Malaysian Applied Biology (2024) 53(4): 7-16
https://doi.org/10.55230/mabjournal.v53i4.3027

Research

Ultra-Processed Food Consumption and Its Relationship with Diet Quality Among Malaysian Young Adults

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ABSTRACT

The global rise in ultra-processed food (UPF) consumption presents potential public health challenges. UPFs, laden with additives and extensively marketed, are increasingly prevalent in modern diets. However, there is limited research on UPF consumption among Malaysian young adults, particularly its relationship with diet quality. This cross-sectional study aimed to investigate the relationship between UPF consumption and diet quality among 177 young adults aged 18 to 29 years from Terengganu, Johor, and Perak. A two-day 24-hour dietary recall was used to assess UPF intake, classified by the NOVA system, while diet quality was evaluated using the Standardised-Malaysian Healthy Eating Index (S-MHEI). The S-MHEI was adopted with the scores for each food group (adequacy component) calculated according to the recommended servings per food group expressed per 1,000 kcaL. Statistical analyses, including Spearman correlation, were conducted using SPSS version 25 to determine the relationship between UPF consumption and diet quality with statistical significance set at $p<0.05$. The median total energy intake was 1,417 kcaL (IQR=735.38), with UPFs contributing 38.6% of this intake. The median S-MHEI score was 44.65 (IQR=12.77), indicating that 74.6% of participants had poor diet quality. Statistical analysis found no significant relationship between UPF consumption and diet quality ($p=0.395$). Although no significant association was found, this study lays the groundwork for further research on nutrition and health among Malaysian young adults.

Key words: NOVA food classification, standardised malaysian healthy eating index, ultra-processed food, young adults

Article History
Accepted: 26 August 2024
First version online: 27 October 2024

Cite This Article:
Ali, A., Ding, N.X., Zakaria, N.S., Kamarudin, K.S., Mohamed, H.J.J., Zainuddin, A.A. & Yusof, H.M. 2024. Ultra-processed food consumption and its relationship with diet quality among Malaysian young adults. Malaysian Applied Biology, 53(4): 7-16. https://doi.org/10.55230/mabjournal.v53i4.3027

INTRODUCTION

As societal trends evolve, young adults often lead the charge, particularly in their dietary choices, which have profound and enduring implications for nutritional, health, and overall well-being (Mamun *et al*., 2020; Sexton-Dhamu *et al*., 2021; Ramón-Arbués *et al*., 2021; Hartman-Petrycka *et al*., 2022). It is well-documented that young adults are prone to favor fast food, lack meal planning, and perceive healthy food options as expensive, particularly during high-stress periods such as examinations or extensive work hours (Marchese *et al*., 2022). This trend toward suboptimal dietary practices is contributing to an escalation in obesity rates and nutritional deficiencies among this demographic, posing significant public health challenges (Mamun *et al*., 2020).

In Malaysia, this global dietary shift is mirrored by a marked increase in the consumption of ultra-processed foods (UPFs), which are often selected for their convenience and palatability despite being laden with sugars, unhealthy fats, and sodium (Da Costa Louzada *et al*., 2015; Moubarac *et al*., 2017; Ganesrau *et al*., 2023). These products, predominantly composed of industrial ingredients, are characterized by their high-caloric density and scant nutritional value (Monteiro *et*

al., 2019). NOVA's food classification system places foods into four groups based on their processing level, offering a framework for understanding the health implications of dietary choices (Monteiro *et al*., 2019). These four groups are (1) Unprocessed or minimally processed foods, which include fresh, dry, or frozen fruits and vegetables, grains, legumes, and nuts; (2) Processed culinary ingredients, such as oils, butter, sugar, and salt, derived from the first group of foods; (3) Processed foods, which are products made by adding sugar, oil, salt, or other substances from group 2 to group 1 food, such as canned vegetables, fruits in syrup, and freshly made bread; and (4) Ultra-processed food and drink products, which are industrial formulations made entirely or mostly from substances extracted from foods (oils, fats, sugar, starch, and proteins), derived from food constituents (hydrogenated fats and modified starch), or synthesized in laboratories (colorings, flavorings, flavor enhancers & other additives used to make the final product palatable or more appealing).

Diet quality, a measure of nutritional intake balance and variety, is pivotal for good health (Demilew *et al*., 2023). A high-quality diet includes a broad spectrum of foods from key food groups, conforming to dietary guidelines and ensuring adequate nutrient consumption necessary for a vibrant and healthy lifestyle (Demilew *et al*., 2023). However, the rise in UPFs has been linked to deteriorating diet quality, with implications such as increased rates of overweight, obesity, and chronic diseases (Da Costa Louzada *et al*., 2017; Vandevijvere *et al*., 2019; Bleiweiss-Sande *et al*., 2020; Griffin *et al*., 2021; Zapata *et al*., 2022). Griffin *et al*. (2021) demonstrated that a predominant portion of energy intake stemmed from UPFs, which inversely affected diet quality. Further, Zapata *et al*. (2022) highlighted the adverse effect of UPFs on the consumption of healthy foods in Argentina, exacerbating concerns given the high prevalence of obesity and chronic conditions. Despite these international findings, there is a paucity of research on the impact of UPF consumption on the diet quality of young adults in Malaysia, a gap that is stark given the unique lifestyle and dietary challenges faced by this group (Moubarac & Cannon, 2017; Da Costa Louzada *et al*., 2017; Vandevijvere *et al*., 2019). Addressing this deficiency, Vandevijvere *et al*. (2019) observed a direct correlation between UPF intake and poor diet quality across various demographic groups in Belgium, including different age groups, income levels, and educational backgrounds, suggesting the need for tailored nutritional policies. Recognizing the necessity to curb non-communicable diseases (NCDs), the Malaysian Ministry of Health has highlighted the reduction of UPFs as a critical strategy within its Nutrition Research Priorities for the 12th Malaysia Plan 2021-2025 (Ministry of Health Malaysia, 2020). This study aims to explore the specific relationship between UPF consumption and diet quality among Malaysian young adults, offering insights that may inform national health policies and promote better dietary habits within this pivotal group.

MATERIALS AND METHODS

Data collection was conducted from August to October 2023, utilizing a mixed-method approach for sampling. Initially, purposive sampling was employed to select respondents from three Malaysian states: Perak, Johor, and Terengganu. This strategic approach aimed to capture the varied dietary patterns and lifestyle choices of young adults within these demographically diverse regions. Specifically, respondents from Perak were mostly from rural areas, Johor participants were primarily from urban areas, and Terengganu included a mix of urban and rural respondents. This selection was intentional to reflect the different access and availability of ultra-processed foods across diverse housing logistics. Maintaining an equal number of respondents from each state was purposeful to ensure equitable representation. Subsequently, convenience sampling methods were used to recruit the respondents, between the ages of 18 and 29 years, within the selected regions. The sample size was determined using the Cochran formula (Uakarn *et al*., 2021), which, considering the previous findings of Asma' *et al*. (2019) that ultra-processed foods constituted 40.38% of the adult diet, suggested a minimum sample size of 161 respondents. To account for potential attrition, an additional 10% was added, culminating in a total of 177 respondents for this study. This study received ethical approval from the UMT Research Ethics Committee (UMT REC), denoted by reference number UMT/JKEPM/2023/154. All respondents were fully informed about the study's objectives and processes, and written informed consent was obtained before data collection.

This study utilized a structured questionnaire divided into two main sections. Section A was designed to capture the socio-demographic profiles of the respondents, including gender, age, ethnicity, marital status, education level, household income, employment, and residency status. This section was self-administered using physical copies of the questionnaire, allowing respondents to provide their socio-demographic data, which was subsequently analyzed using the SPSS software. Section B focused on assessing the consumption of ultra-processed foods and evaluating diet quality. This evaluation employed a 2-day 24-hr dietary recall method, conducted through face-to-face interviews.

Respondents detailed their food and beverage intake over the previous 24 hr, including specific times, types, and quantities of consumption, as per Shim *et al*. (2021). The Malaysian Food Album - *Album Makanan Malaysia* (Institute for Public Health, 2014a) in physical format played a crucial role in aiding respondents' memory during the recall process.

The dietary recall was conducted over two non-consecutive days, with the dietary intake for the first and second days separated by a minimum of one day and a maximum of eight days, as suggested by previous studies (Huang *et al*., 2022). This approach was chosen to provide a representative snapshot of the respondents' dietary habits. Prior research has shown that a 2-day dietary recall is reliable for estimating an individual's dietary intake (Melough *et al*., 2019; Arsenault *et* al., 2020; Madrigal *et al*., 2020). This method allowed us to capture variations in dietary intake while maintaining a practical and manageable data collection process for the respondents. Data from the dietary recalls were entered into Nutritionist Pro Software version 5.3.0 (Axxya Systems LLC, Redmond, WA), which referenced the Malaysian Food Composition Database to analyze the nutrient content of the consumed foods. The analysis focused on total energy intake, total fat, added sugar, and sodium.

Ultra-processed food consumption assessment

For the analysis of UPF consumption, we categorized the recalled foods and beverages using the NOVA food classification system (Monteiro *et al*., 2019). In our methodology, we integrated NOVA's Group 1 and Group 2 to streamline the classification process. This unification was employed to address the void of standardized recipes in the dataset, a known issue highlighted in previous research (Asma' *et al*., 2020a). Group 1 typically includes unprocessed or minimally processed foods, while Group 2 consists of ingredients used in culinary preparations. Their merger was an analytical strategy to sharpen the focus on our primary research interest—the assessment of processed versus ultra-processed food intake. Despite the amalgamation of Groups 1 and 2, Groups 3 and 4 were deliberately kept distinct to underscore the study's commitment to meticulously distinguishing between processed foods and their ultra-processed counterparts, thereby facilitating a precise investigation into the dietary impact of processing intensity. The contribution of each NOVA group to total daily caloric intake was calculated with Nutritionist Pro Software and organized in Microsoft Excel. To compute the average energy intake contribution for each group (Group 1+2, Group 3 & Group 4), we first calculated the energy intake contribution for each day and then averaged these values. Median scores and interquartile ranges (IQR) were derived using SPSS version 25. The following formulas were used:

The formula for average energy intake contribution in each group (%):
Average intake contribution (%) = (Energy intake contribution on Day 1 (%) + Energy intake contribution on Day 2 (%)) / 2

The formula for energy intake contribution in each group (%):
Energy intake contribution (%) = (Energy intake in one day for each group (kcaL) / Total energy intake in one day (kcaL)) × 100

Diet quality evaluation

The Standardised Malaysian Healthy Eating Index (S-MHEI), developed and validated by Jailani *et al*. (2021), is adopted to assess diet quality in alignment with the Malaysian Dietary Guidelines (MDG) 2020 and the Recommended Nutrient Intake (RNI) 2017. This tool evaluates both the quantity and balance of nutrients consumed, providing a comprehensive assessment of dietary intake. The S-MHEI comprises 11 components that cover eight food groups and three nutrient groups, including grains, fruits, vegetables, protein sources (e.g., fish, meat, poultry, eggs, legumes & nuts), dairy products, total fats, added sugars, and sodium. Key nutrient groups focus on the intake of total fats, added sugars, and sodium. Each component is scored based on its adherence to the serving size and nutrient intake recommendations established in the RNI 2017. To prevent overlap, particularly between related food groups like total grains and whole grains, both are capped at a maximum score of five points each. The aggregate of these components can achieve a maximum score of 100, with a higher score signifying superior diet quality. The scoring for each component is calculated using specific formulas. For components focused on adequacy, the formula used is (Jailani *et al*., 2021):

$$= \frac{\text{The reported intake}}{\text{The cut off value}} \times \text{The maximum score}$$

For components requiring moderation, where the intake is between a cutoff and a threshold value, the formula is (Jailani *et al*., 2021):

$$= \frac{(\text{The threshold value - The reported intake})}{(\text{The threshold value - The cut off value})} \times \text{The maximum score}$$

Using SPSS, researchers calculate the daily score for each component and then average these scores across the two-day dietary recall period to determine the respondent's total S-MHEI score. The scoring system adopted in the S-MHEI is intricate and systematically structured to quantify the level of compliance with the RNI 2017 as shown in Table 1.

Table 1. The Standardized Malaysian Healthy Eating Index (S-MHEI) (Source: Jailani *et al*., 2021)

No	Component	Type [a]	Max Score	Criteria for Min Score (0)	Criteria for Max Score
1	Total grains	A	5	0 servings/1,000 kcaL	1.4 servings/1,000 kcaL
2	Whole grains	A	5	0 servings/1,000 kcaL	0.7 servings/1,000 kcaL
3	Fruits	A	10	0 servings/1,000 kcaL	0.9 servings/1,000 kcaL
4	Vegetables	A	10	0 servings/1,000 kcaL	1.2 servings/1,000 kcaL
5	Fish	A	10	0 servings/1,000 kcaL	0.4 servings/1,000 kcaL
6	Meat, poultry and eggs	A	10	0 servings/1,000 kcaL	0.4 servings/1,000 kcaL
7	Legumes and nuts	A	10	0 servings/1,000 kcaL	0.4 servings/1,000 kcaL
8	Milk and milk products	A	10	0 servings/1,000 kcaL	0.9 servings/1,000 kcaL
9	Total Fat	O	10	0 or ≥55% of TEI	25–30% of TEI
10	Added Sugar	M	10	≥25% of TEI	≤5% of TEI
11	Sodium	M	10	≥2,300 mg	≤1,925 mg

[a] A refers to the adequacy component; O refers to optimal components; M refers to the moderation component.

For each dietary component, scoring tables have been developed, which inversely relate the intake of total fat, added sugars, and sodium to the Malaysian recommended dietary intake percentages or absolute amounts. This graded scoring system ensures that each respondent's dietary habits can be evaluated on a continuum, from poor to excellent, providing a detailed perspective of diet quality and identifying potential nutritional improvements. In the context of evaluating dietary intake, our scoring methodology adheres to the RNI 2017, emphasizing the consumption of total fat, added sugar, and sodium. The assessment operates on a reverse scale, where lower intake percentages that align with nutritional recommendations score higher, promoting a balanced and healthy diet. Total fat intake scores are based on the proportion of total energy intake, ideally 25-30%. Scores decrease as fat intake exceeds this range, discouraging high-fat consumption linked to health issues. Added sugar intake scores higher for lower consumption, with the top score for 5% or less of total energy. Sodium intake follows a similar pattern, with lower intakes receiving higher scores to mitigate hypertension risks. This scoring system encourages balanced diets, guiding healthier food choices and adherence to national dietary standards for optimal health outcomes (Jailani *et al*., 2021).

Data analysis

Statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) version 25. All reported p-values were two-tailed and a significance level of $p<0.05$ was used. Descriptive statistics was used to present socio-economic characteristics (frequency and percentage), and Standardised Malaysian Healthy Eating Index (S-MHEI) scores. Spearman correlation was used to determine the relationship between the consumption of ultra-processed food and diet quality among Malaysian young adults.

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents

In this cross-sectional study, 177 young adults residing in Perak, Johor, and Terengganu were selected to participate. The socio-demographic profile, as shown in Table 2, reveals that the majority of respondents were females (69.5%), with the largest age group being 21-23 years old (49.7%). Ethnic composition was predominantly Chinese (53.1%), and most respondents were unmarried (93.2%). A

significant portion reported a monthly household income below RM 4,850 (70.1%) and were pursuing bachelor's degrees (39.0%).

Table 2. Socio-demographic Characteristics of Respondents (*n*=177)

Characteristics	Frequency (n=177)	Percentage (%)
Gender		
Female	123	69.5
Male	54	30.5
Age		
18-20 years old	54	30.5
21-23 years old	88	49.7
24-26 years old	25	14.1
27-29 years old	10	5.6
Ethnicity		
Malay	71	40.1
Chinese	94	53.1
Indian	11	6.2
Others [c]	1	0.6
Marital Status		
Never married	165	93.2
Married	12	6.8
Highest Education Level		
Secondary school/SPM	14	7.9
Diploma/ Foundation/ Matriculation	38	21.5
STPM/ A level	34	19.2
Currently doing bachelor's degree	69	39.0
Bachelor's degree	21	11.9
Master's degree	1	0.6
Monthly Household Income [a]		
< RM 4,850	124	70.1
RM 4,850 – RM10,959	45	25.4
> RM 10,959	8	4.5
Job [b]		
Government employee	3	1.7
Semi government employee	1	0.6
Private employee	26	14.7
Self-employed	6	3.4
Unpaid worker	1	0.6
Not working	2	1.1
Still studying	138	78
Residency Status		
Perak	59	33.3
Johor	59	33.3
Terengganu	59	33.3

a = Household income range based on Department of Statistics, Malaysia

b = Job based on NHMS 2014: MANS (Institute of Public Health, 2014b)

c = "Others" refers to ethnic groups that are not classified under the major ethnic categories listed (e.g., Malay, Chinese, Indian). This includes, but is not limited to, indigenous groups and individuals of mixed ethnic backgrounds.

Classification of energy intake based on NOVA food classification

The dietary patterns of respondents, detailed in Table 3, were evaluated using the NOVA food classification. Median total energy intake, as assessed by a 2-day 24-hr dietary recall, was 1,417 kcaL (IQR: 735.4), which falls short of the Recommended Nutrient Intake (RNI) for Malaysia (National Coordinating Committee on Food & Nutrition, 2017). This intake is notably lower compared to the 2014 Malaysian Adults Nutrition Survey (MANS), which reported a mean energy intake of 2,123 kcaL. The differences observed may be attributed to variations in age groups, study designs, and methodologies employed in data collection. Despite these differences, our findings contribute to a deeper understanding of the nutritional behaviors of Malaysian young adults, emphasizing the importance of nuanced, context-

specific research for effective public health interventions. From the data presented, unprocessed/ minimally processed foods and processed culinary components (Groups 1 & 2) comprised the majority of the energy intake (58.6%), while ultra-processed foods (Group 4) accounted for 38.6%. This suggests a preference for meals prepared from basic ingredients over processed foods, possibly due to time constraints which may contribute to the 38.6% intake of processed and ultra-processed foods. The consumption of ultra-processed foods in Malaysia is a relatively under-explored area. Our study found that Group 4 foods contributed a substantial 38.6% to the total energy intake. This is consistent with a study conducted in Kuala Nerus, Terengganu by Asma' *et al*. (2020b), which reported ultra-processed foods as the second-highest contributor to total energy intake among adults. Our findings indicate that Malaysian young adults consume less ultra-processed food compared to their counterparts in more affluent nations, such as Canada and Australia, where such foods contribute nearly 55% and 42%, respectively, to total daily caloric intake. These disparities could be reflective of varying dietary trends across different economic backgrounds.

Table 3. Energy Consumption from Each Group Towards Total Daily Energy Intake (%) in Two Days 24-hr Dietary Recall (*n*=177)

Total Energy Intake by NOVA Food Classification	Frequency (*n*)	Percentage of Contribution from Each Group Toward Total Daily Energy Intake (%)	Median (IQR*)
Total Energy Intake (kcaL)	177	-	1417 (735.4)
Total Energy Intake for:			
Group 1 + Group 2	177	58.6	751 (562.1)
Group 3	177	2.8	0 (29.0)
Group 4	177	38.6	461 (531.2)

Note: *IQR = Interquartile Range

Furthermore, Asma' *et al*. (2019) categorized ultra-processed food consumption based on daily energy intake, with intakes below 30% classified as low and above 30% as high. Our study positions the respondents within the high consumption category due to Group 4 foods contributing 38.6% to total energy intake. Notably, instant noodles, cheese slices, and hot dogs were among the commonly reported ultra-processed foods consumed according to our 24-hr dietary recall data. In conclusion, the dietary landscape in Perak, Johor, and Terengganu is predominated by the intake of unprocessed or minimally processed foods. The information gathered through the dietary recalls suggests a substantial inclination towards home-cooked meals, underscoring a potential cultural or regional influence on the dietary choices of Malaysian young adults.

Diet quality

The dietary intake patterns of our respondents, summarized in Table 4, reveal that total grains (5 out of 5) and meat, poultry, and eggs (10 out of 10) received the highest median scores, indicating these food groups are the most consistently consumed. In contrast, median scores of zero for whole grains, fruits, fish, legumes, and nuts, and milk and dairy products highlight a significant shortfall in these crucial dietary elements. This lack of variety in food group consumption suggests that socioeconomic barriers may considerably limit access to diverse and nutritious food choices, emphasizing the critical importance of education and financial resources in influencing dietary behaviors (Ramón-Arbués *et al*., 2021). The Adolescent Health Survey 2022 (Institute for Public Health, 2022) found that only about 16.1% of Malaysian adolescents consume fruits and vegetables regularly, suggesting a widespread deficiency in their intake. This could explain the low scores for fruits and vegetables among adolescents in Johor, who were included in this study's respondents. The median sodium intake was reported at 5.00 out of 10.00, with an average daily intake of 2,112.5 mg. This exceeds the RNI 2017 recommendation for adults aged 18-70 years, which is 1,500 mg per day, yet remains below the 2300 mg threshold that denotes the minimum score of zero, indicating that the intake level, while high, is still within an acceptable range. The median score for total grains was 5.00, achieving the maximum score possible in the S-MHEI, likely due to the predominant consumption of rice, a staple food in the Malaysian diet, as suggested by data from the 24-hr dietary recall questionnaire. The higher median scores for total fat (7.46) and added sugar (7.86) compared to other components such as whole grains (0.00), fruits (0.00), vegetables (5.00), fish (0.00), legumes and nuts (0.00), and milk and milk products (0.00) indicate a trend towards diets high in fat, sugar, and salt among Malaysians (Mohammad *et al*., 2023).

The overall median S-MHEI score was 44.65, indicating poor diet quality as presented in Table 4. These data reveal that none of the respondents achieved a good diet, which is consistent with the

findings of Lee *et al*. (2023), who also reported that no participants in their study adhered to a healthy diet. Among our respondents, 132 (74.6%) had poor diet quality, while the remaining 45 (25.4%) had diets that required improvement. This underscores the pressing issue of inadequate dietary practices, which fall short of meeting the guidelines for optimal health and wellness as stressed by MDG 2020. The emphasis on consuming the right foods and following good nutrition principles, including variety, balanced nutrient intake, and moderation, becomes increasingly important (National Coordinating Committee on Food & Nutrition, 2021). The lack of dietary variety, insufficient nutrient consumption, and unbalanced intake often signal poor diet quality (Tay *et al*., 2023). Socioeconomic factors, especially among individuals with lower incomes, may hinder access to and affordability of healthier food options. The propensity to opt for cheaper, more accessible ultra-processed foods, as indicated by Julia *et al*. (2017) and Machado *et al*. (2017), detrimentally affects dietary nutritional quality. Thus, socioeconomic disparities, alongside social and economic influences, are likely contributors to the substandard diet quality observed among young adults. Ramón-Arbués *et al*. (2021) found that young adults in Spain generally had poor diet quality, with most failing to meet recommended fruit and vegetable intake levels and consuming a diet rich in energy-dense, nutrient-poor items. This mirrors our findings, where respondents predominantly consumed foods high in fats and added sugars, with median scores of 7.46 and 7.86 (out of 10.00), respectively. Therefore, targeted interventions are essential to enhance dietary habits and improve the nutritional status of these groups.

Table 4. Median score of Standardized Malaysian Healthy Eating Index (S-MHEI) Component (*n*=177)

S-MHEI Component	Possible Range of Score	Median score (IQR)
Total grains	0 to 5	5 (0.73)
Whole grains	0 to 5	0.00 (0.00)
Fruits	0 to 10	0.00 (2.52)
Vegetables	0 to 10	5.00 (6.39)
Fish	0 to 10	0.00 (5.00)
Meat, poultry, and eggs	0 to 10	10.00 (5.00)
Legumes and nuts	0 to 10	0.00 (5.00)
Milk and milk product	0 to 10	0.00 (3.46)
Total fat	0 to 10	7.46 (2.38)
Added sugar	0 to 10	7.86 (3.88)
Sodium	0 to 10	5.00 (7.95)
Total S-MHEI score	0 to 100	44.65 (12.77)

Note: *IQR = Interquartile Range

Table 5. Standardized Malaysian Healthy Eating Index (S-MHEI) Score (*n*=177)

Standardized Malaysian Healthy Eating Index (S-MHEI) Scores	Ratings	*n* (%)
Less than 51	Poor	132 (74.6)
51-80	Needs Improvement	45 (25.4)

Relationship between ultra-processed food consumption and diet quality

When assessing the relationship between ultra-processed food consumption and diet quality using Spearman correlation (Table 6), no significant association was found ($p>0.05$). This result stands in contrast to prior research suggesting a negative impact of ultra-processed food on diet quality (Vandevijvere *et al*., 2019; Griffin *et al*., 2021). Despite the slightly high intake of ultra-processed foods, these did not emerge as a significant predictor of poor diet quality in our study. This inconsistency with previous findings highlights the complexity of dietary behavior and suggests the need for a broader evaluation of the factors influencing diet quality. The analysis points to a stark reality: the diets of young adults in Malaysia are suboptimal, marked by insufficient intake of diverse and nutritious foods. With rising concerns over the impact of socioeconomic status on access to healthy foods, the inclination toward more affordable and accessible ultra-processed foods might be exacerbating dietary quality issues. Our study reinforces the pattern observed by Ramón-Arbués *et al*. (2021) in Spain, where young adults fail to meet adequate fruit and vegetable intake levels and instead consume diets high in fat and added sugar. Such diets are linked to various chronic health conditions, necessitating urgent public health interventions focused on nutrition education and improved food access.

Given these insights, there is a compelling case for comprehensive public health policies aimed at improving the nutritional literacy and dietary habits of the Malaysian population. The MDG 2020 underscores the need for dietary variety, balanced nutrient intake, and moderation - all essential for combating the observed poor dietary quality (Tay *et al*., 2023).

Table 6. Relationship between Ultra-processed Food Consumption and Diet Quality (*n*=177)

Correlation	Ultra-processed Food (Group 4) (24-hr Dietary Recall)	
	r-value	*p*-value
Diet Quality	0.064	0.395

* = Spearman correlation significant at $p<0.05$

CONCLUSION

This study explored dietary patterns among young adults in Perak, Johor, and Terengganu, revealing that 38.6% of total energy intake came from ultra-processed foods (UPFs). Despite this substantial consumption, UPFs were not significantly linked to poor diet quality as measured by the Standardized Malaysian Healthy Eating Index (S-MHEI). Notably, 74.6% of participants exhibited poor diet quality, highlighting the need for dietary improvements. The study's strength lies in its focus on a diverse sample and the application of the S-MHEI, revealing the complex relationship between food processing and diet quality. The findings suggest that UPF consumption alone does not determine diet quality, pointing to the broader socioeconomic factors at play. The study also identified limitations in the S-MHEI and the need for a comprehensive Malaysian food database to enhance dietary assessment accuracy. A refined S-MHEI that penalizes excessive consumption could provide a more accurate reflection of dietary risks. Future research should focus on refining dietary tools and investigating the influence of the food environment on dietary choices. This study underscores the importance of accessible nutrition education and affordable healthy food options in Malaysia. A multifaceted approach—encompassing education, policy reform, and comprehensive research—is essential for improving the nutritional well-being of Malaysian young adults.

ACKNOWLEDGEMENTS

The authors would like to express their deep and sincere gratitude to all the respondents for their full support, encouragement, and cooperation throughout this study. The authors would like to acknowledge the Institut Masa Depan Malaysia for funding the project under the MASA Policy Development Programme (MPDP) 2.0 P22.0/2023/04/03/012.

ETHICAL STATEMENT

The application of human was approved by the human ethics board of committees of Universiti Malaysia Terengganu with the reference number: UMT/JKEPM/2022/111.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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