

Lingjun Meng¹ 
Xu Guo² 
Qian Shi^{3,*} 

Perceived Stress and Emotional Eating in University Students: The Mediating Role of Shame and the Moderating Role of Loneliness

¹Department of Public Health School, The Student Affairs Office, Qiqihar Medical University, 161000 Qiqihar, Heilongjiang, China

²Medical Technology, Qiqihar Medical University, 161000 Qiqihar, Heilongjiang, China

³College Students Psychological Counseling Center, Student Affairs Department, Qiqihar Medical University, 161000 Qiqihar, Heilongjiang, China

Abstract

Background: To investigate the current status of perceived stress and emotional eating among university students, and to examine the mediating role of shame and the moderating role of loneliness in this relationship.

Methods: From March to October 2025, a randomized cluster sampling method was used to select students from Qiqihar Medical University in Heilongjiang Province. A total of 1000 university students were invited to participate in the survey using the Chinese Perceived Stress Scale (CPSS), the University of California at Los Angeles Loneliness Scale (UCLA) Loneliness Scale, the Experience of Shame Scale (ESS), and the Dutch Eating Behavior Questionnaire (DEBQ).

Results: Ultimately, 920 valid questionnaires were collected, yielding an effective response rate of 92.00%. Scores for perceived stress, emotional eating, shame, and loneliness were all significantly positively correlated with each other ($p < 0.05$). Shame played a partial mediating role in the relationship between perceived stress and emotional eating. The interaction term between shame and loneliness significantly associated with emotional eating (standardized coefficient = 0.083, $p = 0.008$).

Conclusions: Perceived stress in university students is

directly associated with emotional eating. Shame mediates the relationship between perceived stress and emotional eating, and loneliness moderates this mediating pathway.

Keywords

emotional eating; loneliness; perceived stress; shame; university students

Introduction

Obesity has become one of the most prevalent global epidemics. Obesity resulting from overeating triggered by negative emotions induced by stress is often termed “stress-induced obesity.” Bruch [1] posited that individuals may struggle to differentiate hunger sensations arising from different emotions, particularly when negative emotions lead to food intake, resulting in emotional eating. Research demonstrates that emotional eating constitutes not merely a risk factor for obesity at the individual level, but also acts as a mediating variable in the association between body mass index, abdominal adiposity, and the subsequent development of depressive symptoms [2,3]. A 13-year longitudinal study found that among adolescents, the proportion of emotional eaters who developed cardiovascular disease increased by 38% [4], placing a substantial burden on both individuals and society.

Negative affective states can undermine an individual’s self-regulatory capacity regarding dietary maintenance, increasing susceptibility to overconsumption [5]. Research has shown that emotions can influence an individual’s appetite by 30% to 48% [6], with negative emotions having a greater impact. More than a quarter of adolescents report overeating due to negative emotions caused by stress

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*Corresponding author details: Qian Shi, College Students Psychological Counseling Center, Student Affairs Department, Qiqihar Medical University, 161000 Qiqihar, Heilongjiang, China. Email: phy202604@163.com

[7]. Under chronic high-stress conditions, induced emotional numbness, impulsivity, and psychological inflexibility can lead individuals to attempt to escape negative emotions, thereby exacerbating emotional eating behaviors [8]. Perceived stress is the psychological response an individual generates after cognitively appraising threatening stimuli in the environment [9]. University students with high levels of loneliness often exhibit lower self-evaluation and poorer self-concept, experiencing it as a negative emotional response when their need for belonging is unmet [10], which can intensify tendencies toward unhealthy behaviors. Shame, as a negative self-directed evaluation, is frequently associated with an individual's negative psychological and behavioral outcomes, and is prone to inducing adverse mental and behavioral issues such as post-traumatic stress disorder, avoidance behaviors, and violent behaviors [11,12], potentially further aggravating emotional eating behaviors.

Emotional eating is currently a major focus of societal concern. Although extensive research has examined the associations among stress, negative affect, and emotional eating, a comprehensive understanding of the underlying mechanisms remains elusive. Perceived stress is a significant factor triggering emotional eating, and loneliness and shame are key psychological variables that may influence self-control resources within this process. However, the interrelationships among these factors have not been sufficiently and thoroughly investigated, and research explaining the potential mechanisms is also limited. Accordingly, this study seeks to investigate the pathway from perceived stress to emotional eating among university students, a mediation model with shame as the mediator while also examining the potential moderating effect of loneliness. We therefore proposed the following hypotheses: perceived stress in university students is directly associated with emotional eating behavior; shame mediates the relationship between perceived stress and emotional eating; and loneliness moderates this mediating pathway.

Materials and Methods

Participants

From March to October 2025, random sampling was conducted at Qiqihar Medical University in Heilongjiang Province. The inclusion criteria for participants were: (1) currently enrolled university students; and (2) aged ≥ 18 years. This study was reviewed and approved by the Institutional Review Board of Qiqihar Medical University [Ethical Approval No. (2024)-114]. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research

committee and with the Declaration of Helsinki (2013). Of the 1000 questionnaires initially distributed, 920 valid responses were obtained after data screening, resulting in a 92.00% effective response rate. The sample included 399 males (43.37%) and 521 females (56.63%). The distribution across academic years was as follows: freshmen: 434 (47.17%), sophomores: 232 (25.22%), juniors: 254 (27.61%). Regarding household registration, 468 (50.87%) were from urban areas and 452 (49.13%) from rural areas. Written informed consent was obtained from all participants prior to their participation in the study. As all participants were adults (≥ 18 years), no additional parental or guardian consent was required.

Measurements

Chinese Perceived Stress Scale (CPSS)

The scale, originally developed by Lee [13] and revised by Yang and Huang [14], consists of 14 items. It comprises two dimensions: tension and uncontrollability, assessing stress responses across three situational contexts: life changes, significant events, and daily hassles. Of the 14 items, seven are positively scored and seven are reverse-scored. The reverse-scored items are 4, 5, 6, 7, 9, 10, and 13. All items are rated on a 5-point scale. The scale demonstrates good reliability and validity. The Cronbach's α coefficients for the total scale and its two sub-dimensions were 0.97, 0.98, and 0.95, respectively.

University of California at Los Angeles Loneliness Scale (UCLA)

The third version of this scale was developed by Russell [15] in 1996 as a refinement of the original 1978 version and the 1980 revised version, this scale contains 20 items, including 11 positively scored and 9 reverse-scored items. Responses are recorded on a 4-point Likert scale. Higher total scores indicate greater feelings of loneliness. The scale exhibits good psychometric properties, with a Cronbach's α coefficient of 0.94.

Experience of Shame Scale (ESS)

Jointly developed by Andrews *et al.* [16], this scale includes 25 items across four dimensions: personality, behavior, body, and family. Responses were made on a 4-point Likert scale, yielding total scores between 25 and 100, where higher scores correspond to higher levels of shame. The measure showed excellent reliability, with a Cronbach's α coefficient of 0.92.

Dutch Eating Behavior Questionnaire (DEBQ)

This is a classic measure of psychological eating patterns, developed by van Strien [17]. It comprises three dimensions: emotional eating, external eating, and restrained eating with a total of 33 items. The emotional eating subscale consists of 13 items rated on a 5-point Likert scale, with higher scores indicating more severe abnormal eating behaviors. The questionnaire demonstrates good reliability and validity, with Cronbach's α coefficients ranging from 0.83 to 0.95 for its subscales.

Statistical Analysis

All statistical analyses were performed using SPSS version 26.0 (IBM Corporation, Armonk, NY, USA). We calculated descriptive statistics for all study variables, presenting continuous variables as means and standard deviations ($M \pm SD$) and categorical variables as frequencies and percentages. To verify the normality of the data distribution, we examined the skewness and kurtosis values for the four continuous variables (perceived stress, shame, loneliness, and emotional eating). The absolute values of skewness and kurtosis for all four variables were less than 2.0, indicating approximately normal distributions; therefore, we used parametric tests for all analyses. We used independent samples t -tests to compare emotional eating scores across gender, residence (urban vs. rural), and only-child status. We calculated Pearson correlation coefficients to examine bivariate associations among perceived stress, shame, loneliness, and emotional eating. To assess common method bias, we conducted Harman's single-factor test using a latent common method factor approach, with a change of less than 0.03 in all model fit indices (e.g., CFI, TLI, RMSEA) set as the threshold.

To control for the potential confounding effect of gender, which showed a significant association with emotional eating in univariate analysis, we performed a hierarchical multiple regression analysis. In Step 1, we entered gender as a control variable; in Step 2, we entered perceived stress and shame to examine their unique predictive effects on emotional eating after controlling for gender. Subsequently, to test the hypothesized mediation and moderated mediation effects, we used the PROCESS macro for SPSS (version 4.0, developed by Andrew F. Hayes). We applied Model 4 to examine the mediating role of shame and Model 5 to test the moderated mediation model with loneliness as the moderator. In all PROCESS analyses, we included gender as a covariate. For all mediation and moderation analyses, we generated 5000 bootstrap resamples to obtain 95% bias-corrected confidence intervals for the indirect effects.

We set the significance level at two-tailed $p < 0.05$, or a 95% confidence interval that did not include zero.

Results

Univariate Analysis of Emotional Eating

Independent samples t -tests were conducted to explore differences in emotional eating among university students based on gender, urban/rural residence, and whether they were only children. The results are shown in Table 1.

Table 1. Differences in emotional eating scores among university students with different characteristics (N = 920).

Characteristic	n	Emotional eating ($M \pm SD$)	t	p
Gender				
Male	399	23.92 $\pm$ 10.87	3.12	0.002
Female	521	26.19 $\pm$ 10.99		
Residence				
Urban	468	25.29 $\pm$ 10.90	0.23	0.820
Rural	452	25.12 $\pm$ 11.09		
Only child				
Yes	527	25.67 $\pm$ 11.30	-1.49	0.138
No	393	24.58 $\pm$ 10.53		

Note: M, mean; SD, standard deviation. p -values are two-tailed.

Correlational Analysis

Pearson correlation analysis was used to examine the relationships among perceived stress, emotional eating, shame, and loneliness. The results revealed significant positive correlations between the scores of perceived stress, emotional eating, shame, and loneliness (all $p < 0.01$). The results are shown in Table 2.

Hierarchical Regression Analysis After Controlling for Gender

Given that gender showed a significant association with emotional eating in univariate analysis (see Table 1), we performed a hierarchical multiple regression analysis to control for its potential confounding effect. In Step 1, we entered gender as a control variable; in Step 2, we entered perceived stress and shame to examine their unique predictive effects on emotional eating after controlling for gender. As shown in Tables 3 and 4, in Step 1, gender alone explained 1.0% of the variance in emotional eating ($R^2 = 0.010$, $\Delta F = 9.736$, $p = 0.002$), with a standardized regression coefficient of $\beta = -0.102$ ($p = 0.002$), indicating that fe-

Table 2. Means, standard deviations, and correlations among study variables.

Variable	M	SD	1	2	3	4
1. Perceived stress	40.21	6.99	—			
2. Shame	57.01	14.90	0.508**	—		
3. Loneliness	42.33	9.23	0.488**	0.404**	—	
4. Emotional eating	25.21	10.99	0.273**	0.347**	0.208**	—

Note: N = 920. M, mean; SD, standard deviation. ** $p < 0.01$ (two-tailed).

Table 3. Hierarchical regression analysis predicting emotional eating with gender as a control variable (model summary).

Model	R	R ²	Adjusted R ²	SE	ΔR^2	ΔF	df1	df2	p for ΔF
Step 1	0.102	0.010	0.009	10.937	0.010	9.736	1	918	0.002
Step 2	0.377	0.142	0.139	10.196	0.132	70.070	2	916	<0.001

Note: Gender was coded as 0 = female, 1 = male. Dependent variable: emotional eating. SE, standard error.

Table 4. Hierarchical regression analysis predicting emotional eating with gender as a control variable (coefficients).

Model	Predictor	B	SE	β	t	p	Lower 95% CI	Upper 95% CI	Tolerance	VIF
Step 1	(Constant)	26.190	0.479		54.660	<0.001	25.250	27.130		
	Gender	-2.270	0.728	-0.102	-3.120	0.002	-3.698	-0.842	1.000	1.000
Step 2	(Constant)	6.277	2.026		3.099	0.002	2.301	10.252		
	Gender	-2.090	0.679	-0.094	-3.079	0.002	-3.422	-0.758	0.999	1.001
	Shame	0.207	0.026	0.281	7.905	<0.001	0.156	0.259	0.742	1.348
	Perceived stress	0.200	0.056	0.127	3.572	<0.001	0.090	0.309	0.741	1.350

Note: SE, standard error; CI, confidence interval; VIF, variance inflation factor. Gender was coded as 0 = female, 1 = male. Step 1 predictors: gender; Step 2 predictors: gender, perceived stress, and shame. Dependent variable: emotional eating.

male students scored significantly higher on emotional eating than their male counterparts. In Step 2, after adding perceived stress and shame, the model R^2 increased to 0.142, with a significant R^2 change of 0.132 ($\Delta F = 70.070$, $p < 0.001$). Gender remained a significant predictor ($\beta = -0.094$, $p = 0.002$), while both perceived stress ($\beta = 0.127$, $p < 0.001$) and shame ($\beta = 0.281$, $p < 0.001$) independently and significantly predicted emotional eating. These results indicate that perceived stress and shame retain significant explanatory power for emotional eating even after accounting for the confounding effect of gender.

Relationship Between Perceived Stress and Emotional Eating: Testing a Moderated Mediation Model

Mediating Role of Shame

A three-step regression analysis was conducted to examine the mediating role of shame. In the first step, perceived stress was entered as a predictor of emotional eating, yielding a significant positive association (standardized $\beta = 0.273$, $p < 0.01$). In the second step, perceived stress significantly associated with shame (standardized $\beta = 0.508$, $p < 0.001$). Third, with both perceived stress and shame

as independent variables, the model significantly predicted emotional eating scores (standardized $\beta = 0.281$ for shame, $p < 0.001$, standardized $\beta = 0.130$ for perceived stress, $p < 0.01$), indicating that both perceived stress and shame positively associated with emotional eating scores. This model accounted for 13.3% of the variance in emotional eating ($R^2 = 0.133$). Results are presented in Table 5.

Bootstrapping analysis (5000 resamples) was conducted to verify the mediation effect. The results indicated a significant partial mediation, as evidenced by the 95% bias-corrected confidence intervals for the indirect effect not including zero [0.091, 0.202]. Results are presented in Table 6, and the mediation model is illustrated in Fig. 1.

The Moderating Role of Loneliness

To examine the moderating role of loneliness, a moderated mediation model was tested (Fig. 2). In this model, emotional eating was regressed on perceived stress, shame, loneliness, and the shame $\times$ loneliness interaction term. The results revealed that the interaction term between shame and loneliness significantly associated with emotional eating (standardized $\beta = 0.083$, $t = 2.674$, $p = 0.008$),

Table 5. Hierarchical regression analysis predicting shame and emotional eating

Predictor	Shame				Emotional eating			
	β	SE	t	p	β	SE	t	p
Step 1: perceived stress	—	—	—	—	0.273**	0.032	8.593	<0.001
Step 2: perceived stress	0.508**	0.028	17.886	<0.001	—	—	—	—
Step 3: perceived stress	—	—	—	—	0.130**	0.036	3.644	<0.001
Shame	—	—	—	—	0.281**	0.036	7.863	<0.001

Note: β = standardized regression coefficient; SE, standard error. Dashes indicate that the predictor was not entered in that step. ** $p < 0.01$ (two-tailed). All regression models were significant ($p < 0.001$).

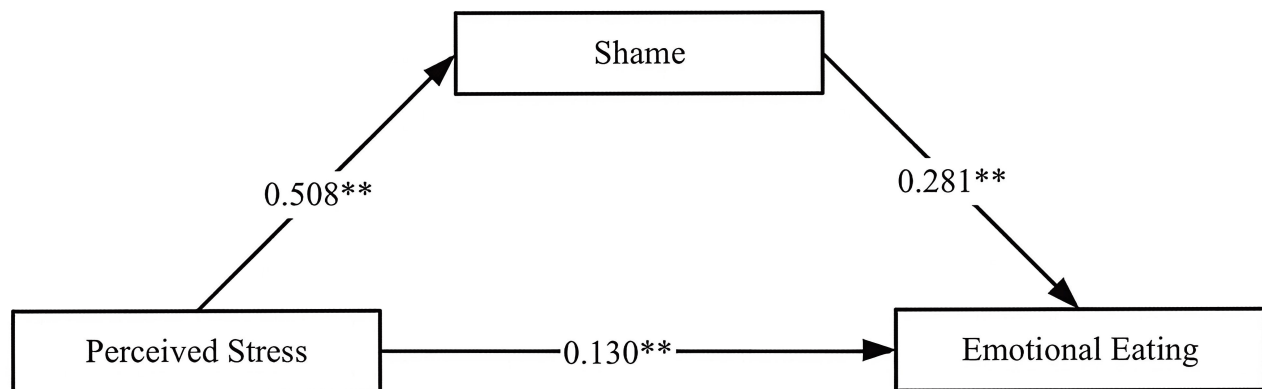


Fig. 1. The mediation model involving perceived stress, shame, and emotional eating scores. Note: ** $p < 0.01$. All coefficients were estimated with gender as a covariate.

Table 6. Bootstrap analysis for the mediating effect of shame.

Effect	Effect size	Boot SE	95% CI	
			Lower	Upper
Total effect	0.273	0.032	0.211	0.335
Direct effect	0.130	0.038	0.056	0.205
Indirect effect	0.143	0.030	0.091	0.202

Note: Bootstrap resamples = 5000. CI, confidence interval; SE, standard error.

indicating that loneliness moderates the relationship between shame and emotional eating. The full model accounted for 14.1% of the variance in emotional eating ($R^2 = 0.141$). To further probe this interaction, simple slope analyses were conducted by dividing the sample into low (≤ -1 SD), moderate (-1 SD to $+1$ SD), and high ($\geq +1$ SD) loneliness groups based on standardized loneliness scores. As shown in Table 7, shame significantly predicted emotional eating across all three groups, with the predictive effect increasing monotonically with loneliness level. Fig. 3 visualizes these simple slopes, illustrating that the positive association between shame and emotional eating becomes

progressively stronger as loneliness increases, with slopes of $\beta = 0.172$ for the low, $\beta = 0.343$ for the moderate, and $\beta = 0.353$ for the high loneliness group (Fig. 3, Table 7).

Table 7. Conditional effects of shame on emotional eating at different levels of loneliness.

Effect	Effect size	Boot SE	95% CI	
			Lower	Upper
Low (-1 SD)	0.172	0.076	0.028	0.330
Moderate (Mean)	0.343	0.043	0.260	0.429
High ($+1$ SD)	0.353	0.083	0.188	0.518

Note: Bootstrap resamples = 5000. CI, confidence interval. SD, standard deviation; SE, standard error.

Discussion

Perceived stress is defined as the subjective psychological response arising from individuals' appraisal of environmental threats as exceeding their available coping re-

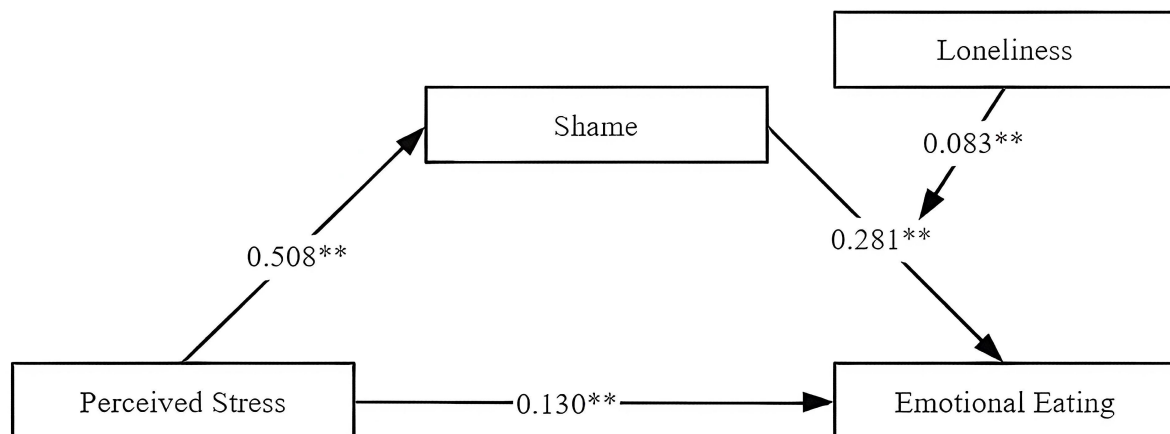


Fig. 2. The moderated mediation model involving perceived stress, loneliness, shame, and emotional eating scores. Note: $**p < 0.01$. All coefficients were estimated with gender as a covariate. The value 0.083 represents the coefficient for the shame $\times$ loneliness interaction term (i.e., the moderating effect of loneliness on the shame–emotional eating relationship), not the direct effect of loneliness on emotional eating.

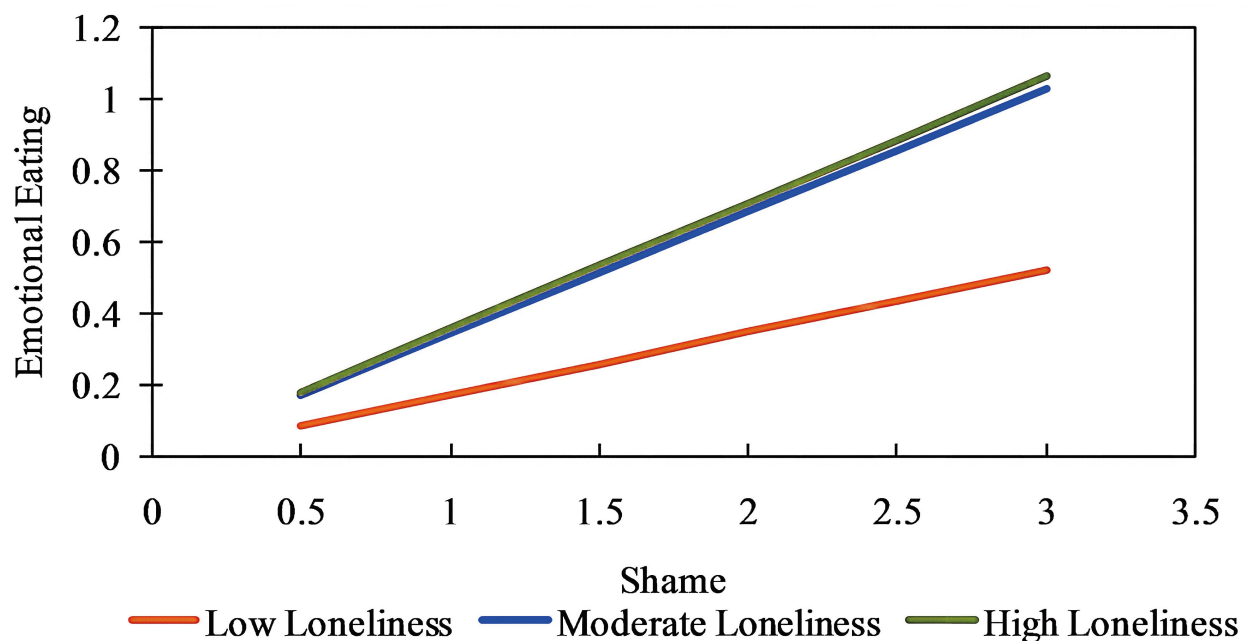


Fig. 3. Simple slopes of the association between shame and emotional eating at low, moderate, and high levels of loneliness. Note: All simple slopes were statistically significant at $*p < 0.05$. Gender was included as a covariate in all analyses.

sources [9]. For university students, academic workloads, examination pressure, social adaptation challenges, and uncertainties regarding future career development constitute primary sources of perceived stress [18,19]. When students perceive these demands as exceeding their coping capacity, self-regulatory resources become depleted, thereby increasing vulnerability to maladaptive coping behaviors,

including emotional eating [20]. Extensive prior research has established a robust positive association between perceived stress and emotional eating across diverse populations [21,22], a finding corroborated in the present Chinese university student sample, wherein higher perceived stress levels were significantly associated with more frequent emotional eating behaviors.

This association may be understood through multiple interrelated mechanisms. Stress initiates physiological and psychological stress responses that prompt individuals to seek foods offering rapid pleasurable sensations as a means of alleviating discomfort [23]. However, such eating behavior is not driven by physiological hunger, but rather by the desire to escape or mitigate the negative internal states elicited by stress. According to the emotion regulation model, individuals lacking effective regulatory strategies when confronted with stress are more inclined to resort to food as a transient source of emotional relief [23]. Moreover, chronic perceived stress may exhaust self-regulatory resources [5], further compromising individuals' capacity to resist eating-related impulses and perpetuating a self-reinforcing cycle of stress-induced eating [24].

Notably, all regression and PROCESS models in this study were adjusted for gender, given that female students scored significantly higher on emotional eating scores than their male counterparts in univariate analyses. The hierarchical regression analysis revealed that after controlling for gender, both perceived stress and shame remained significant and associated with emotional eating, suggesting that the observed mediation and moderation effects are not solely due to gender differences. These findings suggest that the hypothesized relationships hold beyond the influence of gender.

This study identified shame as a mediator in the relationship between perceived stress and emotional eating. Perceived stress was significantly associated with shame, and shame was in turn significantly associated with emotional eating. The results support a dual-pathway model in a non-clinical sample, indicating that perceived stress influences emotional eating both directly and indirectly via the mediating role of shame. Shame significantly impacts the mental health development of university students. When individuals perceive external pressure due to perceived personal inadequacies, they often experience self-negation and powerlessness [25]. This frequently leads to avoidance of internal feelings, impairing self-awareness and reducing self-concept clarity [26]. Elevated levels of shame can diminish internal awareness, thereby compromising behavioral control and adaptive coping capacities. Consequently, individuals become more prone to maladaptive behaviors—such as increasing food intake to compensate for perceived internal deficits [27], as a means of venting emotional pressure. Although this temporarily shields them from the psychological impact of shame, it merely offsets the negative emotional reactions triggered by stressful events.

Research has consistently shown that perceived stress is a robust predictor of loneliness in university students,

with higher stress levels correlating with greater severity of loneliness [28,29]. Loneliness [10] can be understood as a product of stress, shaped by complex biopsychosocial and genetic factors, with evidence pointing to stress-related physiological mechanisms as potential predisposing elements [28]. In this study, loneliness served as a moderator in the relationship between shame and emotional eating, specifically moderating the second stage of the mediation pathway (“perceived stress $\rightarrow$ shame $\rightarrow$ emotional eating”). Unlike previous studies [12,27] focusing solely on direct associations, our model highlights the conditional indirect effects of loneliness, offering a more comprehensive perspective on the psychosocial determinants of emotional eating. Moreover, the direct association between perceived stress and emotional eating was stronger in individuals with high loneliness compared to those with low loneliness. Evidence suggests [30] that individuals lacking satisfaction in real-world social interactions may seek alternative means to fill the void, potentially leading to dysregulated behaviors. Highly lonely individuals exhibit heightened vigilance toward external information, which amplifies perceived stress intensity [31]. This heightened state may impair behavioral restraint mechanisms and reduce an individual's capacity for goal-directed execution. Additionally, loneliness was found to strengthen the association between shame and emotional eating. Specifically, the positive link between shame and emotional eating was more pronounced at heightened levels of loneliness. Studies indicate that individuals with high loneliness are more susceptible to negative self-evaluation in social situations, which can further amplify feelings of shame [31,32]. This intensified negative affect subsequently strengthens the drive toward emotional eating. Conversely, individuals with low loneliness benefit from stable social connections [31], often receiving timely comfort and encouragement. Consequently, they are less likely to engage in emotional eating, as they tend to employ positive appraisals and adaptive coping mechanisms in response to shame, thereby reducing emotional distress [33].

A closer examination of the simple slope estimates (0.172 $\rightarrow$ 0.343 $\rightarrow$ 0.353) revealed a nonlinear pattern: the predictive effect of shame on emotional eating increased sharply from low to moderate loneliness, but plateaued from moderate to high loneliness, suggesting a possible “ceiling effect” of loneliness as a moderator (Fig. 3). Theoretically, this may be explained by self-regulation depletion theory [34,35]—chronic high loneliness depletes self-regulatory resources [36], limiting further emotional reactivity to shame—and by social baseline theory [37], which implies that severe loneliness may lead to habituation to social disconnection, attenuating the impact of socially-

evaluative emotions. From an intervention perspective, shame-focused strategies may be most effective for individuals with moderate loneliness, whereas those with severe loneliness may require broader approaches targeting social connectedness first [24].

It is worth noting that the present model explained only 13.3% to 14.1% of the variance in emotional eating, indicating that a substantial portion of variance remains unaccounted for. This is not unexpected, however, as eating behaviors are influenced by a complex interplay of biological, psychological, social, and environmental factors, many of which were not captured in our study. Nonetheless, the modest R^2 values are consistent with those commonly reported in similar behavioral research, where small-to-moderate effect sizes are the norm. From a clinical and behavioral standpoint, even limited explanatory power can be of value. The fact that shame and loneliness—two potentially modifiable psychological constructs—consistently emerged as significant correlates of emotional eating suggests that they may represent meaningful targets for preventive interventions in university populations. Thus, despite the modest variance explained, our findings offer actionable insights for health promotion and obesity prevention efforts.

Significance and Limitations

This study contributes to the existing literature by examining a moderated mediation model in which shame mediates the relationship between perceived stress and emotional eating, and loneliness moderates this mediating pathway in a sample of Chinese university students. While the individual components—perceived stress, shame, loneliness, and emotional eating—have each been examined in previous studies, the specific moderated mediation pathway proposed and tested here has not been previously documented. Theoretically, this model advances understanding in three ways. First, it identifies shame as a mechanism linking perceived stress to emotional eating, moving the focus from whether stress is associated with emotional eating to how it translates into eating behavior. Second, it specifies loneliness as a boundary condition, addressing the question of “for whom” this pathway is most salient. Third, it bridges self-conscious emotion and interpersonal connectedness perspectives, offering a more integrated framework for understanding emotional eating in non-clinical populations. Fourth, specific age data (e.g., mean age or age range) were not collected in this study, although all participants were confirmed to be ≥ 18 years through the inclusion criteria. Future research should include detailed age information to better characterize the sample and as-

sess its generalizability. The primary contribution lies in elucidating the mechanisms and boundary conditions of this relationship. Three primary limitations should be acknowledged. First, the use of a university student sample limits the generalizability of our findings to other age groups or clinical populations, warranting future replications in more diverse community-based samples. Second, the cross-sectional design precludes any causal inferences; the proposed mediation and moderation pathways are statistically derived and require confirmation through longitudinal or experimental designs. Third, we did not control for potential confounding variables that may independently affect both perceived stress and emotional eating, such as body mass index (BMI), socioeconomic status (e.g., family income and parental education), and habitual dietary patterns (e.g., daily caloric intake or meal frequency). Consequently, the observed effect sizes should be interpreted as preliminary correlational evidence, and future studies with comprehensive covariate adjustment are necessary to validate the robustness of these findings.

Conclusions

In summary, the moderated mediation model of “perceived stress $\rightarrow$ shame $\rightarrow$ emotional eating” constructed in this study was partially validated. Perceived stress is not only directly associated with emotional eating behavior in university students but also indirectly associated with emotional eating through the mediating role of shame. Simultaneously, loneliness plays a significant moderating role in this process, enhancing both the direct predictive effect of perceived stress on emotional eating and amplifying the positive influence of shame on emotional eating. Future research could further explore the differential impacts of various types of stressors on emotional eating and investigate the neurophysiological mechanisms underlying the moderating effect of loneliness. Additionally, employing longitudinal designs would allow for a more in-depth examination of the dynamic relationships among these variables.

Availability of Data and Materials

The datasets used and/or analysed during the current study were available from the corresponding author on reasonable request.

Author Contributions

QS designed the study; LJM provided materials; QS and XG collected the data and analyzed the data. All au-

thors participated in drafting and reviewed the manuscript, and all authors contributed to critical revision of the manuscript for important intellectual content. All authors gave final approval of the version to be published. All authors participated fully in the work, took public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or completeness of any part of the work were appropriately investigated and resolved.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of Qiqihar Medical University (institution review board number, (2024)-114) and was performed in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the study.

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Conflict of Interest

The authors declare no conflict of interest.

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