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Exploring the impact of interpersonal sensitivity on anxiety symptoms: the mediating role of psychological capital and social support among nursing students

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Abstract

Background As the demand for healthcare in society continues to rise, nursing students are likely to face various challenges related to their profession in the future. Anxiety symptoms have increasingly become a significant factor affecting their mental health. Given that nursing students are crucial to building the future nursing workforce, it is essential to prioritize their mental well-being. This study aims to explore the relationships between anxiety symptoms, interpersonal sensitivity, psychological capital, and perceived social support among nursing undergraduates.

Methods In April 2022, 1,885 nursing undergraduates at a university in eastern China participated in a survey using the Generalized Anxiety Disorder Questionnaire (GAD-7), the interpersonal sensitivity subscale of the SCL-90, the Multidimensional Scale of Perceived Social Support (MSPSS), and the Psychological Capital Questionnaire (PCQ-24). Statistical analysis was conducted using SPSS 24.0 and PROCESS v3.4 macro to assess the impact of interpersonal sensitivity on anxiety and the mediating roles of social support and psychological capital.

Results Anxiety showed a positive correlation with interpersonal sensitivity ($r = 0.43$) and negative correlations with perceived social support ($r = -0.32$) and psychological capital ($r = -0.40$), all significant ($p < 0.001$). Interpersonal sensitivity directly affects anxiety ($\beta = 0.306$, $SE = 0.023$, 95% CI [0.260, 0.352]). Psychological capital served as an independent mediator ($\beta = 0.051$, $SE = 0.011$, 95% CI [0.031, 0.075]) and also in a chain mediation with social support ($\beta = 0.050$, $SE = 0.104$, 95% CI [0.031, 0.072]).

Conclusion Interpersonal sensitivity is a positive predictor of anxiety symptoms. Both psychological capital and social support effectively reduce interpersonal sensitivity and anxiety symptoms. Enhancing the availability of psychological capital and social support for nursing students is essential.

Keywords Anxiety, Interpersonal relations, Positive psychology, Social support, Mediation analysis

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Introduction

As the demand for health care increases in society, nursing students may face various challenges that can impact their future careers. Anxiety symptoms have gradually become an important factor affecting their mental health. A systematic literature review identified two main sources of stress in nursing students: academic factors and clinical factors [1]. Because of stressors such as the clinical and educational environments, the death of patients, and the psychological pressures within hospitals, nursing students are more susceptible to developing mental and emotional disorders [2–4]. Previous studies suggest that modifying academic stressors and enhancing social support can improve students' social well-being and self-identity, and these strategies may be effective in protecting their mental health, especially in the context of the COVID-19 pandemic [5].

Anxiety is a type of negative emotion and a mental health issue characterized by excessive fear, restlessness, and behavioral disorders [6]. It can lead to a series of negative consequences, including insomnia [7], depression [8], post-traumatic stress disorder (PTSD) [9], and even more serious suicidal behaviors [10]. Anxiety is widespread throughout adolescence [11], especially among college students [12]. College students are at an important stage in which they seek intimate relationships, pay attention to social relationships, and are anxious to socialize [13]. However, nursing students reported more stress, anxiety, depression, and sleep problems than non-nursing students did [14, 15]. These psychological states impact an individual's health, academic performance, and communication skills with patients during a clinical internship [16]. The more serious result is that if nursing students leave nursing profession positions, the shortage of nurses will continue to expand, the quality of nursing will be affected in the future, the relationship between nurses and patients will be more tense, and the safety of patients will be threatened [14, 17, 18]. It is widely recognized that nursing students possess distinct professional qualities and unique ways of thinking. As such, there is a crucial need to prioritize the mental health of undergraduate nursing students. In this study, we examine the factors that influence anxiety levels, investigate effective methods to reduce psychological stress and mental health issues and propose strategies for the sustainable development of professional care services.

Literature review

Interpersonal sensitivity refers to psychological symptoms in which individuals are vigilant to the behaviors and emotions of others in interpersonal communication and are extremely sensitive to perceived or actual criticism and rejection [19]. Interpersonal sensitivity is recognized as one of the premorbid personality traits associated with depression, reflecting an individual's ability to regulate emotions. Historically, there has been limited research on the connection between interpersonal sensitivity and anxiety; however, several recent studies have begun to explore this relationship [20, 21]. Although interpersonal sensitivity was originally developed as a means to measure depression [19], it appears to be highly correlated with anxiety [22]. In a study of Chinese college students, interpersonal sensitivity was found to be positively correlated with negative emotions [23]. Higher levels of interpersonal problems were found to be associated with higher levels of emotional distress and anxiety [24]. Interpersonal sensitivity has been identified as a potential feature of anxiety symptoms in individuals with negative cognitive tendencies [25]. One study also indicated that school interpersonal relationships are closely related to mental health problems [26]. Nursing students with higher interpersonal sensitivity, who are more attuned to the attitudes and behaviors of others, may feel uncomfortable or distressed during social interactions, which can lead to self-doubt and an increased risk of transition to psychiatric disorders [27, 28]. In addition, individuals with interpersonal sensitivity are more likely to worry about interpersonal problems caused by mistakes [29]. Research reported that interpersonal sensitivity scores were higher in patients with social anxiety disorder than in the control group [20]. However, to our knowledge, no studies have been performed to date on whether interpersonal sensitivity may positively predict anxiety symptoms.

Perceived social support (PSS) is defined as an individual's subjective feeling of social support from an intimate relationship and his or her desire to be respected and understood [30]. The PSS buffer model suggests that the PSS can buffer the impact of stressful situations on individuals' physical and mental health and help individuals cope with stress [30]. People with high interpersonal sensitivity face great challenges in resource utilization and adaptation to the surrounding environment, which may harm the acquisition of social support [25]. Previous research indicates that individuals with higher interpersonal sensitivity tend to have lower awareness of social support. Conversely, those with greater awareness of social support are typically better equipped to navigate and adapt to relationships [31]. The support of family and friends plays a crucial role in providing love and companionship to teenagers during sensitive periods. It can encourage and uplift them when they face setbacks and offer timely assistance when they encounter difficulties. This support helps to reduce negative emotions such as anxiety and depression [32]. A lack of social support has been linked to anxiety in nursing students [33]. Recent studies have shown that nursing students face more stress than other students do, especially during clinical

practice [34]. In general, stress may lead to increased anxiety symptoms. Timely external support may reduce anxiety symptoms and turnover of professional intentions to a certain extent among nursing students [35, 36]. Therefore, we hypothesize that the perception of social support may partially mediate the relationship between interpersonal sensitivity levels and anxiety symptoms.

Psychological capital (PsyCap) is a type of positive mental state that an individual shows in the process of growth and development [37]. Interpersonal sensitivity is manifested not only by the misunderstanding and exaggeration of others' interpersonal behavior but also by the inadequacy of self-cognition and lack of confidence [19, 38]. The interpersonal sensitivity of poor undergraduates [39] and freshmen [40] is negatively related to PsyCap. College students with higher interpersonal sensitivity often perceive interpersonal problems as threatening or unsolvable. This perception can lead to feelings of discouragement and lower self-efficacy when addressing these issues, thereby contributing to anxiety-related problems [41–43]. Numerous studies have demonstrated that Psychological Capital is a crucial resource for mitigating negative emotions [44]. As a significant factor, PsyCap can effectively lessen the anxiety that stems from academic pressure [45] and reduce the effects of anxiety and depression on psychological outcomes [46]. College students with high Psycap can alleviate the pressures from their learning environment and manage sensitive interpersonal relationships by leveraging positive psychological resources. They tend to view the sensitivity of these relationships as something they can control, enabling them to recover quickly and effectively from negative emotions while reducing the likelihood of experiencing anxiety symptoms [41].

Theoretical framework and research hypothesis

In terms of the conservation of resources (COR), external factors can affect mental health in the form of internalized positive characteristics [47]. As a positive indicator of psychological quality, PsyCap can be regarded as a psychological resource that can predict individual cognition, attitudes, and behavior [37] and can enhance individuals' strong perceptions of support from others [48]. Many researchers have explored the relationship between social support and PsyCap, and the results show that there is an obvious positive correlation between these two factors [49] and that PSS also affects mental health status through PsyCap among adolescents and adults during the COVID-19 pandemic [50]. In addition, the PSS and PsyCap are negatively associated with anxiety symptoms [51]. According to the research, social support forms an optimistic or favorable attitude in the minds of job seekers, and job seekers with positive social support are more likely to achieve positive results in their ideal jobs [52]. Studies have confirmed that people who have a weak ability to deal with emotions and social acceptability have difficulty developing mental resources and are more likely to suffer from mental illness [53].

Within the framework of resource conservation theory, psychological capital, and social support, as important resources available to individuals, are of great significance in alleviating the symptoms of current interpersonal sensitivity and future anxiety, especially in the unique group of nursing undergraduates, and ultimately affect their career value orientation. This theoretical basis suggests that PsyCap and PSS have a potential mediating role between interpersonal sensitivity and anxiety symptoms, which deserve to be explored in more depth in current research. Based on the extensive literature review, this study proposes a theoretical mediation model (Fig. 1) to evaluate the mediating function of PsyCap and PSS in the relationship between interpersonal sensitivity and anxiety symptoms. The model includes four primary hypotheses:

H1 *Interpersonal sensitivity may positively predict anxiety symptoms among nursing students.*

H2 *PSS may play a mediating role in the relationship between interpersonal sensitivity and anxiety symptoms.*

H3 *PsyCap may play a mediating role in the relationship between interpersonal sensitivity and anxiety symptoms.*

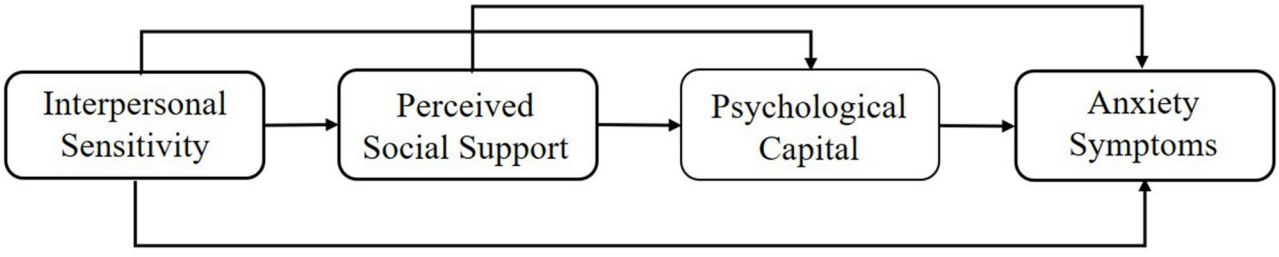

Fig. 1 Chain mediating model. Independent variable: interpersonal sensitivity; Dependent variable: anxiety symptoms; Mediating variables: perceived social support and psychological capital

H4 *PSS and PsyCap may play a chain mediating role in the relationship between interpersonal sensitivity and anxiety symptoms.*

Materials and methods

Setting and sample

Following Costello and Osborne's [54] research on the ratio of items to sample size in exploratory factor analysis, we perform an empirical method of sample estimation for the sample size, which should be no less than 10–20 times the number of scale items [55]. Based on a total of 52 measurement items in this study, we needed a sample size of 624 to 1248 respondents, taking into account a potentially invalid response rate of 20%. A cross-sectional survey was conducted via the online platform "WenJuanXing" (https://www.wjx.cn/), includ ing four scales (see the measurement tools) and general demographic characteristics (such as gender, grade, and hometown). The sampling technique employed in this study is convenience sampling.

Procedure

Undergraduate students were organized by the student mental health center and grade counselor to distribute QR codes from April 10 to April 19, 2022. The first page of the questionnaire contains information about the purpose of the research and seeks informed consent from the participants. Respondents are asked to provide their consent by ticking a box. They are informed about the confidentiality and anonymity of their data, with assurances that the information will not be shared with anyone and will be used solely for academic purposes. Participants are also made aware that their involvement in the survey is entirely voluntary, and there are no right or wrong answers. Furthermore, all questions must be answered before the questionnaire can be submitted to ensure there are no missing responses. During the data screening process, any completed questionnaire that exhibits logical errors or clear response patterns will be excluded from the study.

Measurements

Generalized anxiety disorder scale In this study, the Generalized Anxiety Disorder 7-Item Scale (GAD-7) compiled by Spitzer [56] was used to measure anxiety symptoms. The review indicated that the GAD-7 had > 80% sensitivity and specificity for detecting anxiety [57]. The seven items were scored on a scale of 0–21, with total scores of 5, 10, and 15 representing thresholds for mild, moderate, and severe anxiety symptoms, respectively. The GAD-7 has been used to screen anxiety symptoms among Chinese adolescents and has shown good reliability [58]. The Cronbach's α of the scale was 0.933 in our study.

Symptom checklist 90 interpersonal sensitivity subscale The interpersonal sensitivity subscale of Symptom Checklist 90 (SCL-90) was employed [11], which has been used among Chinese college students and has shown good reliability [40]. It has been proven that it can perform a psychometrically valid evaluation of interpersonal sensitivity [59]. The subscale consists of 9 items, each rated on a scale of 0–4. The higher the sum scores of all the items are, the more severe the individual's interpersonal sensitivity symptoms are. The Cronbach's α of the scale was 0.908 in the present study.

Multidimensional scale of perceived social support The multidimensional scale of perceived social support (MSPSS) was adopted to measure individuals' social support [60] and was developed into the PSS in China [61]. The PSS is a 12-item scale that measures perceived social support adequacy in three areas, namely, family, friends, and significant others (teachers, classmates, and relatives), with each dimension having four items rated from 1 to 7. A higher score indicates a higher level of social support. A higher score represents a higher level of social support. The good reliability of this scale has been demonstrated in studies of Chinese college students [53]. In our study, the Cronbach's α for the MSPSS was 0.958.

Psychological capital questionnaire The PsyCap of college students was measured via the Psychological Capital Questionnaire (PCQ-24). The scale was developed by Luthans et al. [37] and consists of four dimensions and 24 items, and each item is scored on a 6-point Likert scale. A higher score generally indicates a higher level of PsyCap. The PCQ-24 has good reliability in the study of nursing students in China [62]. In this study, the Cronbach's α for the PCQ-24 was 0.939.

Demographic and control variables Based on previous studies, this study included gender, grade, only child status, hometown status, and parents' marriage status as control variables for sociodemographic characteristics. Research in a study of emergency physicians in China revealed that sex had no significant effect on depression, PsyCap, or social support [63]. An empirical study of college students revealed that there were significant differences in the anxiety level and PsyCap level of students in different grades, whereas there was no significant difference in the PsyCap score or anxiety level according to parents' marital status [45]. In a study of Chinese college students, age was found to affect interpersonal sensitivity scores, while the difference in anxiety scores was not significant [64]. When the relationship between social support and anxiety in parents of severely ill children was explored, the longitudinal results revealed that parental type had no significant effect on anxiety [65]. A study of

nursing students' PsyCap in China revealed that there was no significant difference between the scores of only children and birthplaces in terms of school adjustment [66]. After the references above were summarized, gender, grade, only child status, hometown status, and parents' marriage status were included as control variables in this study.

Data analysis

The obtained data were analyzed via descriptive statistics via SPSS 24.0 software. Pearson's coefficient was used to determine the correlation between the four measurement variables. The PROCESS v3.4 macro (https://www.processmacro.org/download.html) was adopted to test the serial multiple mediation model, and models 4 and 6 were selected [67]. The mediating effect was estimated with a 95% confidence interval (95% CI) via a bootstrap procedure, and the number of repeated samples was set to 5000. If the 95% CI does not include zero, the mediating effect is considered significant [68].

Ethics approval and consent to participate

This study, as a nonintervention study based on a sample database, was approved by the Xuzhou Medical University Ethics Committee (Approval no. XMUs-22/0406). All procedures implemented in the present research followed the ethical standards and principles of the Declaration of Helsinki and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. All the respondents met the requirement of informed consent. Information from all samples was authorized by the database owner for use in this study and was desensitized before the study to protect respondents' privacy.

Results

Common method Bias

The Harman single-factor method often uses exploratory factor analysis to test common method bias [69]. It is generally accepted that the variation in the single-factor explanation should be less than 40% [70] or 50% [71]. In our study, the first common factor interpretation variance of all sample data is 39.83%, indicating that common method bias is not a serious problem.

Preliminary analyses

A total of 1,818 respondents completed online questionnaires in this study. After excluding invalid data, there were 1,815 valid samples with a valid rate of 99.83%. A total of 1,511 females, accounting for 83.3% of the respondents, participated in the survey. There was a significant discrepancy between male and female group interpersonal sensitivity ($p < 0.01$) and perceived social support ($p < 0.001$). There were differences in social support among nursing students in different grades ($p < 0.01$). There was a significant difference in interpersonal sensitivity between nursing students from urban areas and those from rural areas ($p < 0.05$). Among the nursing students, the perceived social support score of only children was higher than that of nonchild-only children ($p < 0.01$). There were differences in social support scores among nursing students with different parental marital statuses ($p < 0.01$). The sociodemographic characteristics and comparisons of the demographic factors of the nursing students are shown in 1.

The mean value (M) and standard deviation (SD) of interpersonal sensitivity, anxiety symptoms, PSS, and PsyCap were 2.13 ± 0.72, 2.50 ± 3.57, 65.89 ± 12.46 and 102.04 ± 15.74, respectively. The results of the correlation analysis revealed that interpersonal sensitivity was positively correlated with anxiety symptoms ($r = 0.43$) and

Table 1 Sociodemographic characteristics and comparisons of the demographic factors of the nursing students ($N = 1815$)

Variables	Category	N (%)	IS		PSS		PsyCap		ANS	
			M ± SD	*t/F(p)*	M ± SD	*t/F(p)*	M ± SD	*t/F(p)*	M ± SD	*t/F(p)*
Gender	Male	304(16.7)	2.26 ± 0.82	**3.215****	62.61 ± 13.81	**-0.463*****	100.77 ± 17.27	-1.434	2.70 ± 4.07	0.970
	Female	1511(83.3)	2.11 ± 0.70		66.55 ± 12.07		102.30 ± 15.41		2.46 ± 3.47	
Grades	Freshman	532(29.3)	2.19 ± 0.70	2.097	66.46 ± 11.58	**3.872****	101.39 ± 15.47	0.709	2.63 ± 3.35	1.873
	Sophomore	565(31.1)	2.11 ± 0.74		66.34 ± 12.44		102.76 ± 15.32		2.62 ± 3.87	
	Junior	396(21.8)	2.13 ± 0.72		66.21 ± 12.21		102.04 ± 15.16		2.47 ± 3.49	
	Senior	322(17.7)	2.07 ± 0.73		63.75 ± 13.94		101.86 ± 17.56		2.09 ± 3.48	
Hometown	Rural	939(51.7)	2.16 ± 0.71	**2.176***	65.63 ± 12.02	-0.904	101.44 ± 15.23	-1.703	2.40 ± 3.36	-1.254
	Urban	876(48.3)	2.09 ± 0.73		66.16 ± 12.92		102.69 ± 16.26		2.61 ± 3.79	
Only child	Yes	812(44.7)	2.12 ± 0.73	-0.700	66.76 ± 12.15	2.681**	102.50 ± 15.73	1.125	2.52 ± 3.55	0.247
	No	1003(55.3)	2.14 ± 0.72		65.18 ± 12.67		101.67 ± 15.75		2.48 ± 3.59	
Parents marital status	Married	1624(89.5)	2.49 ± 3.53	1.314	66.19 ± 12.47	**4.748****	102.37 ± 15.78	**3.553***	2.49 ± 3.53	0.057
	Divorced	85(4.7)	2.61 ± 4.11		62.69 ± 11.46		98.49 ± 16.37		2.49 ± 3.78	
	Single parent	106(5.8)	2.50 ± 3.57		63.82 ± 12.46		99.85 ± 14.22		2.61 ± 4.11	

Note: Interpersonal sensitivity (IS), anxiety symptoms (ANS), perceived social support (PSS), and psychological capital (PsyCap); $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table 2 Serial multiple mediation models and their influential variables

Variables	Model 1 (Y = PSS)		Model 2 (Y = PsyCap)		Model 3 (Y = ANS)	
	B	t	B	t	B	t
(Constant)	0.094	0.609	0.080	0.644	-0.140	-0.901
Gender	0.276	**4.729*****	-0.167	**-3.743*****	0.046	0.813
Grade	-0.093	**-5.017*****	0.043	**3.062****	-0.007	-0.366
Only child	-0.132	**-2.985****	0.043	1.278	-0.025	-0.589
Parents marital status	-0.097	**-2.267***	-0.013	-0.401	-0.036	-0.894
Hometown	-0.038	-0.866	0.045	1.348	0.104	**2.483***
Interpersonal sensitivity	-0.371	**-17.074*****	-0.230	**-12.910*****	0.306	**13.130*****
Perceived social support			0.607	**33.983*****	-0.063	**-2.187***
Psychological capital					-0.224	**-7.589*****
R^2	0.160		0.517		0.244	
F	57.460		276.599		72.688	

Note: Interpersonal sensitivity (IS), anxiety symptoms (ANS), perceived social support (PSS), and psychological capital (PsyCap); $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

Table 3 Direct and indirect effects of the serial multiple model

Pathway	Effect	SE	Bootstrap 95%CI	
			LLCI	ULCI
Total effects	0.431	0.022	0.389	0.473
Direct effects	0.306	0.023	0.260	0.352
Indirect effects	0.125	0.018	0.092	0.161
ind1 (IS→PSS→ANS)	0.023	0.014	-0.004	0.052
ind2 (IS→PC→ANS)	0.051	0.011	0.031	0.075
ind3 (IS→PSS→PC→ANS)	0.050	0.104	0.031	0.072

Note: Interpersonal sensitivity (IS), anxiety symptoms (ANS), perceived social support (PSS), and psychological capital (PC)

negatively correlated with the PSS (*r* = -0.37) and PsyCap (*r* = -0.46); anxiety symptoms were negatively correlated with the PSS (*r* = -0.32) and PsyCap (*r* = -0.40); and the PSS was positively correlated with PsyCap (*r* = 0.68). The *p*-values of the above correlation coefficients are all significant at the 0.001 critical point ($p<0.001$).

Hypothesis analyses

In addition to standardization, we set gender, grade, hometown, only child status, and parent's marital status as control variables in this study. As shown in Table 2, interpersonal sensitivity had a direct effect on anxiety symptoms ($\beta=0.306$, $p<0.001$) and a significant effect on PSS and PsyCap (β = -0.371 and −0.230, $p<0.001$, respectively). Anxiety symptoms were impacted by PSS (β = -0.063, $p<0.05$) and PsyCap (β = -0.224, $p<0.001$). As the basis of the serial model, a significant regression result between PSS and PsyCap was observed ($\beta=0.607$, $p<0.001$).

The results of the bootstraps showed that interpersonal sensitivity may have a significant total effect on anxiety ($\beta=0.431$, $SE=0.022$, 95% CI [0.389, 0.473]) and a significant direct effect on anxiety ($\beta=0.306$, $SE=0.023$, 95% CI [0.260, 0.352]). However, the chained mediations revealed that the mediating effect of social support on interpersonal sensitivity and anxiety was not significant ($\beta=0.023$, $SE=0.014$, 95% CI [-0.004, 0.052]). For interpersonal sensitivity and anxiety, PsyCap played a mediating role independently ($\beta=0.051$, $SE=0.011$, 95% CI [0.031, 0.075]) and a chain mediating role jointly with PSS ($\beta=0.050$, $SE=0.104$, 95% CI [0.031, 0.072]) (Table 3). The independent model and the serial mediating model are shown in Fig. 2.

Discussion

In this cross-sectional study of undergraduate nursing students, we explored the basic demographic information of nursing students, and women still account for a relatively high proportion of the major distribution in Jiangsu Province, China. In addition, we also found that men scored higher on interpersonal sensitivity than women, which is consistent with the results of a recent study of Chinese college students [72]. Existing accounts of this conclusion differ. A study from Changsha, Hunan, China, revealed that female adolescents had more interpersonal sensitivities than male adolescents did [73]. Women reported greater social support than men did. These findings are consistent with previous reports in first-year Israeli nursing students [74]. Women often have a natural advantage in interpersonal communication, which enables them to build strong relationships with classmates, teachers, and loved ones. This ability can make it easier for them to obtain social support. Additionally, studies have indicated that women are more likely to take the initiative in seeking help and support, while men may be more accustomed to solving problems independently. This tendency may contribute to female nurses having higher social support scores compared to their male counterparts [75, 76].

In terms of grades, the higher the grade is, the lower the score of perceived social support. This finding is similar to the findings of a major university Israeli study, which revealed that freshmen received more social support from family and friends than seniors did [77]. As

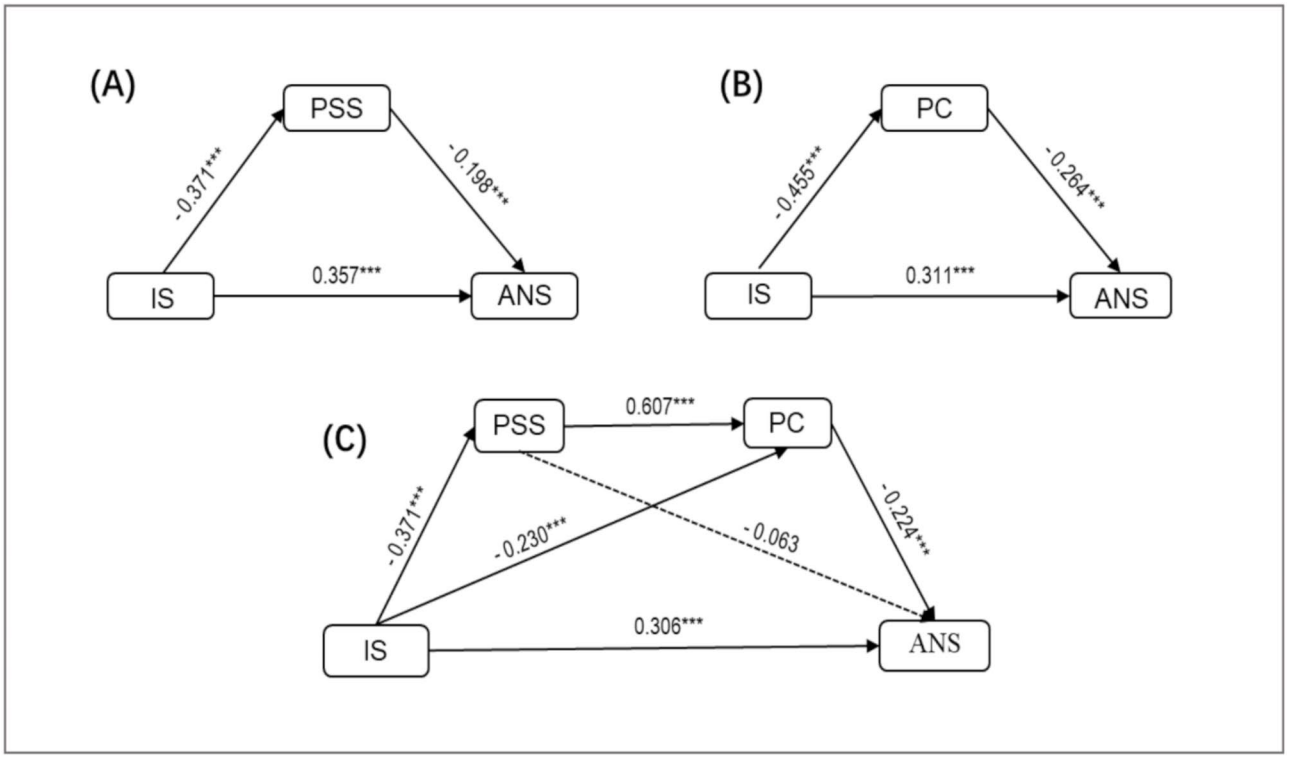

Fig. 2 Perceived social support as an independent mediator of the model (**A**); psychological capital as an independent mediator of the model (**B**); perceived social support and psychological capital jointly play a mediating role in the chain mediation model (**C**). Note: Perceived social support (PSS); Psychological capital (PC); Interpersonal sensitivity (IS); Anxiety symptoms (ANS); *** $p < 0.001$

students' grades increase, nursing students may face greater academic pressure and clinical placement pressure, which may affect their perception of social support. In addition, with increasing grades, students' social circles and mental changes may be more inclined to focus on themselves, or self-repair and stress resistance may improve. Our results are consistent with the results of Han et al. [78]in China; that is, the scores of interpersonal sensitivities of adolescents with rural household registration are higher than those with urban household registration. This may be because rural life is relatively simple and intimate, making it easier for people to form deep personal relationships. Students who grow up in such an environment may attach more importance to interpersonal relationships and are more likely to detect and understand the emotions and needs of others, thus displaying a higher level of interpersonal sensitivity. In general, only children seem to receive more care and resources than families with many children do, which may be the reason why nursing students as only children perceive a higher level of social support. Nursing students from two-parent families have higher levels of social support and PsyCap. Two-parent families are associated with a lower risk of mental health problems in adolescents, which may be related to positive interpersonal relationships [78].

This research revealed a positive correlation between interpersonal sensitivity and anxiety, which is consistent with previous findings [22]. Interpersonal sensitivity directly predicts anxiety among undergraduate nursing students. Maslow's hierarchy of needs theory points out that people have basic needs for interpersonal communication [79]. Unable to maintain normal relationships, people with high interpersonal sensitivity are prone to anxiety and other negative emotions, and their basic needs are not guaranteed. Moreover, some studies have confirmed that a negative cognitive tendency (interpersonal sensitivity) is a potential feature of anxiety, which may result in a series of problems, such as low social ability, decreased quality of life and physical health [80]. Before clinical practice, nursing students can develop their personal growth ability through group training and role plays to better adapt to the social problems encountered in clinical practice [81].

This study also explored the individual mediating effects of PSS on interpersonal sensitivity and anxiety and revealed that PSS has a partial mediating effect. Individuals with high levels of social support are able to feel their worth and receive help from friends, family, and other important aspects in the face of external doubts and criticism. This feeling can alleviate anxiety and other negative emotions caused by sensitive relationships. Our research

once again validates the buffer model of the PSS; that is, the PSS under stressful conditions or events is beneficial for an individual's physical and mental health [30]. Previous studies have also mentioned coping styles and social support as important measures for college students to relieve stressful events and solve problems [82]. Schools should offer counseling services and practice training courses along with other resources to help address psychological issues. Families and schools need to collaborate, maintain open lines of communication, and offer proper support to nursing undergraduates to reduce their stress and anxiety levels.

In addition, our study revealed that PsyCap acts as a mediator between interpersonal sensitivity and anxiety. According to self-expansion theory, individuals form interpersonal relationships to enhance their resources. They view these resources as extensions of themselves, which in turn helps to improve their abilities and self-efficacy through this process of expansion [83, 84]. Likewise, Liu et al. found that PsyCap negatively impacts school adaptation during challenging events [66]. An increase in adverse events, such as interpersonal sensitivity, is likely to lead to a decrease in PsyCap, which may subsequently increase anxiety levels. Conversely, a higher level of PsyCap can help reduce anxiety. Therefore, PsyCap is becoming increasingly important for enhancing mental health and subjective well-being [85]. Nursing educators should recognize the negative impact of interpersonal sensitivity and appreciate the role of PsyCap in helping nursing students effectively cope with stress and challenges.

In the present study, we find that PSS is positively correlated with PsyCap and that PSS positively predicts PsyCap. This finding is consistent with the results of related research [49]. Through the chain mediation model developed in this work, PsyCap is found to play the most important role in the mediation model. Therefore, when interventions based on this model for nursing student anxiety are considered, PsyCap can be considered the focus of the intervention. This study confirms that PSS can independently mediate the relationship between interpersonal sensitivity and anxiety. However, the PSS does not have a significant effect in the series mediation between interpersonal sensitivity and anxiety. This suggests that interventions aimed at reducing anxiety in nursing students should prioritize enhancing PsyCap. Several studies have conveyed the relevance of social support as a catalyst for further building other resources (such as self-efficacy, optimism, self-esteem, courage, hope, etc.) [86–90], also mentioning that social support can improve individuals' resilience and enhance their ability to cope with adverse events for a longer period without negatively affecting their physical health [91, 92]. PsyCap has been proven to be exploitable and beneficial [37]and is increasingly valuable for improving mental health [85].

Practical implications and intervention suggestions

It is crucial to highlight the importance of PsyCap in career planning education for nursing students. Additionally, the significance of PSS should not be overlooked; both schools and families need to provide material and emotional support to students. When facing interpersonal and psychological challenges, students should actively seek help from external sources, develop a comprehensive understanding of themselves, and fully leverage available resources.

Schools should offer courses on interpersonal communication and enhance training in communication skills to ensure that nursing students acquire high-level communication abilities. Additionally, schools should establish clinical skills laboratories to enhance practical learning, including providing academic support through personalized instruction, peer assistance programs, study groups for collaborative learning, tutoring services for key subjects, and workshops on time management, which may relieve nursing students' academic stress and improve their learning adjustment. Schools also should provide counseling services, stress management workshops, physical health programs, and life education. Opportunities for career development can be expanded through career counseling, professional development workshops, and internships. Additionally, technology-assisted interventions should include online learning platforms, telemedicine training, and virtual reality simulations of clinical procedures.

Limitations and future directions

Some limitations of this study are unavoidable. First, the adoption of a cross-sectional approach in this study does not establish causality. Second, the use of self-report questionnaires to measure variables in the study may have led to greater self-social approval bias. Third, the respondents in this study were exclusively from a single university, which is not sufficiently representative. Finally, other factors might also have an impact on the anxiety symptoms of nursing students.

A longitudinal study design could be employed in future research. This will help in tracking the progression of variables and understanding their causal relationships more effectively. When it comes to collecting data from a larger sample, more objective methods can be used, such as collecting data from peers, family members, or supervisors who can see respondents' behaviors and experiences from an outside perspective. Expand the sample to include respondents from multiple universities or different demographic backgrounds. Further research incorporating a wider range of variables will be required to

thoroughly understand the mechanisms underlying nursing students' anxiety symptoms.

Conclusion

Anxiety among nursing students was significantly associated with interpersonal sensitivity. PsyCap and social support can alleviate the effects of interpersonal sensitivity and anxiety and act together as a chain of mediators. Group counseling, interpersonal training, career development planning, and other measures should be adopted to continuously improve the PsyCap and PSS of nursing college students to help them overcome interpersonal sensitivity and relieve anxiety symptoms.

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Author contributions
HX: Designed the work and conceptualization, revised the manuscript, and approved the submitted version; YM: Investigation, acquisition data and resources, and writing-original draft; ZW: Writing-original draft, methodology, formal analysis; LP & CZ: Writing-original draft, methodology, validation, and visualization. All authors have substantively revised it and to have approved the submitted version.

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Data availability
Data is provided within the manuscript, and obtained from the corresponding author on request.

Declarations

Ethics approval and consent to participate
This research was conducted according to the guidelines of the Declaration of Helsinki and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines and was approved by the Ethical Committee at Xuzhou Medical University. Informed consent was obtained from all individual respondents included in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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