

Multiple Traffic Light Food Labeling Acceptance Among Students: Systematic Literature Review

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Abstract: *Prevalence of overweight and obesity are escalating not only among adults but also children and adolescents. Evidence suggest that effective food label helps consumers to make quick and easy decision on healthy and less healthy products based on the key nutrients such as sodium, fat, saturated fat, and sugar content. No reviews have been published on multiple traffic light (MTL) food label as a tool used to prevent obesity among students. A search of three databases (September 2024 to October 2024) and gray - literature sources in English (2012 – 2024) were retrieved. A final of 19 studies met the inclusion criteria. The analysis showed a more salient type of food label is called the MTL demonstrated to be superior in perceived healthfulness of food products and purchased intention compared to other food label used among students. Therefore, educational institutional as a primary setting for promoting healthy eating behaviors is well recognized in reducing obesity risks due to time spent in first 2 decades of their life.*

Keywords: Acceptance, Food Label, Obesity, Multiple traffic light (MTL)

1. Introduction

Obesity is the one of the most significant preventable causes of death worldwide. As the prevalence of overweight and obesity are escalating not only among adults but also children and adolescents [1]. Childhood obesity has been one of the greatest threats to public health putting children and adolescents at risk of poor health. The availability of refined carbohydrates and fats are at increasing pace with the readily available and cheaper accessibility of energy dense and processed food [2]. Obesity increases the risk of type 2 diabetes mellitus, insulin resistance, heart disease, high blood pressure, metabolic syndrome, and other health - related disorders [3]. Prevalence of childhood obesity in Asian countries like Malaysia is as well at worrying state. According to National Health Morbidity Survey (NHMS) 2011, the prevalence of obesity among children aged between 5 years and 17 years is 6.1%. The trend in Malaysia shows a significant increment in 2015 and 2019 with the percentage of obesity increases 11.9% and 14.8% respectively [4]. Prevalence of obesity among adolescent aged 13 to 17 years is 13.3% [5] increased to 14.3% in 2022 [6], while the prevalence among university students is 20% - 30.1% [7], particularly 17.6% of them are undergraduate students [8]. Therefore, overweight and obesity appear to have the potential to course from children and adolescence into adulthood [1].

Monitoring child growth in schools, colleges and universities should be emphasized to achieve the global target of having zero increment of obese prevalence among students [1], [4]. Institutional education becomes an effective weapon in the fight against obesity as no other institution has as much continuous and intensive contact with students during their first 2 decades of life [3]. During the key developmental phase, the more hours that students spend in school, universities and colleges, they would consume a substantial proportion of their daily energy intake [9]. Therefore, time spent in the institute is likely to influence student's dietary pattern [3]. Adolescents do not consider the long - term consequences of their health and assumed they can alter their

habit later in life, but however university life is very stressful, and university students showed a transition during which the major cause of stress were due to academic stress and time management that decrease the likelihood for the students to practice healthy eating habits [1]. A cluster randomized controlled trial study among Australian students showed the frequent ordered food in their canteen are foods that are high in salt, sugar, fat, and saturated fat such as pizza, proceed chicken, and hot dogs [10]. Thus, reasonable approach on schools, colleges and universities to promote healthy eating and nutrition among students would be beneficial [3]. Targeting nutrition education and experiences in educational institution would be an advantage as it may affect lifelong behaviors [11] and obese children and adolescents often become obese adults as their eating pattern would persist into adult life [12].

In many countries, the government has been consistent with World Health Organization (WHO) in mandating nutrition information on packaged foods and menu labels especially in school - based in promoting healthy eating policies in order to be parallel with national dietary guidelines [9]. The Nutrition Facts panel (NFP) is the most common nutrition information applied on either front - of - pack label (FOPL) or back - of - pack label (BOPL) [13]. A large body of literature has demonstrated the use of nutrition food labels has been notably affecting consumers food choice selection upon purchasing [14]. Nutrient and health claims are source of nutritional information, written as text on FOPL. Nutrient claims refer to the amount of nutrient within a product, while health claims describe how certain nutrient present in a food product related to health [15]. However, this nutrition information has been a debate on various factors including time pressure, comprehension difficulties, and competing priorities such as taste, price, promotions, or habit. Thus, can prevent consumers to use the information as it is complex and effortful to interpret. Therefore, attempts were made on the simplification of the nutrition label as an important obesity tool [15] in order to reduce the cognitive load and to increase probability of consumers to refer nutrition value on the point of purchase. An effective food label helps consumers to make

quick and easy decision on healthy and less healthy products based on the key nutrients such as sodium, fat, saturated fat, and sugar content [13], [15].

Many nutrition labelling formats have been introduced such as Guideline Daily Amounts (GDA), Multiple Traffic Light (MTL), Chilean Warning labels, Warning labels in red, 5 - Color Nutrition Label, Health Star Rating (HSR), and Healthy Choice label. Studies have shown that people find interpretive nutritional label provide a greater evaluation of information with the use of colors to emphasize the nutrient whether it is low (green), medium (yellow/amber), or high (red) such as MTL. Interpretive nutritional label such as MTL lead to a more accurate impressions of product healthfulness than reductive nutritional label [13]. Simplified food labelling such as using colors to indicate food choice improve customers food selection into a healthier food possibly because the customers can easily perceive the cues from the colors [16]. Color - coding food label found to be an effective in improving consumers attentiveness and reducing the time taken to read the selected nutrition information of food products [14]. Table 1 shows the cut - off used for traffic light labels for a usual food serving based on the criteria from UK Food Standards Agency [17].

Table 1: Cut - offs used for traffic light labels

Nutrient	GDA	Low (Green) <7.5% GDA	Moderate (Yellow) 150 - 500	High (Orange) >20% GDA
Energy (kcal)	2000	150	150 - 500	400
Fat (g)	70	≤5.25	5.25 - 14	≥14
Saturated fat (g)	20	≤1.5	1.5 - 4	≥4
Sugar (g)	60	≤4.5	4.5 - 12	≥12
Salt (g)	6	≤0.45	0.45 - 1.2	≥1.2

A randomized - controlled study conducted to evaluate different nutritional label formats on consumers' choice, demonstrated that MTL had the most influential on consumers perception of healthy and less healthy food products. Under time constrain, proven the presence of MTL on food packaging consumers had the ability on the likelihood to facilitate the identification of healthy food choices [2]. Most children in a study demonstrated improved knowledge significantly following nutrition education. Positive attitude and asking behavior for red food decreased. Children refusing on red food also increased after an education intervention was implemented to them [12]. In United Kingdom, the usage of MTL alerts the consumers on low/medium/high levels of saturated fat, fat, sodium and sugar per serving [9].

The aim of this review is to provide an overview of the recent field of investigation related to MTL. MTL nutrition food label has been a common tool used to prevent obesity in worldwide, however no reviews have synthesized this evidence among students [18], [19]. Therefore, this review provides a summary on the influence of MTL on purchasing behavior and consumption to treat childhood obesity.

2. Method

a) Study selection

Three electronic databases were used to search for relevant papers published in English: PubMed, The Cochrane Library, and Wiley Online Library from August 2024 to October 2024.

The search was using Patient/Problem, Concept, and Context (PCC), in which the patient would be children, adolescents or students. The concept would be MTL food label or MTL nutrition label and the context used was schools, school canteens, universities or universities cafeteria. Publications were limit to human subjects only and where possible number of terms describing various disease were excluded except obesity. The keywords used for the search were "front of pack labelling", "traffic light menu label", "traffic light food label", "children", "adolescent", "student", "school", "canteens", "universities", "college", "cafeteria", "understanding", "acceptance", "knowledge", "attitude", and "purchasing". Record retrieval was limited to studies published between 2012 and 2024. These publication dates were selected to ensure strong evidence support this study as this was the first review done on students. With the aim of addressing the research questions on do Malaysian educational institution should emphasize multiple traffic light (MTL) food label among students and how this influences their product perception, purchasing behavior and consumption.

b) Eligibility criteria

To guide publication selection, a set of eligibility criteria were established that aligned with the research question defined. Publications were only included in the analysis if it provided information on multiple traffic light food or menu label among students particularly school, and university and college students, if it provided on the perception, understanding and acceptance of students on this label and if there are any significant changes on students point of purchase post exposure of this label. Eligibility criteria required the articles retrieved to be in English language and full text articles were provided for analysis. Publications were excluded if they reported information on MTL label among adults' consumers. Publications were also excluded if the MTL exposure on participants were a pilot studies and study protocol. Publication on findings providing parameter relating to student's perception, interpretation and food choice selection were chosen.

c) Data charting

From each selected study, two investigators extracted data on study design (e. g., sample size and setting), sample characteristics (e. g., age) and conclusions were compiled in a single Microsoft Excel spreadsheet. Extracted data were further grouped into the following sub - sections, each of which were summarized in table format: authors (year), country, sample size, study setting, participant age, main findings relating to perception, understanding and behavior.

3. Results

a) Publication selection

A total of 234 publications were identified as part of the electronic database searches PubMed (n = 224), The Cochrane Library (n = 3), Wiley Online Library (n = 5), and from other source (n = 2). Duplicates were removed (n = 12), which left 222 titles and abstracts to be screened, and among them, 146 publications were seen irrelevant based on title and abstract screening. The remaining 66 full - text reports were assessed for inclusions. 19 publications were included for the final synthesis as shown in Figure 1.

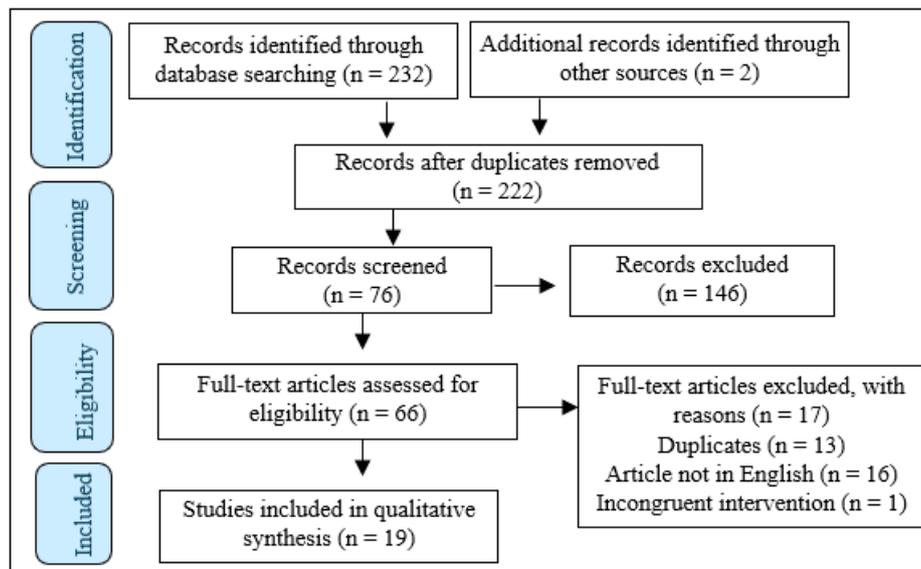


Figure 1: PRISMA flowchart

b) Description of included studies

The 19 papers reporting findings from 22 studies were published between 2012 and 2023. Studies took place in various countries, including Mexico (n = 1), Brazil (n = 1), Canada (n = 2), Australia (n = 1), United States (n = 6), Germany (n = 2), Netherlands (n = 1), Uruguay (n = 1), Spain (n = 1), Ecuador (n = 1), Peru (n = 1), Indonesia (n = 1), and Japan (n = 1). Sample size across these studies ranged from n = 39 to n = 2714, including one study did not mention their sample size of participants. Observations were either made in the form of online survey (n = 3), primary and secondary

school (n = 5), university (n = 9), hospitals (n = 2), and local community setting such as convenience store (n = 1). Participants in these studies were children, adolescents, and young adults specifically students from primary, secondary and undergraduates. Most studies were mixed gender. One study only involved female gender, while 5 studies did not mention the genders involved in their studies. The average participant age ranged from 5 years to 26 years. Table 2 provides a summary of descriptive data for each of the included studies.

Table 2: Description of studies included in the review

Publication	Sample Size	Setting	Age	Objective
[20]	67	Four convenience stores (2 in low SES, 2 in middle SES)	13 - 23	Explore the subjective understanding of food labels that are currently used internationally among low - and middle - income consumers
[21]	492	Four school from two cities in Brazil	6 - 12	Compare children's emotional association with food products featuring different FOP nutrition label schemes.
[22]	163	6 pediatric wards	N/A	To evaluate patient meal orders and consumption with a revised menu design that includes child - friendly menu labelling
[23]	2008	Online survey	16 - 24	To examine the efficacy of various calorie labelling formats on recall, comprehension, and consumer references for calorie information
[10]	2714	Online survey	5 - 12	To assess the efficacy of a consumer - behavior intervention on a menu label implemented in an online school - canteen ordering system of primary students ordering lunch
[24]	1329	Harvard university	N/A	To examine whether MTL and choice architecture interventions improved dietary choices among students.
[25]	N/A	Café Bay at children's hospital	N/A	To examine the changes in healthy and unhealthy items purchased following the implementation of MTL and cartoon labelling.
[26]	39	Montclair State University	18 - 24	To evaluate an effective design to promote healthy selections from university foodservice menus
[27]	288	Germany university	N/A	To examine the ability of different types of FOPL schemes to communicate product healthiness across different product categories, between same product category, and when viewed in isolation and in comparison, with other product.
	87	Netherlands university		
[28]	646	Three primary & secondary schools	N/A	To study attitudes towards sugar reduction in three dairy products of children and adolescents and to assess if these attitudes are modulated by the inclusion of MTL.
[29]	1294	Harvard university	N/A	To assess student perceptions of MTL in two college cafeterias
[30]	2002	Online survey	18 - 24	The effects of MTL signposting scheme on consumers' food choices
[17]	81	Spanish secondary school	14 - 16	To compare in adolescents two models of FOP labels in terms of friendliness and acceptance, and the ability to choose a diet that closely follows the nutritional recommendations based on the labelled menu.

[31]	178	School in Ecuador	5 - 14	To analyze patterns of knowledge, comprehension, attitudes, and practices regarding MTL placed on processed food packages to inform consumers about levels of added fat, sugar, and salt.
[32]	123	Undergraduates of Boston university	N/A	To determine MTL approach to product labelling can have a substantial impact on perceptions of foods health quality and food choice
	182			
	227			
[33]	100	Peruvian university students	16 - 26	To assess whether the multiple MTL can improve the nutritional quality of consumer decisions
[34]	80	University hall	6 - 10	To evaluate how four different FOP label designs impact the ability of children to assess product healthfulness and time to assessment.
[14]	41	Secondary school at East Jakarta	15 - 17	To evaluate the impact of MTL nutrition label on female teenagers' comprehension of nutritional values.
[35]	247	Japanese university students	21 - 24	To determine whether the use of MTL food labels on the FOP increases people's choices of healthy meals, whether their effects are consistent across three meal timings in one day, and whether they can increase people's awareness about food components, such as calories, sugar, and saturated fats.

c) Description of Study Findings

The 19 publications selected for inclusion in this review related to a range of research questions and hypotheses. The studies were sufficiently consistent in design and measures to

be consolidated into a set of study findings, as they were concerned with either the perception and interpretation, or behaviors (purchase, consumption) in relation to the MTL food labelling. Table 3 summarizes the findings of study.

Table 3: Summary of findings

Publication	Country	Food Type	Findings
[20]	Mexico	Dairy products, cereals, ready - made products, beverages, and salty snacks	<ul style="list-style-type: none"> • MTL may be better at helping population of low - and middle - income make healthier food choices. • Participants mentioned the colors of this label represented clear messages.
[21]	Brazil	Chocolate flavored milk, sandwich cookies, frosted corn flakes, gelatin, yogurt, corn snack, ice cream, banana, broccoli	<ul style="list-style-type: none"> • Children who evaluated packages featuring MTL showed significant decrease on the frequency of use the emoji face savoring delicious food, face with mouth open. • Children tend to use emoji associated with positive emotions less frequently.
[22]	Canada	N/A	<ul style="list-style-type: none"> • Significant higher odds of ordering green - light healthier option foods and lower odds of ordering red - light foods. • The combination of menu labelling was an effective short - term tool for increasing the intake of healthier foods.
[23]	Canada	N/A	<ul style="list-style-type: none"> • When small fonts on food packaging, MTL performed best to improve recall.
[10]	Australia	N/A	<ul style="list-style-type: none"> • The mean proportion per student of all online lunch items purchased that were green was significantly higher and the mean proportion of purchased items that were classified as red was significantly lower in the intervention group than in the control group.
[24]	United States	N/A	<ul style="list-style-type: none"> • No significant changes in red or green items served at intervention sites compared with controls. • Most students wanted labels and felt they were useful.
[25]	United States	N/A	<ul style="list-style-type: none"> • MTL was associated with fewer unhealthy purchases and thus may have potential to decrease the amount of unhealthy items purchased in a children's hospital food retail venue
[26]	United States	N/A	<ul style="list-style-type: none"> • The students itemized five nutrients they wanted labelled with colors and quantified on menu (calories, sodium, sugar, fat and carbohydrates), plus beneficial ingredients or nutrients for display as menu icons
[27]	Germany	Pasta, spaghetti, ciabatta, corn flakes, Thai chips, cheese balls	<ul style="list-style-type: none"> • MTL label can achieve all three objectives. • MTL food label increased the ability of consumer to differentiate between more and less healthful products.
	Netherlands	Broccoli, red cabbage, orange, peach, tomato, curry, garden herbs, yogurt	<ul style="list-style-type: none"> • MTL food label was able to significantly decrease the perceived healthfulness of the less healthfulness option compared to the control condition.
[28]	Uruguay	Chocolate - flavored milk, milk desserts and yogurt	<ul style="list-style-type: none"> • The inclusion of sugar reduction claims significantly affected the frequency of use of the terms good for my health and bad for my health. • However, inclusion of MTL label and sugar reduction claim significantly affected the frequency of use of the term bad for my health.
[29]	United States	N/A	<ul style="list-style-type: none"> • Post - intervention survey, 60% found MTL food label was helpful, 57% used them few times a week. • 16% developed eating disorder post MTL food label exposure, 47% said MTL food label might exacerbate eating disorder.

[30]	Germany	N/A	<ul style="list-style-type: none"> Participants rated understandability of MTL signposting scheme fairly high (5.9 out of 7) Sugar and fat were found to be the most important attributes of the schemes The color coding helped reduce complexity of decision making
[17]	Spain	N/A	<ul style="list-style-type: none"> Participant used the MTL food label chose significantly less total energy, sugar, fat, saturated fat, and salt. MTL food label helped adolescents to differentiate between healthier and less healthy food, making it possible for them to choose diet closer to dietary recommendation
[31]	Ecuador	N/A	<ul style="list-style-type: none"> Participants knew about the MTL food label and understood the information it conveys, but not all changed their attitudes and practices related to the purchase and consumption of processed food Children and adolescents used the information less frequently. Adolescents concern about their health used the label when selecting products
[32]	United States	Marbella chicken sandwich	<ul style="list-style-type: none"> MTL label provide non dieters with an information processing cue that directly influences evaluations in a manner that is consistent with the “stop” and “go” logic behind the MTL. Dieters simply do not adopt the red, yellow and green cues into their health quality evaluations. Dieters focus more on cost of consumption, and as a result lower their health quality evaluations.
		Marbella chicken sandwich, stuffed chicken breast, that chicken salad, breakfast sandwich	
		Marbella chicken sandwich	
[33]	Peru	Crackers and beverages	<ul style="list-style-type: none"> MTL significantly increases the probability of avoiding the least healthy options and of choosing the healthiest among the alternatives provided
[34]	United States	N/A	<ul style="list-style-type: none"> Color coding and/or facial icons significantly benefit selection accuracy and speed
[14]	Indonesia	N/A	<ul style="list-style-type: none"> Both groups (control and intervention) had significant change on their comprehension after the intervention. The group used MTL had higher scores of 39.17points compared to control group used nutrition fact tables of 20.63points.
[35]	Japan	Fried prawn bento, rice ball bento, fried oyster bento, fried chicken bento, grilled salmon bento, salt - grilled mackerel bento, ginger grilled pork bento, sukiyaki bento, dried laver bento, croquette bento, pork cutlet bento, hamburger steak bento, fried food bento, grilled meat bento, and various side dishes bento	<ul style="list-style-type: none"> MTL significantly increased the consciousness of healthy eating during all three (breakfast, lunch and dinner) meals. MTL created awareness of nutrients that were not indicated such as protein and dietary fiber. MTL significantly increased the selection of healthy meals and conscious towards nutritional component.

Two studies have identified most consumers aware of the GDA but rarely used it because the nutrition information displayed is quite complex. HSR, Warning Labels, MTL and the Healthy Choice Logo were the most understandable. Results of directive and semi - directive labels such as Warning labels, HSR and MTL are the better choice of helping population to make healthier food choice, than non - directive GDA [20]. The directive and semi - directive labels associated with the consumer’s emotions as children used the emoji associated with positive emotions less frequently on food that indicated these labels [21]. Similarly, study comparison on children exposure on text with color and non - color - coding labels with colored and non - colored facial icon demonstrated that text with color coding and/or colored facial icons significantly benefits selection accuracy and speed of healthy and less healthy food products ($p < 0.001$) [34].

Study conducted in a pediatric ward, found a significant 1.75 higher odd of ordering green light healthier option foods and 0.65 lower odds of ordering red light foods when exposed to child friendly menu labelling. However, the effect wanned over time, such that after the 8 meals, proportions of ordering red light and green light foods were similar. Therefore, it was

found that the child friendly menu label was an effective short - term tool for encouraging and to increase the intake of healthy foods [22]. Likewise, a study conducted in a retail food venue in a children hospital, found that traffic light labelling associated with significant decrease in purchasing unhealthy food items, while cartoon labelling on food items associated with increase in unhealthy items purchased [25]. The traffic light food label evoked the feeling of guilt among children when taking the food items colored red to the counter [25]. When comparing to font size of food labels, nutrition fact tables with calories in large fonts enhanced the calorie recall ($p < 0.001$), however when small font was being displayed on food products the MTL performed the best at improving the calorie recall ($p < 0.01$). This study finding was consistent with the findings of other research suggesting that traffic light labels had the maximal capacity to capture attention and increase consumers understanding and correct interpretation of nutrient levels in a food product [36]. Therefore, enhancement of the visibility and design of the labels can improve the efficacy of calorie labeling to be noticed and interpreted on packed foods [23].

In two randomized controlled trial study involving school children and university students, the mean proportion of

primary school children ordered and purchased their lunch meal through online in green category was significantly higher 51.21% in intervention group compared to 37.93% in control group ($p < 0.001$). However, the mean proportion of foods purchased that was classified as red was significantly lower 1.21% in intervention compared group compared to 11.11% in control group ($p < 0.001$) [10]. Correspondingly, among Japanese university students, the proportion of students in labeled group who chose healthy diet in all three meal selections was significantly higher and were aware of other nutritional components that were not listed in the label such as protein and dietary fiber than the unlabeled group [35]. This study provided strong evidence supporting the effectiveness of a consumer - behavior intervention using color coding food labels among students. In two intervention studies conducted on university students, and children and adolescents found that university students being exposed on traffic light label, no significant changes were reported in red foods ordered ($p > 0.20$) and green foods ordered ($p > 0.40$) in the intervention group. However, a survey was conducted and identified 58% students used traffic light labels at least few times per week and 73% students wanted the traffic light labels to be continued in their college cafeterias [24]. In primary and secondary schools' student's exposure on traffic light label, most of them knew and understood about the information on the label but no significant changes were reported on their purchasing and consumption behavior. However, adolescents concerning about the health used the label during product selection for purchasing [31].

In a study conducted that gathers university students on nutrition labelling on college menus and a prototype design creation, the students itemized five nutrients particularly calories, sodium, sugar, fat, and carbohydrate to be colored as traffic light system. This finding presented that students are interested in color coding food labels that could positively impact the general selection of healthy foods [26]. In three experimental study involving three different universities, two study concluded traffic light label has a larger differentiation between more and less healthful as compared to other food labels introduced which was nutrition table and GDA. Traffic light label appeared to be effective in communicating the healthfulness of a product both across and within product categories, and for products evaluated in isolation traffic light label packed food seem to be perceived healthfulness of less and healthy food category ($p < 0.05$) [27], [33]. In another study, which involves dieters and non - dieters. Non - dieters able to perceive information on traffic light food label that influenced their perception on "stop" and "go" logic behind the color - coding label, however among dieters was found that they do not simply adopt the color cues on the food label and taking into account on the cost of consumption and resulted into lower health quality evaluation [32].

In another experimental study which involves primary and secondary students that were being exposed with sugar reduction claim and traffic light label on three different dairy products such as yogurt, chocolate - flavored milk, and vanilla dessert. Sugar reduction claim appearance to cause a slight significant increase in the children and adolescents' expected liking ($p < 0.01$), however, when the sugar reduction claim was included with traffic light label created a more expected

liking and influence the selection of the products ($p < 0.01$) [28]. Traffic light label was also found to create an eating disorder among university students based on a cross - sectional mixed method study. Even 60% of the students found traffic light label was helpful and 57% students used the label few times a week ($p < 0.001$), however 16% of the students said they developed eating disorder, while 47% said traffic light label might exacerbate existing eating disorder ($p < 0.001$). Traffic light labels on foods made them to be more likely to restrict the amount of food they eat to influence shape or weight which eventually influence eating disorder [29].

In an online survey study, students were presented with pictorial examples and had asked them to rate the usefulness of the labels. Then the students were exposed with traffic light labels and rated their usefulness. The students rated traffic light labelling as fairly understandable with the mean of 5.9 out of 7.0 on a Likert scale and it was shown that color coding anticipated a healthy perception on selecting food choice as compared to text - based nutrition declaration [30]. Similarly, when students were exposed on traffic light label and GDA using randomized cross over method, selection was significantly less in total energy ($p < 0.001$), sugar ($p < 0.001$), fat ($p < 0.01$), saturated fat ($p < 0.01$), and salt ($p < 0.001$) when using traffic light label that the GDA system. Traffic light color food label helped the students differentiate between healthy and less healthy food and making it possible for them to choose the diet that is close to their dietary recommendation [17]. In a quasi - experimental study, student's exposure on traffic light label in intervention group improved their nutrition labels comprehension compared to the control group which being exposed to nutrition fact tables [14].

4. Discussion

This review was undertaken to identify on student's perceptions, attitudes and understanding on MTL. This study aim was to determine the suitability of the implementation of MTL in Malaysian educational institution such as school canteens, and universities and colleges cafeterias to provide as a role in curbing childhood obesity and leading to a healthier diet. In all the studies among students on MTL, a moderated hypothetical model was examined. Firstly, the process by which the MTL nutrition information achieved its effects on the meal choice and energy intake, and second whether the information was more effective in changing the meal choice of subgroups of students [37].

Of the different food label currently use around the world, it can be classified as reductive or interpretive. Reductive food label provides factual nutrient information about a food with minimal interpretation, while interpretive food label contains similar factual nutrient information but also use colors to indicate the healthiness of a food [38]. Interpretive food label can be either nutrient - specific such as MTL which provides information on the individual nutrients within a food or summary indicator such as Nutri - Score which provides overall evaluation of the nutritional quality of the product. The visual depictions of these food label can be found in Figure 2.

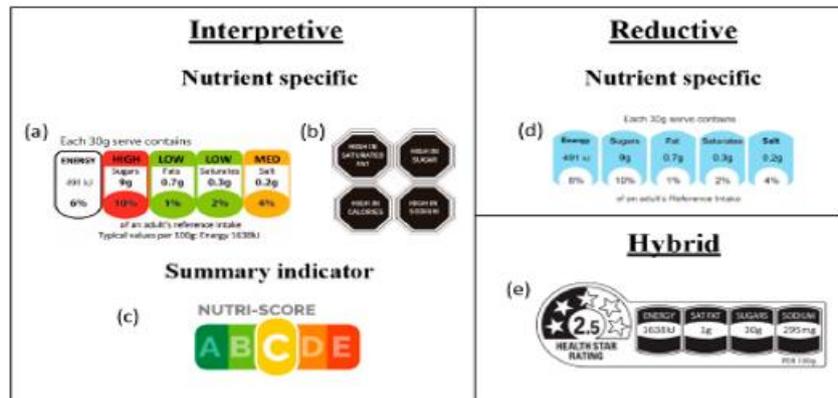


Figure 2: Examples of interpretive and reductive food label

A more salient type of food label is called the MTL, the idea of this label is to mark foods with high in sugar, fats, and sodium content as red should be consumed infrequently, yellow (or amber) for foods that can be consumed in moderation, and green for foods that can be consumed any time [18]. Food label with an evaluative component (i. e., Traffic Light Label) demonstrated to be superior in perceived healthfulness of food products and purchased intention compared to other food label used among students [39]. Children being exposed to MTL showed a significant decrease in their body mass index (BMI) over the course of 10 weeks of exposure. Therefore, MTL food and menu labels perhaps to be the best evidence - therapy for obese children and in fact children exposed to MTL demonstrated a maintenance of effects in 10 - year follow up studies [40].

Based on a study on 81 adolescents ages between 14 and 16, it was discovered that MTL helped them to identify healthier products than color - free labels. The subjects as well displayed a better ability in selecting food products containing fewer calories and lower levels of total fat, saturated fat, sugar, and salt [17]. Additionally, in a one week follow up period among university student exposed to MTL, the students had a better and increased healthy diet selection with an increase conscious of other nutritional ingredients such as protein that was not listed in MTL food label. It was also found that the exposed students required a minimal knowledge to process the nutrition label with no significant differences on psychological stress during food selection [41]. Similarly, a study conducted by Kelly et al., (2009) on 790 adults in Australia found that those who used MTL displayed an ability to identify healthier products five times greater than the ability of those who used labels with no color - coding [42]. Study among Ecuador population on carbonated soft drink purchases showed no significant effects on reducing purchases of high sugar soft drinks during first year of implementation. However, a significant decrease on purchase of high sugar soft drinks, while low and no sugar soft drinks increased over time after displaying MTL on the product content [43].

MTL is somewhat simplified and easier to be read by consumers at the point of purchase. However, some studies have shown that health literacy would affect the MTL understanding among parents and their children. Parental literacy was an important role for their children's healthy body weight. Higher parental health literacy seen to have a better portion - size estimation skill, better comprehension on

nutrition labels, and better comprehension on growth chart [44]. WHO defines health literacy as the cognitive and social skills which determines the motivation and ability of individuals to gain access, to understand, and use the information in which promote and maintain good health. The overall health literacy level in Malaysia recorded that majority of the population were categorized having sufficient health literacy (40.7%), limited health literacy (35%), and excellent health literacy level (24.3%) [4].

5. Strength and Limitation

The strength of this review is that a comprehensive search strategy and systematic selection process was done to ensure the most up to date publications were included and that inclusion criteria were rigorously applied. This review is somewhat can be a future reference that provides general information on the MTL treating childhood obesity and treating NCD among children and adolescents. However, the results of this review need to be evaluated while taking into account several limitations. As of all the papers, sociodemographic demographic background of the subjects was not included. Besides, subject's socio - economic status was also not being determined in each of the publications. This was somewhat a limiting factor as some publications conducted among adults on MTL exposure, identified that lower socio - economic subjects tend to purchase more on higher calories food ignoring the health label displayed on food products. The reason of the frequent purchase on higher calorie, salt, sugar, sodium and fat foods are due to cheaper price and readily available in their convenience stores. Information on nutrition literacy among Malaysian students is somewhat limited to be used as guidance in its acceptability and suitability on MTL being implemented to Malaysian students.

6. Conclusion

In general, the importance of educational institutional environments as a setting for promoting healthy eating behaviors is well recognized. The canteens and cafeterias are a key intervention site as the provision of nutritious foods and drinks. Schools and universities can use the canteen and cafeteria to help deliver consistent messages to students about recommended eating practices to promote the adoption of lifelong healthy eating behaviors [25]. However, in universities and college cafeteria, it will be beneficial to involve eating disorder experts to overcome students who are

at risk of exhibiting eating disorders [29]. This is related to current evident in Malaysia by Chin et al., 2020 demonstrated that university students are at most risk group of developing eating disorders [45].

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Author Profile



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