

Association between Psychological Stress Levels and Habitual Dietary Intake among Japanese University Students: A Cross-sectional Pilot Study

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Abstract Depression and mental health issues due to psychological stress have increased in recent years globally. Mental health issues, particularly in younger populations, can lead to poor eating habits, negatively impacting the overall health. This cross-sectional study aimed to examine the association between psychological stress levels and habitual dietary intake, including energy consumption, nutrient composition, and food types, in a cohort of Japanese university students. The study included 163 healthy students aged 18–22 years. The habitual dietary intake of the participants was assessed using a Brief Self-administered Diet History Questionnaire. Psychological stress was assessed using the Japanese version of the General Health Questionnaire 30, and stress levels were categorized as low (<8) or high (≥ 8). Energy intake was significantly higher in the high-stress group than in the low-stress group ($p < 0.05$). Conversely, dietary fiber intake and fat proportion in the total energy intake were significantly lower in the high-stress group than in the low-stress group ($p < 0.05$). The subsequent multivariate analysis revealed that energy (odds ratio [OR] = 1.0005, confidence interval [CI] = 1.0000 to 1.0011) and noodles (OR = 1.014, CI = 1.003–1.024) were positively associated with stress levels, whereas the variable other vegetables (OR = 0.98, CI = 0.97–0.99) was independently negatively associated with stress levels. These findings suggested a potential association between food and nutrient intake and psychological stress levels in Japanese university students. However, further longitudinal cohort studies with a larger sample size are imperative to determine a causal relationship between habitual dietary intake and psychological stress among university students.

Keywords: *psychological stress, noodles, vegetables, university students, Japan*

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1. Introduction

The prevalence of psychological stress-induced depression and other mental illnesses has increased in recent years globally. Depression is a prevalent mental disorder and a major public health concern in the general population. In Japan, 1.28 million individuals are affected by mood disorders [1]. Furthermore, in modern society, many young individuals experience psychological issues stemming from stressful events, including academic pressure, interpersonal relationships, and concerns about the future. Notably, the underlying reason for approximately 10% of Japanese university students taking a leave of absence is mental health problems [2]. Mental disorders, specifically depression, can lead to considerable changes in appetite. Additionally, negative emotions due to psychological problems, such as sadness and anxiety,

are associated with food intake.

Some psychological studies have highlighted an association between psychological stress and eating behaviors, reporting that high-stress situations lead to changes in dietary choices across various populations. For example, a previous study revealed that high-stress weeks were associated with greater anxiety, depression, and negative mood than low-stress weeks; in particular, men reported increased consumption of beef, pork, and lambs during high-stress weeks [3]. Other study on workplace stress showed that workers had higher energy, fat, carbohydrate, and sugar intake in high-work-stress sessions than in low-work-stress sessions [4]. One more study reported that increased stress leads to an increase in the frequency of food intake, as well as the consumption of foods high in fat and/or high energy [5].

The previous research indicates that human eating behavior changes in response to variations in psychological stress. Abnormal food intake behaviors,

such as overeating and anorexia, may adversely affect health. Consequently, the relationship between food intake behaviors and health among college students has gained significant attention. A study involving Egyptian university students found a significant association between higher perceived stress scores and less frequent intake of fruits and vegetables in both males and females [6]. Some studies have also reported both increased and decreased food intake among college students under stress and a decrease in the consumption of fruits and vegetables during stressful periods [7]. Many surveys targeting college students have reported that mental health affects adherence to the Mediterranean diet [8,9,10] and overall patterns of food consumption [6,11]. However, research on the relationship between habitual dietary intake and stress levels among college students in Japan remains limited. Only a single study has investigated the association between stress and dietary intake among Japanese college students [12]. However, the sample cohort in this previous study was limited to female students, focusing on overall dietary patterns rather than the intake of specific nutrients [12]. Therefore, the present pilot study aimed to fill this gap in the literature by investigating the relationship between psychological stress levels and dietary habits, including energy consumption, nutrient composition, and food types, in a cohort of Japanese college students. We hypothesized that higher stress levels would be associated with poorer dietary quality, characterized by a lower intake of fruits and vegetables and a higher intake of unhealthy foods. The findings of this study may contribute to the development of interventions aimed at improving overall health and well-being.

2. Materials and Methods

2.1. Study Participants

This cross-sectional study was conducted at a university in Aichi, Japan, between April and August 2019. In total, 163 healthy students, including 77 men and 86 women, aged 18–22 years, were included. The study complied with the principles of the Declaration of Helsinki. All participants provided written informed consent, and the study protocol was approved by the Ethics Committee of Aichi Shukutoku University (No. 2018-10).

2.2. Dietary Assessment

A Brief Self-administered Diet History Questionnaire (BDHQ) was used to assess energy, nutrient, and food group intake. The BDHQ is a food intake frequency survey method that evaluates the content of daily meals of Japanese people based on questions regarding the intake frequency of 46 food items, such as rice and miso soup, as well as 5 types of alcohol, including the cooking methods, eating habits, and drinking frequency. The adequacy of habitual nutrient intake over the past month assessed using the BDHQ has already been previously validated [13,14] and is widely used in nutritional epidemiological studies [15,16,17]. Nutrient and food group intakes were calculated per 1,000 kcal of energy intake [18].

2.3. Psychological Stress Levels

Psychological stress was assessed using the Japanese version of the General Health Questionnaire 30 (GHQ-30), which was constructed to assess stress intensity and detect neurosis [19]. GHQ-30 includes 30 questions, involving the following 6 factors: “general health,” “physical condition,” “sleep disorder,” “social activity,” “anxiety and dysphonia,” and “suicidal ideation and depression.” Each question is rated on a four-grade scale, where 0, 0, 1, and 1 points are assigned to “not at all,” “no more than usual,” “rather more than usual,” and “much more than usual,” respectively. In this study, a cutoff score of 7/8 was considered reasonable [20] and a total score of ≥ 8 and < 7 represented high and low stress, respectively.

2.4. Variables

Using a self-report questionnaire, the information on age, sex, body weight (kg), and height (cm) was collected. The body mass index (BMI) was calculated as body weight divided by height squared.

2.5. Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics for Windows (version 25.0; IBM, Tokyo, Japan). All data were expressed as the mean $\pm$ standard deviation. Differences between groups were evaluated using an unpaired t-test. The relationship between dietary intake and stress levels was examined using a logistic regression analysis, involving univariate and multivariate models. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were then calculated. The variables sex, age, and BMI were adjusted in the multivariate model. All models were analyzed using the low-stress group as a reference. Differences were considered statistically significant at $p < 0.05$.

3. Results

Of the total 163 participants, 119 (51 men and 68 women) and 44 (26 men and 18 women) were included in the low- and high-stress groups, respectively. No significant differences for age, body weight, and BMI were observed among the groups (Table 1).

Table 1. Characteristics of study participants

	All participants (n = 163)			Low-stress group (n = 119)			High-stress group (n = 44)		
Proportion of men (%)	77 (47%)			51 (43%)			26 (59%)		
Age (years)	18.9	$\pm$	1.3	18.8	$\pm$	1.3	19.3	$\pm$	1.1
Body weight (kg)	59.7	$\pm$	12.1	58.7	$\pm$	10.9	62.4	$\pm$	14.5
BMI (kg/m ²)	21.7	$\pm$	3.0	21.5	$\pm$	2.7	22.4	$\pm$	3.8

Values are presented as the mean $\pm$ standard deviation

Table 2 presents the results of the comparison of energy and nutrient intakes between the groups. Energy intake was significantly higher in the high-stress group than in the low-stress group ($p < 0.05$). In contrast, dietary fiber intake and fat proportion in the total energy intake were

significantly lower in the high-stress group than in the low-stress group ($p < 0.05$).

Table 2. Comparison of nutritional intakes between the low- and high-stress groups

	Low-stress group			High-stress group		
Energy (kcal/day)	1903	±	625	2190	±	816*
Protein (% energy)	15.1	±	3.1	14.1	±	2.9
Fat (% energy)	28.9	±	6.9	26.6	±	5.9*
Carbohydrate (% energy)	53.1	±	9.0	55.3	±	9.4
Dietary fiber (g/1000 kcal)	5.8	±	1.7	5.1	±	1.4*
Salt (g/1000 kcal)	5.6	±	1.2	5.6	±	1.2

Values are presented as the mean ± standard deviation

* $p < 0.05$ versus low-stress group determined using unpaired t-test

Table 3. Comparison of food group intakes between the low- and high-stress groups

	Low-stress group			High-stress group		
Cereals (g/1000 kcal)	227	±	78	240	±	80
Bread (g/100 kcal)	21	±	15	19	±	14
Noodles (g/1000 kcal)	41	±	12	60	±	46*
Rice (g/1000 kcal)	164	±	75	162	±	83
Potatoes (g/1000 kcal)	24	±	25	18	±	16
Sugar and sweeteners (g/1000 kcal)	2.2	±	2.3	1.8	±	2.0
Pulses (g/1000 kcal)	26	±	27	22	±	22
Vegetables (g/1000 kcal)	129	±	68	110	±	48
Green and yellow vegetables (g/1000 kcal)	56	±	35	51	±	28
Other vegetables (g/1000 kcal)	73	±	40	59	±	29*
Fruits (g/1000 kcal)	55	±	50	65	±	64
Fish and shell fish (g/1000 kcal)	37	±	24	34	±	17
Meat (g/1000 kcal)	49	±	27	45	±	24
Eggs (g/1000 kcal)	29	±	17	23	±	11*
Milk and dairy products (g/1000 kcal)	71	±	57	65	±	56
Fats and oils (g/1000 kcal)	6.7	±	2.5	6.4	±	2.3
Confectionaries (g/1000 kcal)	45	±	32	42	±	28
Western sweets (g/1000 kcal)	12	±	12	13	±	10
Japanese sweets (g/1000 kcal)	3.1	±	4.1	3.1	±	4.8
Senbei, rice cakes, and okonomiyaki (g/1000 kcal)	6.8	±	10.1	7.2	±	6.8
Ice cream (g/1000 kcal)	22	±	22	19	±	18
Sugar-sweetened beverages (g/1000 kcal)	323	±	291	328	±	252
Seasonings and spices (g/1000 kcal)	138	±	66	144	±	72

Values are presented as the mean ± standard deviation

* $p < 0.05$ versus low-stress group determined using unpaired t-test

Table 3 presents the results for food group intake of the high- and low-stress groups. The intake of noodles was significantly higher in the high-stress group than in the low-stress group ($p < 0.05$), whereas the intake of other

vegetables and eggs was significantly lower in the high-stress group than in the low-stress group ($p < 0.05$).

This study investigated the association between dietary intake and risk of psychological stress using univariate and multivariate analyses (Table 4). Univariate analysis revealed a significant association between stress levels and increased intake of energy and noodles and decreased intake of dietary fiber, other vegetables, and eggs. The subsequent multivariate analysis revealed that energy (OR = 1.0005, 95% CI = 1.0000–1.0011) and noodles (OR = 1.014, 95% CI = 1.003–1.024) were positively associated with stress levels, whereas the variable other vegetables (OR = 0.98, 95% CI = 0.97–0.98) was independently negatively associated with stress levels.

4. Discussion

This cross-sectional study investigated the association between stress levels and dietary intake in Japanese university students. The results revealed that the dietary intake, particularly the energy consumption and intake of dietary fiber, noodles, other vegetables, and eggs, differed between the low- and high-stress groups. Furthermore, in the food groups, both crude and adjusted models showed higher ORs for noodles and lower ORs for vegetables in the high-stress group than in the low-stress group.

To date, several studies have explored the relationship between fruit and vegetable consumption and their potential impact on mental health in various populations. A previous cross-sectional study reported an inverse correlation between frequent consumption of fruits and vegetables and perceived stress levels among university students in Egypt [6]. Furthermore, two cross-sectional studies have also reported an association between the risk of psychological distress and lower fruit and vegetable intake in Iranian and Australian populations [21,22]. The present study found that higher intake of other vegetables may be linked to reduced odds of psychological stress. Moreover, the low-stress group exhibited a significantly higher consumption of other vegetables than the high-stress group; however, no significant differences were observed for fruit consumption. Although few studies to date have conducted extensive international comparisons of fruit intake, it is well documented that the fruit intake in Japanese people is lower than people in other countries. For example, a study on fruit and vegetable intake in eight Western European countries found that individuals in Italy and Spain consumed >250 g of fruit per day on average [23]. Furthermore, even in Sweden, which has the lowest average fruit intake, individuals consume >120 g of fruit daily. In contrast, fruit consumption among Japanese individuals is strikingly low, with a daily intake of 41.2 g for men and 52.7 g for women aged 20–29 years [24]. Consequently, a considerable disparity exists in the assessment of the relationship between fruit consumption and mental health disorders in studies involving Japanese individuals compared with those conducted in other countries.

Table 4. Association between dietary intake and the risk of psychological stress: odds ratios and 95% confident intervals from multivariate adjusted regression analysis

Crude							Adjusted model†				
	Group	B	SE	OR	95% CI	p-value	B	SE	OR	95% CI	p-value
Energy (kcal/day)	Low	Reference					Reference				
	High	0.0006	0.0003	1.0006	1.0001–1.0011	<0.05	0.0005	0.0003	1.0005	1.0000–1.0011	<0.05
Fat (% energy)	Low	Reference					Reference				
	High	-0.054	0.028	0.95	0.90–1.00	0.05	-0.053	0.023	0.95	0.90–1.00	0.06
Dietary fiber (g/1000 kcal)	Low	Reference					Reference				
	High	-0.248	0.117	0.78	0.62–0.98	<0.05	-0.201	0.121	0.81	0.64–1.03	0.09
Noodles (g/1000kcal)	Low	Reference					Reference				
	High	0.014	0.005	1.014	1.004–1.024	<0.01	0.014	0.005	1.014	1.003–1.024	<0.01
Other vegetables (g/1000 kcal)	Low	Reference					Reference				
	High	-0.011	0.005	0.98	0.97–0.99	<0.05	-0.011	0.01	0.98	0.97–0.99	<0.05
Eggs (g/1000 kcal)	Low	Reference					Reference				
	High	-0.025	0.013	0.98	0.95–1.00	<0.05	-0.024	0.013	0.98	0.95–1.00	0.18

B, partial regression coefficient; SE, standard error; OR, Odds ratio; 95% CI, 95% confidence interval

†A stepwise method was used to adjust for sex, age, and BMI

In this study, the individuals in the high-stress group had significantly higher energy and fat (% energy) intake than those in the low-stress group. Moreover, energy intake was significantly correlated with stress levels. A previous study investigating the effects of stress related to school examinations on eating habits found significantly increased total energy intake and fat content in meals on the day of the examination among high school students [25]. Another study reported a higher frequency of sweet food consumption among university students with high academic stress [26]. Additionally, two studies reported an increase in the consumption of energy-dense foods high in fat or sugar during stressful situations [27,28]. Therefore, stress may be associated with disordered eating behaviors, including food preferences, particularly among young people. Furthermore, mild stress in daily life, except for extreme stress, may induce appetite and increase energy intake.

Interestingly, this study revealed an association between higher consumption of noodles and increased odds of psychological stress levels. Rice is the most frequently consumed staple carbohydrate source in the Japanese diet. However, rice consumption has decreased in recent years in Japan [29], and the consumption of noodles has increased, resulting in diversified lifestyles and values. Although previous studies have underscored a relationship between habitual noodle intake and hypertension [30], halitosis [31], sleep quality [32], and academic performance [33], this is the first study to report that noodle consumption contributes to stress. Nevertheless, further studies are needed to determine the relationship between noodle consumption and mental health among Japanese college students.

This study has certain limitations that should be considered when interpreting the results. As this was a cross-sectional study, the direction of the association between habitual dietary intake and psychological stress could not be determined. This study was conducted at a

single university in Japan. Therefore, subsequent cohort studies with larger sample sizes are crucial to determining whether dietary habits are correlated with mental health. Furthermore, the GHQ-30 is a self-reported scale used to assess mental health status, and its results may not reflect long-term conditions. In general, questionnaires such as the Perceived Stress Scale and the Kessler Psychological Distress Scale are often used to assess psychological stress [34,35,36,37]. Psychiatric research also utilizes salivary cortisol as an objective indicator of stress [38,39]. Future studies should assess stress from multiple perspectives using these indicators and investigate the relationship between stress and habitual dietary intake.

5. Conclusions

Psychological stress was found to increase energy intake and noodle consumption among the Japanese university students while decreasing the consumption of other vegetables. However, owing to certain limitations, the results of this study should be interpreted with caution. A key strength of this study is the use of a quantitative approach to analyze the relationship between psychological stress levels and food and nutrient intake among university students.

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Conflict of Interests

The authors declare no conflicts of interest.

List of Abbreviations

BDHQ: Brief Self-administered Diet History Questionnaire

BMI: Body mass index

CI: confidence interval

GHQ-30: General Health Questionnaire 30

OR: Odds ratio

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