Original Article

The mediating role of anxiety and depression between academic satisfaction and academic performance among bachelor's and master's nursing students

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Article info

Article history:
Received 12 Jan. 2025
Accepted 17 Jun. 2025
Published 13 Jul. 2025

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How to cite this article:
Yadollahi P, Salmanpour M, Shaygan M, Jahandideh Z. The mediating role of anxiety and depression between academic satisfaction and academic performance among bachelor's and master's nursing students. J Med Edu Dev. 2025; 18(2):39-48. http://dx.doi.org/10.61882/edcj.18.2.55

Abstract

Background & Objective: Mental distress, such as anxiety and depression, are important components that affect educational achievement. This study aimed to examine the mediating role of anxiety and depression in the relationship between academic satisfaction and academic performance among bachelor's and master's nursing students.

Materials & Methods: This is a cross-sectional study that utilized a structural equation model. Sampling was conducted using a two-stage cluster sampling method, considering the inclusion and exclusion criteria for 1,695 bachelor's and master's nursing students from February 11 to November 30, 2019. Data were collected using four questionnaires, namely a demographics survey, the Spielberger State-Trait Anxiety Inventory (STAI), the Patient Health Questionnaire-9 (PHQ-9), and the Academic Satisfaction Scale. Data analysis was conducted using SPSS 26.0 and the macro PROCESS model 6 to evaluate the mediating effects of depression and anxiety simultaneously. A p-value of less than 0.05 was considered statistically significant.

Results: This study demonstrated that the direct effect of nursing students' academic satisfaction significantly correlated with their academic performance. Additionally, the relationship between nursing students' academic satisfaction and academic performance was significantly mediated, both separately and simultaneously, by their levels of depression and anxiety ($\beta = 0.0005$, CI = 0.0001 to 0.001).

Conclusion: Considering the importance of academic satisfaction and performance of nursing students, as well as the adverse effects of anxiety and depression on these variables, the implication of suitable strategies is essential for preventing academic burnout. Therefore, educational system authorities are advised to prioritize students' well-being to prevent future negative consequences, especially in their professional roles.

Keywords: depression, anxiety, academic satisfaction, academic performance, bachelor and master students

Introduction

One of the most significant and stressful periods in a nursing student's life is entering university and facing clinical practices, final exams, and the potential impact on their mental health [3, 4]. This stress is exacerbated by the loss of support from families, financial obligations, and personal responsibilities, which in turn affect student satisfaction levels [1, 2]. The degree to which students feel satisfied with their university experiences and whether their expectations for learning are met during their time at an academic institution is known as student satisfaction. Nursing students' satisfaction can significantly influence their academic achievements, ability to continue their studies, and overall well-being, leading to increased engagement and motivation [5]. In contrast, discontent can result in reduced educational motivation and potentially even educational attrition [6]. There has been an increasing interest in studying the elements that influence academic

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[DOI: 10.61882/edcj.18.2.55]

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satisfaction and success in recent years. Researchers have examined several aspects, including the individual attributes of nursing students, such as age, gender, personality, the institutional environment, and factors that affect students' mental health, such as depression and anxiety. These factors are emotional states that arise in reaction to difficult circumstances, and nursing students are more prone to suffering intense, prolonged distress and even depression compared to other demographic groups [7, 8]. In this line, Beck's cognitive theory of depression suggests that in achievement-oriented environments like university, individuals with depressive symptoms are prone to feeling inadequate, having negative self-perceptions, and having low self-esteem when they receive low grades. This issue leads to reduced academic satisfaction [9].

Additional research has suggested that students may have underperformance, not due to a deficiency in their capabilities but rather as a result of their anxiety-related situation [10]. Based on past studies, academic dissatisfaction can trigger feelings of nervousness, anxiety, irritability, impatience, a lack of interest, and demotivation related to coursework, which may be reflected in decreased class attendance. Therefore, distinguishing the factors that affect this issue is crucial [11, 12]. However, it's crucial to note that the relationship between these factors and academic achievement is merely correlational, and correlation does not imply causation. Given the negative effects of psychological distress on academic satisfaction and performance among nursing students, as well as the controversial data surrounding this issue, this study aims to investigate the relationship between academic satisfaction and academic performance among bachelor's and master's nursing students while considering the mediating roles of anxiety and depression.

Materials & Methods

Design and setting(s)

This study is a cross-sectional analysis based on a structural equation model to examine nursing students at medical sciences universities in Iran. The study was done from 11 February to 30 November 2019. The setting of this study was the nursing colleges in Iran. The Bachelor of Nursing program in Iran has a duration of four years, which is divided into eight semesters. During this period, students must fulfill the obligation of earning 130 credits. Starting from the second semester, nursing students are allowed to enroll in courses that involve practical training in clinical settings. The master's nursing program has a duration of two years, consisting of four semesters. During this time, students must fulfill a total of 32 credits. Postgraduate students begin clinical training starting with the first semester.

Participants and sampling

To calculate the sample size for the structural equation model [13], we used the guideline of 20 subjects per observable variable. In our study, 72 observable variables (items and dimensions from questionnaires on academic performance, academic satisfaction, anxiety, and depression) were identified, resulting in an estimated sample size of 1,440 nursing students. Considering a 20% dropout rate, the final sample size was determined to be 1,728 subjects. During the data collection and analysis process, data from 1,695 participants were ultimately analyzed.

The sampling method used was a multistage approach. Nursing colleges in Iran were originally categorized into five distinct geographic regions: North, South, East, West, and Center. Each region was then classified into a category, with regions having a higher percentage of students assigned a larger number of participants. A two-stage cluster sampling method was used to select two provinces from each area randomly, and from those two provinces, three nursing colleges were randomly selected. Each college was randomly sampled for students. The researchers obtained a roster of students' names from the education department of each school. They selected individuals who met the inclusion criteria by using a table of random numbers generated by SPSS version 26.0.

The inclusion criteria for the study were students pursuing undergraduate studies from Semester 2 to Semester 8 or postgraduate studies from Semester 1 to Semester 4. The exclusion criteria included students who were not willing to participate in the study, those who had transferred from another school, had been absent or on a break at the time of sampling, had a severe mental or physiological disorder during the study, or had a history of using psychoactive drugs or sedatives.

Tools/Instruments

The demographic form included in the collected data were the students' age, gender, marital status, education level, parents' education level, place of residence, and Grade Point Average (GPA). Additional instruments used in this study were adapted from the article by Shaygan et al. [14].

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[DOI: 10.61882/edcj.18.2.55]

The Spielberger State-Trait Anxiety Inventory (STAI), a commonly used instrument in psychological research, comprises separate self-assessment scales for measuring state and trait anxiety. The state anxiety subscale consists of 20 items that assess the respondent's feelings at the moment they are answering. Each statement is rated on a 4-point Likert scale ranging from (1) not at all, (2) somewhat, (3) moderately, and (4) very much. The items measuring anxiety levels are scored from 1 to 4, while questions that indicate a lack of anxiousness are ranked in reverse order, from 4 to 1. A score of 4 on the anxiety scale suggests a significant level of anxiety; specifically, this score is assigned to 10 items from the state anxiety scale and 11 items from the trait anxiety scale. In contrast, a high score on the other items indicates an absence of worry. In this context, there are ten items specifically addressing state anxiety and nine items addressing trait anxiety. To calculate a respondent's score for each of the two subscales, certain items are scored in the opposite direction. The researchers then calculate the total sum of the 20 items in each subscale. The scores for each subscale range from 20 to 80. The scale demonstrated a high level of internal consistency, with a range of 0.86 to 0.95, as reported by Spielberger et al. The test-retest reliability of the scale was assessed over 2 months, yielding a range of 0.65 to 0.75. The construct validity of the scale was deemed satisfactory [15]. Abdoli et al. (2020) assessed the reliability and validity of the Persian version of the Spielberger State-Trait Anxiety Inventory (STAI) using a group of 492 students. The scale demonstrated strong internal consistency, with Cronbach's alpha coefficients of 0.88 for trait anxiety and 0.84 for state anxiety. To evaluate the construct validity, we conducted a comparative analysis between the STAI and the Beck Anxiety Inventory. The comparison resulted in Cronbach's alpha coefficients of 0.64 for both trait and state anxiety [16]. The study assessed the reliability of the scale, resulting in a coefficient of 0.89.

Patient Health Questionnaire-9 (PHQ-9) contains nine items, each of which addresses one of the symptoms of depres-sion according to DSM criteria [Diagnostic and Statisti-cal Manual of Mental Disorders]. One of the most reliable tools for discovering depression in chronic diseases is PHQ-9. The items are scored on a 3-point Likert scale, ranging from always [3] to never [0]. The total scores range between 0 and 27. A score of under 5 indicates the absence of depression; mild depression is represented by scores ranging from 5 to 9; moderate depression corresponds to scores from 10 to 14; and severe depression is identified by scores above 15. Construct validity of PHQ-9 has been confirmed by Zuithoff et al. The reliability of this scale is supported by an ICC of 0.88 and a test-retest correlation of r = 0.94 [17].

Additionally, the validity and reliability of the Persian version of PHQ-9 have been confirmed by Dadfar et al. The total score of this version ranges from 0 to 27. To ensure the reliability of the scale, Intraclass Correlation Coefficient (ICC) and test-retest analyses were conducted, resulting in values of 0.88 and 0.79, respectively. Evaluation of the convergent validity of the questionnaire resulted in 0.7 with the brief version of the Beck Depression Inventory-13 (BDI-13) and −0.35 with the World Health Organization Well-Being Index (WHO5). Confirmatory factor analysis proved the good fit of the data: CFI=-0.94, TLF = 0.93, and RMSEA = 0.069 [18]. The reliability of the scale was obtained at 0.84 in the present study. *Academic satisfaction scale* was developed by Atashkar et al. [19] in Iran. It consists of 20 items that thoroughly evaluate students' perceptions regarding their motives for selecting their major, as well as their academic, professional, and financial prospects. The items are scored with a five-point Likert scale, ranging from 1 to 5. The total score on this scale ranges from 20 to 100 points. Five experts confirmed the content validity of the questionnaire. Finally, the Content Validity Ratio (CVR) was determined to be 0.87, while the content validity index (CVI) was measured at 0.88. The scale was found to be reliable, with a Cronbach's alpha coefficient of 0.89 [19]. Additionally, the researchers administered the scale to a sample of 30 students to assess its reliability, yielding a Cronbach's alpha coefficient of 0.84.

Data collection methods

After obtaining permission from the dean of each nursing school, the researcher went to the education department at the respective institutions. There, a comprehensive list of all undergraduate students from Semester 2 to Semester 8, as well as postgraduate students from Semester 1 to Semester 4, was obtained. Following this, a subset of students who met the specified criteria was randomly selected using a table of numbers generated by SPSS. The selected students were given an envelope containing information about the study's objectives, an informed consent form, and self-report questionnaires.

In addition, the students were informed face-to-face about the study's goals and asked to complete the questionnaires if they were willing to participate

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manually. The surveys were distributed and collected manually. This study was carried out on a national level and received approval from the Iranian Biomedical Ethics Committee.

Additionally, all necessary permissions from the relevant university were obtained. Before distributing the surveys manually, we ensured that the deans of each nursing school secured the appropriate permits.

To maintain the reliability and accuracy of the data, the coresearcher was given explicit instructions to adhere strictly to a standardized methodology during both the data collection and the random sampling processes. Furthermore, to minimize the risk of social desirability bias, participants were informed about the study's objectives and assured that their responses would remain anonymous, with all data kept confidential throughout the study.

Data analysis

The data analysis was performed using SPSS version 26.0. Frequencies and means were reported to summarize the data.

The relationships among the variables were assessed using Pearson correlation coefficients. The r-values were interpreted as follows: an r-value of 0 indicated no correlation, values between 0 and 0.4 represented weak correlation, values between 0.4 and 0.8 indicated moderate correlation, and values from 0.8 to 1 showed a strong linear correlation.

The mediation analysis was conducted using the PROCESS macro (version 4.2) developed by Hayes. Model 4 was utilized to assess the individual mediating effect of each psychological variable (anxiety and depression), while Model 6 was employed to evaluate the sequential (serial) mediation effects when both mediators were analyzed simultaneously.

Statistical significance was established at a threshold of $p < 0.05$.

Results

In this study, 1695 nursing students participated. The mean age of the nursing students was 22.41 years (SD = 2.98). Most of the subjects were female (n = 1046, 61.7%), and the others were male. In addition, 1476 (87.1%) nursing students were single, and the others (12.9%) were married. Other characteristics are indicated in **Table 1**.

The mean scores of academic performance and satisfaction in nursing students were 16.02 (SD = 1.19) and 53.24 (SD = 7.47), respectively.

Table 1. Demographic and academic characteristics of nursing students

Variables	n (%)
Gender	
Female	1046 (61.7)
Male	649 (38.3)
Marital status	
Single	1476 (87.1)
Get married	219 (12.9)
Father's education	
Academic education	500 (29.5)
High school and diploma	786 (46.4)
Secondary and primary School	345 (20.4)
illiterate	64 (3.7)
Mother's education	
Academic education	455 (26.8)
High school and diploma	727 (42.9)
Secondary and primary school	398 (23.5)
illiterate	115 (6.8)
Living place	
Dormitory	986 (58.2)
Living with family	672 (39.6)
Individual house	37 (2.2)

Abbreviations: n, number of participants; %, percentage.

The mean scores for nursing students' depression and anxiety were 8.74 (SD = 4.71) and 88.63 (SD = 17.00), respectively. The mean scores of state and trait anxiety were 44.37 (SD = 8.74) and 44.25 (SD = 8.99), respectively. As **Figures 1** and **2** show, approximately half of nursing students reported moderate levels of state and trait anxiety.

Table 2 displays a significant, positive, and weak association between the mean score of nursing students' academic performance and academic satisfaction ($r = 0.11$, $p < 0.001$).

Furthermore, a significant, negative, and weak association was identified between the mean scores of nursing students' academic performance and their levels of depression ($r = -0.09$, $p < 0.001$) as well as anxiety ($r = -0.10$, $p < 0.001$). According to **Table 3**, the direct effect of nursing students' academic satisfaction significantly correlated with their academic performance (b = 0.01, t-value = 4.26, p-value <0.001). The nursing students'students' depression correlated significantly with their academic performance (b = - 0.02, t-value = -3.27, p-value = 0.001).

The indirect effect of nursing students' academic satisfaction on academic performance by depression was significant (Effect = 0.001, Boot SE = 0.0006, 95% CI: 0.0005 to 0.002). This model showed that nursing students' academic satisfaction and depression accounted for 1.8% of the variance in academic performance ($R = 0.13$, $R^2 = 0.018$, MSE = 1.39, F = 16.27, p-value < 0.001).

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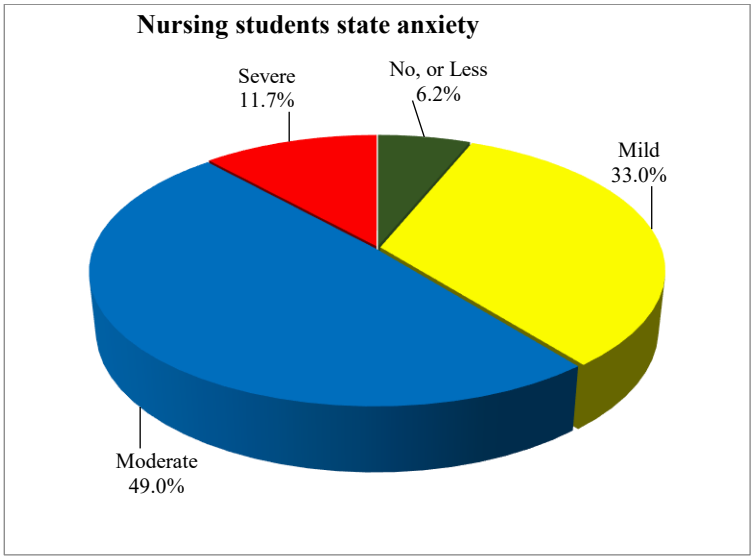
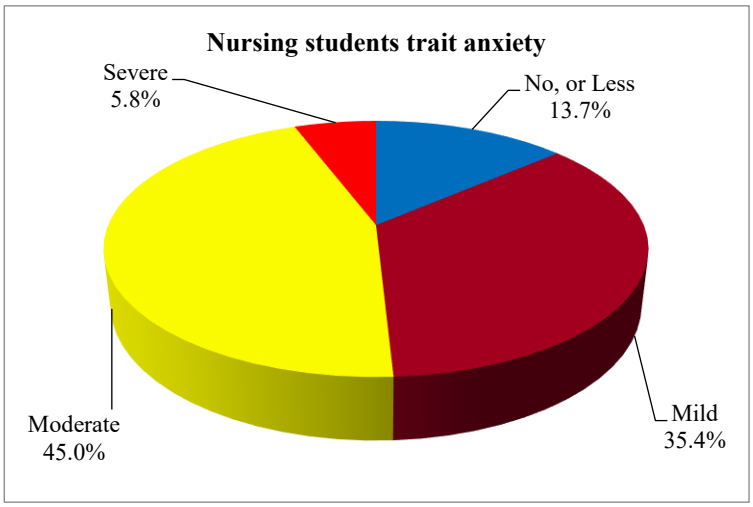


Figures 1. The percentage of state anxiety in nursing students



Figures 2. The percentage of trait anxiety in nursing students

Table 2. The association among nursing students' academic performance, satisfaction, depression, and anxiety

Variables		Academic performance	Academic satisfaction	Depression	Anxiety
Academic performance	Pearson Correlation	1			
	Sig. (2-tailed)				
Academic satisfaction	Pearson Correlation	0.11**	1		
	Sig. (2-tailed)	< 0.001			
Depression	Pearson Correlation	- 0.09**	- 0.11**	1	
	Sig. (2-tailed)	< 0.001	< 0.001		
Anxiety	Pearson Correlation	- 0.10**	- 0.15**	0.43**	1
	Sig. (2-tailed)	< 0.001	< 0.001	< 0.001	

Note: Pearson correlation coefficient was used to assess the linear relationship between variables.
Abbreviations: Sig, statistical significance; p, probability value.
**. Correlation is significant at the 0.01 level (2-tailed)

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Table 3. The mediating effect of nursing students' depression in the relationship between academic satisfaction and performance

	Effect (β)	SE	t Statistics	P-Values	95% CI
Direct effect					
Academic satisfaction → Academic performance	0.01	0.003	4.26	< 0.001	0.008 to 0.02
Depression → Academic performance	- 0.02	0.006	- 3.27	0.001	- 0.03 to - 0.008
Academic satisfaction → Depression	- 0.07	0.01	- 4.83	< 0.001	0.10 to - 0.04
Indirect effects					
Academic satisfaction → Depression → Academic performance	0.001	0.0006 [a]	----	----	0.0005 to 0.002

Note: t-statistic was used to assess the ratio between the deviation of an estimated value from its hypothesized value and its standard error.
Abbreviations: β, standardized regression coefficient; SE, Standard Error; a Bootstrapping Standard Error; Sig, statistical significance; p, probability-value; 95% CI, A 95% Confidence Interval.

According to **Table 4**, nursing students' academic satisfaction significantly correlated with their academic performance (b = 0.01, t-value = 4.05, p-value = 0.0001). The students'students' anxiety significantly correlated with their academic performance (b = -0.006, t-value = -3.70, p-value = 0.002). The indirect effect of nursing students' academic satisfaction on academic performance by anxiety was significant (Effect = 0.002, Boot SE = 0.008, 95% CI 0.0009 to 0.003). This model indicated that nursing students' academic satisfaction and anxiety accounted for 2% of their academic performance (R = 0.14, R2 = 0.02, MSE = 1.39, F = 17.82, p-value < 0.001). Therefore, based on the findings, nursing students'students' anxiety mediates the relationship between academic satisfaction and performance.

The results of this study showed r = 0.15, r square = 0.02, MSE = 1.39, F = 13.07, and p < 0.001. As **Table 5** shows, nursing students' academic satisfaction significantly correlated with academic performance (b = 0.01, t = 3.94, p = 0.0001). Depression was correlated with nursing students'students' academic performance (b = -0.01, t = -1.88, p = 0.04). Moreover, anxiety was correlated with nursing students'students' academic performance (b = -0.004, t = -2.56, p = 0.01).

As **Table 4** displays, the relationship between nursing students' academic satisfaction and academic performance was significantly mediated by depression (b = 0.002, CI = 0.001 to 0.004). In addition, the relationship between nursing students' academic satisfaction and academic performance was significantly mediated by their anxiety (b=0.0009, CI = 0.00001 to 0.002). Moreover, as can be seen in **Table 4**, the relationship between nursing students' academic satisfaction and academic performance was significantly mediated by their depression and anxiety (b = 0.0005, CI = 0.0001 to 0.001).

Table 4. The mediating effect of nursing students' anxiety in the relationship between academic satisfaction and performance

	Effect (β)	SE	t Statistics	P-Values	95% CI
Direct effect					
Academic satisfaction → academic performance	0.01	0.003	4.05	0.0001	0.008 to 0.02
Anxiety → Academic performance	- 0.006	0.001	- 3.70	0.002	- 0.009 to - 0.003
Academic satisfaction → Anxiety	- 0.34	0.05	- 6.40	< 0.001	- 0.45 to - 0.24
Indirect effects					
Academic satisfaction → Anxiety → Academic performance	0.002	0.0008 [a]	----	----	0.0009 to 0.003

Note: t-statistic was used to assess the ratio between the deviation of an estimated value from its hypothesized value and its standard error.
Abbreviations: β, standardized regression coefficient; SE, Standard Error; a Bootstrapping Standard Error; Sig, statistical significance; p, probability-value; 95% CI, A 95% Confidence Interval.

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Table 5. The mediating effect of nursing students' depression and anxiety in the relationship between academic satisfaction and performance

	Effect (β)	SE	t Statistics	P-Values	95% CI
Direct effect					
Academic satisfaction → Academic performance	0.01	0.003	3.94	0.0001	0.007 to 0.02
Depression → Academic performance	- 0.01	0.006	- 1.88	0.04	0.00001 to 0.0005
Anxiety → Academic performance	- 0.004	0.001	- 2.56	0.01	- 0.008 to -0.001
Academic satisfaction → Depression	- 0.07	0.01	- 4.83	< 0.001	- 0.10 to -0.04
Academic satisfaction → Anxiety	- 0.23	0.04	- 4.76	< 0.001	- 0.33 to -0.13
Depression → Anxiety	1.52	0.07	19.26	< 0.001	1.36 to 1.67
Indirect effects					
Academic satisfaction → Depression → Academic performance	0.002	0.0008 [a]	----	----	0.001 to 0.004
Academic satisfaction → Anxiety → Academic performance	0.0009	0.0005 [a]	----	----	0.0001 to 0.002
Academic satisfaction → Depression → Anxiety → Academic performance	0.0005	0.0003 [a]	----	----	0.0001 to 0.001

Note: t-statistic was used to assess the ratio between the deviation of an estimated value from its hypothesized value and its standard error.
Abbreviations: β, standardized regression coefficient; SE, standard error; a, bootstrapping standard error; Sig, statistical significance; p, probability value; 95% CI, a 95% confidence interval.

Discussion

In the present study, 1965 nursing students participated. They had mild depression, and approximately half of them had moderate levels of state and trait anxiety. In line with this study, Jamil et al. showed half of the nursing students who participated in this study had anxiety and depression[20]. However, Aloufi et al. Based on a systematic review of 44 studies reported a statistically significant reduction in the stress, anxiety, or depression experienced by nursing students. This finding can be influenced by various factors, including individual, socio-cultural, and psychological factors, as well as their relationship with professors [21].

Other findings of this study showed nursing students' academic satisfaction significantly correlated with their academic performance. In other words, a high score in academic satisfaction assisted with a high score in academic performance, while Mahdavi et al. indicated students' satisfaction and achievement were not significantly correlated [22]. Different reasons, including cultural differences among students, the quality of university services, interaction with faculty, and the organization of courses, can contribute to this dissatisfaction. Despite this finding, academic satisfaction and trust in the system are crucial factors that administrators must not overlook. The present study revealed a significant mediator role of depression between academic satisfaction and performance. In other words, high depression scores in nursing students led to a negative relationship between academic satisfaction and their performance. The results of several studies align with this issue. Harrison et al. indicated that depression symptoms significantly predicted academic progression delay [23]. Additionally, the findings of Vishakha et al.'s research, which aimed to determine the impact of mental health on academic performance, highlighted that while some students effectively cope with stress and challenges, others may struggle, ultimately negatively affecting their academic performance, in some cases, leading to interruptions in their studies [24]. Since mental health disturbances lead to dissatisfaction and disachievement in educational settings, identifying the cognitive factors that induce this discomfort and addressing them can be effective in assessing academic achievement. In this study, it was found that nursing students' anxiety mediated the relationship between academic satisfaction and performance. This finding aligns with Lisnyj et al.'s results, which report that anxiety negatively impacts students' educational outcomes, including poor academic performance and student attrition [25]. Numerous internal and external factors induce anxiety. Evidence indicates that anxiety can lead to subpar performance, while a history of inadequate performance may cause anxiety. These two parameters exhibit a bidirectional link or synergistic effect [20]. Identifying and managing these factors can help reduce anxiety, leading to

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improved academic performance. The main finding of this study was the significant mediator role of nursing students' depression and anxiety in academic satisfaction and performance. Therefore, high scores in both depression and anxiety of nursing students are associated with low scores in academic satisfaction and performance. In line with this finding, Harison et al. and Jamil et al. indicated that comorbid psychological distress such as anxiety and depression would result in increased levels of incompetence in academic tasks than those who have only one of them [20,23]. Some researchers believe that academic dissatisfaction in nursing students can influence not only their personal well-being and academic performance but also their communication with patients during clinical placement and the quality and safety of the healthcare they deliver [12]. It seems that the creation of an educational environment characterized by hope, happiness, attention to student's expectations and needs, professional qualifications, innovation, and the appropriateness of educational curricula to the professional practice environment leads to a reduction in distress behaviors, such as depression and anxiety, and ultimately improves academic satisfaction and academic performance. Some studies have indicated that academic dissatisfaction and poor performance can lead to academic burnout, resulting in a loss of confidence and emotional problems, such as academic exhaustion. In the future, this issue will likely interfere with job preparation, the transfer of professional roles, socialization, and job satisfaction [26].One of the limitations of the present study was the personal, familial, cultural, and social differences between the nursing students, which may have affected the study's results. Additionally, factors such as sitting time, maintaining proper posture while sitting, academic semester, and the use of assistive devices during reading at the university were not considered in the present study. Since correlational designs don't determine the cause and effect of variables, longitudinal or interventional studies should investigate the effect of anxiety and depression on academic performance in nursing students. Additionally, research should be conducted using qualitative methods to gain a deeper understanding of the factors that influence academic performance.

Conclusion

This study indicates that nursing students' depression and anxiety have a central role in the relationship between academic satisfaction and academic performance. While some studies indicated that students' satisfaction and achievement were not significantly correlated, other findings, as well as the present research, corroborate evidence of the relation between these variables. Therefore, it is possible to enhance academic satisfaction and performance by identifying and addressing factors that contribute to anxiety and depression. Additionally, providing effective teaching methods, ensuring professional qualifications, fostering innovation, and aligning educational curricula with the professional practice environment can stimulate students to be critical and reflective thinkers. It is necessary to emphasize the importance of mental health support in academic settings. Therefore, administrators need to continuously examine qualitative and quantitative evaluation processes through observation, feedback, and reflection and develop proper interaction with nursing students to improve educational outcomes.

Ethical considerations

The present study has been approved by the Ethics Committee of Shiraz University of Medical Sciences (IR.SUMS.REC.1397.52), and relevant guidelines and regulations performed all methods. Informed consent was taken from participants before participation. All the nursing students were informed about the objectives of the study and subsequently asked to fill out the informed consent form. The students were assured of anonymity and confidentiality regarding their information. The study procedures adhered to the principles outlined in the Declaration of Helsinki.

Artificial intelligence utilization for article writing

The utilization of artificial intelligence in the process of article editing was carried out with strict adherence to ethical principles and guidelines, ensuring transparency, integrity, and the preservation of original thought.

Acknowledgment

This article is the result of a research project registered at Shiraz University of Medical Sciences, Shiraz, Iran (no. 13666). The authors would like to express their gratitude to all the nursing students who participated in this study.

Conflict of interest statement

The author(s) declared no potential conflicts of interest for the research, authorship, and/or publication of this article.

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[DOI: 10.61882/edcj.18.2.55]

Author contributions

PY and M SH are responsible for the study design and interpretation of data, drafting and revising the article critically, and approving the version to be published.MS aided in data analysis data, and ZJ aided in critical revision of the final manuscript. All authors read and approved the final manuscript.

Funding

The author(s) received no financial support for the research, authorship, and publication of this article.

Data availability statement

All data generated or analyzed during this study are included in this published article.

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