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Emotional Eating and Psychological Distress: Unveiling the Hidden Struggles of International Students in Surabaya

Makan secara Emosional dan Stres Psikologis: Mengungkap Perjuangan Tersembunyi Mahasiswa Internasional di Surabaya

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ABSTRACT

Background: International students often face significant adaptation challenges in new academic settings, leading to increased psychological stress, which may affect their emotional well-being and eating habits. Emotional eating is commonly triggered by stress and may contribute to the development of abdominal obesity, which is a serious health concern associated with a higher risk of metabolic and cardiovascular diseases.
Objectives: This study aims to examine the presence of psychological stress and the incidence of emotional eating among international students.
Methods: A cross-sectional study was conducted at Airlangga University in April 2024 with 130 international student respondents from a total of 165 international students recorded, who provided consent and met the inclusion criteria. Data were collected and analyzed descriptively, and statistical testing was conducted using Spearman's correlation, setting the significance level at p-value<0.05.
Results: Most respondents were female (54.62%), undergraduate students (60.00%), Malaysians (57.70%), and had a median waist circumference of 82.59 cm. Psychological stress was associated with emotional eating behavior, as indicated by significant correlations between the subscales of depression, anxiety, and stress as well as the total Depression Anxiety Stress Scales (DASS) score and the total Dutch Eating Behavior Questionnaire Emotional Eating (EE) score (p-value<0.001).
Conclusions: International students experiencing psychological stress during their studies are more likely to engage in emotional eating behaviors, which can subsequently increase their potential for body size changes if not balanced with increased calorie burning.

INTRODUCTION

University life across cultures is widely recognized as an intense period of transition for young adults, where academic demands and social pressures often create a high-stress environment[1]. This stress is particularly pronounced among international students who move from their home countries and must adapt to the new environment. International students may need to adjust to new customs, cultures, traditions, living arrangements, and foods that put more pressure on them than non-international students[2,3]. Differences in habits can make international students more prone to psychological distress because of their inability to adapt to the new environment. Psychological distress is commonly understood as a form of emotional strain that manifests as depressive feelings (disinterest, sadness, and despair) and anxiety (nervousness and tension). In addition, the symptoms include insomnia, headache, and fatigue, which can vary across different contexts[4]. Another definition of psychological distress encompasses general experiences of anxiety, stress, and depression[5]. It is a temporary reaction to specific stress triggers and is often marked by sleep problems, shifts in eating habits, headaches, digestive issues, chronic pain, increased irritability, overwhelming fatigue, memory lapse, and forgetfulness. Symptoms tend to lessen once a person adapts to or eliminates the cause of stress[4]. A residential movement that requires adaptation often significantly impacts an individual's psychological distress, because it requires individuals to adjust to new norms in both personal and social contexts. Changing established habits can lead to feelings of alienation, where individuals feel separated from their previously inhabited environment[6]. Adapting to new norms often requires changing how individuals think, act, and interact with others. Individual changes can involve changing daily habits, learning different social rules, or facing new challenges that one may never have experienced before. This process can evoke discomfort, anxiety, or even fear owing to uncertainty about the future and the individual's ability

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to adapt[7]. Furthermore, individuals may feel burdened by the expectations of their new environment. They may also feel distressed about meeting new social, academic, or professional expectations, leading to increased stress and anxiety levels. International students may experience feelings of incompetence or inadequacy in response to adaptation challenges[8].

When facing the feelings of alienation and psychological distress that arise during the adaptation process, individuals need adequate social and psychological support. International students often face unique challenges in new educational environments, including social isolation, potential discrimination, and difficulty adapting to academic and cultural environments[9]. These challenges can be significant barriers to their adaptation process as they must learn to function effectively in a new context that may be very different from their previous experiences. Social isolation often arises because international students must overcome differences in language, culture, and social norms that may differ from those in their home country[10]. They may feel alienated or lonely because of the lack of social support from their peers or families. Additionally, potential discrimination or unfair treatment owing to cultural or racial differences can cause significant stress and discomfort. The adaptation process often triggers complex stress for international students, which leads to distress in academic achievement while adapting to the new environment, creating a difficult balance between academic and social demands. Anxiety related to language, communication, and social integration can also increase stress[11].

Psychological distress is closely related to changes in eating behaviors, often leading individuals to alter their eating habits or eat emotionally, such as overeating or regularly skipping meals. Individuals with excessive psychological distress are prone to developing serious eating disorders. In situations of high psychological distress, individuals may experience an increased tendency to eat compulsively or, conversely, lose appetite, which can significantly affect their nutritional balance and overall body health[5]. Eating disorders exacerbate psychological tension, cause severe health complications, affect individuals' mental and physical conditions, and require intensive medical and psychological interventions[10]. However, when individuals with psychological distress prefer to follow their cravings and eat compulsively, this may lead to an increase in fat storage from unused calories stored in the abdomen, which later leads to abdominal obesity. Abdominal obesity, characterized by excessive fat accumulation around the abdomen, is a significant health concern because of its association with various metabolic and cardiovascular diseases[12]. Previous studies have found a complex and bidirectional association between abdominal obesity and psychological distress. Furthermore, the association between psychological distress and abdominal obesity may be mediated by hormonal imbalances [13]. For example, when individuals experience high levels of stress, their bodies release cortisol, a stress-associated hormone. Elevated cortisol levels can also lead to increased abdominal fat deposition [14]. Furthermore, stress and psychological distress often lead to emotional eating in which individuals consume high-calorie, high-fat, or high-sodium foods to cope with negative emotions[1]. This behavior further exacerbates abdominal obesity as these foods contribute to increased fat accumulation in the abdominal area.

Moreover, Individuals with abdominal obesity may experience negative body image and self-esteem, leading to heightened psychological distress[4]. In turn, this can perpetuate a cycle of emotional eating; in such cases, food may become a way to cope with stress or challenging emotions[1]. The connection between emotional distress, emotion-driven eating, and obesity can create a harmful cycle, particularly when compounded by the social stigma around obesity. Prior studies have shown that individuals with more abdominal fat are more prone to emotional eating behaviors than those with less abdominal fat[15].

Emotional eating is a condition marked by overeating in response to feelings of stress or negative emotions, such as sadness or worry, in which individuals typically tend to choose high-energy and preferred foods[12]. This phenomenon can arise from various complex mechanisms, including the tendency to wreak or alleviate perceived negative emotions toward food. People who experience emotional eating often misinterpret the internal signals of hunger and satiety, viewing emotions as signs that they need to eat even though their bodies may not require additional food intake at that time [14]. Irregular eating behaviors lead to unhealthy weight gain and negatively affect both physical and mental well-being in the long term[15]. Sultson et al. reported that emotional eating triggered by positive and negative emotions has two different constructs for each mechanism[16]. Positive emotional eating is typically associated with external factors that trigger more intense positive emotions such as celebrations, happiness, or euphoria, which encourage individuals to consume more food while enjoying those moments[15]. Additionally, individuals engaged in positive emotional eating tend to have a lower likelihood of experiencing emotional regulation problems because they often use food to extend or reinforce their existing feelings of happiness. Conversely, people with negative emotions tend to vent the negative emotions experienced by eating the food they like the most[13].

Negative emotional eating is typically triggered by internal factors such as bad mood, prolonged negative feelings, and sustained stress[17] and increases the risk of experiencing more serious eating disorders. For example, in binge eating disorders, a person may consume large amounts of food within a short time owing to emotional stress[18]. Maladaptive behavior and affect regulation theory suggest that those who engage in negative emotional eating consume food temporarily to indulge in hedonic pleasure from food, with the primary goal of reducing or eliminating the negative emotions they experience[19]. Although this behavior may provide temporary relief, it can exacerbate emotional regulation problems and overall health issues in the long run, as individuals do not learn healthy and adaptive ways to manage their emotions. Therefore, it is important to understand the differences between positive and negative emotional eating and their implications for

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individual well-being so that more effective intervention strategies can be developed to address these issues. Based on these considerations, the authors explored the relationship between psychological distress, emotional eating behavior, and abdominal obesity among international students in Surabaya. This study aimed to gain a clearer understanding of how psychological stress affects emotional eating patterns among students from various cultural backgrounds who are in the environments that may be unfamiliar to them and their association with the prevalence of abdominal obesity. This study is important because the interaction between psychological stress and emotional eating affects students' well-being and productivity. International students often face unique challenges including cultural adjustment, academic distress, and homesickness, which can increase their levels of psychological stress. By understanding the relationships between these factors, effective prevention, improvement, and control measures can be implemented to help students manage their stress.

METHODS

This cross-sectional study was conducted in April 2024 following ethical approval from the Universitas Airlangga's Faculty of Dental Medicine Health Research Ethical Clearance Commission (Number: 0343/HRECC. FODM/IV/2024 issued on April 18, 2024). We included 130 voluntary international students from bachelor's to doctoral study programs at Airlangga University from a total of 165 international students recorded, who provided consent and met the inclusion criteria, such as not undergoing specific drug therapies or diets, not having consulted a psychiatrist, and not suffering from any noncommunicable diseases. This study assessed respondents' psychological distress using the Depression, Anxiety, Stress Scale (DASS)-21 questionnaire, which includes 21 questions across three subscales to assess symptoms related to depression, anxiety, and stress)[20]. It is widely used to assess self-perceived depression, anxiety, and stress. Every question in the DASS-21 questionnaire must be answered using a Likert scale from zero to three, which summarizes a total of 21-question (called DASSt), or summarized into each subscale score, such as the D-Score, A-Score, and S-Score (a total score for the depression, anxiety, and stress subscales, respectively). For classification, the scores on each subscale were grouped as normal, mild, moderate, severe, or extremely severe, and the results were further categorized into two groups: normal or mild and above[21]. The depression subscale assesses symptoms such as loss of interest and low mood, the anxiety subscale assesses feelings of nervousness and muscle tightness, and the stress subscale measures the inability to relax and other tension-related symptoms. Each question is measured using a 4-point Likert scale ranging from 0 ("did not apply to me at all") to 3 ("applied to me very much or most of the time")[20]. Higher scores indicate higher levels of each psychological condition. After calculating the total score, the participants were categorized into three groups based on their scores. These categories were normal, mild, moderate, severe, and extremely severe, representing the severity level of each psychological condition. Utilizing the DASS-21 offers an advantage in illustrating the broad spectrum of psychological conditions that the participants may experience. However, it is essential to note that the DASS-21 is a self-reported measurement tool; therefore, its results may be influenced by individual subjective factors. Moreover, the assessment of psychological distress using the DASS-21 only provides a general overview of the participants' psychological conditions within a specific period and may not capture the complexities that may underlie the reported symptoms.

Emotional eating was examined using the Dutch Eating Behavior Questionnaire's Emotional Eating (DEBQ-EE) subscale, which assesses eating habits triggered by emotions such as sadness, anger, or anxiety[22]. The DEBQ-EE consists of 13 questions rated on a 5-point Likert scale, from 1 ("never") to 5 ("very often"), resulting in scores that can range from 13 to 65[1]. Higher scores indicate a stronger emotional eating tendency, with an average score above 3.25 suggesting high emotional eating levels, whereas scores below 3.25 indicate typical levels[23].

Furthermore, we measured the respondents' waist circumferences using a nonstretchable measuring tape. Waist circumference reflects the amount of visceral fat associated with the risk of metabolic diseases[24,25]. To accurately measure waist circumference, an individual should stand in an upright and relaxed position[26]. The measurement was taken at the narrowest part of the waist, typically between the hip bone and the lower rib. The measuring tape was wrapped horizontally around the body, without exerting excessive pressure on the skin. Subsequently, waist circumference was measured and recorded in centimeters. We categorized it into "having abdominal obesity" if the female is larger than 80 cm or the male is larger than 90 cm and "without abdominal obesity" if their waist was smaller than the cutoff point[26]. We added a checklist question about the food the respondents preferred during moments of emotional eating. The available answers included high-energy, sweet, or salty foods. The collected data were analyzed using STATA version 17, and normality was tested using the Kolmogorov-Smirnov test. The correlation between psychological distress using the DASS-21, emotional eating using the DEBQ-EE, and waist circumference in centimeters was examined using the Spearman Rank Test. Categorical data were presented as numbers and percentages, and continuous data were presented as medians and ranges. Furthermore, we analyzed the regression test model to determine the strength of the correlation between the variables. Statistical significance was set at $p\text{-value}<0.05$.

RESULTS AND DISCUSSIONS

Our study included 130 students from Airlangga University, including 59 males (45.38%) and 71 females (54.62%). Among the 130 respondents, 78 were in a bachelor's program, 34 in a master's program, 18 in a doctoral program, and most were Malaysian (57.70%). The countries of origin of the remaining respondents are Pakistan, Timor-Leste, Philippines, Yemen, Spain, Sudan, Nigeria, Portugal, the United States, Liberia, Madagascar, Japan, Sierra Leone, and Malawi. We used the Kolmogorov-Smirnov normality test and then conducted

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non-parametric analyses for the rest of the statistical tests. The respondents' median waist circumference was 81.34 cm (Female: 79.18 cm; Male: 83.93 cm). Furthermore, we analyzed the median score of the DASS-21 questionnaire with three subscales 6.97, 9.68, and 11.60 for depression, anxiety, and stress, respectively. Meanwhile, the median score of the total DASS-21 was 28.25 and DEBQ-EE questionnaire was 32.55, as shown in Table 1.

Table 1. Frequency distribution of characteristics of international students in Surabaya

Variable	Total			Female			Male			p-value
	n (%)	Median	Range	n (%)	Median	Range	n (%)	Median	Range	
n	130 (100.00%)			71 (54.62%)			59 (45.38%)			
Waist Circumference, cm		82.95	58.00-110.00		78.40	62.10-110.00		84.40	58.00-95.20	0.053
Educational Level										<0.001*
Bachelor	78 (60.00%)			57 (73.08%)			21 (26.92%)			
Master	34 (26.20%)			10 (29.41%)			24 (70.59%)			
Doctoral	18 (13.80%)			4 (22.22%)			14 (77.78%)			
Nationality										0.005*
Malaysian	75 (57.70%)			55 (73.34%)			20 (26.66%)			
Others	55 (42.30%)			16 (29.09%)			39 (70.91%)			
Depression Subscale Score		5.00	0.00-38.00		8.00	0.00-38.00		2.00	0.00-20.00	<0.001*
Anxiety Subscale Score		8.00	2.00-30.00		10.00	2.00-30.00		6.00	2.00-20.00	<0.001*
Stress Subscale Score		20.00	2.00-34.00		12.00	2.00-34.00		8.00	2.00-20.00	<0.001*
Total DASS-21 Score		24.00	6.00-92.00		32.00	10.00-92.00		18.00	6.00-52.00	<0.001*
DEBQ-EE Score		31.00	17.00-65.00		38.00	19.00-65.00		23.00	17.00-48.00	<0.001*

Note: DASS-21: Depression Anxiety and Stress Scale Questionnaire, which consists of 21 questions; DEBQ-EE: Dutch Eating Behaviors Questionnaire-Emotional Eating Subscale. Descriptive analyses used numbers and percentages of n (%) for categorical data, and median and range values for continuous data. We used a chi-square test to assess categorical data and a Student's t-test for continuous data. Statistical significance was set at p-value<0.05, (*): significant

Table 2. Respondents' food preferences during emotional eating moment

Variable	Total		Female		Male	
	n	(%)	n	(%)	n	(%)
Consume 3 Food Types	61	46.92	32	52.46	29	47.54
Consume 2 Food Types						
High-Energy + Sweet	9	6.92	6	66.67	3	33.33
Sweet + Salty	9	6.92	7	77.78	2	22.22
High-Energy + Salty	15	11.54	3	20.00	12	80.00
Consume 1 Food Type						
High-Energy	15	11.54	4	26.67	11	73.33
Sweet	16	12.31	16	100.00	0	0.00
Salty	5	3.85	3	60.00	2	40.00

Note: Descriptive analyses used numbers and percentages of n (%) for categorical data.

This study assessed the food types consumed by the respondents experiencing emotional eating moments (Table 2). Sixty-one students (46.92% of the total respondents) reported that they preferred a combination of high-energy, sweet, and salty foods, whereas 33 students (25.38% of the total respondents) reported that they preferred a combination of high-energy with sweet foods, sweet with salty foods, or high-energy with salty foods. We found that female students preferred sweet foods as either a single food type or a combination of two types of food. Table 3 presents the values of the coefficients obtained from the pairwise correlation test between the independent and dependent variables. This study found significant positive correlations within the DASS-21 subscales and between DASS-21 and DEBQ-EEt scores. However, the DASSt and DEBQ-EEt scores were not significantly correlated with waist circumference.

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Table 3. Results of the Spearman Rank test on the correlations among study variables.

Variable	D-Score	A-Score	S-Score	DASSt	DEBQ-EEt	WstCr
D-Score	1.0000					
A-Score	0.7678*	1.0000				
S-Score	0.7368*	0.6935*	1.0000			
DASSt	0.9360*	0.8922*	0.8750*	1.0000		
DEBQ-EEt	0.6631*	0.5775*	0.6116*	0.6930*	1.0000	
WstCr	0.0464	-0.0683	-0.0305	0.0030	-0.0500	1.0000

Note: D-Score: Depression Anxiety and Stress Scale-Depression subscale; A-Score: Depression Anxiety and Stress Scale-Anxiety subscale; S-Score: Depression Anxiety and Stress Scale-Stress subscale; DASSt: Total score of Depression Anxiety and Stress Scale; DEBQ-EEt: Dutch Eating Behaviors Questionnaire Emotional Eating Scale; WstCr: Waist Circumference; (*): significant correlation p-value 0.51-0,75

Table 4 presents the results of the logistic and linear regressions between the variables. In the linear model analysis, significant positive relationships were found between various scores and the DEBQ-EEt in both the unadjusted and adjusted models. In the unadjusted model, D-Score, A-Score, S-Score, and DASSt showed significant positive associations with DEBQ-EEt, with exponentiated coefficients of 2.26, 2.85, 3.27, and 1.48, respectively (p-value<0.001 for all), indicating that increases in these scores were associated with increases in DEBQ-EEt. After adjustment, these relationships remained significant, with exponentiated coefficients of 1.73 for the D-Score, 2.14 for A-Score, 2.25 for S-Score, and 1.33 for DASSt (p-value< 0.001 for all), suggesting robust associations even after accounting for other variables. In the logistic model, emotional eating demonstrated significant positive associations with mild and high levels of depression, anxiety, and stress in the unadjusted model, with odds ratios of 5.02, 12.02, and 2.59, respectively (p-value<0.001, p-value=0.001, and p-value=0.044, respectively). This indicates that emotional eating increases the likelihood of experiencing mild or high levels of these conditions. Additionally, significant negative relationships were observed between emotional eating and both non-bachelor and non-Malaysian statuses, with odds ratios of 0.11 and 0.12, respectively (p-value=0.002 and p-value=0.001), indicating that emotional eating is less common among these groups. After adjustment, the positive associations between emotional eating and mild and high levels of depression and anxiety remained significant, with odds ratios of 2.93 (p-value=0.029) and 7.33 (p-value=0.011), respectively, highlighting that emotional eating continues to be a risk factor for these conditions even after controlling for other variables. However, the association between mild and severe stress was no longer significant (odds ratio of 1.27, p-value=0.645), suggesting that the initial relationship was likely influenced by other factors. The negative associations with non-bachelor and non-Malaysian statuses remained significant, with odds ratios of 0.18 (p-value=0.017) and 0.20 (p-value = 0.018), respectively, confirming that emotional eating was consistently lower among individuals without a bachelor's degree and non-Malaysians after adjustment.

This study investigated the link between psychological distress and emotional eating tendencies among international students in Surabaya, and the findings revealed a significant positive relationship. The data indicated that heightened levels of psychological distress were closely associated with an increase in emotional eating behaviors, which is consistent with the findings of recent studies. For instance, Guerini et al. and Wijnan et al. demonstrated that individuals facing high psychological stress levels were more prone to turn to emotional eating as a way of managing their emotions[21,27–29]. This underscores the importance of addressing emotional eating behaviors as part of mental health interventions among university students.

The results highlight several important findings regarding the relationship between psychological distress and emotional eating among international college students in Surabaya. Analysis of respondent characteristics revealed significant gender differences in several variables, including educational level and nationality. Most female respondents were at the bachelor's level, whereas male respondents were more prevalent at the master's and doctoral levels. Additionally, most female respondents were from Malaysia, whereas the male respondents had more diverse nationalities. These differences should be considered in interventions designed to address psychological distress and emotional eating behaviors among international student populations.

Table. 4 Regression Model Analyses

Dependent	Independent	Exp. Coefficient	Confidence Interval		p-value
Linear-Unadjusted Model					
DEBQ-EEt	D-Score	2.26	1.83	2.79	<0.001
	A-Score	2.85	2.22	3.66	<0.001
	S-Score	3.27	2.46	4.36	<0.001
	DASSt	1.48	1.36	1.62	<0.001
Linear-Adjusted Model					
DEBQ-EEt	D-Score	1.73	1.39	2.15	<0.001
	A-Score	2.14	1.69	2.73	<0.001

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Dependent	Independent	Exp. Coefficient	Confidence Interval		p-value
	S-Score	2.25	1.67	3.05	<0.001
	DASSt	1.33	1.22	1.46	<0.001
Dependent	**Independent**	**Odd Ratio**	**Confidence Interval**		**p-value**
Logistic-Unadjusted Model					
Emotional Eating	Depression (Mild and Up)	5.02	2.07	12.18	<0.001
	Anxiety (Mild and Up)	12.02	2.71	53.32	0.001
	Stress (Mild and Up)	2.59	1.03	6.54	0.044
	Non-Bachelor	0.11	0.03	0.45	0.002
	Non-Malaysian	0.12	0.03	0.41	0.001
Logistic-Adjusted Model					
Emotional Eating	Depression (Mild and Up)	2.93	1.17	7.68	0.029
	Anxiety (Mild and Up)	7.33	1.57	34.27	0.011
	Stress (Mild and Up)	1.27	0.46	3.52	0.645
	Non-Bachelor	0.18	0.04	0.73	0.017
	Non-Malaysian	0.20	0.05	0.77	0.018

Note: The adjusted models use gender and waist circumference as adjustment variables. Logistic regression was used for the normal group in the DASS Subscale categories, bachelor's degree program, and Malaysian nationality as references.

The median waist circumference was 82.95 cm among all respondents, with female respondents having a lower median waist circumference (78.40 cm) than male respondents (84.40 cm), although the difference was not statistically significant (p-value=0.053). This finding suggests that abdominal obesity, which is a risk factor for metabolic diseases, may be more prevalent among male students[30]. Considering these findings in the context of health interventions is crucial, as waist circumference is a significant indicator of visceral fat and related health risks[30]. The correlation between abdominal obesity and emotional eating behavior has been well documented in the literature. Abdominal obesity, characterized by excess abdominal fat, is often associated with high levels of stress and psychological distress, which can trigger emotional eating behaviors[11]. Emotional eating involves food consumption in response to emotional cues rather than physical hunger, often leading to the intake of high-calorie, sugary, and fatty foods that contribute to weight gain and abdominal obesity[1]. Previous research has shown that individuals with higher levels of visceral fat are more likely to engage in emotional eating to cope with negative emotions, such as anxiety and depression.

Educational level differences were also notable, with a higher proportion of females (80.28%) having a bachelor's degree than males (35.59%). Conversely, more males were pursuing master's (40.68%) and doctoral degrees (23.73%) than females (14.08% and 5.64%, respectively). This discrepancy highlights the potential influence of educational demands and stressors on psychological distress and eating behaviors. Higher educational levels may be correlated with increased stress, which could exacerbate emotional eating tendencies, particularly among male students[31]. Nationality also played a significant role, with 77.46% of female respondents being Malaysian compared to 33.90% of male respondents. This suggests a more homogeneous nationality distribution among female students, whereas male students represent a broader range of nationalities. The cultural and social contexts of students of different nationalities could influence their coping mechanisms, including emotional eating and should be considered when developing tailored interventions[32].

Moreover, our study highlighted the underlying mechanisms driving emotional eating in response to psychological distress. Recent research has suggested that stress hormones such as cortisol play a crucial role in influencing both mood regulation and appetite[33]. Both short- and long-term psychological pressure can trigger a physiological cascade in the hypothalamic-pituitary-adrenal (HPA) axis[34]. The hypothalamus sends corticotropin-releasing factors to the pituitary gland, which signals the adrenal glands through adrenocorticotropic hormone[35]. The adrenal glands release cortisol, which controls energy consumption and hunger[35]. High cortisol levels stimulate gluconeogenesis and lead to insulin resistance[36]. The release of cortisol stimulates the brain and increases appetite. Cortisol also promotes eating by reducing leptin sensitivity in the brain[33]. Elevated cortisol levels triggered by chronic stress may lead to increased cravings for high-calorie comfort foods as a means of relieving negative emotions[37].

Regarding psychological distress, the study used the DASS-21 to measure depression, anxiety, and stress levels[20]. Female respondents reported higher median scores across all subscales: depression (8.00 vs. 2.00), anxiety (10.00 vs. 6.00), and stress (12.00 vs. 8.00), with all differences being statistically significant (p-value<0.001). This indicates that female students experience higher levels of psychological distress than their male counterparts, which may contribute to increased emotional eating behaviors as a coping strategy. Emotional eating, assessed using the DEBQ-EE[22], was also higher among female respondents, with a median score of 38.00 compared to 23.00 for males (p-value<0.001). This aligns with the higher levels of psychological distress reported by the female students. Correlation analysis further supported these findings, showing significant positive correlations between the DEBQ-EE and DASS-21 subscale scores, indicating that higher psychological distress was associated with increased emotional eating. This study found that more

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severe psychological distress was associated with increased emotional eating behaviors, consistent with recent research findings[21]. For example, Guerini et al. found that individuals experiencing higher levels of psychological distress were more likely to engage in emotional eating as a coping mechanism[21].

Individuals typically employ two methods to manage psychological distress: problem-focused and emotion-focused coping[23]. Problem-focused coping involves direct efforts to address or change the source of stress, such as problem-solving, seeking information, or developing effective action plans. By contrast, emotion-focused coping aims to manage emotional responses triggered by stressful situations through techniques such as relaxation, meditation, or seeking emotional support from friends and family. Psychological distress not only affects individuals' mental conditions but also indirectly influences their metabolic processes[38]. When an individual experiences psychological distress, the body responds by activating the sympathetic nervous system, which affects various metabolic functions[38].

Short- and long-term psychological stress can trigger physiological cascades in the HPA axis, which plays a crucial role in regulating the body's response to stress[35]. Activation of the HPA axis begins with the hypothalamus releasing corticotropin-releasing hormone (CRH), which stimulates the pituitary gland to release adrenocorticotropic hormones (ACTH). ACTH stimulates the adrenal glands to release cortisol, the primary stress hormone[35]. Cortisol has various effects on the body, including increasing blood sugar levels; altering the metabolism of fats, proteins, and carbohydrates; and suppressing the immune system's functions[33]. Although cortisol helps the body cope with stress in the short-term, chronic exposure to high cortisol levels can lead to various health problems.

An effect of excessive cortisol is increased insulin resistance, which means that body cells become less responsive to insulin. Insulin is a hormone that helps cells absorb glucose from blood for energy[36]. When insulin resistance occurs, the body produces more insulin to maintain blood sugar levels under control[36]. Prolonged insulin resistance can lead to a condition known as metabolic syndrome and an increased risk of developing type 2 diabetes. In addition, high cortisol levels can lead to increased appetite and changes in body fat distribution, often leading to fat accumulation in the abdominal area[33]. Visceral fat accumulation is associated with an increased risk of cardiovascular disease, hypertension, and other metabolic disorders[36,39]. Overall, the stress response mediated by the HPA axis and increased cortisol levels play a crucial role in ensuring that the body has sufficient energy during stressful situations. However, it is important to manage stress effectively to prevent the long-term negative effects of high cortisol levels on physical health and metabolism.

When cortisol is released by the adrenal glands in response to stress, it can have various effects on the body and brain[33]. One of the main effects of cortisol is its ability to stimulate the brain, leading to increased appetite[33]. Cortisol can affect various neurobiological pathways that regulate hunger and satiety; thus, individuals may feel hungry or are compelled to eat more than usual. Additionally, cortisol has a significant effect on leptin, a satiety hormone[34]. Leptin is produced by fat cells and sends signals to the brain that the body has sufficient food and does not require additional food[40]. However, high cortisol levels reduce the brain's sensitivity to leptin[41]. Consequently, the brain does not effectively receive satiety signals, causing individuals to feel hungry, even though they have already eaten enough[42].

Interestingly, this study found a negative correlation between emotional eating and the consumption of high-energy foods among some students. This contradicts the traditional view that emotional eating involves an increased consumption of calorie-dense comfort foods[37]. Recent studies have suggested that individuals with severe psychological distress may exhibit decreased preferences for such foods, possibly owing to the physiological impact of stress on appetite regulation[43]. One possible explanation for this finding is the role of leptin in appetite regulation. Leptin, a hormone involved in energy balance, can reduce food intake by influencing the neural circuits in the hypothalamus and reducing the reward response to food[40]. High levels of leptin, often found in individuals with significant fat stores, might blunt the desire for high-energy foods, even in the context of stress[41]. Leptin, whether present at normal or elevated levels, decreases food consumption by suppressing orexigenic NPY/AgRP neurons and stimulating anorexigenic POMC neurons in the hypothalamus[44]. This action also reduces pleasure associated with food by decreasing the activity of dopaminergic VTA neurons. Consequently, leptin serves as a continuous signal that informs the brain of the body's fat reserves (i.e., energy). Moreover, it enhances the gut-derived satiation signals responsible for ending meals[37,45,41]. This indicates a complex interplay between physiological stress responses, emotional eating, and eating behavior.

Regression analysis further elucidated these relationships, showing that depression, anxiety, and stress significantly predicted emotional eating behaviors in both the unadjusted and adjusted models. For example, higher scores on the DASS-21 subscales were associated with higher DEBQ-EE scores, even after adjusting for gender and waist circumference. This robust association underscores the need for mental health interventions to address emotional eating behaviors among students. Finally, logistic regression analysis revealed that students with mild or high levels of depression and anxiety were significantly more likely to engage in emotional eating behaviors. This finding emphasizes the importance of the early identification and management of psychological distress to prevent maladaptive eating behaviors that can lead to adverse health outcomes.

In summary, this study highlights the intricate relationship between psychological distress and emotional eating among international students. Gender, educational level, and nationality are important factors that influence these behaviors. These findings suggest that tailored interventions addressing both mental health and eating behaviors are necessary to support the well-being of this diverse student population. Future research should explore the mechanisms underlying these

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relationships and develop effective strategies for managing psychological distress and emotional eating.

This process can lead to a phenomenon known as emotional eating, in which individuals experiencing psychological distress tend to engage in eating behavior to alleviate or cope with their negative emotions rather than eating owing to physiological needs or hunger. Emotional eating often involves consuming high-calorie, sugary, and fatty foods that provide temporary comfort but do not provide balanced nutrition[15,46]. Individuals engaged in emotional eating use food to seek comfort and reduce emotional tension; however, this behavior can lead to a continuous cycle of overeating and feelings of guilt or regret. In the long term, emotional eating can contribute to various health problems, including unhealthy weight gain, obesity, and the risk of metabolic disorders, such as type 2 diabetes[13]. Additionally, emotional eating can exacerbate psychological conditions, as individuals may feel a loss of control over their eating habits, which can increase their stress and anxiety. Therefore, individuals need to recognize emotional eating patterns and seek healthier strategies to manage psychological distress, such as exercise, meditation, or psychological counseling, to prevent negative effects on their physical and mental health.

The unexpected negative correlation between psychological distress and consumption of high-energy foods presents a perplexing phenomenon that challenges the traditional understanding of emotional eating and dietary behaviors among college students. While emotional eating is often associated with consuming calorie-dense comfort foods as a coping mechanism for stress or negative emotions, recent research suggests a contrary trend, that is, individuals experiencing heightened psychological distress exhibit a decreased preference for such foods[37]. This paradoxical relationship underscores the complexity of human behavior and the multifaceted interactions between psychological factors and dietary choices. Another reason could be normal and high levels of leptin[41]. Leptin, whether present at normal or elevated levels, decreases food consumption by suppressing orexigenic NPY/AgRP neurons and stimulating anorexigenic POMC neurons in the hypothalamus[44]. This action also reduces pleasure associated with food by decreasing the activity of dopaminergic VTA neurons. Consequently, leptin serves as a continuous signal that informs the brain about the body's fat reserves (i.e., energy). Furthermore, it enhances the gut-derived satiation signals responsible for ending meals[41,45].

This study has some limitations. This cross-sectional design limits the ability to infer causality between psychological distress and emotional eating. Additionally, self-reported measures may be subject to response bias. The data on age were not comprehensive as some students chose not to disclose their age, which limited their ability to generalize the findings across different age groups. Future studies should incorporate a longitudinal design and objective measures to validate and extend these findings. Despite these limitations, this study provides valuable insights into the complex dynamics of psychological distress and emotional eating among international students, highlighting the need for comprehensive and culturally sensitive interventions.

CONCLUSIONS

International students experience psychological stress during their studies and are potentially more likely to engage in emotional eating behaviors, which can subsequently increase their potential for body size changes, if not balanced with increased calorie burning. University life can be both stressful and fruitful if individuals adapt to their surrounding environment. In addition, institutional facilities can be tailored to accommodate all users, particularly students. Thus, international students may benefit from the university's facilities in maintaining their health status.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

NSAN: Responsible for all scientific content of the article, making research concepts and designs, formulating the problem formulation, data collection, analyzing and interpreting the data, preparing the draft manuscript, and making revisions; ERI: Conducted supervision and guidance in manuscript writing, collecting data, analysis, and interpretation of data, providing criticism, input, and suggestions for writing manuscripts, and revising the manuscript.

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