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Research Article

Higher Ultra-Processed Food Consumption is Associated with Increased Risk of Mental Health Issues in Undergraduates

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ABSTRACT

This cross-sectional study, involving 250 healthy undergraduate students, aimed to examine the association between Ultra-Processed Food (UPF) consumption and mental health status. Mental health was assessed using the 12-Item General Health Questionnaire (GHQ-12), where participants were classified as either normal or high-risk based on their scores. Subsequently, dietary intake was assessed using the Dietary History Questionnaire (DHQ), examining meals throughout the day. Additionally, the degree of food processing was classified using the NOVA food classification. Univariate and multivariate logistic regression analyses were used to evaluate the relationship between mental health status, UPF consumption, and the contributing factors. The average daily energy intake was 1,216±488 kcal, with 25.7% coming from UPFs. Those at higher risk for mental health issues typically had a slightly lower fat percentage (26.5±8.5%) but a higher total body water percentage (50.6±4.7%) compared to those with normal mental health. Even after adjustment for confounding factors, high consumption of UPFs remained strongly associated with an increased risk of mental health problems (OR=2.196, 95% CI:1.056–4.566, p=0.035). Further research is needed to fully understand the effects of UPFs on mental health and enhance awareness of their risks while promoting fresh, minimally processed alternatives.

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INTRODUCTION

Ultra-Processed Foods (UPFs) are formulations of materials used exclusively in the food industry, derived from substances obtained from foods or synthesized from other organic sources (Monteiro *et al.* 2018). According to previous studies, UPFs are highly palatable, habit-forming, and with characteristics of high-energy-dense foods. They often contain added sugar, salt, and saturated fat content, in addition to artificial additives, flavors, and colors that add value to them (Louzada *et al.* 2015; Monteiro *et al.* 2010). Some foods can be categorized as UPFs within the NOVA food classification system (Monteiro *et al.* 2018). This system classifies four main food groups, UPFs being the fourth after unprocessed and minimally processed foods, processed culinary ingredients, and processed foods. This system is important and is widely used to evaluate and understand the dietary patterns of populations to analyze the nutritional status of the populations and the dietary impact on health (Asma *et al.* 2019; Adams *et al.* 2020; Elizabeth *et al.* 2022).

The consumption of UPFs often leads to an increase in daily energy intake and can result in a dietary imbalance (Ganesrau *et al.* 2023; Dicken & Batterham 2021). Moreover, it has been linked to non-communicable diseases (NCDs) such as obesity, cardiovascular disease, and mental health problems (GBD 2019; Ali *et al.* 2020; Eng *et al.* 2022). Poor dietary patterns, such as diets with inadequate essential nutrients,

high glycemic index, and high sugar content, can cause mental health problems (Rahe *et al.* 2014; Lai *et al.* 2014; Molendijk *et al.* 2018).

Research on the effects and implications of consuming UPFs in the context of Malaysia is limited. Previous studies have investigated the intake of UPFs among Malaysian adults, but research involving university students is limited and did not specifically focus on mental health status. Therefore, it is crucial to conduct research on the relationship between UPF consumption and mental health status among university students, as they are a group at high risk of experiencing mental health problems due to the potential risks associated with the consumption of UPFs.

METHODS

Design, location, and time

This cross-sectional study was conducted on the Universiti Kebangsaan Malaysia campus, Kuala Lumpur (UKM KL). The participants, who were undergraduate students enrolled at the university, were provided with a briefing to ensure that they understood the questionnaires. Ethical approval for this research was obtained from the Research and Ethics Committee of Universiti Kebangsaan Malaysia (JEP-2023-712).

Sampling

The purposive sampling techniques was used to select participants based on their availability to complete the questionnaires and their fulfilment of the inclusion and exclusion criteria set for this study. The study included a total of 250 participants, exceeding the minimum required sample size of 243, as determined using the Cochran (1963) formula, with an 80% statistical power. This calculation was based on an estimated population proportion of 24%, representing adults aged 18 to 59 years who consumed UPFs in Malaysia (Asma' *et al.* 2019).

Eligible participants were those proficient in Malay or English and in good health, with no chronic medical conditions. Individuals who were fasting, on dietary interventions, facing mental health challenges, or receiving psychological counseling were excluded from the study.

Data collection

The research instruments used in this study comprised a set of questionnaires with six key components. Sociodemographic data, including name, age, gender, race, faculty, program, education level, and source of daily expenses, were collected. Anthropometric assessments included body weight and composition analysis using a Tanita SC-330 analyzer, height measurement with a SECA 213 stadiometer, and waist and hip circumference measurements with a Lufkin tape, while BMI was calculated based on weight and height following World Health Organization (WHO 2004) guidelines, and waist circumference and waist-to-hip ratio were evaluated according to WHO (2008) standards.

The 12-Item General Health Questionnaire (GHQ-12), used to assess mental health, includes questions with four answer choices. GHQ-12 focuses on three areas: anxiety and depression, social dysfunction, and loss of confidence (Asghari *et al.* 2022; Ganasan & Azman 2021). Participants selected the options that best reflected their current situation. Based on their total score, they were classified into two groups: normal (0–11) and at high risk (12 or more) for mental health issues.

The Dietary History Questionnaire (DHQ) covers five meal sections (breakfast, morning snack, lunch, afternoon snack, and dinner), recording dish type, portion size, preparation, and consumption frequency over the past week. The ratio of energy intake to basal metabolic rate (EI/BMR ratio) assessed energy intake reporting, categorizing participants as under-reporters (<1.34), normal (1.35–2.39), or over-reporters (>2.40) (Black 2000). UPFs were categorized using the NOVA food classification, which distinguishes foods into several groups: fresh or minimally processed foods (Group 1), processed culinary ingredients (Group 2), processed foods (Group 3), and ultra-processed foods (Group 4). The percentage of energy contribution from UPFs was determined by calculating the proportion of total calories derived from UPFs relative to the total daily energy intake recorded in the DHQ and then classified based on tertiles: low (<15.7%), medium (15.7–32.2%), and high (>32.2%).

Data analysis

The participants' food intake data were assessed using Nutritionist Pro. The key references used to determine food composition included the Malaysia Food Album (IPH 2024), Food Atlas (Shahar *et al.* 2015), Nutrient Composition of Malaysian Foods, and the Malaysian Food Composition Database.

Data analysis was conducted using SPSS version 26.0 (IBM Corp.). The Kolmogorov-Smirnov test checked data distribution, and descriptive statistics summarized the results. Binary logistic regression was performed ($p<0.05$), with Model 1 for univariate analysis and Model 2 for multivariate analysis, adjusting for age, gender, ethnicity, BMI, waist-to-hip ratio, body composition, energy intake, and key nutrient levels in relation to mental health and UPFs consumption.

RESULTS AND DISCUSSION

As indicated in Table 1, the study involved 250 participants, most of whom were young adults aged 18–20 years (56.4%), with females making up the majority (85.6%). The ethnic distribution was predominated by the Malay (50.4%) and Chinese (42.4%). Most students were first-year undergraduates (46.4%), with student loans being the primary source of daily expenses (51.6%).

This study classified UPF consumption as low (<15.7%), medium (15.7–32.2%), and high (>32.2%), using slightly different thresholds due to age differences among participants, as the previous study had a higher mean age (da Silva Scaranni *et al.* 2021).

The average daily energy intake in our study was 1,216±488 kcal, lower than the daily intake specified by the Recommended Nutrient Intake (RNI) 2017 for Malaysian (NCCFN 2017). This study's self-reported dietary assessments depended on participants' recall ability, with over 86% under-reporting their intake, highlighting potential data accuracy issues, consistent with previous findings in Malaysian adults (Zainuddin *et al.* 2019).

This study found that UPFs contributed 25.7% of the total energy intake among university students, a lower percentage compared to previous findings in a population with characteristics similar to those of ours, encompassing six universities in Malaysia (Ganesrau *et al.* 2023). The reduced UPFs consumption observed in this study is likely attributed to the participants being health science students, whereas the participants in the earlier study were students of diverse academic backgrounds. Research has shown that individuals in health-related fields generally exhibit healthier eating habits and a greater awareness of their dietary and lifestyle choices

Table 1. Sociodemographic information of subjects

Characteristics	n=250 n (%)
Age	
18–20	141 (56.4)
21–23	105 (42.0)
≥24	4 (1.6)
Gender	
Female	214 (85.6)
Male	36 (14.4)
Ethnicity	
Malay	126 (50.4)
Chinese	106 (42.4)
Indian	13 (5.2)
Others	5 (2.0)
Program	
Nutrition science	56 (22.4)
Pharmacy	39 (15.6)
Biomedical science	38 (15.2)
Environmental health and industrial safety	27 (10.8)
Dietetics	24 (9.6)
Speech science	17 (6.8)
Occupational therapy	12 (4.8)
Physiotherapy	11 (4.4)
Optometry	9 (3.6)
Dentistry	8 (3.2)
Diagnostic imaging and radiotherapy	6 (2.4)
Audiology	3 (1.2)
Education level	
Year 1	116 (46.4)
Year 2	74 (29.6)
Year 3	30 (12.0)
Year 4	30 (12.0)
Source of daily expenses	
Loans	129 (51.6)
Parents	100 (40.0)
Scholarship	15 (6.0)
Part-time job	4 (1.6)
Others	2 (0.8)

(Alghamdi *et al.* 2021; Marendić *et al.* 2024). Students with high UPFs consumption reported the greatest UPFs contribution to total energy intake, averaging 560±460.6 kcal (45.8%), which accounted for nearly half of their total energy intake, the highest among all groups (Table 2). Ultra-processed breads and breakfast foods like white bread, wholemeal bread, cereals, and instant oats were the most consumed, followed by sugary or artificially sweetened beverages like carbonated drinks, 3-in-1 coffee, and malted drinks. Fats/condiments/sauces like soy sauce, chili sauce, and mayonnaise came in third. According to Haron *et al.* (2020), these foods have the greatest average salt content, which might result in health complications. The high

Table 2. UPFs consumption and contribution to total energy intake

UPFs consumption	n	Average energy intake (kcal)	UPFs consumption contribution to total energy intake (kcal) (%)
Total energy intake		1,216±488	
Low (<15.7%)	82	100±64.8	8.1±4.6
Medium (15.7–32.2%)	86	281±95.9	23.3±4.6
High (>32.2%)	82	560±460.6	45.8±12.0
Total UPFs intake	250	313±330.0	25.7±17.3

UPFs: Ultra-processed foods

consumption of UPFs among university students is driven by their market availability, affordability, promotions, and advertising (Andreyeva *et al.* 2010), with similar factors influencing students' food choices in online delivery services, where health and nutrition are the least prioritized (Eu & Sameeha 2021).

Table 3 explores the relationship between nutritional status and mental health, revealing significant differences in fat percentage and total body water percentage across mental health categories. Individuals at higher risk for mental health issues exhibited a slightly lower fat percentage (26.5±8.5%) but a higher total body water percentage (50.6±4.7%) compared to those with normal mental health, which contradicts findings from previous studies. Recent research has linked increased body fat to a higher likelihood of depression (Gu *et al.* 2025). Additionally, inadequate water intake has been associated with a two-fold increase in the risk of depression and anxiety (Haghighatdoost *et al.* 2018).

Table 4 shows that participants at higher risk of mental health issues generally had lower nutrient intake compared to those with normal mental health. Significant differences ($p<0.05$) were observed only in energy intake, protein, vitamin D, α-tocopherol, pyridoxine, cobalamin, potassium, magnesium, and zinc levels, with the normal group having higher intake than those at high risk. Among males, only vitamin C and vitamin D showed significant differences across mental health groups, whereas in females, significant differences were found in energy intake, protein, vitamin D, α-tocopherol, pyridoxine, cobalamin, potassium, magnesium, and zinc levels. These findings align with previous studies, which suggested that adequate intake of

Table 3. Nutritional status in relation to mental health status

Anthropometry measurements	Mental health status n=250		Total	*p*
	Normal (n=143)	High risk of problems (n=107)		
Body weight (kg)	55.1±11.1	56.6±12.5	55.7±11.7	0.259
Height (cm)	159.0±7.0	160.1±7.6	159.5±7.3	0.413
Waist circumference (cm)				
Low risk	126 (57.5%)	93 (42.5%)	219 (87.6%)	0.847
High risk	17 (54.8%)	14 (45.2%)	31 (12.4%)	
Waist-to-hip ratio (cm)				
Low risk	133 (58.3%)	95 (41.7%)	228 (91.2%)	0.266
High risk	10 (45.5%)	12 (54.5%)	22 (8.8%)	
Fat percentage (%)	27.5±7.4	26.5±8.5	27.1±7.9	0.043*
Muscle mass (kg)	37.3±6.2	38.7±7.2	37.9±6.6	0.115
Total body water percentage (%)	50.0±3.7	50.6±4.7	50.2±4.2	0.005*
Body mass index (kgm^{-2})				
Underweight (<18.5)	30 (56.6%)	23 (43.4%)	53 (21.2%)	0.742
Normal (18.5– 24.9)	85 (57.0%)	64 (43.0%)	149 (59.6%)	
Overweight (25–29.9)	21 (63.6%)	12 (36.4%)	33 (13.2%)	
Obesity (>30)	7 (46.7%)	8 (53.3%)	15 (6.0%)	

*:Significant value ($p<0.05$) based on the Independent t-test

Table 4. Nutrient intake and UPFs consumption according to mental health status

Nutrient	Mental health status n=250		Total	*p*
	Normal (n=143)	High risks of problem (n=107)		
Energy (kcal)	1,236±575.6	1,191±344.5	1,216.6±489.8	0.039*
Protein (g)	50.7±21.6	45.8±21.6	48.6±19.4	0.004*
Carbohydrate (g)	162.9±107.1	156.1±47.0	160.0±86.5	0.190
Total fat (g)	43.0±18.4	42.5±15.8	42.8±17.3	0.338
Fiber (g)	5.7±10.1	4.04±2.8	5.0±7.9	0.067
Vitamin A (RE)	761.6±579.0	677.4±616.9	725.5±595.8	0.263
Beta-carotene (µg)	1,459.3±2,129.0	1,179.0±3,445.7	994.6±2,767.4	0.603
Vitamin C (mg)	52.5±52.9	42.2±47.8	48.1±50.9	0.096
Vitamin D (µg)	2.5±16.0	0.6±0.7	1.7±12.1	0.036*
α-tocopherol (mg)	0.9±1.6	0.6±0.7	0.8±1.3	<0.001*
Thiamine (mg)	0.5±0.3	0.5±0.3	0.5±0.3	0.299
Riboflavin (mg)	0.8±0.4	0.7±0.5	0.8±0.4	0.934
Niacin (mg)	9.0±4.4	8.6±4.2	8.9±4.3	0.934
Pyridoxine (mg)	1.1±3.3	0.6±0.3	0.9±2.5	0.029*
Folate (µg)	90.9±143.8	77.2±60.1	85.0±115.7	0.348
Cobalamin (µg)	4.6±29.6	1.0±0.7	3.1±22.5	0.027*
Sodium (mg)	2,211.4±3,552.4	1,786.7±854.2	2,029.6±2,748.0	0.184
Potassium (mg)	995.0±958.3	766.8±276.1	897.3±754.3	0.005*
Calcium (mg)	329.1±280.6	292.3±148.7	313.4±233.8	0.107
Iron (mg)	21.3±58.0	14.0±8.3	18.2±44.3	0.079
Phosphorus (mg)	641.7±308.4	618.2±268.8	631.6±291.8	0.149
Magnesium (mg)	106.1±146.8	77.8±38.0	94.0±114.4	0.033*
Zinc (mg)	7.3±29.1	3.2±1.5	5.5±22.1	0.029*
UPFs consumption				
Low (<15.7%)	8.0±4.8	8.4±4.3	8.1±4.6	0.059
Medium (15.7–32.1%)	22.5±4.6	24.3±4.4	23.2±4.6	
High (>32.2%)	44.7±10.4	46.7±13.3	45.8±12.0	
UPFs consumption from total energy intake (%)	23.1±16.1	29.2±18.2	25.7±17.3	0.005*

*:Significant value at p<0.05 with Independent t-test; UPF: Ultra-Processed Foods

these vitamins and minerals is associated with a lower risk of mental health issues (Li *et al.* 2020; Huang & Huang 2022; Tarleton & Littenberg 2015; Muscaritoli 2021; Mulyadi 2024). Although higher energy intake was observed in the normal group, the quality of foods consumed must be considered. Healthier diets have been linked to lower depressive symptoms, whereas high consumption of junk foods, often high in energy but low in nutritional value, has been associated with poorer mental well-being (Keck *et al.* 2020).

A significant difference was observed between the high-risk and normal groups (p<0.05), with the former tending to consume more UPFs (29.2±18.2%) than the latter (23.1±16.1%). A study in Egypt revealed that the daily consumption of sodium-rich snacks is significantly associated not only with mental health concerns but also with higher blood pressure among university students (Zafar *et al.* 2023). In light of this, Elbarazi and Tikamdas (2023) recommended implementing health programs focused on sodium intake to raise awareness among university students.

Table 5 summarizes the univariate and multivariate analysis results. The univariate analysis showed a significant association between high UPF consumption and poorer mental health (OR=2.126, 95% CI:1.133–3.990, p=0.019). This association remained significant even after adjusting for other variables (OR=2.196, 95% CI:1.056–4.566, p=0.035). Additionally, increased energy intake (OR=1.001, p=0.025) was also significantly linked to mental health status.

Similarly, previous studies have found a connection between high consumption of UPFs

Table 5. Univariable and multivariable analyses of the mental health status according to the amount of UPFs consumed

Predictors	Model 1		Model 2	
	OR (95% CI)	*p*	OR (95% CI)	*p*
UPFs consumption				
Low	1.00		1.00	
Medium	1.389 (0.743–2.597)	0.304	1.470 (0.723–2.987)	0.287
High	2.126 (1.133–3.990)	0.019*	2.196 (1.056–4.566)	0.035*
Age			1.159 (0.967–1.390)	0.111
Gender				
Male			1.00	
Female			0.741 (0.289–1.896)	0.531
Ethnicity				
Malay			1.00	
Others			0.954 (0.496–1.834)	0.887
Waist-to-hip ratio (cm)				
Low risk			1.00	
High risk			2.992 (1.026–8.728)	0.045*
Fat percentage (%)			0.981 (0.879–1.096)	0.738
Total body water percentage (%)			1.0012 (0.819–1.252)	0.911
Energy (kcal)			1.001 (1.000–1.003)	0.025*
Protein (g)			0.982 (0.954–1.010)	0.203
α-tocopherol (mg)			0.735 (0.491–1.101)	0.135
Potassium (mg)			0.999 (0.998–1.001)	0.316
Magnesium (mg)			0.998 (0.985–1.011)	0.771
Vitamin D			1.297 (0.885–1.901)	0.182
Riboflavin (mg)			2.310 (0.582–9.171)	0.234
Pyridoxine (mg)			0.840 (0.550–1.283)	0.420
Zinc (mg)			0.896 (0.707–1.137)	0.367
Sodium (mg)			1.000 (1.000–1.000)	0.079

*: Significant value at p<0.05, binary logistic regression analysis; Model 1: Univariate model; Model 2: Multivariate analysis in which the associations between mental health status and UPFs consumption were adjusted for age, gender, ethnicity, BMI, waist-to-hip ratio, fat percentage, total body water percentage, energy intake, protein, α-tocopherol, potassium, magnesium, magnesium, vitamin D, riboflavin, pyridoxine, zinc and sodium. CI: Confidence Interval. OR: Odds Ratio; BMI: Body Mass Index; UPFs: Ultra-Processed Foods

and mental health problems, such as depression (Adjibade *et al.* 2019; Gómez-Donoso *et al.* 2020). The contributing factors include hectic schedules, extended study hours, and living away from home, which make students more likely to adopt nutrient-poor diets and less likely to make healthy food choices (Fondevila- Gascón *et al.* 2022).

Emotional eating is a common way to cope with academic stress and is linked to unhealthy eating habits, especially during psychological distress and depression (Sahid *et al.* 2023; Calcaterra *et al.* 2024). In addition to contributing to excessive energy intake and poor general health, this cycle of emotional eating and overeating has a detrimental effect on mental health as well as a significant impact on the total number of healthy days and overall quality of life (Dakanalis *et al.* 2023; Zapawi *et al.* 2024).

Additionally, psychosocial factors and a lack of physical activity may reduce cognitive engagement and brain activity, potentially leading to lower academic performance among students with a higher waist-to-hip ratio, which could, in turn, contribute to mental health concerns. Maintaining a healthy waist-to-hip ratio is essential for overall well-being (Borse *et al.* 2014).

This study provides foundational data on the association between UPF and mental health. Excessive UPFs intake disrupts the gut microbiota balance, causing gut dysbiosis, which in turn negatively impacts the gut-brain axis. This disruption reduces the production of key neurotransmitters like serotonin, which play a crucial role in maintaining mental health (Ortega *et al.* 2022). Nevertheless, there are several limitations of this study.

Although UPFs are generally low in fiber, vitamins, minerals, and nutrients that are abundant in fresh vegetables and fruits and are essential for overall health (Lee & Choi 2023), some UPFs,

such as wholemeal bread, breakfast cereals, and instant oats, are actually high in fiber. This underscores the importance of considering the nutritional variability within UPFs classifications rather than assuming that all UPFs lack essential nutrients.

Since intake was assessed using the NOVA food classification, it is important to acknowledge that the assessment focused more on the degree of food processing rather than the nutritional composition of foods. This approach might not fully capture overall diet quality. Therefore, future research could benefit from incorporating alternative dietary quality measures, such as nutrient profiling, dietary diversity, or whole-food-based assessments.

This also highlights the need for additional research, particularly research of a longitudinal nature, to clarify the causal relationship between UPFs consumption and mental health status. Expanding future studies to include university students from various regions of Malaysia will improve the generalizability of our results.

Other than that, university students may be more susceptible to mental health issues due to their hectic schedule. This study did not, however, look into the potential effects of these strenuous daily activities on mental health in addition to UPF intake. To close this gap, future studies could look at how dietary practices, mental health outcomes, and academic workload interact to give a more thorough knowledge of this relationship.

The study also had a gender imbalance, with more female participants than male participants, which could influence the representativeness of the findings. Moreover, because the study was limited to undergraduate students from a single university, the generalizability and accuracy of the results may be limited.

CONCLUSION

Our findings indicate that high consumption of UPFs is linked to an increased risk of mental health issues. It is important to highlight the risks associated with a high intake of these foods in public discussions and to promote the benefits of choosing fresh, minimally processed alternatives. Furthermore, additional longitudinal research is necessary to gain a deeper understanding of how UPFs affect mental health and clarify their contribution to the decline in mental well-being.

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DECLARATION OF CONFLICT OF INTERESTS

Authors declare no conflict of interest regarding the publication of this paper.

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