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EFFECTIVENESS OF EDUCATIONAL INTERVENTION ON KNOWLEDGE, ATTITUDE AND PRACTICE TOWARDS NUTRITION LABELLING AMONG ADULTS IN KUALA NERUS, TERENGGANU

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ABSTRACT

This study evaluates the effectiveness of a structured educational intervention in enhancing the Knowledge, Attitudes and Practices (KAP) related to nutrition labelling among adults in Kuala Nerus, Terengganu. A total of 64 respondents aged 18 and above were randomly assigned to an intervention (n = 32) or control group (n = 32). Data were collected using pre- and post-intervention surveys that assessed sociodemographic factors and KAP outcomes. Baseline analysis revealed no significant differences between the groups in knowledge ($p = 0.989$), attitudes ($p = 0.371$), or practices ($p = 0.340$). Within-group comparisons after four weeks showed significant improvements in the intervention group: Knowledge (non-normally distributed) rose from 40.00 (IQR = 50.00) to 80.00 (IQR = 18.00) ($p < 0.001$); attitudes (normally distributed) improved from 77.76 ± 9.55 to 82.40 ± 8.05 ($p = 0.010$); and practices (non-normally distributed) increased from 63.59 ± 19.84 to 83.75 (IQR = 19.00) ($p < 0.001$). In contrast, no significant changes were observed in the control group across the same metrics. Between-group comparisons showed that the intervention group had significantly higher knowledge (median = 80.00, $p < 0.001$), attitudes (mean = 82.40 ± 8.05, $p = 0.005$), and practices (median = 83.75, $p = 0.011$), compared with the control group. Furthermore, good knowledge was prevalent in the intervention group (78.1%) compared with the control group (18.8%). Poor knowledge was observed more commonly in the control group (34.4%) than in the intervention group (3.1%). These findings highlight the significant positive impact of educational interventions on nutrition labelling, suggesting that such programmes can play a crucial role in fostering healthier dietary choices among adults by improving their ability to understand and apply nutrition information.

Introduction

Nutrition labelling is a mandatory policy in Malaysia since June 2005, which aimed to help consumers identify and understand the nutrient content to choose a healthy food product (Ng *et al*., 2021; Tee *et al*., 2021). It typically provides a list of nutrients present in food items, enabling informed choices and healthier eating practices (Tee *et al*., 2021). However, a lack of awareness and understanding of nutrition labelling information has become a public health issue (Lee & Sozen, 2020). This may increase the risk of non-communicable diseases (NCDs) such as hypertension, diabetes, and obesity (Rimpeekool *et al*., 2017) due to excessive intake of carbohydrates, fats, and sugar.

To address this issue, an educational intervention on nutrition labelling is recommended, based on the positive findings of a study by Chen *et al*. (2017), who implemented "traffic light labelling" as their nutritional educational intervention in Taiwan. The approach of providing educational sessions or materials related to nutrition labels is known as educational intervention. It has been shown to be effective in increasing nutrition labelling in Knowledge, Attitudes and Practices (KAP). Nutrition labelling knowledge is what an individual understands about nutrition labelling that influences them to read it (Miller & Cassady, 2015). Meanwhile, attitudes towards nutrition labelling refer to a person's belief in nutrition labelling as a tool for making good food choices. The frequency in which people use nutrition labels in their daily lives is referred to as "nutrition labelling practices" (Zainol *et al*., 2020).

In Malaysia, the majority of nutrition labelling studies are cross-sectional and focus only on an overview of the population's KAP. Furthermore, there has been little research on educational intervention in recent years, despite Ambak *et al*. (2018) discovering that only 45% of respondents in a nationwide survey said they have been reading food labels. Zulkifli *et al*. (2020) found that only 4.6% of respondents in Peninsular Malaysia's east coast state of Terengganu having good knowledge on nutrition labelling. Furthermore, Malaysian adults are at a high risk of developing NCDs, which are on the rise in recent years (National Health and Morbidity Survey 2019; NHMS 2019). Evelyn *et al*. (2020) discovered that overweight and obese respondents with low nutrition knowledge are associated with CVD risk factors, which is most likely due to a lack of ability to understand and interpret the information.

Given the persistently low knowledge of nutrition labelling and its link to poor dietary decisions and related illnesses, this study aims to improve that knowledge. It tries to determine the baseline level of KAP towards nutrition labelling in the intervention (IG) and control group (CG) of adult subjects in Kuala Nerus, Terengganu. It also evaluates the effectiveness of educational intervention in increasing KAP towards nutrition labelling between and within the intervention and control groups.

Materials and Methods

Materials

This intervention study was conducted in Kuala Nerus, Terengganu, in 2022. It consisted of two groups: An intervention group (IG) and a control group (CG). Sample size was calculated manually according to Charan and Biswas (2013) and Gupta *et al*. (2016), besides using the G-Power 3.0 software (Santalo *et al*., 2019). The Standard Deviation (SD) of the nutrition knowledge score of 14.6 in IG; the mean value difference of 12.1 between IG and CG; the power of 0.8; type 1 error of 0.05; and ratio of 1:1 between IG and CG were obtained from Siew *et al*. (2020). The drop-out rate was expected at 10% (Kok *et al*., 2018; Zaujan *et al*., 2021). The final minimum sample size was 32 respondents per group, making a total of 64 respondents after taking the inclusion and exclusion criteria into consideration.

The inclusion criteria for both groups were residents of Kuala Nerus aged 18 and above. They must be able to read Bahasa Melayu or English and had online access to fill the survey questionnaire. Furthermore, IG respondents must be able to physically participate in scheduled interventional sessions. Ethical approval and permission were obtained from Universiti Malaysia Terengganu's Human Ethics Board of Committees (Reference No.: UMT/JKEPM/2023/120). All procedures involving human participants adhered to the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants.

IG subjects were required to attend a one-hour learning session on nutrition labelling in three modules, namely Module A entitled How to read food labels, Module B (Nutrition claims), and Module C (Real food - chocolate

cream bread). The educational intervention adopted an experiential learning approach, emphasising active engagement with real food packages, interactive discussions, and problem-solving exercises. This was in line with Kolb's experiential learning theory, which supported knowledge retention through concrete experience and reflective observation (Kolb, 1984). Meanwhile, CG subjects were not required to attend any learning sessions or modules.

Modules A and B were created by nutritionists and presented as slides in Microsoft PowerPoint. Module A informed respondents on their recommended amount of sugar and salt intake per day. It also taught them how to read nutrient contents (energy, carbohydrates, proteins, and fat) on food labels, as well as calculating and comparing the amount of nutrients based on the number of servings. Module B highlighted the claims in nutrition labelling such as "nutrient content claims", "nutrient comparative claims", and "nutrient function claims", which were permitted and not permitted in Malaysia. Lastly, Module C was a practical exercise that used information from a chocolate cream bread package. Both groups were required to complete surveys prior and four weeks after the intervention was completed. A four-week intervention period was selected to allow sufficient time for participants to apply what they learned, thereby providing more reliable data on behavioural changes (Ismail *et al*., 2022).

The online self-administered survey questionnaire was prepared in both Bahasa Melayu and English, adapted from previously validated instruments used in similar studies (e.g., Bosman *et al*., 2014; National Coordinating, Committee on Food and Nutrition (NCCFN) (2016); Huang *et al*., 2021). The original items were first compiled in English and translated into Bahasa Melayu by bilingual nutrition researchers. A back-translation was then carried out by an independent translator to ensure semantic and conceptual equivalence. Content validation was conducted by a panel of three experts in nutrition and public health, who reviewed the questionnaire for clarity, relevance, and cultural appropriateness.

The final questionnaire consisted of four sections: (A) sociodemographic information, (B) knowledge towards nutrition labelling, (C) attitudes, and (D) practices. Table 1 summarises the details of each section. A pilot test was conducted among 30 adults aged 18 and above residing in Terengganu to assess validity and reliability. Construct validity was confirmed with correlation coefficients exceeding 0.3 for all sections (knowledge: 0.632; attitudes: 0.567; practices: 0.707), as per Hajjar (2018). Reliability was assessed using Cronbach's Alpha, with acceptable results for knowledge ($\alpha = 0.733$) and practice ($\alpha = 0.858$). Although the attitudes section showed lower reliability ($\alpha = 0.449$), it was retained based on Ekolu and Quainoo (2019), who argued that absolute comprehension and item independence could justify retention in such contexts.

The scoring method for each section was by adding the points for each question, dividing by the total score of the section, and multiplying by a percentage. Referring to Siew *et al*. (2020), the total score for each section indicates their level of KAP towards nutrition labelling as either poor (0–33.33%), moderate (33.34–66.66%), or good (66.67–100%).

Data were collected using an online self-administered questionnaire. Recruitment of respondents was done both physically and through online platforms such as WhatsApp, Instagram, and Telegram. Eligible participants ($n = 64$) were then randomly assigned to their respective groups using a simple randomisation method. This random assignment helped to reduce respondent bias by minimising systematic differences between the two groups, ensuring that any observed effects might be attributed to the intervention rather than pre-existing characteristics.

IG subjects were asked to complete an appointment form via Google Form to select their session date and time, with a maximum

Table 1: Details of questionnaires for each section

Questionnaires	Score Methods	Sources
Section A: Sociodemographic		
1. Gender 2. Age 3. Height 4. Weight 5. Level of education 6. Marriage status 7. Do you understand the information on the nutrition label every time you buy or receive food?	None	Ambak *et al*. (2018); Okocha (2021)
Section B: Knowledge		
1. A calorie is a unit of energy measurement for food 2. Food ingredients are listed in order of decreasing weight on the food label 3. 1 gram of fat is equivalent to 9 calories 4. Energy and nutrient content in 100 g or 100 ml of product is to compare similar food products from different brand 5. The recommended serving size for vegetables is at least 3 servings per day 6. The recommended daily intake of sugar is 75 grams 7. Salt intake must not exceed 1 teaspoon per day 8. The content of trans fatty acids as much as 5 grams in one serving of food is good 9. Cholesterol content is high in palm oil 10. Sugar content of 30 grams in 100 ml of drinking water is not good	Answer provided were "Yes", "No", and "Not sure" with 1 point for correct answer and 0 for wrong or not sure (Zakria *et al*., 2019)	National Coordinating, Committee on Food and Nutrition (NCCFN) (2016); Marina *et al*. (2020); Bosman *et al*. (2014); Mahdavi *et al*. (2012)
Section C: Attitudes		
1. I find nutrition labels helpful 2. The food I eat can affect the development of the disease 3. I buy food that are said to contribute to my health 4. I find it easy to read nutrition labels 5. The nutritional information provided influenced my decision to purchase 6. I became more aware of food nutrition because of food labels 7. I believe he nutrient information provided on food labels is accurate 8. I believe nutrition labels can be used to compare nutrients between similar foods 9. I believe in nutrition claims on food products 10. I will only buy a product with a health message, if it is backed by scientific research 11. I only eat food for pleasure and not for the health benefits it offers 12. I believe in health claims made on a food product	The questionnaire involved 10 positive statements and two negative statements. Answer were provided by giving a 5-point Likert scale from 1 (totally disagree) until 5 (totally agree). The point was given in ascending order for positive statement and in reverse for negative statement (Zakria *et al*., 2019)	Huang *et al*. (2021); Bosman *et al*. (2014); Mahdavi *et al*. (2012)

Section D: Practices		
1. I always read nutrition labels 2. I use nutrition labels as a reference for food purchases 3. I always compare the nutrient content of different brands of food products before buying a product 4. I always look at the calorie content on the nutrition label 5. I always look at the sugar content on food labels 6. I always look at the salt content on food labels 7. I always see trans-fat content on food labels 8. I always look at ingredients on food products	Had 8 positive statement questionnaire on how they use nutrition labelling. The answer provided were 5-point Likert scale ranging from 1 (never) to 5 (always) and point were given in ascending order as the point (Zakria *et al*., 2019)	Pourmoradian *et al*. (2020); Bosman *et al*. (2014); Madhari *et al*. (2012); Huang *et al*. (2021)

of five respondents per session. Both groups received the baseline (pre-) survey link and four weeks later, the post-intervention survey link via email or WhatsApp. Figure 1 illustrates the study workflow.

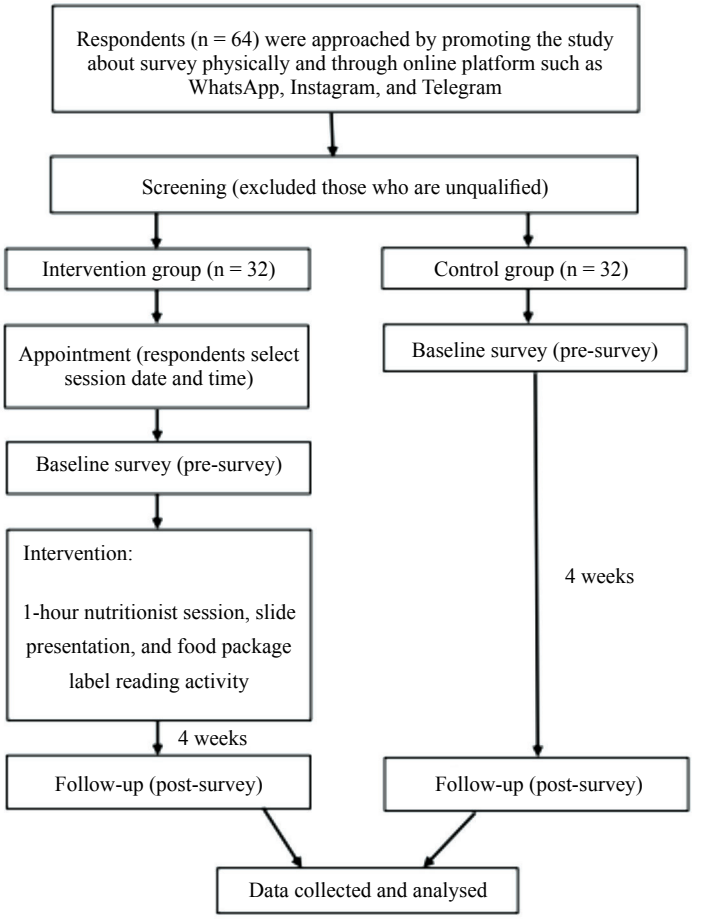

Figure 1: Workflow of the intervention and control study

Data analysis was performed using SPSS software with a significance level of < 0.05 and a confidence interval of 95%. Descriptive analysis was used to determine the sociodemographic profile using frequency and percentage. Following the normality test, either an independent t-test or a Mann-Whitney U test was used to compare mean scores. The paired t-test or Wilcoxon were used to determine significant differences in KAP scores towards nutrition labelling pre- and post-intervention survey.

Results and Discussion

Sociodemographic Profile of Respondents

The baseline sociodemographic data were collected through the pre-survey as the baseline of assessment for both the CG and IG. Table 2 summarises the sociodemographic data of the respondents (CG = 32, IG = 32). The majority of the subjects in the CG were females (56.3%) aged 18–29 (87.5%) who were single (87.5%) with a diploma or foundational level of education (59.4%). Most of the IG subjects were also females (78.1%) aged 18–29 (75.0%) who were single (81.3%), but with a degree in their level of education (40.6%). According to Rustad and Smith (2013), females were possibly more interested in nutrition labelling due to their tendency to consume a healthy diet and taking care of their body.

Baseline Mean KAP Score

Table 3 presents the baseline KAP scores towards nutrition labelling. A Mann–Whitney U test revealed no significant difference in baseline knowledge scores between CG (Median = 40.00, IQR = 38.00) and IG (Median = 40.00, IQR = 50.00), z = -0.014, p = 0.989. Although the data for knowledge in CG was normally distributed (Mean = 44.06, SD = 24.34), the median (IQR) was reported in accordance with the Mann–Whitney U test requirements,

Table 2: Sociodemographic data of respondents

Sociodemographic Profile	Group			
	Control Group (n=32)		Intervention Group (n=32)	
	n	%	n	%
Gender				
Female	18	56.3	25	78.1
Male	14	43.8	7	21.9
Age				
18 – 29 years old	28	87.5	24	75.0
30 – 39 years old	4	12.5	4	12.5
40 – 49 years old	0	0.0	4	12.5
50 – 59 years old	0	0.0	0	0.0
60 years old and above	0	0.0	0	0.0
Marital status				
Single	28	87.5	26	81.3
Married	4	12.5	6	18.8
Education				
SPM and equivalent	3	9.4	4	12.5
Diploma/Foundation	19	59.4	12	37.5
Degree	10	31.3	13	40.6
Master/PhD	0	0.0	3	9.4

which was used due to non-normality in one of the groups. This result were in line with Siew *et al*. (2020), who also observed no significant differences in baseline knowledge, supporting the comparability of groups prior to intervention and minimising bias in evaluating the programme's effects.

The attitudes and practices towards nutrition labelling were compared between CG and IG using an independent sample t-test. The results showed no significant difference in the mean attitude scores between CG (mean = 75.73, SD = 8.46) and IG (mean = 77.76, SD = 9.55): t (62) = -0.90, p = 0.371. Similarly, in the mean practice scores, no significant difference was also observed between CG (mean = 68.44, SD = 20.43) and IG (mean = 63.59, SD = 19.84), t (62) = 0.962, p = 0.340. These findings were likely related to the low level of knowledge towards nutrition labelling as reported by Cooke and Papadaki (2014). Furthermore, Cowburn and Stockley (2005) found that most respondents did not use the nutrition label due to time constraints and poor presentation of information such as the small font size and complex numbering.

Although the data supported the effectiveness of educational intervention, the results were somewhat counterintuitive. Based on the mean percentage of practice, both groups had good scores of 68.44% (CG) and 63.59% (IG). If they did not fully comprehend the nutrition labelling, they would more likely make mistakes and interpret things incorrectly.

Furthermore, the low knowledge level indicated that adults in Kuala Nerus had a lack of knowledge about nutrition labelling, which could lead to poor food choices and diets. This was because they did not have a general understanding of nutrition labels, such as how to read and interpret each component of the label or compare products based on their nutrition labels (Norazmir *et al*., 2012). This likely led to the purchase of nutritionally poor products such as those high in sugar or cholesterol, or that were deficient in nutrients to met their daily requirements (Cooke & Papadaki, 2014).

Table 3: Baseline scores and categorical levels of KAP towards nutrition labelling

Variable	Group	Score (Mean ± SD/Median [IQR])	Poor n (%)	Moderate n (%)	Good n (%)	Test z/t-stat	p-value
Knowledge	Control (n=32)	44.06 ± 24.34 40.00 (38.00)	12 (38.0)	13 (41.0)	7 (22.0)	z = -0.014	0.989
	Intervention (n=32)	40.00 (50.00)	13 (41.0)	10 (31.0)	9 (28.0)		
Attitudes	Control (n=32)	75.73 ± 8.46	0 (0.0)	4 (12.5)	28 (87.5)	t(62) = 0.901	0.371
	Intervention (n=32)	77.76 ± 9.55	0 (0.0)	3 (9.4)	29 (90.6)		
Practices	Control (n=32)	68.44 ± 20.43	3 (9.4)	8 (25.0)	21 (65.6)	t(62) = 0.962	0.340
	Intervention (n=32)	63.59 ± 19.84	2 (6.3)	15 (46.9)	15 (46.9)		

Note: *Statistical tests: Mann–Whitney U test for Knowledge (z); Independent t-test for Attitudes and Practices (t); *Significant difference at $p < 0.05$; Poor: 0–33.33%; Moderate: 33.34–66.66%; Good: 66.67–100%.

Thus, a new approach should be taken to help consumers understand each component of nutrition labelling easily.

Mean KAP Scores of Pre- and Post-intervention Survey

Table 4 shows the pre- and post-intervention survey percentage of KAP scores in both groups. The purpose of this data was to compare and determine the effectiveness of the educational intervention. A statistically significant improvement in knowledge was observed in IG after the educational intervention. The median score increased from 40.00 (IQR = 50.00) to 80.00 (IQR = 18.00) as tested using the Wilcoxon signed-rank test ($z = 7.000$, $p < 0.001$). This suggested that the intervention could effectively improve the subjects' understanding of nutrition labelling. Similar findings were reported by Siew *et al*. (2020) and Jha and Singh (2021), where knowledge significantly increased following structured educational programs involving modules and visual presentations.

Another possible explanation for this positive outcome could be the practical approach used, which included activities and real food evaluation. This was critical to enhance the subjects' understanding about the fundamentals of nutrition labelling such as fact panels, ingredient list, nutrient content, and claims (Graham & Laska, 2012). Santalo *et al*. (2019) reported positive results in nutritional education after using food model activities to encourage their subjects to familiarise themselves with reading the food labels. The same tools were used in this study, where a real food packaging with nutrition details was used. Meanwhile, there was no significant difference in the knowledge score of CG subjects in the pre- and post-intervention survey ($z = -1.163$, $p = 0.245$).

The attitude score of IG subjects showed a significant difference between pre- (mean = 77.76, SD = 9.55) and post-intervention survey (mean = 82.40, SD = 8.05), with $p = 0.011$ and $t(31) = 2.704$. However, no significant differences were found between the pre- (mean = 75.73, SD = 8.46) and post-intervention survey of CG

Table 4: The mean pre- and post-intervention KAP score

Variable	Control Group (n = 32)				Intervention Group (n = 32)			
	Pre	Post	z-statistic/ t-statistic	p-value	Pre	Post	z-statistic/ t-statistic	p-value
	Mean ± SD/ Median Score (IQR)	Mean ± SD/ Median Score (IQR)			Mean ± SD/ Median Score (IQR)	Mean ± SD/ Median Score (IQR)		
Knowledge	44.06 ± 24.34	46.88 ± 23.20	-1.163 [a]	0.245	40.00 (50.00)	80.00 (18.00)	7.000 [b]	< 0.001*
Attitudes	75.73 ± 8.46	76.51 ± 7.98	0.750 [b]	0.459	77.76 ± 9.55	82.40 ± 8.05	2.704 [b]	0.01*
Practices	68.44 ± 20.43	70.63 ± 19.27	0.873 [b]	0.389	63.59 ± 19.84	83.75 (19.00)	5.330 [b]	< 0.001*

Note: * Significant difference at $p < 0.05$; [a] z-statistic if performed using Wilcoxon paired test; [b] t-statistic if perform using paired t-test.

subjects (mean = 76.51, SD = 7.98; t (31) = 0.750, p = 0.459). This was consistent with past findings where limited understanding of claims and nutrition data could reduce trust and label use among consumers (Cowburn & Stockley, 2005; Besler *et al*., 2012). Additionally, Zander (2022) emphasised that belief in label accuracy influenced practice frequency, especially when no prior exposure existed. During IG sessions, we highlighted the accuracy of nutrition labellings, as manufacturers were compelled to follow food regulations. This was supported by Kok and Radzi (2017), who stated that 66 of 100 food items checked were in compliance with the Malaysian Food Act.

Furthermore, another possible reason for the lower attitude score in CG might be attributed to the subjects' limited awareness about the different types of nutrition claims, namely content, comparative, and function claims. Since these concepts were covered in detail only with IG subjects, their CG counterparts might have struggled to evaluate or trust the nutrition label information. The significant difference in attitude score between IG and CG could be explained by the increment in knowledge in the former as well as motivation for a healthy diet (Zander, 2022).

Finally, a significant improvement was observed in the practice scores within the intervention group. The mean percentage score increased from 63.59 (SD = 19.84) in the pre-intervention survey to 83.75 (SD = 19.00) in the post-intervention survey, with a paired t-test showing $t(31) = 5.33$, $p < 0.001$. In contrast, CG showed no significant change in practice scores between the pre- (mean = 68.44, SD = 20.43) and post-intervention survey (mean = 70.63, SD = 19.27), t (31) = 0.873, p = 0.389.

This improvement in IG might be attributed to an enhanced ability to read and apply nutrition label information following the educational sessions. Interestingly, this outcome was in contrast with the findings of Santalo *et al*. (2019), who reported no significant improvement in attitudes or practices regarding reduced sugar intake, despite participants demonstrating adequate understanding of sugar-related nutrition labelling.

Another possible explanation was the subjects' ambition and discipline in improving their attitudes and practices to consume a healthy diet. This was supported by Hagmann *et al.* (2018), who discovered that subject behaviour and weight status influenced their acceptance of any changes in a healthy diet and lifestyle because it contradicted their interests and habits. Besides, the use of nutrition labelling was also influenced by the presentation of labels.

For example, colour-coded labels such as pyramid labelling and traffic light labelling could stimulate awareness and attention of the labels' existence among consumers (Julia *et al*., 2016; Song *et al*., 2021; Zander, 2022). This might increase the use of nutrition labelling compared to common labelling. While this intervention showed short-term success, future efforts should assess the sustainability of these gains. Integrating such modules into community outreach or digital health platforms could support long-term improvements in dietary behaviors, as supported by Rustad and Smith (2013) and Ismail *et al*. (2022).

This study, however, used common nutrition labels, which had a more complex numbering system. According to Besler *et al*. (2012), people preferred simple information for better comprehension. Simple information requires fewer numbering formats, which were introduced in several countries and were referred to as "front-of-pack labelling" (FOPL). There were two types: Interpretive and non-interpretive (Song *et al*., 2021).

Symbols and figures such as a traffic light label and a health star rating label that only highlighted essential nutrients such as energy, fat, and sugar were included in the interpretive. Meanwhile, numerical nutritional content was the second noninterpretive category. This was supported by Graham *et al*. (2015), who discovered in their study by using eye tracking on the shoppers that the majority of respondents (63%) preferred the FOPL to the nutrition fact

label. As a result, while this approach helped respondents improve their knowledge, the likelihood of them using it in real life was unknown.

Mean KAP Score After Four Weeks

Table 5 displays the post-intervention comparison of KAP scores between CG and IG. A significant difference in knowledge scores was observed, with IG showing a higher median score (Median = 80.00, IQR = 15), compared to CG (Median = 50.00, IQR = 30), $z = -4.788$, $p < 0.001$. Although the knowledge data in CG was normally distributed (Mean = 46.88, SD = 23.20), the Mann–Whitney U test was used, and thus results were reported as median (range) to meet non-parametric reporting requirements. For attitudes, IG demonstrated a significantly higher mean score (Mean = 82.40, SD = 8.05) than CG (Mean = 76.51, SD = 7.98), with an independent t-test result of $t(62) = -2.936$, $p = 0.005$.

A significant difference was also found in practice scores, where the IG achieved a higher median score (Median = 83.75, IQR = 19), compared to the CG (Median = 75.00, IQR = 24), $z = -2.545$, $p = 0.011$. Again, although the CG's practice score was normally distributed (Mean = 70.63, SD = 19.27), the Mann–Whitney U test was used and median (range) was reported for consistency with non-parametric analysis conventions. These results indicated that the educational intervention could significantly improve participants' KAP towards nutrition labelling.

The results of this study demonstrated a significant difference ($p < 0.05$) in the mean score of knowledge between IG and CG. This finding suggested that the educational intervention, which consisted of modules and explanations of the components of nutrition labelling was effective in increasing respondents' knowledge of this topic. This result was supported by previous studies (Julia *et al*., 2016; Siew *et al*., 2020; Jha & Singh, 2021) that found providing education and explanations about nutrition labelling results could improve the subjects' choice of eating a healthy diet. The additional activities aimed at familiarising respondents with nutrition labelling might have also contributed to the effectiveness of the intervention. The present findings showed significant improvements in both attitudes ($p = 0.005$) and practices ($p = 0.011$) among IG sunjects compared with those in CG. This aligned with the evidence reported by Sharif Ishak *et al.* (2020) and Siew *et al.* (2020), who also found that nutrition labelling education could positively influence behavioural determinants.

However, the magnitude of improvement in our study might be smaller due to the relatively short intervention period of four weeks, compared to three years in Sharif Ishak *et al.* (2020) and four months in Siew *et al.* (2020). Although short-term intervention might show immediate positive effects (Rustad & Smith, 2013), sustained behavioural change typically required consistent and repeated exposure to nutrition labelling messages (Ismail *et al*., 2022).

This was supported by Julia *et al*. (2016), who reported that repeated exposure over time could lead to progressively higher awareness and stable behavioural patterns. Thus, all in all, there were several reasons for the effective educational intervention in this study, including use of modules and explanations of nutrition labelling components. The educational intervention included modules and explanations of each component of nutrition labelling, which may have helped respondents better understand and retain information.

The educational intervention also included activities aimed at familiarising respondents with nutrition labelling, which might enhance familiarity and confidence in applying this information and increasing their knowledge. The educational intervention was consistent and repeated, which might have allowed respondents to better internalise and remember the information. It is important to note that these explanations were based on this specific study and the results might vary in other studies with different methods and populations.

Table 5: Post-intervention scores and categorical levels of KAP

Variable	Group	Score (Mean ± SD/Median [IQR])	n (%) Poor	n (%) Moderate	n (%) Good	Test z/t-stat	p-value
Knowledge[a]	Control (n = 32)	46.88 ± 23.20 50.00 [30.00]	11 (34.4)	15 (46.9)	6 (18.8)	z = -4.788	< 0.001*
	Intervention (n = 32)	80.00 [15.00]	1 (3.1)	6 (18.8)	25 (78.1)		
Attitudes[b]	Control (n = 32)	76.51 ± 7.98	0 (0.0)	2 (6.3)	30 (93.8)	t(62) = -2.936	0.005*
	Intervention (n = 32)	82.40 ± 8.05	0 (0.0)	1 (3.1)	31 (96.9)		
Practices[c]	Control (n = 32)	70.63 ± 19.27 75.00 [24.00]	1 (3.1)	11 (34.4)	20 (62.5)	z = -2.545	0.011*
	Intervention (n = 32)	83.75 [19.00]	0 (0.0)	5 (15.6)	27 (84.4)		

Note:
*Statistical tests: Mann–Whitney U test for Knowledge and Practice (z); Independent t-test for Attitude (t).
*Significant difference at $p < 0.05$.

[a]knowledge score, minimum score = 0, maximum score = 10.
[b]attitude score, minimum score = 0, maximum score = 60.
[c]practice score, minimum score = 0, maximum score = 40.
Range of scoring; Poor: 0–33.33%; Moderate: 33.34-66.66%, Good: 66.67-100%.
Values represent percentage scores derived from raw scales; Knowledge (0–10), attitudes (12–60), and practices (8–40).

While the short-term outcomes of the intervention were promising, future studies should assess the sustainability of these improvements through longer follow-up or repeated exposures. Embedding such modules into community health outreach or digital nutrition platforms might ensure long-term behaviour change. This aligned with recommendations by Rustad and Smith (2013) and Ismail *et al.* (2022), who observed better retention with ongoing support.

Conclusions

The aim of this study was to assess the effectiveness of an educational intervention focused on nutrition labelling among adults in Kuala Nerus, Terengganu. The results indicated a significant increase in the percentage of knowledge regarding nutrition labelling in the intervention group during follow-up, compared to baseline. This suggested that the educational intervention was successful in improving respondents' KAP towards nutrition labelling. The findings emphasised the importance of having a good understanding of nutrition as it could influence the attitudes and practices related to healthier food purchasing and selection. The study offers valuable insights into the implementation of interventions aimed at improving awareness of nutrition labelling, not only among adults but also across all age groups.

The research contributes to a deeper understanding of the strategies that can be employed to increase knowledge and understanding of nutrition labelling. It has been reported that proper understanding of nutrition labelling can help individuals maintain a healthy diet and prevent chronic diseases such as diabetes, hypertension, and obesity. This study highlighted the potential of educational interventions to enhance knowledge of nutrition labelling and had fostered positive attitudes towards it. The results suggested that such interventions could be implemented not only for adults, but also integrated into school curricula to educate children.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Ethical Statement

Ethical approval and permission were obtained from the Human Ethics Board of Committees of Universiti Malaysia Terengganu (UMT) with reference number, UMT/JKEPM/2023/120.

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