
Bad	4	20	6	30		
Nutrition knowledge						
Good (>64.83)	13	65	9	45	0.636-8.106	0.204
Bad (< = 64.83)	7	35	11	55		

Table 2: Comparison of mean difference nutrition label understanding score after study

	Mean±SD				
Groups	Pre-test	Post-test	Difference	95% CI	p-value
Intervention	61.00±11.72	89.80±8.65	28.80	22.953-34.647	0.000*
Control	53.30±16.86	66.35±15.58	13.05	3.618-22.482	0.009*

*Significant level at p<0.05

Table 3: Comparison of nutrition label acceptability in the two groups

Acceptability component	Mean±SD Intervention	Difference	Control	95% CI	p-value
Liking	4.50±0.500	3.55	0.440	0.648-1.252	*0.000
Attractiveness	4.16±0.603	3.69	0.370	0.155-0.795	*0.005
Perceived cognitive workload	4.42±0.510	3.48	0.533	0.606-1.274	*0.000

*Significance at p<0.05, DS: Deviation standard

DISCUSSION

Amelioration of the understanding and acceptance of nutrition labels at the end of the study period was supported by the significant difference between the understanding and acceptance of nutrition labels of the intervention and control groups. Taking into account the acceptance indicators of (i) Liking, (ii) Attractiveness and (iii) Perceived cognitive workload, the intervention group had a higher acceptance rate than the control group. The present study confirm the results obtained in studies by Borgmeier and Westenhoefer[15] and Sonnenberg *et al.*[17] which revealed a strong association between consumers' ability to select healthy products and the labelling system, which in the case indicated that TL label was more effective in improving consumers' acceptance[15,17]. A study on consumer understanding of nutrition labels stated that interpretive tools can help consumers assess the impact of nutrients on health. The study maintained that consumers prefer simple to complex nutrition labels[1]. This finding was supported in research by Hersey *et al.*[28], who found that simplified nutrition labels influenced consumer decision-making and attitudes, including better attention, understanding, use and purchasing behavior[28]. Edge *et al.*[30] revealed that FoP nutrition labels can

improve consumers' ability to identify healthier products[30]. Likewise, Roberto and Khandpur[31] discovered that the FoP nutrition labels can improve the accuracy of a consumer's assessment of a food product's nutritional value[31]. Research carried out by Hawley *et al.*[32] suggested that consumers perform better in identifying the health value of a product that employs a Multiple Traffic Light (MTL) system of indicators than other labelling formats[32].

Significant differences between the intervention group and control group were primarily found for the categorization component of nutrient content and product selection based on nutrient content. Meanwhile, there was no significant difference between the two intervention groups with regard to nutrient value. It was the case because the FoPTL nutrition label disclose additional information in the form of a color code which can be used to denote high/medium/low as required. As a result, consumers are able to categorize products according to their nutritional value. The numerical information deemed effective for measuring the nutritional value was available on both the FoPTL nutrition label and other nutrition labels. The lower comprehension rate of the control group compared to the intervention group can be explained by a study by Cow burn and Stockley[1], who discovered that consumers had a weak level of comprehension of numerical or technical nutrition labels[1].

Furthermore, consumers had difficulty in understanding the impact of each nutrient in the context of their health, as well as the terms used on the nutrition labels. It was assumed that different label formats can cause a different level of absorption of information[33]. In a study by the Food Standards Agency[34], the subjects were asked to evaluate whether a nutrient was considered to be high, medium or low in content[35]. Among the various label formats, the FoPTL nutrition label were perceived as containing more correct information than other nutrition labels. The underlying cause of this phenomenon was that the FoPTL nutrition label provided the information that was required, which was not the case with the other nutrition labels. In another study, the use of RDA was believed to have helped consumers who wanted to purchase a food product that had a high content of a specific nutrient[36]. Moreover, the present study found that the intervention group outranked the control group in terms of correctly answering the questions posed in the questionnaire. Similar findings were observed by Which[33], where 90% of the subjects in a study correctly answered the questions asked by using TL label[37].

Studies conducted by Grunert and Wills[38] and Van Kleef *et al.*[35] in various countries confirmed that FoP labels have better label acceptance and comprehension than other types of nutrition labels placed on the back of the packaged food[38,35]. Consumers were drawn to a more simplified label, which corroborates our finding of greater acceptance of FOP labels[32]. Besides, unembellished labels can be easily located when shopping for food and beverages[36]. The evidence presented by Maubach *et al.*[37] showed a consistent link between the use of FoP labels and consumers' ability to understand nutrition labels[37]. Among the factors that drew consumers to FoP labels were the use of colored symbols to alert consumers to the nutrient content of the foods or beverages in question, along with the 'easy to understand' nature of FoP label. A study by the FSA found that MTL and color-coded GDA were preferable to other nutrition labels.

As previously mentioned, consumers are attracted to color-coded labels[34,39]. Moreover, the use of RDA serves to bolster consumers' trust in the information disclosed in the nutrition labels. The RDA data also enables consumers to verify information and provides a sense of openness and transparency[39]. Liking is not necessarily associated with comprehension. Nonetheless, it can have a large impact on the use of nutrition labels. Higher liking of a nutrition label was highly correlated with a better product evaluation process[40]. Consumers declared their preference for the FoPTL nutrition label design due to its use of colors, which served to improve the level of attention that they paid to it. In addition, it stimulated their response time and generated a lower rate of misinterpretation of nutritional value compared to non-color-coded nutrition labels[41].

CONCLUSION

The study concluded that the FoPTL label acceptance at the intervention and control groups increased before and after being given intervention. The intervention group had higher FoPTL label understanding and acceptance than the control group. Both groups had FoPTL acceptance which were significantly at pre-post study.

RESEARCH LIMITATIONS

This study had a number of limitations in the form of the time constraint, the absence of a negative control group and the acceptance and comprehension of the nutrition labels questionnaires. Firstly, the study was conducted over a very brief time period (3 weeks), partly due to the end of the research subjects' college term, which made it impossible to extend the research period. Another limitation was the researcher's attempt to avoid the month of Ramadhan (fasting

month). The fact that the majority of the subjects were fasting during Ramadhan reduced the internal validity of the study. A further limitation of the study was that it did not employ a negative control group. Consequently, it was not possible to perform an examination of the intervention group's effectiveness. Moreover, the researcher had not conducted a validation test of the questionnaire, meaning that the sensitivity of each question asked could not be known.

SIGNIFICANCE STATEMENT

The study showed significant difference of FoPTL label understanding and acceptance among the intervention and control groups. The study had new methodology by using quasi experimental study design on the female college students from social science background who might be had limited nutrition information knowledge and care. The study will complete and support over prior research results in the world mainly in Asian Region.

The study findings can be used by the National Agency of Drug and Food Control of Republic of Indonesia (BPOM RI) as the basis for a further investigation of FoPTL label by employing a different research methodology, subject characteristics and location (future studies may be conducted in rural areas).

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REFERENCES

1. Cowburn, G. and L. Stockley, 2005. Consumer understanding and use of nutrition labelling: A systematic review. Public Health Nutr., 8: 21-28.
2. Mejean, C., P. Macouillard, S. Peneau, S. Hercberg and K. Castetbon, 2013. Consumer acceptability and understanding of front of pack nutrition labels. J. Hum. Nutr. Diet., 26: 494-503.
3. Kim, S.Y., R.M.J. Nayga and O.J. Capps, 2000. Food label use on the effect intakes: An endogenous nutrient regression analysis switching. J. Agric. Resour. Econ., 25: 215-231.
4. Drichoutis, A.C., P. Lazaridis and R.M. Nayga, Jr., 2006. Consumers' use of nutritional labels: A review of research studies and issues. Acad. Market. Sci. Rev., 9: 93-118.
5. Besler, H.T., Z. Buyuktuncer and M.F. Uyar, 2012. Consumer understanding and use of food and nutrition labeling in Turkey. J. Nutr. Edu. Behav., 44: 584-591.
6. Kelly, B., C. Hughes, K. Chapman, J.C.Y. Louie and H. Dixon *et al*., 2009. Consumer testing of the acceptability and effectiveness of front-of-pack food labelling systems for the Australian grocery market. Health Promotion Int., 24: 120-129.
7. Silverglade, B. and I.R. Heller, 2010. Food labelling chaos: The case for reform. Center for Science in the Public Interest, Washington D.C., USA.
8. OECD., 2017. Organization for Economic Co-operation and Development, 2017. Obesity update. Organization for Economic Co-operation and Development, Paris.
9. Marietta, A.B., K.J. Welshimer and S.L. Anderson, 1999. Knowledge, attitudes and behaviors of college students regarding the 1990 Nutrition labeling education act food labels. J. Am. Diet. Assoc., 99: 445-449.
10. Smith, S.C., J.G. Taylor and A.M. Stephen, 2000. Use of food labels and beliefs about diet-disease relationships among university students. Public Health Nutr., 3: 175-182.
11. Wengreen, H.J. and C. Moncur, 2009. Change in diet, physical activity and body weight among young-adults during the transition from high school to college. Nutr. J., Vol. 8. 10.1186/1475-2891-8-32.
12. Feunekes, G.I.J, I.A. Gortemaker, A.A. Willems, R. Lion and M. Van Den Kommer, 2008. Front-of-pack nutrition labelling: Testing effectiveness of different nutrition labelling formats front-of-pack in four European countries. Appetite, 50: 57-70.
13. Indonesian Ministry of Trade National Consumer Protection Agency (BPKN), 2007. Study results in the food sector related to consumer protection. Indonesian Ministry of Trade National Consumer Protection Agency (BPKN), Indonesia.
14. Asgha, B., 2016. Analysis of the use of nutritional labels on food products by consumers at Semarang city. J. Econ. Stud. Bull., 21: 128-135.
15. Borgmeier, I. and J. Westenhoefer, 2009. Impact of different food label formats on healthiness evaluation and food choice of consumers: A randomized-controlled study. BMC Public Health, Vol. 9. 10.1186/1471-2458-9-184.
16. Emrich, T.E., Y. Qi, W.Y. Lou and M.R. L'Abbe, 2017. Traffic-light labels could reduce population intakes of calories, total fat, saturated fat and sodium. Plos One, Vol. 12. 10.1371/journal.pone.0171188.
17. Sonnenberg, L., E. Gelsomin, D.E. Levy, J. Riis, S. Barraclough and A.N. Thorndike, 2013. A traffic light food labeling intervention increases consumer awareness of health and healthy choices at the point-of-purchase. Prevent. Med., 57: 253-257.
18. Seward, M.W., J.P. Block and A. Chatterjee, 2016. A traffic-light label intervention and dietary choices in college cafeterias. Am. J. Public Health, 106: 1808-1814.

19. Hamlin, R.P., L.S. McNeill and V. Moore, 2015. The impact of front-of-pack nutrition labels on consumer product evaluation and choice: An experimental study. Public Health Nutr., 18: 2126-2134.
20. Volkova, E., B. Neal, M. Rayner, B. Swinburn and H. Eyles *et al*., 2014. Effects of interpretive front-of-pack nutrition labels on food purchases: Protocol for the Starlight randomised controlled trial. BMC Public Health, Vol. 14. 10.1186/1471-2458-14-968.
21. Arrua, A., M.R. Curutchet, N. Rey, P. Barreto and N. Golovchenko *et al*., 2017. Impact of front-of-pack nutrition information and label design on children's choice of two snack foods: Comparison of warnings and the traffic-light system. Appetite, 116: 139-146.
22. Rasberry, C.N., B.H. Chaney, J.M. Housman, R. Misra and P.J. Miller, 2007. Determinants of nutrition label use among college students. Am. J. Health Edu., 38: 76-82.
23. Kartika, M.D., 2015. The nutrition knowledge as a dominant factor of reading nutrition label among college student at the three selected faculties of Universitas Indonesia year 2015. Faculty of Public Health Universitas Indonesia, Depok.
24. Parmenter, K. and J. Wardle, 2000. Evaluation and design of nutrition knowledge measures. J. Nutr. Educ., 32: 269-277.
25. Alsaffar, A.A., 2012. Validation of a general nutrition knowledge questionnaire in a Turkish student sample. Public Health Nutr., 15: 2074-2085.
26. Drichoutis, A.C., P. Lazaridis, R.M. Nayga, M. Kapsokefalou and G. Chryssochoidis, 2008. A theoretical and empirical investigation of nutritional label use. Eur. J. Health Econ., 9: 293-304.
27. USDA., 2006. Indonesia retail foods: Retail foods update. USDA., Jakarta.
28. Hersey, J.C., K.C. Wohlgenant, J.E. Arsenault, K.M. Kosa and M.K. Muth, 2013. Effects of front of package and shelf nutrition labeling systems on consumers. Nutr. Rev., 71: 1-14.
29. Food Standards Agency, 2005. Qualitative signpost labelling refinement research. Food Standards Agency, Synovate, London.
30. Edge, M.S., C. Toner, W.R. Kapsak and C.J. Geiger, 2014. The impact of variations in a fact-based front-of-package nutrition labeling system on consumer comprehension. J. Acad. Nutr. Diet., 114: 843-854.
31. Roberto, C.A. and N. Khandpur, 2014. Improving the design of nutrition labels to promote healthier food choices and reasonable portion sizes. Int. J. Obesity, 38: S25-S33.
32. Hawley, K.L., C.A. Roberto, M.A. Bragg, P.J. Liu, M.B. Schwartz and K.D. Brownell, 2013. The science on front-of-package food labels. Public Health Nutri., 16: 430-439.
33. Which, 2006. Food Labeling Study. Conquest Research, QT., UK.
34. Food Standards Agency, 2005. Qualitative evaluation of alternative food signposting concepts. Food Standards Agency, Synovate, London.
35. Van Kleef, E., H. van Trijp, F. Paeps and L. Fernandez-Celemin, 2008. Consumer preferences for front-of-pack calories labelling. Public Health Nutr., 11: 203-213.
36. Ares, G., A. Gimenez, F. Bruzzone, L. Antunez, A. Sapolinski, L. Vidal and A. Maiche, 2012. Attentional capture and understanding of nutrition labelling: A study based on response times. Int. J. Food Sci. Nutr., 63: 679-688.
37. Maubach, N., J. Hoek and D. Mather, 2014. Interpretive front-of-pack nutrition labels. Comparing competing recommendations. Appetite, 82: 67-77.
38. Grunert, K.G. and J.M. Wills, 2007. A review of European research on consumer response to nutrition information on food labels. J. Public Health, 15: 385-3991.
39. Food Standards Agency, 2005. Signposting labelling-creative development of concepts. Food Standards Agency, Navigator, London.
40. Becker, M.W., N.M. Bello, R.P. Sundar, C. Peltier and L. Bix, 2015. Front of pack labels enhance attention to nutrition information in novel and commercial brands. Food Policy, 56: 76-86.
41. Antunez, L., A. Gimenez, A. Maiche and G. Ares, 2015. Influence of interpretation aids on attentional capture, visual processing and understanding of front-of-package nutrition labels. J. Nutr. Edu. Behav., 47: 292-299.