

Ultra-Processed Food Consumption Among University Students in Sabah, Malaysia: Evidence from a Knowledge, Attitude, and Practice Study

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ABSTRACT

Ultra-processed foods (UPFs) are industrially formulated food products that are widely consumed because of their convenience, availability, shelf stability and palatability. University students are a relevant population for UPF-related nutrition research because their food choices are shaped by time constraints, limited budgets, academic demands and campus food environments. This cross-sectional study assessed knowledge, attitudes and consumption practices related to UPFs among university students in Kota Kinabalu, Sabah. A total of 384 students from public and private universities participated in an online questionnaire survey conducted from September to November 2025. The questionnaire covered sociodemographic characteristics, UPF knowledge, attitudes towards UPFs and self-reported UPF consumption practices. Data were analysed using descriptive statistics, independent samples t-test, one-way analysis of variance, chi-square or Fisher's Exact Test where appropriate, and Spearman correlation, with statistical significance set at $p < 0.05$. More than half of the respondents had high knowledge of UPFs (52.3%), while 54.4% showed a moderate attitude level and 66.4% reported high UPF consumption practices. Significant differences in knowledge scores were observed by gender, age, living arrangement, monthly allowance and program of study. However, UPF consumption practices did not differ significantly by gender, age, living arrangement, monthly allowance or program of study. Spearman correlation showed that attitude was moderately and significantly associated with practice ($r = 0.490$, $p < 0.001$), whereas knowledge was not significantly associated with attitude or practice. The findings suggest that knowledge alone may be insufficient to reduce UPF consumption among university students. Campus based nutrition strategies should address attitudes, convenience, food access and practical behaviour changes.

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1. Introduction

Ultra-processed foods (UPFs) have become a major component of contemporary diets because they are durable, convenient, affordable and widely available. The NOVA system (NOVA, 2018) classifies foods into four groups according to the extent and purpose of processing. Group 1 comprises unprocessed or minimally processed foods, such as fresh or frozen fruit and vegetables, grains, eggs and milk. Group 2 comprises processed culinary ingredients, such as oils, butter, sugar and salt. Group 3 comprises processed foods, such as canned vegetables or legumes, cheese and freshly prepared bread. Group 4 comprises ultra-

processed foods, including sweetened beverages, packaged snacks, instant noodles, reconstituted meat products and ready-to-eat meals (Monteiro *et al.*, 2019; Ganesrau *et al.*, 2023; Arslan *et al.*, 2026). UPFs are industrial formulations made mainly from food-derived substances and additives rather than intact foods. The distinction therefore concerns the nature and purpose of industrial processing as well as nutrient composition (Monteiro *et al.*, 2019; Ali *et al.*, 2024).

Recent evidence has strengthened concern about the health implications of UPF consumption. Large epidemiological studies and evidence syntheses have linked higher UPF exposure with poorer cardiometabolic, mental health and mortality outcomes, although the strength of evidence varies across outcomes and food subgroups (Cordova *et al.*, 2023; Fang *et al.*, 2024; Lane *et al.*, 2024). These findings are relevant to young adults because dietary habits formed during the university period may continue into later adulthood, increasing the importance of early nutrition awareness and healthier food choice practices.

University students are a priority group for UPF research because their eating behaviour is shaped by academic workload, time pressure, limited budget, peer influence, food outlet availability and reliance on ready-to-eat products. Recent evidence among university students shows that UPF consumption is linked with broader behavioural and psychosocial factors, including food and nutrition literacy, hedonic hunger, emotional eating and sleep quality (Arslan *et al.*, 2026). In Malaysia, a recent Knowledge, Attitude and Practice (KAP) study on fast food consumption also reported a high prevalence of regular consumption among university students, indicating that awareness of health risks does not always translate into healthier eating practices (Husseini *et al.*, 2025).

Local Malaysian evidence further supports the need to examine UPF consumption among young adults. Ganesrau *et al.* (2023) reported that UPFs contributed 31.0% of total energy intake among public university students in Malaysia and found a significant positive correlation between UPF consumption and body mass index. Similarly, Ali *et al.* (2024) found that UPFs contributed 38.6% of total energy intake among Malaysian young adults, while 74.6% of participants had poor diet quality. These findings show that UPF intake is already an important nutritional issue among young adults in Malaysia, but evidence remains largely confined to outside Sabah.

Knowledge, attitude and practice assessment provides a useful framework for examining whether students can identify UPFs, how they perceive these foods and how frequently they consume them. However, current evidence suggests that knowledge alone may be insufficient to change behaviour because UPF consumption is also shaped by taste, convenience, affordability, food environment and personal routines (Husseini *et al.*, 2025; Arslan *et al.*, 2026). In Kota Kinabalu, Sabah, limited empirical evidence is available on university students' knowledge, attitudes and consumption practices related specifically to UPFs. Therefore, this study aimed to assess the knowledge, attitudes and consumption practices of UPFs among university students in Kota Kinabalu, Sabah, and to examine the relationships between KAP components and selected sociodemographic factors.

2. Materials and Methods

2.1 Study Design and Setting

A cross-sectional study was conducted among university students in Kota Kinabalu, Sabah. Data collection was conducted from September to November 2025 using an online, self-administered questionnaire distributed via Google Forms. The study included students from public and private universities in Kota Kinabalu, including Universiti Malaysia Sabah, UiTM Kota Kinabalu, Jesselton University College and Cyberjaya College Kota Kinabalu.

2.2 Participants and Sampling

The inclusion criteria were: (i) aged 18 to 30 years; (ii) currently enrolled full-time or part-time at a public or private university in Kota Kinabalu, Sabah; (iii) able to complete the questionnaire in English or Bahasa Melayu; and (iv) willing to provide digital informed consent. The lower age limit ensured that all respondents

could provide adult consent and allowed the inclusion of students who entered university at 18 years of age. The upper limit accommodated older undergraduate and part-time students within the study's young-adult population. The exclusion criteria were: (i) not currently enrolled as a university student; (ii) younger than 18 years or older than 30 years; (iii) declining digital consent; or (iv) not submitting a complete questionnaire. Ability to consent was operationalised through an electronic information and consent page. Individuals could proceed to the questionnaire only after affirming that they had read the study information, understood that participation was voluntary and consented to participate.

The minimum sample size was calculated using Yamane's formula based on a student population estimate of 9,600, a 95% confidence level and a 5% level of precision (Kementerian Pendidikan Tinggi, 2023; Yamane, 1967). The calculated minimum sample size was 384 respondents. Convenience sampling was used to recruit eligible students through online questionnaire distribution. Because the survey link was circulated online and the number of students who received or viewed the invitation was not recorded, the denominator required to calculate a conventional response rate was unavailable. The final dataset comprised 384 completed, eligible questionnaires. The one-time survey did not involve longitudinal follow-up, therefore, participant dropout after questionnaire submission was not applicable.

2.3 Research Instrument

The research instrument was a structured bilingual questionnaire in English and Bahasa Melayu. It consisted of four sections: sociodemographic information, knowledge of UPFs, attitudes towards UPFs and self-reported UPF consumption practices. The sociodemographic section collected information on age, gender, programme of study, marital status, monthly allowance and living arrangement.

The knowledge section contained six true-or-false items assessing respondents' understanding of UPFs and their ability to identify selected UPF and non-UPF items. The attitude section contained nine items measured from 1 (strongly disagree) to 5 (strongly agree). The practice section contained eleven UPF food items measured from 1 (never), 2 (rarely), 3 (sometimes), 4 (often) to 5 (always). The knowledge domain was adapted from Sarmiento-Santos *et al.* (2022), with the items modified to assess respondents' understanding of UPFs and their ability to identify selected UPF and non-UPF items. The attitude domain was modified from Mirkarimi *et al.* (2016), with statements originally related to fast-food consumption reframed to assess positive and negative attitudes towards UPFs. The practice domain was adapted from Ihensekhien & Oluwagbemileke (2024) and Angarita-Díaz *et al.* (2024). The practice items were modified to assess the frequency of consuming 11 food categories classified as UPFs under the NOVA system. The complete questionnaire was translated into Bahasa Melayu and adjusted for bilingual administration and the cultural and university context of Kota Kinabalu, Sabah. Knowledge items were scored 1 for a correct response and 0 for an incorrect response. Attitude and practice items were scored from 1 to 5, with any negatively worded attitude items reverse-coded before summation so that score direction remained consistent. A percentage score was calculated for each domain as (obtained domain score / maximum possible domain score) $\times$ 100. Scores were classified as low (0-33%), moderate (34-66%) or high (67-100%), following Hussein *et al.* (2025). Higher practice scores represented more frequent self-reported UPF consumption.

2.4 Pre-test and Reliability

A pre-test was conducted with 30 respondents who met the inclusion criteria. This sample size was selected because questionnaire pre-tests involving approximately 30 participants provide a reasonable opportunity to identify common problems with item clarity and comprehension (Perneger *et al.*, 2015). Feedback indicated that the questionnaire was understandable and suitable for the target respondents. Reliability analysis showed acceptable Cronbach's alpha values for knowledge (0.71), attitude (0.84) and practice (0.85). Pre-test respondents were not included in the main analysis.

2.5 Ethical Consideration

Ethical approval was obtained from the Medical Research Ethics Committee of Universiti Malaysia Sabah before data collection. The study was approved under ethics approval code JKEtika 5/25 (3). Participants were provided with study information and gave digital consent before answering the questionnaire. Participation was voluntary and responses were treated confidentially.

2.6 Statistical Analysis

Data were analysed using IBM SPSS Statistics version 30. Descriptive statistics were used to summarise sociodemographic characteristics and KAP levels. An independent samples t-test was used for two-group comparisons, while a one-way analysis of variance with Tukey's HSD post hoc test was used for comparisons involving more than two groups. Chi-square test or Fisher's Exact Test was applied, where suitable, for categorical associations. Spearman correlation was used to examine the relationships between knowledge, attitude and practice scores. Statistical significance was set at $p < 0.05$.

3. Results and Discussion

3.1 Sociodemographic Characteristics of Respondents

A total of 384 university students participated in this study. As shown in Table 1, a slightly higher proportion was aged 25 to 30 years (54.9%). Male students accounted for 63.0% of the sample. Most respondents were enrolled in Bachelor's degree programmes (93.8%), and all respondents were single. The distribution of monthly allowance and living arrangement indicates that the sample included students from different financial and residential backgrounds.

Table 1. Sociodemographic characteristics of respondents

Variable	Category	n	%
Age	18 to 24 years old	173	45.1
	25 to 30 years old	211	54.9
Gender	Male	242	63.0
	Female	142	37.0
Programme of study	Diploma	24	6.3
	Bachelor's degree	360	93.8
Marital status	Single	384	100.0
	Married	0	0.0
Monthly allowance	Less than RM300	102	26.6
	RM300 to RM499	131	34.1
	RM500 to RM699	101	26.3
	RM700 and above	50	13.0
Living arrangement	Hostel	113	29.4
	Living with parents	133	34.6
	Rented accommodation	138	35.9

The dominance of students enrolled in Bachelor's degree programmes should be considered when interpreting comparisons by programme of study. Although the study reached the required sample size, the small number of diploma students limits the strength of comparisons between programme groups. This imbalance may reflect differential accessibility, programme enrolment and willingness to respond under convenience sampling.

3.2 Knowledge, Attitude and Practice Levels Towards UPFs

The distribution of knowledge, attitude and practice levels is presented in Table 2. More than half of the respondents had high knowledge of UPFs (52.3%), while 27.1% had moderate knowledge and 20.6% had low knowledge. This indicates that many respondents were aware of UPFs. However, item-level responses also showed that some respondents misclassified selected foods, suggesting that students may know the term UPF but remain less certain when applying NOVA-based classification to specific food items.

Table 2. Knowledge, attitude and practice levels towards UPFs

KAP Domain	Level	n	%
Knowledge	Low	79	20.6
	Moderate	104	27.1
	High	201	52.3
Attitude	Low	3	0.8
	Moderate	209	54.4
	High	172	44.8
Practice	Low	0	0.0
	Moderate	129	33.6
	High	255	66.4

Attitude scores were mainly moderate, with 54.4% of respondents classified in the moderate category and 44.8% in the high category. The attitude pattern suggests that health awareness co-existed with favourable perceptions of UPFs, including taste, familiarity, convenience and perceived cleanliness of outlets. Consumption practice was the strongest concern. No respondent was classified as having low UPF consumption practice, while 66.4% were classified in the high practice category. This pattern is consistent with Malaysian evidence indicating that UPFs and fast foods are commonly consumed by university students and young adults, despite increasing awareness of diet-related health risks (Ganesrau *et al.*, 2023; Ali *et al.*, 2024; Hussein *et al.*, 2025)

3.3 Consumption Practices by UPF Item

Table 3 presents self-reported consumption practices and shows the proportion of respondents who selected either often or always for each UPF item. The highest proportions were recorded for mass-produced packaged breads and buns (64.1%), instant noodles (64.1%), and soft drinks, tea and soda (60.7%). These responses indicate that these foods were frequently reported within the surveyed sample.

The frequency scale was coded as 1 = never, 2 = rarely, 3 = sometimes, 4 = often and 5 = always; therefore, a mean closer to 5 indicates more frequent self-reported consumption. The highest mean scores were recorded for mass-produced packaged breads and buns ($M = 3.80 \pm 0.93$), instant noodles ($M = 3.76 \pm 1.00$), sweet or savoury packaged snacks ($M = 3.63 \pm 1.05$), and sausages, burgers, hotdogs and other reconstituted meat products ($M = 3.60 \pm 1.05$). These values indicate average responses between sometimes and often. Convenience, price and ease of preparation may help explain this pattern, but these factors were not measured directly in the present study.

The pattern is consistent with research in other university samples in which price, convenience and access to ready-to-eat foods were associated with food choice (Fondevila-Gascón *et al.*, 2022). Other studies have also reported associations between UPF consumption and food and nutrition literacy, hedonic hunger, emotional eating and sleep quality (Arslan *et al.*, 2026). These factors offer plausible contextual explanations, but the present study did not measure them and cannot determine whether they accounted for the reported consumption practices.

Table 3. UPF items reported as always or often consumed

UPF item	Always or often, n (%)
Sweet or savoury packaged snacks	229 (59.6)
Confectionery, chocolates and candies	216 (56.3)
Mass-produced packaged breads and buns	246 (64.1)
Packaged sweet biscuits, cakes or sweet breads	201 (52.3)
Pies, pasta and pizza dishes	202 (52.6)
Instant noodles	246 (64.1)
Instant sauces	207 (53.9)
Poultry or fish nuggets and sticks	210 (54.7)
Sausages, burgers, hotdogs and other reconstituted meat products	220 (57.3)

UPF item	Always or often, n (%)
Ice-cream and frozen desserts	212 (55.2)
Soft drinks, tea and soda	233 (60.7)

3.4 Relationship Between Knowledge, Attitude and Practice

The relationships between knowledge, attitude and practice scores are shown in Table 4. Knowledge was not significantly associated with attitude ($r=0.072$, $p=0.160$) or practice ($r=-0.008$, $p=0.874$). In contrast, attitude was moderately and significantly associated with practice ($r=0.490$, $p<0.001$).

Table 4. Relationship between knowledge, attitude and practice of UPF consumption

KAP relationship	r-value	p-value	Interpretation
Knowledge and attitude	0.072	0.160	Weak, not significant
Knowledge and practice	-0.008	0.874	Weak, not significant
Attitude and practice	0.490	$p < 0.001$	Moderate, significant

Knowledge was not significantly associated with self-reported UPF consumption practice, whereas attitude showed a moderate positive association with practice. Several explanations are possible. First, more than half of respondents were already classified as having high knowledge, which may have limited score variation and weakened the detectable correlation. Second, the six knowledge items assessed factual recognition, whereas the eleven practice items assessed consumption frequency. This difference in domain content may reduce correspondence between the measures. Third, unmeasured influences, such as food availability, cost, taste preferences and time constraints, may affect food choice independently of factual knowledge. Because these influences were not assessed and the design was cross-sectional, these explanations remain hypotheses rather than demonstrated mechanisms.

From a KAP perspective, the absence of a significant knowledge-practice association indicates that knowledge scores alone did not distinguish between students with different reported consumption frequencies in this sample. The attitude-practice association supports examining students' perceptions alongside knowledge in future research. This interpretation is consistent with student-focused evidence showing that UPF consumption can be associated with broader behavioural and psychosocial factors (Arslan *et al.*, 2026), although the present study cannot establish direction or causality.

3.5 Implications, Limitations and Overall Interpretation

The findings support using the KAP framework descriptively while recognising that knowledge, attitude and self-reported practice did not follow a simple sequential pattern. Universities could pilot multicomponent strategies and evaluate their effects. Practical options include setting campus food-vendor standards for affordable minimally processed meals, improving the availability, placement and pricing of fruit, water and less-processed snacks, providing short label-reading and low-cost meal-preparation activities, and using student-developed digital messages that focus on feasible substitutions rather than risk information alone.

At the campus level, these strategies could be paired with periodic audits of food availability and prices, point-of-purchase information and access to drinking water. Any programme should be evaluated using repeated measures and more detailed dietary assessment so that changes in actual intake, affordability and acceptability can be distinguished from changes in awareness.

Several limitations should be acknowledged. The cross-sectional design prevents causal interpretation or determination of the direction of associations. Convenience sampling may have overrepresented students who were easier to reach, more willing to participate or had better digital access. The sample was also imbalanced by programme of study and cannot be assumed to represent all university students in Kota Kinabalu or Sabah. Because the online distribution denominator was not recorded, a conventional response rate could not be calculated and non-response bias could not be assessed. Consumption practices were self-reported rather than directly observed or measured through a validated quantitative dietary assessment, making the results susceptible to recall, interpretation and social desirability biases. Future studies should use probability-based or stratified sampling across universities and apply a food frequency questionnaire or repeated 24-hour dietary recalls.

Overall, the surveyed students reported frequent consumption of several UPF items despite generally high knowledge scores. Attitude, but not knowledge, was associated with self-reported practice. This pattern supports further investigation of perceptions and contextual influences alongside knowledge, but it does not establish that any unmeasured factor caused UPF consumption.

4. Conclusion

University students in this Kota Kinabalu sample generally had moderate to high knowledge of UPFs and frequently reported consuming several UPF items. Knowledge was not significantly associated with attitude or self-reported practice, whereas attitude was moderately and significantly associated with practice. These findings support testing campus strategies that combine nutrition education with feasible food-choice support, while recognising that the present cross-sectional data cannot establish causal effects. Future studies should use broader sampling and detailed dietary assessment methods, such as food frequency questionnaires or repeated 24-hour dietary recalls.

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Author contributions

Conceptualization, K.C.; methodology, K.C., E.L.M., and J.N.S.B.B.J.; formal analysis, E.L.M., H.B.M., and I.N.S.B.A.; investigation, E.L.M., I.N.S.B.A. and J.N.S.B.B.J.; data curation, E.L.M., H.B.M., I.N.S.B.A.; writing, original draft preparation, E.L.M., I.N.S.B.A. and J.N.S.B.B.J.; writing, review and editing, K.C.; supervision, K.C. All authors have read and agreed to the final manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest

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