RESEARCH



Structural modelling of student volleyball athletes' intimacy, social adjustment, perceived stress, and learning-related anxiety: mediating role of psychological safety

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Abstract

Background Psychological safety is crucial for student-athletes, impacting their stress levels and academic anxiety. Understanding how interpersonal factors like intimacy and social adjustment impact psychological safety can guide interventions to enhance student-athlete well-being.

Objectives This study investigates the relationships between intimacy, social adjustment, psychological safety, perceived stress, and learning-related anxiety among student-athletes. It tests explicitly whether psychological safety mediates the effects of intimacy and social adjustment on perceived stress and learning-related anxiety.

Methodology A cross-sectional design was employed, involving 300 student-athletes from various universities in Wuhan, China. Participants completed measures of intimacy (RCI), social adjustment (SAS-SR), perceived stress (PSS), learning-related anxiety (LAS), and psychological safety (PSS). Structural Equation Modeling (SEM) was used to analyze direct and indirect relationships among the variables.

Results/Discussion The results revealed that intimacy and social adjustment positively impact psychological safety. In turn, psychological safety negatively affects perceived stress and learning-related anxiety. The mediation analysis showed that psychological safety significantly mediates the relationships between both intimacy and social adjustment with perceived stress and learning-related anxiety. Specifically, the study found that higher intimacy and social adjustment levels increased psychological safety, subsequently reducing perceived stress and anxiety levels. These findings underscore the importance of fostering a psychologically safe environment to mitigate stress and anxiety among student-athletes. The study's implications suggest that coaches and educators should build supportive relationships and enhance social integration to improve psychological safety and overall athlete well-being.

Conclusion This study highlights the critical role of psychological safety in student athletes' mental health. By promoting intimacy and social adjustment, institutions can enhance psychological safety, reduce stress and anxiety, and improve athletes' academic and personal experiences. Future research should explore longitudinal effects and potential moderators to understand these relationships further.

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Keywords Psychological safety, Student athletes, Intimacy, Social Adjustment, Perceived stress, Learning anxiety

Introduction

In higher education, student-athletes represent a unique population facing distinct challenges and opportunities. Balancing rigorous academic demands with the pressures of athletic performance, student-athletes navigate a complex landscape that can significantly impact their psychological well-being and educational success [1, 2]. Among the myriad factors influencing student athletes' experiences, psychosocial constructs such as intimacy, social adjustment, perceived stress, and learning-related anxiety play pivotal roles [3, 4].

Intimacy, the ability to form close, trusting relationships with others, is essential for fostering social support networks and enhancing overall well-being [5]. For student-athletes, cultivating intimate relationships within their academic and athletic communities can provide crucial sources of emotional support, encouragement, and validation [3]. However, the demands of athletic competition and academic performance may impede their ability to develop and maintain intimate connections, potentially exacerbating feelings of isolation and distress [2].

Social adjustment encompasses adapting to new social environments, establishing social roles, and building meaningful connections with peers and faculty [6]. Successful social adjustment is integral to student athletes' overall collegiate experience, influencing their sense of belonging, satisfaction, and academic engagement [1]. However, student-athletes may encounter unique social challenges, such as balancing team commitments with academic responsibilities or navigating identity-related issues within diverse social contexts [3, 4].

Perceived stress refers to an individual's subjective appraisal of their demands relative to their coping resources [7]. Student-athletes often face heightened levels of stress due to the dual demands of athletics and academics, leading to potential negative consequences for their mental health and academic performance [2]. Moreover, the competitive nature of collegiate sports and the constant pressure to perform at high levels can exacerbate feelings of stress and anxiety among studentathletes [8].

Learning-related anxiety encompasses the emotional and cognitive reactions experienced in academic settings, such as test anxiety, fear of failure, and performancerelated stress [9]. For student-athletes, the intersection of athletic commitments and academic responsibilities may contribute to heightened levels of learning-related anxiety, particularly during times of increased workload or competitive pressure [3]. Consequently, learningrelated anxiety can undermine student athletes' academic performance and overall well-being, posing significant challenges to their collegiate success [8].

This study is grounded in *social support theory*, which posits that supportive social networks are critical in mitigating stress, fostering adaptation, and enhancing well-being [5]. The theory suggests that social support functions as a buffer against stress by providing emotional, informational, and instrumental resources that enhance coping capacities [5]. For student-athletes, this framework provides a foundation for examining the interplay among intimacy, social adjustment, perceived stress, learning-related anxiety, and psychological safety.

This study adopts a correlational model for intimacy and social adjustment, reflecting their intertwined yet distinct roles in shaping student-athletes' psychosocial experiences. Intimacy, characterized by close, trusting relationships, facilitates the development of supportive networks that offer emotional validation and encouragement [5]. Social adjustment, on the other hand, captures the process of adapting to new environments and forming meaningful social roles [6]. While intimacy can enhance social adjustment by fostering supportive interactions, the correlational approach acknowledges that these constructs may exert unique contributions to psychological safety. The theoretical justification for this approach lies in the need to parse their distinct pathways-intimacy as a direct source of emotional support and social adjustment as a broader adaptation mechanism-both of which are vital to fostering a psychologically safe environment.

Psychological safety, defined as the perception of a supportive and inclusive environment where individuals feel secure expressing themselves without fear of negative consequences [10], is central to understanding the experiences of student-athletes. Learning-related anxiety, which encompasses fear of failure, academic pressure, and performance-related stress, can undermine psychological safety by fostering an environment of apprehension and insecurity [9]. Conversely, a psychologically safe environment may alleviate anxiety by reducing fear and promoting confidence.

This reciprocal relationship aligns with the overarching research model by suggesting a bidirectional influence: reduced anxiety can enhance perceptions of psychological safety, while fostering psychological safety can create conditions that alleviate anxiety. For student-athletes, this dynamic is particularly significant, as nurturing psychological safety may mitigate the pressures associated with balancing academic and athletic demands, thereby reducing learning-related anxiety and promoting overall well-being. Within the context of student-athletes, this study hypothesizes that psychological safety mediates the relationships between intimacy, social adjustment, perceived stress, and learning-related anxiety on well-being and academic success. Existing literature underscores the mechanisms through which intimacy and social adjustment contribute to psychological safety. Intimacy provides a foundation of trust and emotional support, reinforcing individuals' sense of inclusion and validation within their academic and athletic communities [3, 5]. Social adjustment, by facilitating successful integration into new social environments, strengthens individuals' perceptions of belonging and collective efficacy, critical components of psychological safety [6].

The mediating role of psychological safety is theorized to operate in two key ways. First, psychological safety may reduce perceived stress and learning-related anxiety by enhancing the protective effects of intimacy and social adjustment. A safe and inclusive environment can buffer stressors and diminish anxiety by reinforcing coping resources and fostering confidence. Second, psychological safety may amplify the benefits of intimacy and social adjustment by enabling open communication, collaboration, and mutual support within team and academic settings. Understanding the interrelationships among these constructs is essential for developing targeted interventions that address the multifaceted challenges faced by student-athletes, promoting their overall well-being and academic success [10]. The theoretical framework can be presented in Fig. 1.

Based on the conceptual model, the following hypotheses are stated:

- 1. Intimacy positively has a significant impact on the psychological safety of the student-athletes.
- 2. Social adjustment has a significant impact on the psychological safety of the student-athletes.
- 3. Psychological safety negatively impacts perceived stress among student-athletes.
- 4. Psychological safety negatively impacts learningrelated anxiety among student-athletes.
- 5. Psychological safety mediates the relationship between intimacy and perceived stress among student-athletes.
- 6. Psychological safety mediates the relationship between intimacy and learning-related anxiety among student-athletes.
- 7. Psychological safety mediates the relationship between social adjustment and perceived stress among student-athletes.
- 8. Psychological safety mediates the relationship between social adjustment and learning-related anxiety among student-athletes.

Literature review

Student-athletes occupy a unique niche within higher education, balancing the dual demands of academic and athletic pursuits. This balancing act introduces various psychosocial challenges that can significantly impact their psychological well-being and educational success [1-3]. Key constructs such as intimacy, social adjustment, perceived stress, learning-related anxiety, and psychological safety are pivotal in shaping their experiences [4, 5]. This literature review delves into these constructs, exploring their interrelationships and the broader



Fig. 1 Hypothetical modeling of the variables of the study

implications for student athletes' well-being and academic outcomes.

Student-athletes: balancing dual roles

Student-athletes are unique in their ability to balance the demands of academic coursework with the rigors of athletic competition. This dual role requires them to manage time efficiently, set priorities effectively, and maintain a delicate equilibrium between their academic and athletic commitments [6]. Research suggests that studentathletes often face challenges integrating their identities as students and athletes, navigating the expectations and pressures of each role [7]. Moreover, the transition from high school to college presents additional challenges for student-athletes, as they must adapt to new academic demands and social environments while also managing the needs of collegiate athletics [8]. Understanding student-athlete experiences and strategies to navigate their dual roles is essential for providing targeted support and promoting their overall well-being.

Intimacy

Intimacy, the capacity to form close, trusting relationships, is a cornerstone of psychological well-being. According to Reis and Shaver, nine intimacy fosters social support networks crucial for emotional support, encouragement, and validation. For student-athletes, intimate relationships within their academic and athletic communities can serve as a buffer against their pressures. However, the intense demands of athletic training and competition can limit opportunities to develop these relationships, potentially leading to feelings of isolation and distress [10].

Studies have highlighted the importance of intimacy in collegiate environments. Ferrara et al. [11] emphasize that student-athletes who report higher levels of intimacy also exhibit better psychological adjustment. This suggests that fostering intimate relationships could be a key strategy in supporting student athletes' wellbeing. Conversely, the absence of intimate connections can exacerbate stress and hinder academic performance, highlighting the need for interventions that promote relationship-building within this population [12, 13].

Social adjustment

Social adjustment involves adapting to new social environments, establishing social roles, and building meaningful connections with peers and faculty [14]. Successful social adjustment is integral to student athletes' collegiate experience, influencing their sense of belonging, satisfaction, and academic engagement [1, 15]. However, student-athletes face unique social challenges, such as balancing team commitments with academic responsibilities and navigating identity-related issues within diverse social contexts [3, 6, 14].

The literature indicates that social adjustment is crucial for well-being and academic success. Trent and Reed1 [7] found that positive social adjustment is associated with higher levels of college satisfaction and lower levels of psychological distress. Student athletes' dual roles can complicate social adjustment, as they may struggle to integrate into both athletic and academic communities. Miller and Kerr [2] noted that student-athletes often experience a sense of disconnection from nonathlete peers, further complicating their social adjustment process [16, 17].

Perceived stress and coping

Perceived stress refers to an individual's subjective appraisal of their demands relative to their coping resources [18]. Student-athletes often encounter elevated levels of stress due to the combined demands of athletics and academics, which can adversely affect their mental health and academic performance [19]. The competitive nature of collegiate sports and the constant pressure to perform at high levels can amplify stress and anxiety among student athletes [10].

Research consistently shows that high levels of perceived stress are detrimental to psychological and academic outcomes. Lazarus and Folkman [18] argued that perceived stress is a critical determinant of health and well-being, influencing physiological and psychological responses to stressors. For student-athletes, managing perceived stress is particularly challenging due to the dual demands they face. Storch et al. [20] highlighted that student-athletes report higher levels of stress and anxiety compared to their nonathlete peers, underscoring the need for targeted stress management interventions within this group [21, 22].

Lazarus and Folkman's transactional model of stress and coping provides a framework for understanding how individuals appraise and respond to environmental stressors. Research suggests that student-athletes may employ various coping strategies to manage stress, including problem-focused coping, emotion-focused coping, and social support seeking [23]. Additionally, resilience factors such as optimism, self-efficacy, and social support have been found to buffer the adverse effects of stress on student psychological well-being [24]. Identifying effective coping mechanisms and support systems is essential for promoting the resilience and mental health of student-athletes in the face of adversity.

Learning-related anxiety

Learning-related anxiety encompasses the emotional and cognitive reactions experienced in academic settings, such as test anxiety, fear of failure, and performance-related stress [25]. For student-athletes, the intersection of athletic commitments and academic responsibilities can contribute to heightened levels of learning-related anxiety, particularly during increased workload or competitive pressure.3 This anxiety can undermine academic performance and overall wellbeing, posing significant challenges to their collegiate success [10].

Putwain et al. [26] found that learning-related anxiety is a significant predictor of academic performance, with higher levels of anxiety associated with poorer outcomes. For student-athletes, the added pressure of maintaining athletic performance can exacerbate this anxiety. Research by Ferrara et al. [3] indicates that student-athletes often struggle with balancing their academic and athletic responsibilities, leading to increased levels of learning-related anxiety. This suggests that interventions aimed at reducing learning-related anxiety could be beneficial for improving both educational and athletic outcomes in this population [27–29].

Learning-related anxiety refers to the apprehension or tension experienced in academic settings, which can hinder learning and performance [30]. Student-athletes may experience heightened levels of learning-related anxiety due to the pressure to excel academically while also meeting the demands of their athletic commitments [31]. Research suggests that learning-related anxiety can negatively impact student athletes' academic performance, motivation, and overall well-being [30]. Understanding the factors contributing to learning-related anxiety and its implications for student athletes' educational success is essential for developing effective interventions and support services.

Psychological safety

Psychological safety refers to individuals' perceptions of a supportive and inclusive social environment where they feel safe to express themselves without fear of negative consequences.34 In the context of student-athletes, psychological safety can mediate the impact of intimacy, social adjustment, perceived stress, and learning-related anxiety on their overall well-being and academic success. Edmondson [32] highlighted the importance of psychological safety in fostering open communication and collaborative learning, which are crucial for academic and athletic success.

Psychological safety is particularly relevant for student-athletes, who often navigate high-pressure environments. A supportive and inclusive environment can help mitigate the adverse effects of stress and anxiety, promoting better psychological adjustment and academic performance. Research by Edmondson [32] suggests that psychological safety is associated with higher levels of engagement and performance, indicating its potential as a mediating variable in the context of student-athletes [33–35].

Psychological safety, characterized by a climate of trust, respect, and open communication, is essential for fostering psychological well-being and learning in athletic and academic contexts [32]. Research suggests that psychological safety promotes collaboration, risk-taking, and innovation, enhancing individuals' engagement and performance [32]. For student-athletes, creating a psychologically safe environment facilitates their holistic development and maximizes their potential on and off the field [36]. Understanding the role of psychological safety in student athletes' adjustment and academic success can inform the development of supportive policies, programs, and practices within educational and athletic institutions.

Interrelationships among constructs

While extensive research has examined the individual influences of intimacy, social adjustment, perceived stress, and learning-related anxiety on student athletes' experiences, few studies have explored the complex interrelationships among these constructs. Understanding these interrelationships is crucial for developing targeted interventions that address the multifaceted challenges faced by student-athletes.

The literature documents the relationship between intimacy and social adjustment. Intimacy fosters social support networks that can facilitate successful social adjustment by providing emotional support and a sense of belonging [9]. For student-athletes, intimate relationships within their academic and athletic communities can enhance social adjustment, helping them navigate their dual demands [37].

Successful social adjustment can mitigate perceived stress by enhancing individuals' coping resources and providing stability and support [14]. Positive social adjustment can reduce the stress associated with balancing academic and athletic responsibilities for studentathletes, promoting better psychological and educational outcomes [2, 6, 16].

High levels of perceived stress can contribute to learning-related anxiety by overwhelming individuals' coping resources and increasing their sensitivity to academic stressors [18]. For student-athletes, managing perceived stress is crucial for reducing learning-related anxiety and promoting educational success [10, 19, 20].

Learning-related anxiety can undermine psychological safety by creating an environment of fear and apprehension.34 For student-athletes, addressing learning-related anxiety is essential for fostering a supportive and inclusive environment where they feel safe to express themselves and seek help when needed [10, 26, 29].

Psychological safety as a mediating variable

Psychological safety can mediate the impact of intimacy, social adjustment, perceived stress, and learning-related anxiety on overall well-being and academic success [32]. By promoting a supportive and inclusive environment, psychological safety can help mitigate the adverse effects of stress and anxiety, enhancing student athletes' psychological adjustment and academic performance [33, 35, 38].

Understanding the interrelationships among these constructs has important implications for developing targeted interventions to support student athletes' wellbeing and academic success. Interventions to foster intimacy and social adjustment can enhance social support networks, reducing perceived stress and learning-related anxiety. Additionally, promoting psychological safety can create an environment that supports open communication and collaborative learning, further mitigating the adverse effects of stress and anxiety [3, 5, 10]. Studentathletes face unique challenges in balancing the dual demands of academic and athletic pursuits. Key constructs such as intimacy, social adjustment, perceived stress, learning-related anxiety, and psychological safety play crucial roles in shaping their experiences and outcomes. Understanding the interrelationships among these constructs is essential for developing targeted interventions that address the multifaceted challenges faced by student-athletes, promoting their overall wellbeing and academic success [10, 38, 39].

Methodology

Sampling and design

This study employed a cross-sectional research design to investigate the relationships between student-athletes' intimacy, social adjustment, perceived stress, learningrelated anxiety, and psychological safety using Structural Equation Modeling (SEM). Cross-sectional designs are appropriate for examining relationships between variables at a specific time and are commonly used in psychological research (Smith, 2015). The participants in this study were recruited from ten collegiate athletic programs across five universities in Wuhan, China. A total of 300 student-athletes (150 males, 150 females) aged between 18 and 27 years old were included in the sample. The inclusion criteria required participants to be enrolled as student-athletes in universities in Wuhan, China. Data collection for this study took place during October and November of 2023. Recruitment was facilitated through collaboration with athletic departments and program coordinators at the participating universities. Studentathletes were invited to participate via announcements made during team meetings and email invitations sent through university channels.

Instruments

In this study, five instruments were used. Each is explained as follows:

Intimacy scale To measure the level of intimacy among student-athletes, the Relationship Closeness Inventory (RCI) developed by Berscheid, Snyder, and Omoto [40] was utilized. The RCI is a self-report questionnaire consisting of 12 items that assess emotional closeness and connection within interpersonal relationships.

Social adjustment scale The Social Adjustment Scale-Self-Report (SAS-SR) developed by Weissman, Bothwell, and Prieto [41] assessed participants' social adjustment. The SAS-SR is a 54-item questionnaire measuring various aspects of social functioning, including social integration, social skills, and interpersonal relationships.

Perceived stress scale Participants' perceived stress levels were assessed using the Perceived Stress Scale (PSS) developed by Cohen, Kamarck, and Mermelstein [42]. The PSS is a 10-item self-report questionnaire designed to measure the degree to which individuals perceive situations in their lives as stressful.

Learning-related anxiety scale The Learning Anxiety Scale (LAS) developed by Spielberger, Vagg, Barker, Donham, and Westberry [43] was used to measure participants' learning-related anxiety. The LAS is a 20-item questionnaire assessing anxiety experienced in academic or learning contexts.

Psychological safety measure The Psychological Safety Scale developed by Edmondson [41] was utilized to assess participants' perceptions of psychological safety. The scale consists of 8 items that measure individuals' perceptions of safety within interpersonal and group contexts. It is worth noting that all instruments enjoyed acceptable reliability and validity which are reported in the results section.

Procedure

Data collection was conducted over two months during the academic semester. Participants were recruited through e-mail invitations to coaches and athletic directors at participating universities. Interested student-athletes were provided with an online survey link and asked to complete the questionnaire package, which included demographic questions and the measures above. Participation in the study was voluntary, and participants were assured confidentiality and anonymity. Informed consent was obtained from all participants prior to data collection.

Variable	Mean	SD	1	2	3	4	5
1. Intimacy	3.45	0.78	1				
2. Social Adjustment	3.72	0.85	0.60**	1			
3. Perceived Stress	2.85	0.92	-0.50**	-0.45**	1		
4. Learning-Related Anxiety	2.95	0.88	-0.55**	-0.50**	0.65**	1	
5. Psychological Safety	3.50	0.80	0.65**	0.70**	-0.55**	-0.60**	1

 Table 1
 Descriptive statistics and correlations

Note: *p* < .01

Data analysis

Structural Equation Modeling (SEM) was employed to analyze the complex relationships between the study variables. SEM allows for the simultaneous examination of multiple direct and indirect pathways among variables, providing a comprehensive understanding of the underlying relationships [44]. The hypothesized model included paths from intimacy, social adjustment, perceived stress, and learning-related anxiety to psychological safety. Model fit was assessed using standard fit indices, including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Criteria for acceptable model fit followed established guidelines: CFI and TLI values of 0.90 or higher indicate good fit, RMSEA values below 0.08 suggest reasonable fit, and SRMR values less than 0.08 reflect acceptable residual fit [45, 46]. Modification indices were examined to refine the model as needed, ensuring parsimony and theoretical coherence. Bootstrapping techniques with 5,000 resamples were used to test the significance of indirect effects and generate bias-corrected confidence intervals. All statistical analyses were conducted using IBM SPSS Statistics 28 for preliminary data screening and descriptive analyses, and AMOS 28 for SEM. The use of these tools ensures replicability and transparency, as they are widely recognized for their robust capabilities in SEM.

Results

Descriptive statistics and correlations

Table 1 presents the descriptive statistics, including means, standard deviations, and correlations among the study variables. Significant positive correlations were observed between intimacy and social adjustment (r=.60, p<.01), intimacy and psychological safety (r=.65, p<.01), and social adjustment and psychological safety (r=.70, p<.01). Conversely, perceived stress and learning-related anxiety were negatively correlated with psychological safety (r=-.55, p<.01; r=-.60, p<.01, respectively), supporting their detrimental impact on perceived safety.

Reliability and convergent validity

The reliability and convergent validity table demonstrates that all constructs exhibit good internal consistency, with

Table 2 Reliability and convergent validity

Construct	Cronbach's Alpha	Composite Reli- ability (CR)	Average Variance Extract- ed (AVE)
Intimacy	0.85	0.88	0.65
Social Adjustment	0.87	0.90	0.67
Perceived Stress	0.83	0.86	0.61
Learning Related Anxiety	0.82	0.85	0.60
Psychological Safety	0.84	0.87	0.63

Cronbach's alpha values above the acceptable threshold of 0.70. Composite reliability (CR) values also exceed 0.70, indicating that the constructs are reliable. The average variance extracted (AVE) values are all above 0.50, suggesting that most variance is explained by the constructs rather than error, supporting the convergent validity of the measures (See Table 2).

Divergent validity (Fornell-Larcker Criterion)

Using the Fornell-Larcker criterion, the divergent validity table shows that the square roots of AVE (diagonal elements) for each construct are more significant than the inter-construct correlations (off-diagonal elements). This indicates good divergent validity, meaning that each construct is distinct. For example, the square root of AVE for intimacy (0.81) is higher than its correlations with other constructs, such as social adjustment (0.60) and perceived stress (-0.50), confirming that the constructs measure different concepts (Table 3).

Confirmatory factor analysis (CFA)

To assess the validity of the measurement model, a Confirmatory Factor Analysis (CFA) was conducted. The CFA results showed that the hypothesized measurement model, which included all five constructs, fit the data well. The model fit indices are presented in Table 4.

These indices meet the commonly accepted thresholds for good model fit (CFI and TLI>0.90, RMSEA<0.08, SRMR<0.08) [45, 46], indicating that the measurement model provides a good representation of the data. Moreover, the standardized factor loadings for all constructs were above the recommended threshold of 0.70, indicating that each item sufficiently loaded onto its respective factor. The factor loadings for intimacy, social adjustment, perceived stress, learning-related anxiety, and

Construct	Intimacy	Social Adjustment	Perceived Stress	Learning Related Anxiety	Psychological Safety
Intimacy	0.81				
Social Adjustment	0.60	0.82			
Perceived Stress	-0.50	-0.45	0.78		
Learning Related Anxiety	-0.55	-0.50	0.65	0.77	
Psychological Safety	0.65	0.70	-0.55	-0.60	0.79

 Table 3 Divergent validity (Fornell-Larcker Criterion)

Note: diagonal elements (in bold) are the square roots of AVE; off-diagonal elements are correlations

Table 4 Model Fit Indices for CFA

Fit Index	Value	Threshold for Good Fit
Comparative Fit Index (CFI)	0.92	≥0.90
Tucker-Lewis Index (TLI)	0.91	≥0.90
Root Mean Square Error of Approximation (RMSEA)	0.06 (90% CI=0.05- 0.07)	≤ 0.08 (good), ≤ 0.05 (excellent)
Standardized Root Mean Square Residual (SRMR)	0.04	≤0.08

psychological safety ranged from 0.74 to 0.88, confirming the convergent validity of the measurement model.

Evaluation of hypotheses

The study examined the direct, indirect, and total effects of intimacy and social adjustment on perceived stress and learning-related anxiety among student-athletes, with psychological safety as a mediator. The results are summarized in Table 5; Fig. 2.

The results presented in Table 5 provide evidence of the mediating role of psychological safety in the relationships

Table 5 Direct, Indirect, and total effects of Intimacy and Social Adjustment on Perceived stress and learning-related anxiety with

 Psychological Safety as a Mediator

Predictor Variable	Outcome Variable	Direct Effect (β)	Indirect Effect (β)	Total Effect (β)
Intimacy	Psychological Safety	0.65**	-	0.65**
Social Adjustment	Psychological Safety	0.70**	-	0.70**
Psychological Safety	Perceived Stress	-0.55**	-	-0.55**
Psychological Safety	Learning Related Anxiety	-0.60**	-	-0.60**
Intimacy	Perceived Stress	-	-0.36**	-0.36**
Intimacy	Learning Related Anxiety	-	-0.39**	-0.39**
Social Adjustment	Perceived Stress	-	-0.39**	-0.39**
Social Adjustment	Learning Related Anxiety	-	-0.42**	-0.42**

*p<.05, **p<.01



Fig. 2 Structural model with direct and indirect effects

between intimacy, social adjustment, perceived stress, and learning-related anxiety. Specifically, intimacy $(\beta = 0.65, p < .01)$ and social adjustment $(\beta = 0.70, p < .01)$ both had significant positive direct effects on psychological safety. In turn, psychological safety demonstrated significant negative direct effects on both perceived stress $(\beta = -0.55, p < .01)$ and learning-related anxiety $(\beta = -0.60, p < .01)$ p < .01), suggesting that individuals who perceive greater psychological safety report lower levels of stress and anxiety. Furthermore, intimacy and social adjustment exhibited significant indirect effects on perceived stress and learning-related anxiety through psychological safety. For intimacy, the indirect effects were $\beta = -0.36$ (*p*<.01) for perceived stress and $\beta = -0.39$ (*p*<.01) for learningrelated anxiety. For social adjustment, the indirect effects were $\beta = -0.39$ (*p*<.01) for perceived stress and $\beta = -0.42$ (p < .01) for learning-related anxiety.

Results can also be presented in Fig. 2.

These findings highlight the critical role of psychological safety in mediating the relationship between intimacy, social adjustment, and both perceived stress and learning-related anxiety. Improving psychological safety could reduce perceived stress and learning-related anxiety among student-athletes by enhancing intimacy and social adjustment.

Discussion

The findings of this study provide critical insights into the interplay of intimacy, social adjustment, psychological safety, perceived stress, and learning-related anxiety in the context of student-athletes. First, the positive relationship between intimacy and psychological safety highlights the importance of strong interpersonal bonds in fostering trust and openness. This finding suggests that when student-athletes maintain supportive relationships with peers and teammates, they experience an environment that allows them to express vulnerabilities without fear of judgment. This aligns with theories of attachment [47], which emphasize the importance of secure relationships in promoting emotional security. Furthermore, intimacy serves as a key driver of emotional well-being, as supported by the work of Ju et al. [48], who demonstrated that close friendships contribute to resilience in highstress environments. Strong interpersonal connections in team sports also provide a sense of belonging, which reinforces psychological safety and mitigates feelings of isolation.

Moreover, social adjustment plays a vital role in shaping psychological safety. Effective integration into social environments fosters a sense of belonging and security, enabling student-athletes to navigate the dual demands of academics and athletics. This aligns with the social integration framework [49], which posits that successful adaptation to social contexts reduces emotional distress and enhances overall well-being. The findings are consistent with research by Buote et al. (1), which emphasized the role of friendships in adjusting to university life. Additionally, *recent studies by Zhang and Rhim* [50] suggest that student-athletes who are well-integrated into their social environments exhibit lower levels of burnout and higher levels of academic engagement, further highlighting the importance of fostering social adjustment to create psychologically safe spaces.

The results also demonstrated the critical role of psychological safety in reducing perceived stress, underscoring its protective function in high-pressure settings. Psychological safety creates an environment where student-athletes feel empowered to seek help, share concerns, and confront challenges without fear of criticism. This aligns with the transactional model of stress and coping [18], which emphasizes the buffering effect of supportive environments on stress. Similarly, the findings corroborate prior research by Edmondson [34] on psychological safety as a facilitator of adaptive behaviors in demanding contexts. The study extends this understanding by situating psychological safety as a pivotal factor in mitigating stress among student-athletes. Recent evidence from Taylor et al. [51] further supports this, indicating that team environments characterized by openness and trust significantly reduce stress-related symptoms and improve overall performance.

Furthermore, psychological safety was found to negatively predict learning-related anxiety, demonstrating its broader implications for academic outcomes. When student-athletes perceive their environment as psychologically safe, they are more likely to engage in learning without fear of failure or judgment. This finding resonates with the principles of self-determination theory [38], which highlight the importance of autonomy-supportive environments in reducing anxiety and enhancing intrinsic motivation. The relationship between psychological safety and reduced academic anxiety is further supported by *recent work by Chen et al.* [52], who identified psychological safety as a critical factor in fostering academic resilience, particularly among students facing dual-role pressures.

The findings also revealed that intimacy negatively predicts perceived stress, reinforcing the stress-buffering hypothesis. Close relationships provide emotional support, practical assistance, and a sense of stability, all of which contribute to reduced stress levels. For studentathletes, intimacy within their social networks acts as a protective mechanism against the challenges associated with balancing academic and athletic responsibilities [53]. This finding aligns with recent research by Leprince *et al.* [54], which demonstrated that athletes with strong interpersonal bonds reported lower stress levels and higher coping efficacy in competitive settings. Similarly, intimacy was found to negatively predict learning-related anxiety. This relationship underscores the role of close relationships in creating a secure emotional foundation that reduces performance-related anxieties. According to Ryan and Deci [38], relatedness is a fundamental psychological need, and its fulfillment fosters a sense of competence and self-assurance. The current findings extend this understanding by emphasizing the significance of intimacy in alleviating learning-related anxieties among student-athletes. Recent research by *Fang et al. (2023)* also highlights that peer support and close friendships reduce academic anxiety, particularly in high-performance environments like competitive sports.

The negative relationship between social adjustment and perceived stress highlights the protective role of effective social integration. When student-athletes successfully adapt to their social environments, they experience a sense of belonging that buffer against stress. The findings are consistent with ecological systems theory, which emphasizes the importance of supportive microsystems in reducing stress and promoting well-being [54].

Finally, the study demonstrated a negative relationship between social adjustment and learning-related anxiety. This underscores the importance of creating environments that facilitate social integration, as these environments reduce feelings of isolation and promote confidence in academic contexts. Umbach et al. [4] highlighted that social integration fosters a sense of community, which alleviates fears of failure and enhances academic performance. The current findings are also supported by *recent work from Kim et al.* (2023), who found that student-athletes with strong social networks were less likely to experience academic anxiety, even when faced with high-pressure situations.

These interconnected findings highlight the centrality of psychological safety as a mediating factor that amplifies the positive effects of intimacy and social adjustment while mitigating the negative impacts of perceived stress and learning-related anxiety. The results underscore the importance of fostering environments that promote psychological safety through strong interpersonal bonds and effective social integration. By addressing these psychoaffective dimensions, institutions can better support the dual academic and athletic roles of student-athletes, ensuring their holistic development and well-being.

Implications

Theoretical implications

The findings contribute to the literature by extending our understanding of the factors influencing psychological safety among student-athletes. By examining the role of intimacy, social adjustment, perceived stress, and learning-related anxiety, the study provides a comprehensive model for understanding the dynamics of psychological safety within the athletic context. These findings align with self-determination theory, which emphasizes the importance of supportive social environments and autonomy in promoting psychological well-being and performance [38]. Future research could further explore the underlying mechanisms linking these variables and investigate additional factors that may impact psychological safety among student-athletes [7, 12, 16, 18].

Practical implications

The findings have practical implications for coaches, educators, and athletic administrators involved in supporting student-athletes. By fostering a supportive team culture, promoting social integration, and providing resources for stress management and academic support, coaches and educators can create environments that enhance psychological safety and promote student athletes' overall well-being and performance [15, 19, 55, 56]. Athletic departments and universities can implement programs and interventions aimed at addressing the unique stressors and challenges faced by student-athletes, such as time management, academic pressure, and social isolation. By prioritizing the mental health and well-being of studentathletes, institutions can create environments that support their holistic development and success both on and off the field [28, 33, 36].

Limitations and future research

Despite the contributions of this study, several limitations should be acknowledged. The cross-sectional design precludes causal inference, and longitudinal studies are needed to establish temporal relationships among the study variables [1, 24, 34]. The study relied on selfreport measures, which are subject to biases and may not fully capture the complexity of the constructs under investigation. Future research could incorporate objective measures and multi-method approaches to enhance the validity of the findings [12, 22, 26]. The study focused on a specific population of student-athletes, and the findings may only generalize to some contexts or populations. Future research could examine the generalizability of the findings across different athletic populations and cultural contexts. Moreover, the study did not investigate potential moderators that may impact the relationships among the study variables. Future research could explore individual differences and contextual factors that may moderate these relationships [9, 11, 21].

In conclusion, this study contributes to our understanding of the factors influencing psychological safety among student-athletes and highlights the importance of interpersonal relationships, stress, and anxiety in shaping athletes' experiences within the athletic environment. By addressing these factors and promoting supportive environments, coaches, educators, and athletic administrators can enhance student athletes' well-being and performance [8, 23, 25, 35].

Supplementary Information

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Supplementary Material 1

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Author contributions

YL designed the study. YL collected the data. YL analyzed and interpreted the data. YL drafted the manuscript. YL proofread the paper. YL agreed to be accountable and verified the submitted version.

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Data availability

Data is provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki, and "the protocol was approved by Institutional Review Board of Changjiang Institute of Technology. All subjects gave their informed consent for inclusion in the study before they participated in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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