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Nutrition Labelling Use and Its Associated Factors Among Medical Students: A Cross-sectional Study

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Abstract

Nutrition labels are important as they provide detailed information about a food item which help consumers in making decisions before purchasing a food item. However, there is a lack of awareness among medical students in using food labels when making purchasing decisions even though they have better understanding and knowledge on nutrition. This study was conducted to assess the nutrition knowledge and usage of nutrition labelling from the perspective of undergraduate medical students of Melaka Manipal Medical College (MMMC). A cross sectional study was conducted from March 2020 to April 2020. Data were collected using online questionnaires which included questions about demographic data, nutrition knowledge, the use of food and nutrition labels and factors that affected the use of food labelling. The analysis included frequency, percentages, mean, standard deviation, unpaired T-test, ANOVA and Chi-square. Statistical tests were done using Epi Info software (version 7.2) in which level of significance was set at $P < 0.05$. 38.10% of the students had high nutrition knowledge level while 58.50% had moderate nutrition knowledge level and the remaining 3.40% had low nutrition knowledge level. There was no significant association between age, gender, academic semester, ethnicity, nationality, family income/month, BMI and knowledge. 59.86% of the students used nutrition labels whereas 40.14% did not use them during food purchasing. There was a significant association between BMI and use of food labelling as obese students were less likely to use of food labelling compared to normal BMI (p value = 0.038). There was no significant association between age, gender, academic semester, ethnicity, nationality, family income/month and use of food labelling. Education on nutrition knowledge and the importance of using nutrition labels should be done in the mass media or incorporated in the curriculum to instil nutrition knowledge and promote frequent usage of nutrition information labels among students.

Keywords

Nutrition Labels, Knowledge of Nutrition, Medical Students

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1. Introduction

In recent times, due to the increasing occurrence of diseases such as obesity, diabetes and cardiovascular disease, the prevention and management of such ailments have become a significant public health concern in most developing countries in order to avoid death and disability due to it. [1] Additionally, 44% of the diabetes mellitus burden, 23% of the ischaemic heart disease burden and between 7% and 41% of the malignancy incidence is attributable to overweight and obesity which often result from poor nutritional choices particularly in urban settings. [2] Therefore, the World Health Organization initiated policies implemented across the globe, to encourage healthier regimes and dietary choices. These policies mainly include strict rules concerning the use of food labelling as a fundamental method to represent nutritional information. [3]

Food labelling mostly consists of printed text, images and pictorial representation which is found either on the label, or alongside the food or its display and also includes material

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that aims to maximize sales. [4] The approach to use food labelling to convey nutritional information is not only economical, but is also ideal as it is available to review during the time of purchase, and this essentially influences a better selection when it comes to packaged food items. [3]

According to a study done in Bahrain on Food Label Use and Awareness of Nutritional Information among consumers in 2018, the consumers are becoming more informed of the correlation between diet and disease, their need for acquiring nutrition information surges. Subsequently food labeling is very advantageous for people advised to be on special diets (e.g. people suffering from diabetes or high cholesterol levels) to select food that are well suited for their health conditions. [5]

It is noteworthy that for the consumer to make a healthier selection in foods, they must be able to localize, read, and comprehend the presented information on food labels. [6] Studies show that the most recurrently read were the calorie, fat, sugar, sodium and fiber contents. [5] Food and Drug Administration (FDA) in the United States remarks that they also use serving size, ingredient list, the% daily values, health and nutrient assertions, value and brands when making a decision to purchase. [6] Many consumers feel assured that they recognize how to read labels and favor using a food label rather than relying on their own pre-acquired understanding. While information like production and expiry dates are popularly read by buyers (92%), they described that quantity of fat and sugar were the most vital details to be considered when they buy a product for the first time. [5]

As for instruction level, The National Health and Morbidity Survey (NHMS) 2006 revealed that those with tertiary training level (74.5%) especially in the health care sector, were bound to peruse the nutritional data that mirrored their specific well-being concern and had the capacity to comprehend phrasing utilized in the labelling. [7] Studies identified that the main reasons customers did not pursue utilizing food labelling in the purchase of food were because of mainly, little awareness on significance of nutritional marking, trouble in understanding the presented data, and low well-being cognizance. [8, 9, 10]

An investigation led among the older populace shows that its utilization was essentially connected with age, formal instruction, higher family pay levels and conjugal status. [11] A review among the Malaysian corpulent grown-up individuals discovered that as high as 75.3% of the populace comprehend the nutritional labels and these were essentially connected with age, race, training and conjugal status. [12]

The effectiveness of the nutritional labels is yet unknown, as a result of nutritional labeling can't be absolutely thriving till customers are educated in a way to use them properly and rules on nutritional claims are placed into legislation. It is so crucial to determine a relationship between consumers' knowledge, attitudes, and use regarding nutritional labels to improve the kind of knowledge provided on labels and the way customers use them to form healthy dietary choices. [13]

Several studies have shown that processed food and beverages contribute to the enlarged intake of fat, sugar, and salt. [14] Ochola and Masibo (2014) showed that the increase and widespread consumption of processed foods among adolescents group contributes to the high prevalence of obesity. [15] In order to forestall the excessive intake of processed foods and to help consumers in making healthier food selections, i.e. to consume foods that are low in sugar, salt, and saturated fats, it's vital that adolescents be motivated to browse nutrition labels. [16] The requirement from manufacturers to give data on specific nutrients in food products can assist with limiting under and over nourishment in buyers. [6]

In a recent systematic evaluation by Campos et al., nutritional labels were better likely used by middle-aged or younger adults, while females were reported to use nutritional labels significantly more regularly than males. Persons from lower-income categories are less likely to use nutrition labels, while it was also found that the Caucasian participants are more prone to use nutrition labels than any other ethnic group. This study shows a steady association between the use of nutrition labels and adopting healthier diets. It is to be highlighted that commonly, younger consumers, and those with higher education, income, literacy and numeracy, affirmed a superior understanding of nutrition labels and were more likely to use it. [17]

In the Malaysian setting, The National Health and Morbidity Survey (NHMS) 2014 disclosed that 55% of Malaysians did not read food labels and this result shows an increase from 19.3% in 2006. [18, 19] Norazmir et al. (2012) showed that a total 53.6% of Malaysian youth did not use nutrition labels, while another 69.5% did not know about food labelling and therefore, they are less inclined to select and purchase healthy food. [20]

Different studies have noted that a small proportion of adolescents use nutrition labels and most of them did not understand the data. [21, 22] In another study conducted it was recognized that the nutrient information exhibited on the labels was too technical to understand even by the well informed consumers. [23] Therefore, nutrition education is vital to extend awareness and use of nutrition labels.

Basic knowledge in nutrition is needed for consumers to perceive the usage of nutrition facts on the label in order to consume a healthy diet. Both knowledge and attitude are essential factors affecting the frequency of the label reading.

[24] However, regardless of great nutrition knowledge and availability, college students rarely use food labels when purchasing food items and this is shown by another study conducted in Malaysia. [25]

Accordingly, the objective of our study was to assess the nutrition knowledge and usage of nutrition labelling from the perspective of undergraduate medical students. Past literature based on this topic is predominantly derived from a consumer point of view. Hence, the target population in this research is novel, as it is exclusively based on undergraduate medical student populace therefore providing a research gap. Specifically, this research targeted to acquire information on the associated factors in context of nutritional labelling, and the attitude towards it, in such a student population. Ultimately, it is crucial for medical students to be aware of nutrition label use and have a positive nutrition label attitude, as it plays a key role to promote healthy food choices for themselves and patients seeking their help to provide holistic management and improve quality of life.

2. Methodology

2.1. Study Design, Population, Time and Place

The study carried out was a cross sectional study, conducted between March 2020 to April 2020 in Melaka Manipal Medical College (MMMC), which is a private institution composing of two campuses in Malaysia; one situated in Muar, Johor and another in Bukit Baru, Melaka. This college offers 3 courses which are Bachelor of Medicine and Bachelor of Surgery (MBBS), Bachelor of Dental Surgery (BDS) and Foundation in Science (FIS). There are a total of 10 semesters in MBBS where semesters 1 to 5 are conducted in the India campus while semesters 6 to 7 are conducted in Muar campus and semesters 8 to 10 in Melaka campus. In our study, we recruited undergraduate students of the MBBS program in Malaysia campus. There were approximately 600 students in the Malaysia campus.

2.2. Sample Size

Based on the previous study conducted on undergraduate students at Universiti Teknologi MARA, it is shown that 26% of the students 'often' use food labels when buying food products, from which an estimated proportion of 0.26 was taken. [25] The sample size was calculated using 'Epi Info' version 7.2 with a population size of 600, expected frequency of 0.26 and precision of error 7%, we concluded that our sample size is 121 with a confidence level of 95%.

A non-response percentage of 30% was taken into consideration and final sample size was calculated as follows:

n final = n calculated / 1 - non response%

= 121 / 1 - 0.3 (30%)

= 173

2.3. Sampling Method

The sampling method in this study used was purposive sampling which is a non-probability sampling. The inclusion criteria were medical students who voluntarily agreed to participate in the study and provided the informed consent whereas the exclusion criteria were students who did not give informed consent, incomplete questionnaires and irrelevant responses.

2.4. Data Collection

The questionnaire consisted of four parts. The first part contained the demographic data (age, gender, semester, ethnicity, nationality, family income, height and weight). This was followed by the second part which included 8 single best answer questions regarding nutrition knowledge. These questions were based on important information depicted on a food label, components of a balanced diet, ways on eating to get all required nutrients, food pyramid, high salt content food, ways of preparing food which will increase fat content and complications of over consumption of calories. For each question, 1 mark was given for choosing the correct answer while 0 mark was given for choosing any other wrong answers. Total maximum score for this part was 8 whereas the total minimum score for this part was 0. The total score was then calculated for each participant. Higher scores obtained indicated participants had higher nutrition knowledge while lower scores obtained indicated participants had lower nutrition knowledge. The third part included 3 questions regarding the use of food and nutrition labels. First two questions were about the frequency of use of food labels and its helpfulness in decision making during food purchases. For the frequency of use of food labels, students could choose between never, rarely, sometimes and often. Then, the options were further categorized into never and rarely as not used whereas sometimes and often as use of food labelling. The third question was focused on which aspect of the food label had been the most important when buying food. For each aspect, students could choose between most important, important, least important and not important based on their opinion. Lastly, the fourth part included 2 questions regarding factors that affected the use of food labelling. Multiple choices were provided to the students from which they could choose more than one option for why they did, or did not refer to food labels. The questionnaire was taken from a previous study [25] and adjusted accordingly. Then, it was

distributed among medical students online using Google forms. The independent variables in this study were age, gender, ethnicity, nationality, semester, economic background and body mass index (BMI). The dependent variables in this study were nutritional knowledge, and use of food and nutritional labels.

2.5. Data Processing and Data Analysis

The data collected from the distributed questionnaires was fed into Microsoft Excel and compiled. Qualitative data such as gender, semester, ethnicity, nationality, family income and the use of food and nutrition labels, was analyzed to derive frequency and percentage. Quantitative data such as age, BMI and knowledge, was analyzed to derive the mean and standard deviation. The statistical tests used to find out the association between the independent variables and dependent variables were tabulated as below:

Table 1. Independent and dependent variables with statistical tests.

Independent Variables	Dependent Variable	Statistical Test
Age	Nutritional knowledge	ANOVA
Gender	Nutritional knowledge	Unpaired t-test
Semester	Nutritional knowledge	ANOVA
Ethnicity	Nutritional knowledge	ANOVA
Nationality	Nutritional knowledge	Unpaired t-test
Family income/month	Nutritional knowledge	ANOVA
BMI	Nutritional knowledge	ANOVA
Age	Use of food and nutritional label	Chi square
Gender	Use of food and nutritional label	Chi square
Semester	Use of food and nutritional label	Chi square
Ethnicity	Use of food and nutritional label	Chi square
Nationality	Use of food and nutritional label	Chi square
Family income/month	Use of food and nutritional label	Chi square
BMI	Use of food and nutritional label	Chi square

2.6. Ethical Consideration

This research was approved by the Research Ethics Committee, Faculty of Medicine, Melaka Manipal Medical College, Melaka, Malaysia. The students were informed that participation in this study was completely voluntary and an informed consent form with all the important and relevant details of the study was given to the participants. Information of the participants was kept confidential and used only for the purpose of this particular research with their anonymity and privacy well maintained.

3. Results

Table 2. Sociodemographic characteristics of medical students (n = 147).

Variables	n (%)
Age (years)	
≤22	42 (28.57)
>22	105 (71.43)
Gender	
Male	49 (33.33)
Female	98 (66.67)
Semester	
7	67 (45.58)
8	40 (27.21)
9	9 (6.12)
10	31 (21.09)
Ethnicity	
Malay	25 (17.01)
Chinese	47 (31.97)
Indian	53 (36.05)
Others	22 (14.97)
Nationality	
Malaysian	137 (93.20)
International	10 (6.80)
Family Income/month	
≤ RM 1500	8 (5.44)
RM 1500 – RM 2500	7 (4.76)
RM 2500 – RM 4000	29 (19.73)
≥ RM 4000	103 (70.07)
Body Mass Index (BMI)	
Underweight	18 (12.24)
Normal	91 (61.90)
Overweight	30 (20.41)
Obese	8 (5.44)
Mean (SD)	22.97 (4.22)

An online Google form consisting of 22 questions were distributed to the medical students in Melaka Manipal Medical college and a total of 147 responses were received by our side, giving a response rate of 84.97%. Of those who responded, the 105 (71.43) from the total participants were in the age group of 22 and below whereas 42 (28.57) from the total participants were in the age group of above 22. For gender, 66.67% of participants were female while the rest, 33.33% of the participants were male. The large proportion of participants were from semester 7 (45.58%), followed by semester 8 students (27.21%) and semester 10 (21.90%) with the least numbers from semester 9 (6.12%). In terms of ethnicity, 36.05% of the participants were Indian, 31.97% were Chinese, 17.01% were Malay, and other ethnicities accounted up to 14.97%. Most of the responses came from Malaysian nationals (93.20%) and the rest of the 6.80% were from international students. About 70.07% students had a monthly family income of above RM 4000, followed by family income between RM 2500-4000 which was 19.73%, between RM 1500-2500 with a percentage of 4.76% and lastly 5.44% students with less than RM 1500 as their monthly household income. As for BMI (Body Mass Index) the largest percentage of students (61.90%) was in the normal range while 20.41% were overweight, 5.44% were obese and 12.24% were underweight. These aforementioned results gave rise to a mean BMI of 22.97 kg/m^2.

Table 3. Correct response of nutrition knowledge among medical students (n=147).

Questions	Correct response n (%)
The following items are important information on a food label, EXCEPT the name of the distributor/producer.	21 (14.30)
A balanced diet has the following nutrients: carbohydrate, fat, protein, mineral and vitamin.	141 (95.52)
You can get all the required nutrients by eating a variety of food.	147 (100.00)
According to the food pyramid, the foods that you can eat the MOST are rice, other cereals and tuber.	61 (41.50)
The nutrient that provides us with the most energy (calories) is carbohydrate.	89 (60.54)
The food with a lot of salt is soya sauce.	120 (81.63)
The way of preparing food which will increase fat content is frying.	142 (96.60)
Over consumption of calories can lead to obesity.	147 (100)

Table 3 illustrates the knowledge part of our questionnaire which was 8 questions based on nutritional labelling, to select the best answer. The highest correct response rate was 100% for both 'Over consumption of calories can lead to obesity' and 'You can get all the required nutrients by eating a variety of food' and the lowest correct percentage was 14.30% for question 'The following items are important information on a food label, EXCEPT the name of the distributor/producer'. One other item which was below the 50% mark was, 'According to the food pyramid, the foods that you can eat the MOST are rice, other cereals and tuber (41.50%)'. Almost all participants were able to answer items 'The way of preparing food which will increase fat content is frying (96.60%), and 'A balanced diet has the following nutrients: carbohydrate, fat, protein, mineral and vitamin (95.52%)'. The other items correct percentage are as follows 'The nutrient that provides us with the most energy (calories) is carbohydrate' (60.54%) and lastly 'The food with a lot of salt is soya sauce.' (81.63%).

Table 4. Level of nutrition knowledge of medical students (n=147).

Knowledge Categories	n (%)
Low	5 (3.40)
Moderate	86 (58.50)
High	56 (38.10)

Table 4 highlights that among the 147 respondents, 58.50% of the medical students had a moderate level of nutrition knowledge while 38.10% had a high level of nutrition knowledge and the remaining 3.40% had a low level of nutrition knowledge.

Table 5. Use of food and nutrition labels among medical students (n=147).

Variables	n (%)
How often do you use nutrition information labels during food purchasing decisions?	
Never (1)	19 (12.93)
Rarely (2)	40 (27.21)
Sometimes (3)	51 (34.69)
Often (4)	37 (25.17)
Are the food label or nutrition label helpful during your food purchasing decision?	
Yes (all the times)	9 (6.12)
Sometimes	81 (55.10)
No	57 (38.78)

The first part of Table 5 answered our objective regarding the use of nutritional labels in making food purchases, where 25.17% of the respondents often used nutritional labels. The highest proportion, 34.69%, sometimes used nutritional labels while 27.21% of the respondents rarely used nutritional labels and lastly the remaining 12.93% never used the labels in making food purchasing decisions. In the second part, 55.10% had opted that nutrition labels were sometimes helpful in making purchasing decisions, while 6.12% had responded that it was helpful all of the times, and 38.78% responded that nutritional labels were not helpful at all when it came to making purchasing decisions.

Table 6. Medical students' opinion on the most important aspect when buying food (n=147).

Variables	Most important (4) n (%)	Important (3) n (%)	Least important (2) n (%)	Not important (1) n (%)
Price	42 (28.57)	88 (59.86)	14 (9.52)	3 (2.04)
Taste	81 (55.10)	62 (42.18)	4 (2.72)	0 (0)
Nutrient content	44 (29.93)	81 (55.10)	20 (13.61)	2 (1.36)
Ingredient	40 (27.21)	82 (55.78)	21 (14.29)	4 (2.72)
Packaging	15 (10.20)	62 (42.18)	57 (38.78)	13 (8.84)
Expiry date	119 (80.95)	28 (19.05)	0 (0)	0 (0)

Table 6 focuses on what are the most important aspects when buying food, ranging from most important and not not important at all. For the price domain, according to 28.57% of the students, is the most important while 59.86 consider it important, 9.52% least important and lastly, 2.04% not important. As for taste, the majority of students, 55.10% considered it as most important, 42.18% as important, 2.72% as least important, and it is seen that none of the students thought taste was not important, (0%) therefore indicating every participant had looked into this component when buying food. The nutrient content component, according to 29.93% students was most important, although most participants, 55.10% considered it important, the rest 13.61% least important and 1.36% not important respectively. As for

ingredients, 27.21% considered it most important, 55.78% important, 14.29% least important and lastly 2.72% not important at all. For the packaging domain, 10.20% participants considered it most important, followed by 42.18% important, 38.78% least important and 8.84% considered packaging not important at all. According to the majority of participants (80.95%) the expiry date was the most important while the rest 19.05% as important. It is noteworthy that one of the participants (0%), considered expiry date least important or not important signifying its importance in the food label.

Table 7. Use or read the item/labelling on a food label among medical students (n = 147).

Variables	Often (4) n (%)	Sometimes (3) n (%)	Rarely (2) n (%)	Never (1) n (%)
List of ingredients	47 (31.97)	70 (47.62)	24 (16.33)	6 (4.08)
Serving size	32 (21.77)	77 (52.38)	24 (16.33)	14 (9.52)
Health claim	50 (34.01)	61 (41.50)	27 (18.37)	9 (6.12)
Calories/Energy	45 (30.61)	62 (42.18)	32 (21.77)	8 (5.44)
Calories from fat	42 (28.57)	54 (36.73)	38 (25.85)	13 (8.84)
Total fat	42 (28.57)	60 (40.82)	34 (23.13)	11 (7.48)
Trans fat	44 (29.93)	54 (36.73)	35 (23.81)	14 (9.52)
Saturated Fat	41 (27.89)	52 (35.37)	36 (24.49)	18 (12.24)
Cholesterol	43 (29.25)	52 (35.37)	33 (22.45)	19 (12.93)
Sodium/Salt	28 (19.05)	59 (40.14)	44 (29.93)	16 (10.88)
Carbohydrate	43 (29.25)	52 (70.75)	35 (35.37)	17 (11.56)
Protein	43 (29.25)	55 (37.41)	33 (22.45)	16 (10.88)
Fibre	38 (25.85)	49 (33.33)	40 (27.21)	20 (13.61)
Sugar	64 (43.54)	48 (32.65)	25 (17.01)	10 (6.80)
Vitamin and Mineral	36 (24.49)	53 (36.05)	37 (25.17)	21 (14.29)

Based on table 7, we can appreciate how often participants used or read items on the food label. As for the list of ingredients, 31.97% often read it, 47.62% sometimes read it while 16.33% rarely used it and 4.08% never read or used it when purchasing food. As for serving size, 21.77% often used it, while the majority (52.38%) sometimes used it, 16.33% used it rarely and lastly 9.52% never used or read serving size. As for health claims, 34.01% often read it, while 41.50% sometimes read it, 18.37% rarely read it and 6.12% participants never read health claims on food labels. As for calories/ energy, 30.61% often used it, while 42.18% sometimes used it, 21.77% rarely used it and 5.44% never used or read calories/ energy on the food label. As for calories from fat, 28.57% participants often read it, 36.73% sometimes read it, 25.85% rarely and 8.84% never read or used calories from fat information. As for total fat, 28.57% of the participants often used it, while the majority of 40.82% sometimes used it, 23.13% rarely used it and lastly 7.48% never read or used total fat given in nutritional labels. As for trans fat, 29.93% often read it, 36.73% sometimes read it, 23.81% rarely read it and 9.52% never read or used information on trans fat available on food labels. As for saturated fat, 27.89% of the participants often used it, 35.37% sometimes used it, 24.49% rarely used it and lastly 12.24% never used or read about saturated fat on food labels. For cholesterol, 29.25% used it often, 35.37% used it sometimes, 22.45% used it rarely, and 12.93% never used cholesterol given on food labels. For sodium/salt 19.05% read it often, while the largest percentage of participants (40.14%) read it sometimes, 29.93% read it rarely and lastly 10.88% never read this information on a food label. As for carbohydrates 29.25% read it often, but a majority of 70.75% read it sometimes, 35.37% read it rarely and 11.56% never read about carbohydrate content on a food label. As for proteins, 29.25% read it often, 37.41% read it sometimes, 22.45% read it rarely and 10.88 never read about it. As for fibre, 25.85% read it often, 33.33% read it sometimes, 27.21% read it rarely and 13.61% of the participants never read about fibre content in a food label. Majority (43.54%) of the participants often read about sugars on a food label while 32.65% sometimes read it, 17.01% rarely read it and 6.80% of the participants never read about the sugar content in a food label. Lastly for vitamins and minerals, 24.49% read it often, 36.05% read it sometimes, 25.17% read it rarely while 14.29% never read about it on the food label. According to the table, the component most read often on a food label is sugar and the component which the highest percentage of the population never read was vitamins and minerals.

Table 8. Factors affecting the use of food labelling among medical students (n=147).

Variables	n (%)
Reason (s) I refer to the food label:	
To understand each information on food	81 (55.1)
Experienced food allergy	17 (11.6)
To control energy intake from food	58 (39.5)
For health or beauty	39 (26.5)
Concerned about taste and price	63 (42.9)
Others	13 (8.8)
Reason (s) I do not refer to the food label:	
Do not know how to use food label	25 (17.0)
Time constraints/limited time	88 (59.9)
Label is not attractive and confusing	33 (22.4)
There is no label on certain food	46 (31.3)
No health problem	41 (27.9)
Others	18 (12.2)

Table 8 shows that the main reason for most participants

(55.1%) to use nutritional labels is to understand the information on the food label. The second reason is concern about taste and price, opted by 42.9% of the participants, followed by 39.5% which responded as to control energy intake from food. The rest of the reasons are as follows; 26.5% for health or beauty reasons, 11.6% had previously experienced a food allergy and lastly 8.8% for other reasons. In contrast, the main reason for most participants (59.9%) to not use nutritional labels is time constraints or limited time. The second reason is there is no label on certain food, opted by 31.3% of the participants, followed by 27.9% which responded as no health problem. The rest of the reasons are as follows; 22.4% for labels are not attractive and confusing, 17.0% do not know how to use food labels and lastly 12.2% for other reasons.

Table 9. Association between age (years), gender, semester, ethnicity, nationality, family income/month, BMI and nutritional knowledge.

Independent Variables	Knowledge Percentage Mean (SD)	Mean Difference (95% CI)	P value
Age (years)			
≤22	79.46 (12.29)		0.242[a]
>22	76.79 (12.55)		
Gender			
Male	76.02 (12.72)	2.30 (-2.02, 6.62)	0.295[b]
Female	78.32 (12.38)		
Semester			
7	78.17 (13.30)		
8	76.88 (11.52)		0.390[a]
9	83.33 (10.83)		
10	75.40 (12.28)		
Ethnicity			
Malay	75.00 (12.50)		
Chinese	79.26 (14.10)		0.408[b]
Indian	78.30 (10.73)		
Others	75.00 (12.79)		
Nationality			
Malaysian	77.92 (12.43)	-5.42 (-13.49, 2.65)	0.186[a]
International	72.50 (12.91)		
Family income/month			
≤ RM 1500	75.00 (9.45)		
RM 1500 – RM 2500	76.79 (16.81)		0.942[b]
RM 2500 – RM 4000	77.59 (11.75)		
≥ RM 4000	77.79 (12.73)		
BMI			
Underweight	83.33 (10.50)		
Normal	76.37 (12.84)		0.077[b]
Overweight	79.17 (11.53)		
Obese	71.88 (12.94)		

[a]Unpaired t-test; [b]ANOVA

Table 9 shows the association between the sociodemographic profile of the undergraduate students and their nutritional knowledge. Age of 22 and below has a mean score of 79.46 (SD=12.29) and those aged above 22 years have a mean score of 76.79 (SD=12.55). The p value is 0.242 which is higher than 0.05 thus there is no significant association between age and nutritional knowledge. Males have a mean score of 76.02 (SD=12.72) which is slightly lower than female with a mean score of 78.32 (SD=12.38). The mean difference is 2.30 with 95% CI range from -2.02 to 6.62. The p value shows a value of 0.295 which means that there is no significant association between gender and nutrition knowledge. Semester 7 students have a mean score of 78.17 (SD=13.30) which is slightly higher than semester 8 students which have a mean score of 76.88 (SD=11.52). Semester 9 students have a mean score of 83.33 (SD=10.83) whereas semester 10 students have a mean score of 75.40 (SD=12.28). The p value is 0.390 which indicates that there is no significant association between semester and nutritional knowledge. Malays have a mean score of 75.00 (SD=12.5), Indians have a mean score of 78.30 (SD=10.73). Chinese have a mean score of 79.26 (SD=14.10) and other races have a mean score of 75.00 (SD=12.79). The p value shows 0.408 thus showing that there is no significant association between ethnicity and nutritional knowledge. Malaysian students have a mean score of 77.92 (SD=12.43) whereas international students have a mean score of 72.50 (SD=12.91). The mean difference is -5.42 with 95% CI range from -13.49 to 2.65. The p value is 0.186 showing that there is no association between nationality and nutritional knowledge. Students with a family income of less than RM1500 have a mean score of 75.00 (SD=9.45), whereas those with family income of RM1500 - RM2500 have a mean score of 76.79 (SD=16.81). Those with family income of RM2500 - RM4000 have a mean score of 77.59 (SD=11.75) and those with income of more than RM4000 have a mean score of 77.79 (SD=12.73). The p value is 0.942 which shows that there is no significant association between family income per month and nutritional knowledge. Underweight students have a mean score of 83.33 (SD=10.50), normal weighing students have a mean score of 76.37 (SD=12.84) whereas those who are overweight have a mean score of 79.17 (SD=11.53). Those who are obese have a mean score of 71.88 (SD=12.94). P value is 0.077 which shows that there is no significant association between BMI scores and nutritional knowledge.

Table 10. Association between age, gender, semester, ethnicity, nationality, family income/month, BMI and use of food and nutritional labels.

Independent Variable	Use of food and nutritional label		OR (95% CI)	Chi-square	P value
	Yes n (%)	No n (%)			
Age (years)					
≤22	20 (47.62)	22 (52.38)	Reference		
>22	68 (64.76)	37 (35.24)	2.02 (0.98 - 4.18)	3.669	0.055
Gender					
Male	27 (55.10)	22 (44.90)	Reference		

Independent Variable	Use of food and nutritional label		OR (95% CI)	Chi-square	P value
	Yes n (%)	No n (%)			
Female	61 (62.24)	37 (27.76)	1.34 (0.67 - 2.69)	0.694	0.405
Semester					
7	40 (59.70)	27 (40.30)	Reference		
8	22 (55.00)	18 (45.00)	0.83 (0.37 - 1.82)	0.227	0.634
9	5 (55.56)	4 (44.44)	0.84 (0.21 - 3.43)	0.057	0.812
10	21 (67.74)	10 (32.26)	1.42 (0.58 - 3.48)	0.583	0.445
Ethnicity					
Malay	17 (68.00)	8 (32.00)	1.00 (0.36 - 2.78)	0	0.995
Chinese	25 (53.19)	22 (46.81)	0.54 (0.24 - 1.21)	2.273	0.132
Indian	36 (46.81)	17 (32.08)	Reference		
Others	10 (45.45)	12 (54.55)	0.39 (0.14 - 1.09)	3.310	0.069
Nationality					
Malaysian	84 (61.31)	53 (38.69)	2.38 (0.64 - 8.82)	1.762	0.184
International	4 (40.00)	6 (60.00)	Reference		
Family income/month					
≤ RM 1500	5 (62.50)	3 (37.50)	1.29 (0.29 - 5.70)	0.116	0.734
RM 1500 – RM 2500	4 (57.14)	3 (42.86)	1.03 (0.22 - 4.86)	0.002	0.966
RM 2500 – RM 4000	21 (72.41)	8 (27.59)	2.04 (0.83 - 5.02)	2.442	0.118
≥ RM 4000	58 (56.31)	45 (43.69)	Reference		
BMI					
Underweight	12 (66.67)	6 (33.33)	1.19 (0.41 - 3.47)	0.105	0.746
Normal	57 (62.64)	34 (37.36)	Reference		
Overweight	17 (56.67)	13 (43.33)	0.78 (0.34 - 1.80)	0.339	0.561
Obese	2 (25.00)	6 (75.00)	0.20 (0.04 - 1.04)	4.326	0.038

Table 10 describes the association between the sociodemographic profile towards the use of food and nutrition labels among the undergraduate students in a private medical college. According to our study, the odds of using food and nutrition labels is 2.02 times more likely compared to those aged less than 22 years. However, findings were not significant (95% CI 0.98 - 4.18; X^2 3.669; p value 0.055). As for gender, it was found that the odds of females using food and nutrition labels is 1.34 times more likely compared to males. However, findings were not significant (95%CI 0.67 - 2.69; X^2 0.694; p value of 0.405). The odds of using nutritional labels in semester 8 students was 0.83 times more likely than those in semester 7. However, findings were not significant (95% CI 0.37 - 1.82; X^2 0.227; p value 0.634). It was found that the odds of using nutritional labels in those students who are currently in semester 9 was 0.84 times more likely than those in semester 7. Findings were not significant (95% CI 0.21 - 3.43; X^2 0.057; p value 0.812). The odds of using nutritional labels in semester 10 students are 1.42 times more likely than those in semester 7. However, findings were not significant (95% CI 0.58 - 3.48; X^2 0.583; p value 0.445). The odds of using nutritional labels in Malays were 1.00 times more likely than Indians. Findings were not significant (95% CI 0.36 - 2.78; X^2 0; p value of 0.995). In comparison with Chinese, the odds of using the nutritional labels are 0.54 times more likely compared to Indians. The findings were not significant (95% CI 0.24 - 1.21; X^2 2.273; p value 0.132). The odds of using nutritional labels in Others were 0.39 times more likely than Indians. However, the findings were not significant (95% CI 0.14 - 1.09; X^2 3.310; p value 0.069). The data showed that the odds of using food and nutritional labels in Malaysian is 2.38 times more likely as compared to international students. Findings were not significant (95% CI 0.64 - 8.82; X^2 1.762; p value of 0.184). It was found that the odds of using nutritional labels was 1.29 times more likely in those with family income of RM1500 than those with more than RM4000. Findings were not significant (95% CI 0.29 - 5.70; X^2 0.116; p value 0.734). The odds of using nutritional labels in those with family income of RM1500-RM2500 was 1.03 times more likely than those more than RM4000. Findings were not significant (95% CI 0.22 - 4.86; X^2 0.002; p value 0.966). The odds of using food labels in those with family income of RM2500-RM4000 was 2.04 times more likely than those more than RM4000. However, findings were not significant (95% CI 0.83 - 5.02; X^2 2.442; p value 0.118). As for BMI, it was found that the odds in underweight students was 1.19 times more likely to use nutritional labels than students who were normal. Findings were not significant (95% CI 0.41 - 3.47; X^2 0.105; p value 0.746). The odds of using nutritional labels in students who were overweight was 0.78 times more likely than students who were normal. Findings were not significant (95% CI 0.34 - 1.80; X^2 0.339; p value 0.561). The odds of using nutritional labels in students who were obese was 0.20 times less likely than students who were normal. Findings were significant (95% CI 0.04 - 1.04; X^2 4.326; p value 0.038).

4. Discussion

This cross sectional study was done among undergraduate medical students of Melaka Manipal Medical College (MMMC) in Malaysia to assess the nutrition knowledge and

usage of nutrition labelling from the perspective of an undergraduate medical student. Regarding nutrition knowledge among 147 undergraduate medical students of MMMC, 58.50% had moderate level of nutrition knowledge while 38.10% had high level of nutrition knowledge and the remaining 3.40% had low level of nutrition knowledge. This shows that the majority of students had a moderate level of nutrition knowledge. In comparison with a previous study among undergraduate students in Universiti Teknologi MARA (UiTM), Puncak Alam, the majority of students had high level of nutrition knowledge (55.0%) followed by medium level of nutrition knowledge (35.3%) and low level of nutrition knowledge (9.7%) respectively. [25] However, in another study done among university students of International Islamic University Malaysia (IIUM), Kuantan, the majority of students had low knowledge (41.2%) followed by lowest level of knowledge (24.2%), medium level of knowledge (23.0%) and highest level of knowledge (11.5%). [26] Based on a study done among Chinese consumers in Shenyang, China, 61.5% of respondents reported a fair level of nutritional knowledge while 21.5% and 11.5% rated their knowledge levels good and very good respectively. Only 5.5% perceived their knowledge level to be excellent. [27]

Our study showed 25.17% of medical students 'often' used nutritional labels in making food purchases. The highest proportion, 34.69%, sometimes used nutritional labels while 27.21% of medical students rarely used nutritional labels and lastly the remaining 12.93% never used the labels in making food purchasing decisions. The study conducted in Universiti Teknologi MARA showed that 21.6% of university students 'often' used nutritional labels whereas 36.5% 'sometimes' used, followed by 34% 'rarely' used and 7.9% 'never' used nutritional labels. [25] A study conducted from WuHu, China showed that 12.1% of the respondents indicated they 'poor' read labels, whereas 59.2% of the respondents 'sometimes' read labels, with 28.7% of the respondents reported that they 'always' read nutritional information on food labels. [1] Compared to the study conducted in International Islamic University Malaysia, it showed that 17% of the university students were excellent nutrition label users, 57.6% moderately used and 25.5% poorly used. [20] Moreover, we found that 55.10% of medical students had opted that nutrition labels were sometimes helpful in making purchasing decisions, while 6.12% had responded that it was helpful all of the times, and 38.78% responded that nutritional labels were not helpful at all when it came to making purchasing decisions. In a study conducted in Bahrain, it showed that around 65% of the respondents believed that food labels are useful tools for consumers. [5] In a study recorded by Misra, R., majority of college students (90%) perceived food labels to be useful. [24]

In our study, according to 28.57% of the students, price is the most important factor when buying food while a study conducted among undergraduate students at UiTM Puncak Alam, 50.2% of the participants considered price as the most important factor. [25] As for taste, the majority of students, 55.10% considered it as most important, and the study in UiTM Puncak Alam stated that 53.8% of the students opted that taste was the most important factor. According to an experimental trial study among adolescents and adults in Minnesota, United States, it was found that taste was the most important factor rated when people are buying foods. [28] Our study also showed that the nutrient content component, according to 29.93% students was most important, although most participants, 55.10% considered it important. The study conducted in UiTM showed that nutrient content was the second last factor the undergraduate students would be considering when they are using food labels. A study conducted in the UK has shown that 27% of the consumers considered nutrition content as the most important factor. [8] As for ingredients, 27.21% of the medical students in our study considered it as most important, 55.78% important, 14.29% least important and lastly 2.72% not important at all. The study conducted in UiTM showed that 52.3% of the respondents opted for ingredients as the most important factor whereas 40.4% rated as important. The rest 5.5% stated that it was the least important factor and 1.8% stated as not important. [25] For the packaging domain, 10.20% of the medical students in our study considered it most important, followed by 42.18% important, 38.78% least important and 8.84% considered packaging not important at all. 21.6% of respondents from the study conducted in UiTM chose packaging as the most important factor and 45.6% considered it as an important factor. 27.4% stated that packaging was the least important factor and the rest 5.5% considered it as not important. According to the majority of participants (80.95%) in our study, the expiry date was the most important whereas the study in UiTM also showed that the majority of the participants (90.6%) chose expiry date as the most important factor. [25]

Upon analyzing the nutritional knowledge levels with respect to age in a study published in Pakistan Journal of Nutrition, it showed that there was a significant difference in nutritional knowledge scores of the participants those who were aged between 18 and 29 compared with other age groups. [29] In our study however, the age group selected was university students below and above the age of 22, and it was found that there is no significant relationship between nutritional knowledge and age. Secondly, we measured the association between gender and nutritional knowledge among

undergraduate medical students, and established that there was no significant difference between nutritional knowledge of both genders. Based on a previous study conducted by Universiti Teknologi MARA, it concluded that female students have slightly high knowledge (57.7%), compared to male students (42.1%) respectively. [25] Our study also compared the nutritional knowledge amongst students from Semester 7 to semester 10, and the results obtained were not statistically significant. In a study conducted among 17-19 year old adolescents in University of Leicester, UK, after the linear regression adjusted for age it was indicated that there was a significant difference in nutritional knowledge among the different socioeconomic status (SES) groups. [30] In our study, we categorized a similar variable under monthly family income, however, there was no significant difference between these income groups and their level of nutritional knowledge in our medical university setting. In a self administered cross sectional survey conducted amongst women in Southeast Texas, the mean nutrition knowledge score was significantly lower among African American women than whites (p value < 0.001). [31] Similarly, upon surveying for a difference in nutritional knowledge among ethnicities in Malaysia such as Indians, Chinese and Malays as well as comparing it with international students, we discovered that there was no significant difference. Another similar pilot study done by the Dietary Nutrition Department of Central Michigan University showed that nutrition knowledge was negatively correlated with fat and cholesterol intake. Students who consumed more than 35% of calories from fat or >300 mg of cholesterol daily had lower mean nutrition scores than those students with lower fat or cholesterol intake. [32] Hence in our study we incorporated the variable of BMI and its association with nutritional knowledge, and found that, however in this setting, there is no significant relationship between BMI and level of nutritional knowledge.

A recent study conducted by Universiti Teknologi MARA suggested identifying the use of nutrition information panels and sociodemographic variables among students who make household food purchasing decisions. In this study, we assessed the association between demographic characteristics of the medical students and usage of food labels when making purchasing decisions. We found that the majority of the students either male or female 'sometimes' considered the food label when making a decision in purchasing food. [25] A study among adults stated that males are less likely to use nutrition information on food labels than females. [33] Surprisingly, another study showed that male students 'often' use the food label compared to females where most of the females 'sometimes' use the food labels during their food purchasing decisions [25]. Our study supports the study from Blistein and Evans where it was found that the odds of females using food and nutrition labels is 1.34 times more likely compared to males whereas the study by UiTM conversely showed that males 'often' use the food label compared to females with 28.1 and 20.2% for each gender. [25, 33] As for age, the odds of using food and nutrition labels is 2.02 times more likely compared to those aged less than 22 years. Regarding semesters, semester 10 had the highest percentage of students using nutritional labels (67.74%). According to our study, Malay students were found to use nutritional labelling the most compared to students of other ethnicity (68%). The data in our study showed that Malaysian students (61.31%) were 2.38 times more likely to use nutritional labelling as compared to International students (40%). It was found that those with family income of RM1500 - RM2500 (72.41%) were most likely to use nutritional labelling. However the study in UiTM depicted that students with a family income of < RM1500 were more likely to use nutritional labelling. [25] As for BMI, it was found that underweight students were more likely to use nutritional labels compared to students who were of different BMI categories whereas results from the study by UiTM suggested that students of normal BMI were most likely to use nutritional labelling. [25] Findings for age, gender, semester, ethnicity, nationality, family income/month, and BMI were not significant. However, for BMI, findings for obese students were significant.

We faced few limitations in this study. Firstly, this cross sectional study was conducted only in a duration of 6 weeks. Thus we were unable to observe the effect of time on the changes in nutrition knowledge and usage of nutrition labelling from the perspective of undergraduate medical students. The findings from this study also cannot be generalized to other settings as the participants of our study were only semester 7 to semester 10 undergraduate medical students in one college (MMMC, Muar and Melaka campus) and we were not able to recruit semester 6 students because they had not registered in Muar campus during the period of our study. Moreover, our questionnaire was distributed via Google form which resulted in a lower response among the undergraduate medical students. We also asked for family income/month in the sociodemographic part of our questionnaire but results might not be accurate as it was a rough estimation and students might not know the exact amount of family income/month.

Education on nutrition knowledge and the importance of using nutrition labels should be done in the mass media or incorporated in the curriculum to instil nutrition knowledge and promote frequent usage of nutrition information labels among students. Furthermore, nutrition workshops can be held to increase nutritional awareness and nutrition

knowledge. Nutrition and food labelling based quizzes or competitions can also be held in order to improve the level of nutrition knowledge among students. As our study only involves undergraduate medical students in one college, more studies involving medical students from other colleges can be done by other researchers. Rather than using family income/month as a variable in the sociodemographic part of the questionnaire in researches such as this which involve students as participants, we would like to recommend putting monthly allowance instead as this is definitely known by the students thus providing a better and more accurate result.

5. Conclusion

Based on our study, the results of nutrition knowledge among undergraduate medical students of MMMC were 8.10% of the students had high nutrition knowledge level while 58.50% had moderate nutrition knowledge level and the remaining 3.40% had low nutrition knowledge level. We found that there was no significant association between age, gender, academic semester, ethnicity, nationality, family income/month, BMI and knowledge. 59.86% of the students used nutrition information labels whereas 40.14% did not use them during food purchasing. There was a significant association between BMI and use of food labelling but there was no significant association between age, gender, academic semester, ethnicity, nationality, family income/month and use of food labelling. Education on nutrition knowledge and the importance of using nutrition labels should be done in the mass media or incorporated in the curriculum to instil nutrition knowledge and promote frequent usage of nutrition information labels among students. Furthermore, nutrition workshops can be held to increase nutritional awareness and nutrition knowledge. Nutrition and food labelling based quizzes or competitions can also be held in order to improve the level of nutrition knowledge among students.

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References

[1] Song J, Huang J, Chen Y, Zhu Y, Li H, Wen Y et al., (2015). The understanding, attitude and use of nutrition label among consumers (China). Nutrición Hospitalaria, 31 (6), 2703-2710.

[2] World Health Organization: WHO. (2020). Obesity and overweight. Retrieved from: https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight

[3] World Health Organization: WHO. (2011). Healthy living. Retrieved from: http://www.kznhealth.gov.za/healthyliving.pdf

[4] Ambak R, Tupang L, Hasim MH, Salleh NC, Zulkafly N, et al. (2018). Who Do Not Read and Understand Food Label in Malaysia? Findings from a Population Study. Health Sci J. Vol. 12 No. 1: 548.

[5] Rabab A. Wahab, (2018). Food Label Use and Awareness of Nutritional Information Among Consumers in Bahrain: An Exploratory Study in Sustainability and Resilience Conference: Mitigating Risks and Emergency Planning, KnE Life Sciences, pages 26–36.

[6] United States Food and Drug Administration: FDA. (2020) How to Understand and Use the Nutrition Facts Label. Retrieved from: https://www.fda.gov/food/new-nutrition-facts-label/how-understand-and-use-nutrition-facts-label

[7] Institute for Public Health (2008) The Third National Health and Morbidity Survey (NHMS III) 2006. Ministry of Health Malaysia, Kuala Lumpur, Malaysia.

[8] Grunert KG, Wills JM, Fernández-Celemín L (2010) Nutrition knowledge, and use and understanding of nutrition information on food labels among consumers in the UK. Appetite 55: 177-189.

[9] Drichoutis A, Lazaridis P, Nayga R (2006) Consumers' use of nutritional labels: A review of research studies and issues. Acad Mark Sci Rev 10: 9.

[10] Annunziata A, Vecchio R (2012). Factors affecting use and understanding of nutrition information on food labels: Evidences from consumers. Agric Econ Rev 13: 103-116.

[11] Cheong SM, Kaur J, Lim KH, Ho BK, Mohmad S (2013). Use and understanding of nutrition labeling among elderly men and women in Malaysia. Malay J Nutr 3: 353-362.

[12] Rashidah A, Balkish MN, Mohd-Azahadi O, Nor-Azian MZ, Syafinaz MS, et al. (2014) Food label reading and understanding among obese adults: A population study in Malaysia. Int J Public Health Res 4: 449-456.

[13] Cannoosamy, Komeela & Pugo Gunsam, Prity & Jeewon, Rajesh. (2014). Consumer Knowledge and Attitudes Toward Nutritional Labels. Journal of nutrition education and behavior. 46. 10.1016/j.jneb.2014.03.010

[14] Baker P & Friel S (2014). Processed foods and the nutrition transition: evidence from Asia. Obes Rev. 15 (7): 564-577.

[15] Ochola S & Masibo PK (2014). Dietary intake of schoolchildren and adolescents in developing countries. Ann Nutr Metab 64 (2): 24-40.

[16] Jun LV, Yong C, Shengfeng W, Qingmin L, Yanjun R, Sara K & Liming L (2011). A Survey of nutrition labels and fats, sugars, and sodium ingredients in commercial packaged foods in Hangzhou, China. Public Health Rep 126 (1): 116-122.

[17] Campos S, Doxey J, Hammond D (2011) Nutrition labels on pre-packaged foods: a systematic review. Public Health Nutr 14: 1496-506

[18] IPH (2006). In: The Third National Health and Morbidity Survey 2006. Institute for Public Health, Ministry of Health Malaysia, Kuala Lumpur. From http://iku.moh.gov.my/index.php/research-eng/list-of-research-eng/ikueng/nhms-eng/nhms-2006-eng

[19] IPH (2014). In: National Health and Morbidity Survey 2014: Malaysian Adult Nutrition Survey. Institute for Public Health, Ministry of Health Malaysia, Kuala Lumpur. From: http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2014-MANS-VOLUME-1-MethodologyandGeneralFind.pdf

[20] Norazmir, M., H. Norazlanshah, et al. (2012). Understanding and Use of Food Package Nutrition Label among Educated Young Adults. Pakistan Journal of Nutrition, 11 (10): 836-842.

[21] Talagala IA & Arambepola C (2016). Use of food labels by adolescents to make healthier choices on snacks: a cross-sectional study from Sri Lanka. BMC Public Health 16 (1): 739.

[22] Wojcicki JM & Heyman MB (2012). Adolescent nutritional awareness and use of food labels: results from the National Nutrition Health and Examination Survey. BMC Pediatr 12: 55.

[23] Vemula, S. R., Gavaravarapu, S. M., Mendu, V. V. R., Mathur, P., & Avula, L. (2014). Use of food label information by urban consumers in India: A study among supermarket shoppers. Public Health Nutrition, 17, 2104–2114

[24] Misra, R. (2007). Knowledge, attitudes and label use among college students. J Am Diet Assoc., 107: 2130-2134

[25] Nurliyana, G., M. Norazmir, et al. (2011). Knowledge, Attitude and Practices of University Students Regarding the Use of Nutritional Information and Food Labels. Asian Journal of Clinical Nutrition 3: 79-91.

[26] Hazali, Norazlanshah and I, Muhammad and MD, Hasmira and M, Mashita and MR, Norfazilah and MF, Fazlyla Nadya (2013) The use of nutrition label on food purchasing decision among university students in Kuantan, Malaysia. Health and the Environment Journal, 4 (1). pp. 1-10. ISSN 2180-1126

[27] MacArthur, R. L., Wang, Y. H., & Feng, X. (2016). Influence of Age and Education on Nutritional Knowledge and Dietary Choices among Chinese Consumers in Shenyang, China. Malaysian Journal of Nutrition, 22 (1).

[28] Harnack, L. J., S. A. French, J. M. Oakes, M. T. Story, R. W. Jeffery and S. A. Rydell. (2008). Effects of calorie labeling and value size pricing on fast food meal choices: Results from an experimental trial. Int. J. Behav. Nutr. Phys. Act., 5: 1-13

[29] Hakli, G., As, E., Uçar, A., ÖZdogan, Y., Yilmaz, M. V., ÖZçelik, A. Ö.,... & Akan, L. S. (2016). Nutritional Knowledge and Behavior of Adults: Their Relations with Sociodemographic Factors. Pakistan Journal of Nutrition, 15 (6), 532.

[30] Nabhani-Zeidan, M., Naja, F., & Nasreddine, L. (2011). Dietary intake and nutrition-related knowledge in a sample of Lebanese adolescents of contrasting socioeconomic status. Food and Nutrition Bulletin, 32 (2), 75–83.

[31] Laz, T., Rahman, M., Pohlmeier, A., Berenson, A. (2015). Level of Nutrition Knowledge and Its Association with Weight Loss Behaviors Among Low-Income Reproductive-Age Women. Journal of Community Health, 40, 542–548.

[32] Yahia N, Brown C, Rapley M, Chung M (2016). Level of nutrition knowledge and its association with fat consumption among college students. BMC Public Health

[33] Blitstein, JL & Evans, WD (2006). Use of nutrition facts panels among adults who make household food purchasing decisions. J Nutr Educ Behav 38, 360–364