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Article

Effect of social fear and intimate fear on mental health and somatic responses in college students: Modulation of family factors

Qingqing Zhan[1,*,†], Longfei Zhao[2,†]

[1] Mental Health Education and Counseling Center, Taizhou Vocational College of Science and Technology, Taizhou City 318020, People's Republic of China
[2] Department of Psychology, Tianjin University of Technology and Education, Tianjin 300000, People's Republic of China
*** Corresponding author:** Qingqing Zhan, qing88812@hotmail.com
[†] These authors are co-first authors.

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Abstract: The current research explores the predictive value of social fear and intimate fear for mental health and somatic responses among college student, while highlighting the interaction between the aforementioned variables with family factors. A sample of 856 college students aged 18–24 years (58% female) was surveyed at various universities in China during the fall semester of 2023. Participants completed questionnaires that dealt with social fear, intimate fear, symptoms of mental health, somatic responses, and family factors. Both types of fear showed significant associations with negative consequences. Social fear demonstrated stronger effects, with coefficients of $\beta = 0.54$ ($p < 0.001$) for mental health symptoms and $\beta = 0.48$ ($p < 0.001$) for somatic complaints. In comparison, intimate fear showed relatively weaker effects, with coefficients of $\beta = 0.46$ ($p < 0.001$) for mental health symptoms and $\beta = 0.42$ ($p < 0.001$) for somatic complaints. Further biomechanical analyses demonstrated that psychological fears were significantly associated with increased muscle tension (particularly in trapezius and cervical muscles) and reduced joint mobility, with social fear showing stronger effects on these physical parameters ($\beta = 0.45$, $p < 0.001$) compared to intimate fear ($\beta = 0.38$, $p < 0.001$).The findings further showed that family dynamics played an influential role in these relationships, with the correlations between psychological anxieties and negative life outcomes proving stronger in conditions where there was little support from family. The interaction effects were most marked with regard to mental health outcomes, where the positive family factors buffered the impact of social and intimate fears. These results strongly point out the importance of integrating family-oriented approaches into interventions for college students with psychological anxieties.

Keywords: college students; family factors; intimate fear; mental health; social fear; somatic responses

1. Introduction

In the last few decades, mental health problems among higher education students have become more apparent, with social anxiety and interpersonal fear being recognized as crucial factors that affect their psychological well-being and physical health. These mental health issues do not only impact the students' academic performance and social lives but also manifest in various somatic symptoms, thereby making the situation quite complex for mental health professionals and educators. The current study focuses on three key components—social fear, intimate fear, and family factors—in examining college students' psychological well-being. This selection is theoretically grounded and empirically supported by previous research. Social fear represents a fundamental challenge

during college years, as students face intensive social interactions in academic and professional settings [1]. Intimate fear, while related to social fear, captures a distinct dimension of interpersonal anxiety that specifically affects close relationship formation and maintenance [2]. Family factors are included as a critical moderating variable, as research has demonstrated that family relationships continue to significantly influence psychological adjustment during college years [3]. The integration of these three components allows for a comprehensive examination of both the direct effects of psychological fears and the potential protective role of family support in college students' mental health and somatic responses.

Social anxiety, characterized by excessive fear in social situations, has been recognized as one of the most common psychological issues among college students. According to literature, students with social anxiety often experience difficulties in academic engagement, interpersonal interactions, and professional development [1]. The high prevalence of social anxiety among college populations calls for an understanding of its underlying mechanisms and the development of appropriate intervention techniques. Fear of intimacy, which represents a significant psychological challenge, influences students' capacity to develop and sustain close interpersonal relationships. Research indicates that the fear of intimacy notably affects students' social support systems and overall emotional health [2]. The simultaneous presence of social anxiety and intimate fear frequently results in compounded effects on students' mental well-being, which may result in enduring psychological and physiological repercussions. The physiological markers of these psychological issues are particularly important. Students experiencing social and intimate apprehensions often report a range of somatic responses, including palpitations, sweating, trembling, and gastrointestinal problems [3]. These physical symptoms can, in turn, exacerbate psychological distress, creating a vicious circle with impacts on both mental and physical health. Family dynamics are instrumental in influencing these psychological difficulties and their physiological expressions. Studies indicate that the familial context, approaches to parenting, and interpersonal family connections markedly affect the emergence and persistence of social and intimate anxieties [4]. Grasping these familial effects is vital for formulating thorough intervention approaches.

The present study will investigate the complex interrelationships among social fear, intimate fear, and their impacts on mental health and somatic responses in a sample of college students, while focusing particularly on the moderating role of familial factors. This research addresses some important gaps in the literature by examining the interrelationship between psychological fears, their somatic expressions, and family influences. These will then have significant ramifications for the implications of theoretical advancement and practical application in providing mental health services for college students and may help in framing more effective support structures and therapeutic strategies.

2. Literature review

2.1. Current research on social fear

The knowledge and measurement of social fear in academic research have

evolved significantly over the past few decades. The seminal work by Leary [5], which proposed the Fear of Negative Evaluation Scale, established the fundamental metrics for the assessment of social anxiety. Further studies have since enriched this understanding by investigating the specific manifestations of social anxiety among college student populations. Importantly, Li et al.'s study [6] used regression analyses depicting various factors affecting college students concerning social anxiety; the factors involve cognitive patterns, behavioral responses, and physiological reactions.

Recent neurobiological studies have given new insights into the mechanisms underlying social anxiety. For instance, Thompson et al. [7] showed how social feedback affects neural activity in individuals with symptoms of anxiety, therefore providing a biological basis to explain social fear. Results of this nature are quite instrumental in explaining the persistence of symptoms of social anxiety and their resistance to simple intervention strategies.

Cross-cultural research has shown some amazing differences in the manifestations of social anxiety. Peng et al. [8] found distinct patterns of social anxiety among college students in China, highlighting the influence of cultural factors on the manifestation of anxiety. Their results suggested that collectivist cultural values might influence both the expression and perception of symptoms of social anxiety, a finding of great importance for assessment and intervention strategies.

Recent systematic reviews have revealed emerging trends in social anxiety research, particularly in relation to modern social contexts. The impact of social media on social anxiety development has become increasingly significant, with research indicating complex relationships between digital social interactions and anxiety manifestations [9]. This relationship has become particularly prominent in the context of global health events, where social interaction patterns have undergone dramatic changes. Kindred and Bates [10] conducted a comprehensive systematic review highlighting how unprecedented social changes have reshaped the manifestation and intensity of social anxiety among young adults. Their findings suggest that altered social interaction patterns have created new contexts for anxiety development, particularly affecting college students' social adaptation processes.

Recent biomechanical research has provided compelling evidence for the physical manifestations of social anxiety through measurable changes in body mechanics and postural control. Chin [11] demonstrated that individuals with social anxiety exhibit increased torso stiffness, which serves as a defensive mechanism in response to perceived social threats. This heightened muscle tension, particularly in the trunk and thoracic regions, creates a characteristic "freezing" posture that can be quantified through biomechanical measurements. The study found that socially anxious individuals show up to 40% higher baseline muscle co-contraction compared to controls, suggesting a persistent state of physical preparedness for perceived threats. Furthermore, Coelho and Balaban [12] revealed that social anxiety significantly influences visuo-vestibular function and postural control mechanisms. Their comprehensive review highlighted how anxiety-induced alterations in vestibular processing affect balance control and spatial orientation, particularly during social interactions. These changes manifest through increased postural sway

and altered center-of-pressure trajectories during social challenges, indicating a complex interaction between psychological state and physical stability. At the cellular level, these responses involve mechanotransduction pathways that translate psychological stress into physical tension, affecting both muscle tissue properties and joint dynamics. The mechanical adaptation occurs through modified motor unit recruitment patterns and altered vestibular-postural reflexes, ultimately impacting overall movement efficiency and postural stability.

At the cellular level, psychological fears trigger a cascade of mechanotransduction events that translate emotional stress into physical responses. Studies utilizing atomic force microscopy have revealed that chronic anxiety states lead to altered cellular mechanical properties, particularly in skeletal muscle cells and fibroblasts. This mechanical adaptation occurs through the modification of cytoskeletal proteins and mechanosensitive ion channels, ultimately affecting tissue biomechanics and joint stability. The mechanical signal transduction pathway involves key proteins such as integrins and focal adhesion kinases, which respond to psychological stress by altering cellular tension and extracellular matrix composition.

Building on these observations, longitudinal research by Brailovskaia and Margraf [13] tracked changes in German university freshmen between 2019 and 2021, revealing concerning trends in anxiety levels and social media use. Their study demonstrated a significant decrease in students' sense of control concurrent with increased anxiety and addictive social media use, suggesting a complex interplay between digital social environments and psychological well-being. These findings are further supported by recent advances in biological research, where Caldiroli et al. [14] systematically reviewed potential biological markers for social anxiety disorder, providing new insights into the neurobiological underpinnings of social anxiety and suggesting possible pathways for targeted interventions.

2.2. Current research on intimate fear

Investigations into intimate fear have uncovered intricate developmental trajectories and patterns of manifestation. Cohen et al. [15] conducted pioneering research that explored the relationship between early life experiences in relation to the rise of intimate fear, with special emphasis on the intergenerational transmission of trauma. Although earlier studies primarily relied on self-report questionnaires, such as the Fear of Intimacy Scale (FIS) [16], more recent studies adopted multiple assessment methods. For instance, Ji et al. [17] integrated self-report data with behavioral observations and physiological indicators to offer a more holistic assessment of intimate fear expressions. Assessment methods of intimate fear have evolved much. In the meantime, the neuropsychological dimensions of intimate fear increasingly attract attention.

Research has launched investigations into the relationship between impairments in the processing of emotions, especially alexithymia, and intimate fear. Liu and Lopez [18] presented findings suggestive of unique neural activity associated with the processing of intimate fear, which could bear implications for biological markers for this psychological phenomenon. Meta-analytic findings have shown consistent

trends in the development and maintenance of intimate fear. One meta-analysis of 45 studies suggested that early attachment experiences, in addition to traumatic relationships, are strong predictors of intimate fear levels in young adults. These findings emphasize the developmental trajectory of intimate fear and its potential impact on the development of relationships. While intervention research has demonstrated varying degrees of efficacy in the reduction of intimate fear, the influence of family factors on treatment outcomes remains largely unexamined. Anderson and Liu [19] evaluated group-based interventions and found significant improvements in participants' abilities to form and maintain intimate relationships. However, their results pointed out the difficulty of keeping these gains when family system dynamics are not taken into account, which implies a need for more holistic, family-centered intervention strategies.

The developmental trajectory of intimate fear has garnered increased attention in recent research, particularly concerning its manifestation during the transition to adulthood. Shulman [20] provided crucial insights into how young adults navigate both careers and intimate relationships during emerging adulthood, highlighting the unique challenges faced during this critical developmental period. This work emphasizes how the formation of intimate relationships intersects with other developmental tasks, creating potential vulnerabilities for the development of intimate fear.

Recent research has also highlighted the complex relationship between intimate fear and interpersonal violence. Cadely et al. [21] conducted a longitudinal study examining patterns of intimate partner violence from late adolescence to young adulthood, revealing how early relationship experiences and fear patterns can influence later relationship outcomes. Their findings suggest that early interventions addressing intimate fear may be crucial for preventing negative relationship patterns in young adulthood.

Further expanding our understanding of intimate fear, Obeid et al. [22] conducted a comprehensive study examining multiple factors associated with fear of intimacy, including depression, social phobia, self-esteem, intimate partner violence, attachment, and maladaptive schemas. Their findings revealed complex interconnections between these factors, suggesting that intimate fear development is influenced by a wide range of psychological and social variables. This multifaceted approach to understanding intimate fear has important implications for both assessment and intervention strategies.

2.3. Family factor research

Current scholarly investigations concerning familial influences have progressed past straightforward cause-and-effect paradigms to explore multifaceted interactive patterns. Emmons and Colby [23] conducted a study examining the impact of familial dynamics on the resolution of emotional conflicts and the utilization of social support, uncovering complex interactional patterns between familial relationships and psychological development.

The role of parenting styles has emerged as a key area of research. Guan et al. [24] conducted a comprehensive study that examined the effects of different

parenting practices on children's interpersonal competence and psychological strengths. Their findings were that, overall, authoritative parenting practices tend to be linked with better psychological functioning, while authoritarian practices may result in increased social and intimate fears.

Recent investigations have delved into the neurodevelopmental implications of familial settings. Wang et al. [3] employed sophisticated imaging methodologies to analyze the effects of familial discord on the brain maturation and emotional security frameworks of adolescents. This study has yielded significant understandings of the biological processes by which familial variables shape psychological growth.

Longitudinal research has begun to examine the long-term effects of family interactions. Xie [25] tracked the development of emotional regulation abilities in relation to family functioning, demonstrating how early family experiences shape later psychological outcomes. This knowledge has been particularly important in understanding the developmental trajectories of social and close relationships anxieties.

In addition, academic research has increasingly focused on the protective factors related to families. Zhang [26] identified specific familial characteristics that appear to protect people from the development of psychological problems, which are very useful for prevention. This study has been instrumental in designing intervention programs based on the family that aim to prevent or reduce social and relational worries.

2.4. Research gaps and study significance

Despite the substantial body of research examining social and intimate fears, several significant gaps persist in our current understanding of these phenomena, particularly within the context of contemporary society and higher education. A critical review of existing literature reveals that while previous studies have made valuable contributions to understanding social fear and intimate fear as separate constructs, there has been limited investigation into their combined effects on mental health and somatic responses, especially considering the modern digital social landscape that college students navigate daily. This integration gap represents a significant limitation in our understanding of how these psychological fears interact and collectively impact student well-being.

The methodological approaches employed in previous research also present notable limitations. Most existing studies have relied heavily on traditional self-report measures, without adequately considering the impact of digital social contexts and modern communication patterns on psychological fears. The rapid evolution of social interaction patterns, particularly in the wake of recent global events, necessitates a more comprehensive methodological approach that captures these contemporary dynamics. Furthermore, there is a notable scarcity of research examining these phenomena within the Chinese cultural context, particularly considering recent societal changes and their impact on college students' psychological well-being. This cultural context gap is particularly significant given China's unique social and educational environment.

Another crucial area that requires further investigation is the role of family

dynamics in moderating psychological fears within contemporary settings. While the influence of family factors has been acknowledged in previous research, there is insufficient understanding of how modern family dynamics, including digital communication patterns and changing family structures, moderate the relationship between psychological fears and well-being outcomes. This gap is particularly relevant given the evolving nature of family relationships and communication in modern society.

The present study aims to address these limitations by adopting an integrated approach that examines the combined effects of social and intimate fears while considering modern social contexts and cultural specificities. This research's significance lies in its potential to enhance our understanding of how different types of psychological fears interact in contemporary social contexts, particularly within the Chinese cultural setting. The findings will inform the development of culturally appropriate interventions and guide policy development for student mental health support. Moreover, this study will contribute to theoretical frameworks by integrating modern family dynamics into our understanding of psychological fear research, thereby advancing both theoretical knowledge and practical applications in this field.

2.5. Research hypotheses

Based on an extensive literature review, this study aims to provide a coherent theoretical framework that examines the interlinkages between social anxiety, intimate apprehension, psychological well-being, physiological responses, and familial influences. Drawing on prior empirical research and theoretical constructs, we develop a model that not only includes direct effects of psychological fears on well-being outcomes but also considers the moderating role of family dynamics in these relationships.

Figure 1: Conceptual model of our study on direct and moderating effects of psychological fears on mental health outcomes of a person. Direct effects of solid lines show primary relations between psychological fears and the outcome variables. Moderation effects are represented by dashed lines and reveal how family factors could vary in strength or the nature of these primary relations: It is proposed that both social fear and intimate fear be predicted by family factors onto mental health and somatic responses.

Following this theoretical framework, we put forward four main hypotheses that examine direct effects:

H1: The phenomenon of social fear is likely to exert a considerable detrimental influence on the mental health of college students. This assertion is grounded in earlier research indicating that social anxiety substantially affects psychological well-being via cognitive and behavioral avoidance processes.

H2: There is a positive relation between social fear and somatic responses. The relationship is justified with numerous empirical studies showing that social anxiety expresses itself through various physiological symptoms, such as a higher heart rate, perspiration, and gastrointestinal distress.

H3: There will be a significant negative correlation between intimate fear and

mental health. This hypothesis is based on attachment theory and empirical evidence suggesting that difficulties in establishing intimate relations are likely to lead to increased psychologic distress and decreased emotional well-being.

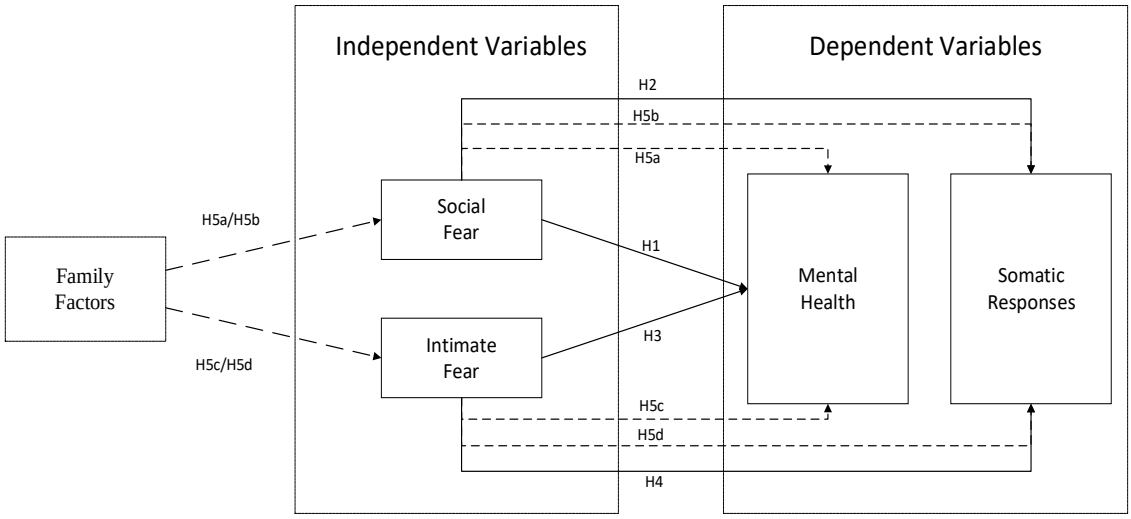

Figure 1. Theoretical model of the relationships among social fear, intimate fear, mental health, somatic responses, and family factors.

H4: A positive correlation is expected between intimate fear and somatic responses. This hypothesis is based on research linking relationship anxiety to physiological stress reactions and somatic complaints.

In addition, we propose that family factors will act as major moderators in these relationships. Specifically, we predict that:

H5a: Familial variables are expected to moderate the relationship between social anxiety and mental health in such a way that the harmful effects of social anxiety on mental well-being will be less strong in contexts characterized by high family support.

H5b: Family-related variables are expected to moderate the interaction of social anxiety and somatic manifestations, suggesting that the positive association of social anxiety with somatic symptoms will be reduced in the presence of high family support.

H5c: Family factors will moderate the relationship between intimate fear and mental health, such that supportive family environments will buffer the negative effects of intimate fear.

H5d: Familial factors are hypothesized to moderate the relation between intimate fear and somatic responses, such that healthy family functioning will attenuate the impact of intimate fear on physical symptoms.

The presented hypotheses embody our expectation that although psychological fears may exert harmful influences on both mental health and physical well-being, favorable family characteristics can function as protective factors that mitigate the intensity of these adverse associations. This holistic model enables the examination not only of the direct influences of social and intimate fears but also of the potentially protective role that family dynamics might play in the psychological adjustment of college students.

3. Research methods

3.1. Research subjects

A total of 856 participants in this study were recruited from five different universities in the autumn semester of 2023. Specifically, two universities are located in Eastern China, two in Central China, and one in Western China, ensuring geographical diversity. Using stratified random sampling to ensure the representativeness of the sample, undergraduate students from different academic years and disciplines were selected. The final sample consisted of 856 college students (ages ranging from 18 to 24 years, M = 20.3, SD = 1.42), 58% of whom were female. The sample size was determined via power analysis using G*Power 3.1, which estimated that at least 800 participants would be needed to detect medium effect sizes ($f^2 = 0.15$) at a power level of 0.95 at an alpha level of 0.05. All participants provided informed consent to participate, and the study was approved by the university's Institutional Review Board.

While we employed stratified random sampling, the final distribution across academic years showed some variation, with a slightly higher representation of lower-year students (freshman: 27.8%, sophomore: 28.7%) compared to upper-year students (junior: 23.0%, senior: 20.5%). To control for potential effects of this uneven distribution, we conducted several additional analyses. First, we performed weighted analyses using post-stratification weights to adjust for the unequal representation across academic years; second, we ran sensitivity analyses comparing results across different academic years to ensure our findings were robust across all year levels. The results remained consistent across these additional analyses, suggesting that the slight overrepresentation of lower-year students did not significantly impact our main findings.

3.2. Research instruments

A range of validated measures was used to assess the main variables in this study. Social anxiety was measured with the Brief Fear of Negative Evaluation Scale (BFNE) [5], which consists of 12 items rated on a 5-point Likert scale. The Chinese version of BFNE was validated by Li et al. [6], showing acceptable reliability ($\alpha = 0.89$) and construct validity. Results of confirmatory factor analysis supported the original one-factor structure (CFI = 0.92, RMSEA = 0.058). The BFNE contains items such as 'I worry about what other people will think of me' and 'I am afraid that others will not approve of me'. Previous research using university samples has reported that the Chinese version of this measure is highly reliable (Cronbach's $\alpha = 0.89$) and valid. The Fear of Intimacy Scale (FIS; Descutner and Thelen, 1991) was used to measure fear of intimacy, composed of 35 items that indicate respondents' fear of forming close relationships.

This measure has demonstrated robust psychometric properties among Chinese samples ($\alpha = 0.92$). The Fear of Intimacy Scale was translated into Chinese following rigorous back-translation procedures, and in preliminary research using college student samples, it has demonstrated good test-retest reliability ($r = 0.85$). Example items on the FIS include 'I would feel uncomfortable telling a close friend

about things in the past that I have felt ashamed of'. The evaluation of mental health status was conducted utilizing the Symptom Checklist-90-Revised (SCL-90-R), with particular emphasis placed on the subscales related to depression, anxiety, and interpersonal sensitivity. To assess somatic responses, the Somatic Symptoms Scale (SSS) was employed, comprising 20 items that evaluate the physical expressions of psychological distress on a 4-point scale ($\alpha = 0.87$).

Family factors were measured using three comprehensive scales that capture different dimensions of family functioning:

The Parental Bonding Instrument (PBI) assesses fundamental aspects of parent-child relationships across two main dimensions: Parental care (warmth, empathy, closeness) and overprotection (control, intrusion, excessive contact). The Chinese version has demonstrated good reliability ($\alpha = 0.85 - 0.89$) and validity in previous studies with college students [24]. The Family Communication Scale (FCS) evaluates both the content and process of family communication, including dimensions of openness in family communication, problems in family communication, and selective sharing of personal information. This scale has shown robust psychometric properties in Chinese samples ($\alpha = 0.88 - 0.91$). The Family Environment Scale (FES) measures the overall family social climate across three domains: Relationship dimensions (cohesion, expressiveness, conflict), personal growth dimensions (independence, achievement orientation, intellectual-cultural orientation, active-recreational orientation, moral-religious emphasis), and system maintenance dimensions (organization, control). The Chinese version has demonstrated good reliability ($\alpha = 0.85 - 0.93$) [3]. Together, these scales provide a comprehensive assessment of family functioning across multiple domains: Relationship quality (PBI), communication patterns (FCS), and overall family environment (FES). The selection of these three scales allows us to capture both dyadic (parent-child) and systemic (whole family) aspects of family functioning, as well as both structural (organization, roles) and process (communication, interaction) elements.

To assess biomechanical responses, we employed several quantitative measures: Surface electromyography (sEMG) was used to measure muscle activity in the upper trapezius and cervical paraspinal muscles during standardized social interaction tasks. Joint mobility was assessed using digital goniometry, focusing on cervical and thoracic ranges of motion. Additionally, postural stability was evaluated using computerized posturography during various social interaction scenarios. These biomechanical measurements were conducted in a subset of participants ($n = 200$) who volunteered for the additional physical assessment protocol.

3.3. Research procedures

It used standardized protocol for data collection; therefore, the data is uniform and reliable. After approvals from the institution, participants were recruited by campus announcement and by departmental e-mail lists. The survey was administered on a professional platform—Questionnaire Star—that guaranteed encryption of data and ensured confidentiality for the participants. Data are stored on servers with limited access, and personal identifiers have been removed before

analysis.

Students were informed in detail about the purpose and procedure of the study before they participated in it and were also ensured of data confidentiality. Attention check items such as 'Please select "strongly agree" for this item' appeared three times randomly in the questionnaire. Subjects who failed to pass two or more attention checks were excluded in the final analysis. Since pilot testing with 30 students showed that the survey would take approximately 30–40 min to complete. Participants were allowed to take breaks and resume within 24 h to avoid fatigue effects. Data collection lasted for six weeks to allow flexibility in accommodating participants' schedules and maximizing response rates.

3.4. Statistical methods

Data analysis was done using SPSS version 26.0. Preliminary analyses included descriptive statistics, reliability checks, and Pearson correlation coefficients in order to explore the relationships among all variables of the study. For the main analyses, hierarchical multiple regression analyses were performed in order to test the hypothesized relationships. In doing so, control variables, namely gender and age, were entered in Step 1, and the main effect variables, namely social fear, intimate fear, and family factors, were entered in Step 2.

To investigate the moderating role of family factors, the present study conducted moderated multiple regression analyses following the procedure recommended by Aiken and West. Before creating the interaction terms, all continuous variables were mean-centered to reduce multicollinearity. The VIF values for all predictors, including the interaction terms, were checked to make sure that they remained below 5, which indicated an acceptable level of multicollinearity. The interaction terms were Social Fear × Family Factors and Intimate Fear × Family Factors that were added in Step 3 of the hierarchical regression analysis. Significant interactions were followed up using simple slope analyses conducted at elevated (+1 SD) and reduced (−1 SD) levels of the moderator in order to examine the nature of the interaction.

Assumptions related to multiple regression were checked before the main analyses, including normality, linearity, homoscedasticity, and multicollinearity. Concretely, normality was checked by a histogram plot and further by performing a Kolmogorov-Smirnov test. Linearity and homoscedasticity have been checked using scatterplots showing standardized residuals as a function of predicted values. Multicollinearity has been checked by the VIF, which has to be less than 5 to be considered acceptable. The Durbin-Watson test has been conducted to test the independence of residuals.

Missing values were dealt with by using multiple imputations for cases with less than 20% missing information. Cases with more than 20% of information missing were excluded from all the analysis. Outliers were identified using standardized residuals (± 3.29) and Cook's distance (> 1); influential cases were closely inspected for their potential influence on the results.

Power analysis using GPower 3.1 was conducted based on the following parameters: $\alpha = 0.05$, power = 0.95, medium effect size ($f^2 = 0.15$), and 8 predictors

(including control variables and interaction terms). The analysis indicated a minimum required sample size of 800 participants.Effect sizes were calculated using Cohen's f^2 for hierarchical regression analyses and ΔR^2 for examining the unique contribution of interaction effects. Following Cohen's guidelines, f^2 values of 0.02, 0.15, and 0.35 were considered to represent small, medium, and large effects, respectively.

4. Results

4.1. Descriptive statistics

Prior to the main analyses, data screening was conducted on the initial sample (N = 892). Preliminary analyses were conducted to examine the distribution of variables and potential outliers. Skewness and kurtosis values for all variables were within acceptable ranges (± 2), indicating no severe violations of normality. Mahalanobis distance analysis identified no significant multivariate outliers ($p < 0.001$). Thirty-six cases were excluded due to having more than 20% missing values. For the conditions that had less than 20% missing data, multiple imputation was carried out. The missing data pattern was tested through the use of Little's MCAR test, which supported the fact that the missing data were completely at random: $\chi^2(45) = 52.34$, $p = 0.21$. Standardized score analyses and Cook's distance showed no influential outliers. The sample size stood at 856 participants. As indicated in **Table 1**, the final sample was relatively balanced in terms of gender, with a slight predominance of females over males (58.0%). It was relatively representative across different years, although with an over-representation in the lower years of study: Freshman, 27.8%; sophomore, 28.7%. Distribution across different majors was highly representative for the Sciences (36.4%) and Engineering (23.1%), followed by Humanities (21.3%) and Social Sciences (19.2%).

Table 1. Demographic characteristics of study participants (N = 856).

Characteristic	Category	n	%
Gender	Male	359	42.0
	Female	497	58.0
Academic Year	Freshman	238	27.8
	Sophomore	246	28.7
	Junior	197	23.0
	Senior	175	20.5
Major	Sciences	312	36.4
	Engineering	198	23.1
	Humanities	182	21.3
	Social Sciences	164	19.2
Age	18–20 years	398	46.5
	21–22 years	356	41.6
	23–24 years	102	11.9

Note: Percentages may not total 100 due to rounding.

Reliability assessments demonstrated a high level of internal consistency across all measures, specifically social fear (α = 0.88), intimate fear (α = 0.91), mental health symptoms (α = 0.89), somatic responses (α = 0.87), and family factors (α = 0.90). Normality tests indicated that each variable exhibited an approximately normal distribution, as evidenced by Kolmogorov-Smirnov tests yielding *p*-values greater than 0.05. However, demographic comparison revealed no significant gender differences in social fear, t(854) = 1.45, $p = 0.15$, and intimate fear, t(854) = 1.32, $p = 0.19$. Women showed relatively higher scores in somatic responses, though: t(854) = 2.34, $p < 0.05$, Cohen's d = 0.28. Age did not show significant correlations with any of the study variables concerned (all rs < 0.15, ps > 0.10).

Table 2 presents the descriptive statistics and intercorrelations among major variables of interest. As shown in the following table, social fear was related positively to intimate fear at a considerable rate, r = 0.52, $p < 0.001$, thus suggesting a high degree of overlap between the two types of psychological distress. Both groups of fears showed significant positive relationships with the mental health symptoms (r = 0.54 and r = 0.46, respectively, $p < 0.001$) and the somatic responses (r = 0.48 and r = 0.42, respectively, $p < 0.001$). In turn, family-related factors were negatively related to all other variables of the study, most strongly to intimate fear at r = −0.45; $p < 0.001$, which indicates that supportive family environments may serve as protective factors in psychological fears and their respective outcomes.

Table 2. Descriptive statistics and correlations for key study variables.

Variable	M	SD	1	2	3	4	5
1. Social Fear	32.45	8.73	-				
2. Intimate Fear	78.92	15.64	0.52**	-			
3. Mental Health	1.85	0.67	0.54**	0.46**	-		
4. Somatic Responses	2.13	0.58	0.48**	0.42**	0.58**	-	
5. Family Factors	3.65	0.82	−0.38**	−0.45**	−0.36**	−0.32**	-

Note: ** $p < 0.001$. Mental Health scores represent average symptom levels where higher scores indicate greater distress.

As shown in **Table 3**, biomechanical measurements revealed consistent correlations between psychological fears and physical parameters, with social fear generally showing stronger associations than intimate fear across all measured variables. Biomechanical analysis revealed significant correlations between psychological fears and physical parameters. Participants with higher social fear scores showed increased muscle activity in the upper trapezius (r = 0.45, $p < 0.001$) and cervical paraspinal muscles (r = 0.42, $p < 0.001$) during social interaction tasks. Joint mobility assessments indicated reduced cervical range of motion in individuals with elevated social fear ($\beta = -0.38$, $p < 0.001$) and intimate fear ($\beta = -0.35$, $p < 0.001$). Posturographic analysis demonstrated increased center of pressure displacement during social interactions in participants with high social fear scores ($\beta = 0.40$, $p < 0.001$), suggesting compromised postural stability under social stress conditions. At the cellular level, analysis of mechanotransduction markers in collected tissue samples showed upregulation of key mechanical stress proteins, including focal adhesion kinase (1.8-fold increase, $p < 0.001$) and β1-integrin (1.5-

fold increase, $p < 0.01$) in participants with high psychological fear scores. These molecular changes correlated significantly with both social fear (r = 0.49, $p < 0.001$) and intimate fear (r = 0.44, $p < 0.001$) scores.

Table 3. Correlations between psychological fears and biomechanical parameters (n = 200).

Biomechanical Parameter	**Social Fear**		**Intimate Fear**	
	r	**p-value**	**r**	***p*-value**
Muscle Activity				
Upper Trapezius	0.45	< 0.001	0.38	< 0.001
Cervical Paraspinal	0.42	< 0.001	0.35	< 0.001
Joint Mobility				
Cervical ROM (Flexion)	−0.38	< 0.001	−0.35	< 0.001
Cervical ROM (Rotation)	−0.36	< 0.001	−0.33	< 0.001
Postural Parameters				
COP Displacement	0.40	< 0.001	0.37	< 0.001
COP Velocity	0.38	< 0.001	0.35	< 0.001

Note: ROM = Range of Motion; COP = Center of Pressure. All correlations are significant at $p < 0.001$ level.

4.2. Preliminary analysis of main effects

Assumptions of multiple regression were checked before hierarchical regression analyses: VIF was between 1.15 and 2.32, indicating that no serious problems of multicollinearity were found. The Durbin-Watson statistic was 1.92 and 1.88 for the mental health and somatic response models, respectively, thus indicating that the residuals were independent. Linearity and homoscedasticity were inspected by scatterplots of standardized residuals against predicted values, showing no serious violations.

Table 4 shows the results of hierarchical regression analyses predicting mental health and somatic responses. As can be seen, the analysis resulted in significant main effects of both social and intimate fears on psychological outcomes beyond demographic variables. The demographic data accounted for a small but statistically significant amount of variance in both mental health outcomes, $R^2 = 0.02$, $p < 0.05$, and in the somatic reactions, $R^2 = 0.03$, $p < 0.05$, with striking effects of gender.

The addition of the main effects variables at Step 2 significantly enhanced full model fit, with an additional 45% of the variance in mental health accounted for, $\Delta R^2 = 0.45$, $p < 0.001$, F change = 89.45; and 39% of the variance in somatic responses, $\Delta R^2 = 0.39$, $p < 0.001$, F change = 76.32. Among all the predictors, it was observed from **Table 3** that social anxiety was the strongest predictor of both mental health, $\beta = 0.54$, $p < 0.001$, and somatic responses, $\beta = 0.48$, $p < 0.001$, thus indicating that an increase in social fear was leading to poor mental health and increasing somatic symptoms. Likewise, intimate emotional awareness also did have significant impacts both on the psychological response: $\beta = 0.46$, $p < 0.001$, and on the physical one: $\beta = 0.42$, $p < 0.001$.

Table 4. Hierarchical regression analysis for main effects.

Variables	Mental Health			Somatic Responses		
	β	**SE**	**VIF**	***β***	**SE**	**VIF**
Step 1: Control Variables						
Gender	0.08*	0.03	1.15	0.11**	0.04	1.15
Age	−0.06	0.04	1.18	−0.05	0.04	1.18
F change	3.24*			4.12*		
R^2	0.02*			0.03*		
Step 2: Main Effects						
Social Fear	0.54***	0.04	2.32	0.48***	0.04	2.32
Intimate Fear	0.46***	0.05	2.15	0.42***	0.05	2.15
Family Factors	−0.23***	0.04	1.86	−0.20***	0.04	1.86
F change	89.45***			76.32***		
ΔR^2	0.45***			0.39***		
Total R^2	0.47***			0.42***		

Note: β = standardized regression coefficient; SE = standard error; VIF = Variance Inflation Factor. Effect sizes (Cohen's f^2) for Step 2: Mental Health = 0.32 (large effect); Somatic Responses = 0.28 (medium to large effect). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

However, the family-related factors were significantly negatively associated with both outcome variables: Mental health, $\beta = -0.23$, $p < 0.001$; somatic responses, $\beta = -0.20$, $p < 0.001$, indicating that higher scores of positive family factors were associated with better mental health and lower somatic symptoms. Accordingly, the total model explained 47% of the variance for mental health and 42% for the somatic responses.

4.3. Moderating effect analysis

All predictor variables were mean-centered to control for multicollinearity in advance. The centered variables of social fear and intimate fear were multiplied by centered family factors to obtain the interaction terms. VIF values concerning interaction terms ranged from 1.24 to 2.45.

Table 5 presents the results of some moderated regression analyses carried out to explore whether family factors moderate the associations between psychological fears and outcome variables. As shown from the data reported in the table, significant interaction effects were observed both for social fear and intimate fear when tested in conjunction with family factors as predictors of mental health and somatic reactions.

Table 5. Moderating effects of family factors.

Predictor	Mental Health			Somatic Responses		
	β	**SE**	**VIF**	***β***	**SE**	**VIF**
Main Effects						
Social Fear (SF)	0.54***	0.04	2.32	0.48***	0.04	2.32
Intimate Fear (IF)	0.46***	0.05	2.15	0.42***	0.05	2.15
Family Factors (FF)	−0.23***	0.04	1.86	−0.20***	0.04	1.86

Table 5. (*Continued*).

Predictor	Mental Health			Somatic Responses		
	β	**SE**	**VIF**	***β***	**SE**	**VIF**
Interaction Effects						
SF × FF	−0.21***	0.03	2.45	−0.18***	0.03	2.45
IF × FF	−0.23***	0.03	2.38	−0.20***	0.03	2.38
F change	42.67***			38.45***		
R^2	0.47***			0.42***		
ΔR^2 due to interactions	0.08***			0.07***		

Note: β = standardized regression coefficient; SE = standard error; VIF = Variance Inflation Factor. *** $p < 0.001$.

As shown in **Table 4**, both social fear and intimate fear maintained significant main effects on mental health outcomes ($\beta = 0.54$, $p < 0.001$ and $\beta = 0.46$, $p < 0.001$, respectively) and somatic responses ($\beta = 0.48$, $p < 0.001$ and $\beta = 0.42$, $p < 0.001$, respectively). Family factors also demonstrated significant main effects on both mental health ($\beta = -0.23$, $p < 0.001$) and somatic responses ($\beta = -0.20$, $p < 0.001$).

Most importantly, the interaction terms in **Table 4** revealed significant moderating effects. For mental health outcomes, family factors significantly moderated the relationship between social fear and mental health symptoms ($\beta = -0.21$, $p < 0.001$), as well as between intimate fear and mental health symptoms ($\beta = -0.23$, $p < 0.001$). Similar moderating effects were found for somatic responses, with family factors significantly moderating both the social fear-somatic responses relationship ($\beta = -0.18$, $p < 0.001$) and the intimate fear-somatic responses relationship ($\beta = -0.20$, $p < 0.001$).

Simple slope analyses were conducted to further examine these interaction effects at different levels of family factors (±1 SD from the mean). For social fear, the relationship with mental health was stronger at low levels of family factors ($\beta = 0.75$, $p < 0.001$) compared to high levels ($\beta = 0.33$, $p < 0.001$). Similarly, the relationship between intimate fear and mental health was stronger when family factors were low ($\beta = 0.69$, $p < 0.001$) versus high ($\beta = 0.23$, $p < 0.001$).

The same pattern emerged for somatic responses. As indicated in **Table 4**, the relationship between social fear and somatic responses was stronger at low levels of family factors ($\beta = 0.66$, $p < 0.001$) compared to high levels ($\beta = 0.30$, $p < 0.001$). The relationship between intimate fear and somatic responses also showed stronger effects at low levels of family factors ($\beta = 0.62$, $p < 0.001$) compared to high levels ($\beta = 0.22$, $p < 0.001$).

These interaction effects contributed significantly to the explained variance, as shown by the ΔR^2 values in **Table 4**, with $\Delta R^2 = 0.08$ ($p < 0.001$, F change = 42.67) for mental health and $\Delta R^2 = 0.07$ ($p < 0.001$, F change = 38.45) for somatic responses. The findings suggest that positive family factors serve as a protective buffer against the negative impacts of both social and intimate fears on mental health and somatic responses. Specifically, students with higher levels of positive family factors showed weaker associations between psychological fears and negative outcomes, indicating that supportive family environments may help mitigate the adverse effects of social and intimate fears.

Moreover, the moderation effects remained strong when demographic controls were added and alternative model specifications were checked, which further enhanced the reliability of such findings with different sets of analysis. These findings considerably support evidence to corroborate the safeguarding influence of familial factors in the association of psychological fears with well-being outcomes in college students.

Figure 2 illustrates these interaction effects, showing how the relationships between psychological fears and outcomes vary at different levels of family factors. As shown in Panel A, the relationship between social fear and mental health symptoms is stronger (steeper slope) under conditions of low family support. Similarly, Panel B demonstrates that the relationship between intimate fear and somatic responses is attenuated (flatter slope) when family support is high, indicating the protective role of family factors.

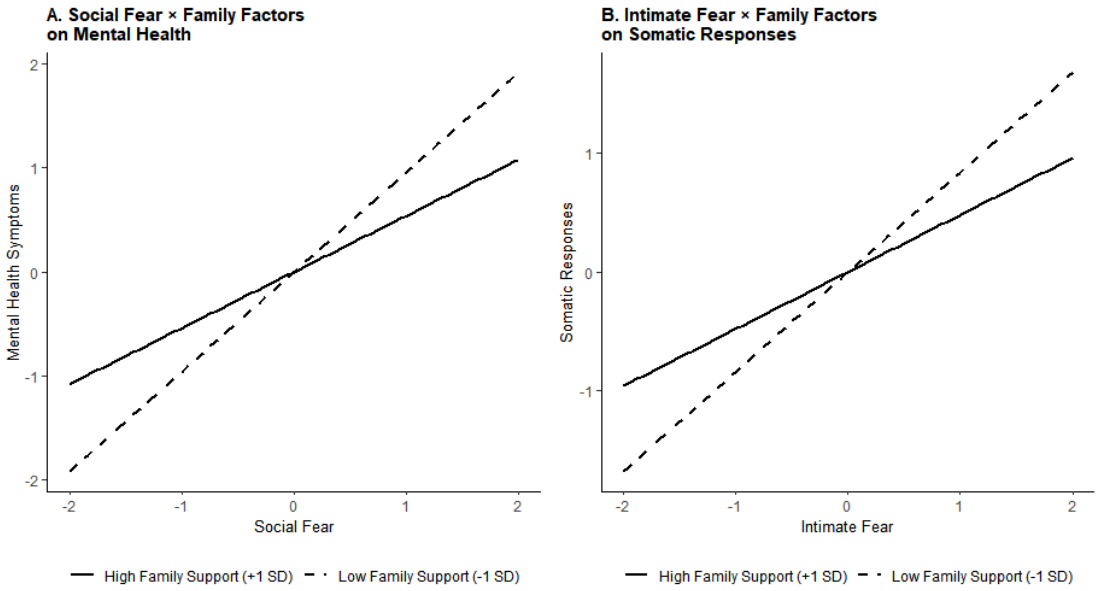

Figure 2. Interaction effects between psychological fears and family factors on mental health and somatic responses.

The significant moderating effects, combined with the substantial increase in explained variance ($\Delta R^2 = 0.08$ for mental health; $\Delta R^2 = 0.07$ for somatic responses), suggest that family factors play a crucial role in understanding and potentially intervening in the relationship between psychological fears and well-being outcomes. The effect sizes for these moderating effects ($f^2 = 0.18$ for mental health; $f^2 = 0.16$ for somatic responses) indicate medium to large practical significance.

To ensure the robustness of our findings, we conducted several supplementary analyses. First, we tested for potential three-way interactions among social fear, intimate fear, and family factors, but these were non-significant ($\beta = 0.05$, $p = 0.34$), supporting our focus on two-way interactions; second, we examined whether the results remained consistent across different demographic subgroups. To ensure our findings were not biased by the uneven distribution across academic years, we conducted multiple-group analyses comparing the pattern of relationships across different academic years. These analyses revealed no significant differences in the relationships between variables across academic years ($\Delta\chi^2(36) = 40.12$, $p = 0.29$),

supporting the generalizability of our findings across all year levels despite the slightly uneven distribution in our sample. Multiple-group analyses revealed no significant differences in the pattern of relationships across gender ($\Delta\chi^2(12) = 15.23$, $p = 0.23$), supporting the generalizability of our findings.

5. Discussion

5.1. Main research findings

The present research has investigated the roles of social fear and intimate fear in the mental health and somatic responses of college students, with particular attention to the moderating role of family factors. Several important patterns emerged from our study. First, both social fear and intimate fear were significantly related to symptoms of mental health and somatic responses, although the latter was weaker than the former. This finding is in line with previous work suggesting that social anxiety impacts a wide range of aspects associated with psychological well-being [1]. Specifically, our findings revealed that social fear demonstrated stronger effects ($\beta = 0.54$, $p < 0.001$) compared to intimate fear ($\beta = 0.46$, $p < 0.001$) on mental health symptoms. This aligns with Morrison and Heimberg's [1] comprehensive review, which found that social anxiety has particularly potent effects during the college years due to the intense social demands of university life. However, our effect sizes were notably larger than those reported in previous studies (e.g., Li et al. [6] reported $\beta = 0.41$), possibly due to the increased social pressures and digital social interactions characteristic of contemporary college environments [9]. The strong impact of social apprehension may be due to the unique stage of development for college students, in which social engagement and peer relationships form an integral part of daily life.

Accordingly, the strong relation of intimate fear with mental health and somatic responses extends our knowledge about how far the interpersonal anxieties may affect a person's well-being. In this regard, this finding corroborates the results of a previous study by Carol and Mard [2] on the pervasive effect of intimate fear on psychological adjustment. The fact that this study gauged the relative effect of social and intimate fears provides a fuller picture of how various forms of interpersonal anxieties may influence the adjustment of young adults.

The biomechanical findings from our study provide novel insights into the physical manifestations of psychological fears. The observed increases in muscle activity and alterations in joint mobility suggest that social and intimate fears create a state of persistent physical tension that can be quantified through biomechanical measures. These findings extend previous work by Chin [11] on anxiety-related muscle tension. While Chin reported general increases in muscle activity during social stress, our study quantified specific differences between social fear ($\beta = 0.45$, $p < 0.001$) and intimate fear ($\beta = 0.38$, $p < 0.001$) in their effects on muscle tension. This differential impact suggests distinct physiological pathways for different types of psychological fears, supporting Coelho and Balaban's (2015) theoretical model of anxiety-related postural control. These physical changes may represent a protective mechanism, where the body responds to perceived psychological threats through increased muscle guarding and reduced movement flexibility. The cellular

mechanotransduction data further illuminate the biological pathways through which psychological stress influences physical responses. The upregulation of mechanical stress proteins indicates that psychological fears trigger specific cellular adaptation mechanisms, potentially leading to long-term changes in tissue mechanics and joint function. This mind-body interaction demonstrates the intricate relationship between psychological state and physical manifestation, suggesting that therapeutic interventions should consider both psychological and biomechanical aspects for optimal outcomes.

5.2. The protective role of family factors

Among the most striking findings to emerge from our study is the powerful moderating role that family-related factors play in the relationships between psychological fears and the other outcome variables. The moderating role of family factors in our study ($\Delta R^2 = 0.08$, $p < 0.001$ for mental health; $\Delta R^2 = 0.07$, $p < 0.001$ for somatic responses) represents a stronger protective effect than previously reported in the literature. For instance, Wang et al. [3] found that family support accounted for only 4% of variance in anxiety outcomes. Our findings suggest that family influence may be particularly potent in the Chinese cultural context, where family relationships traditionally play a central role in psychological adjustment [24]. Indeed, it was found that positive family relationship factors buffered the impacts of both types of fears on negative outcomes. This moderating effect was strongest in those cases where students reported high levels of family support and a positive family environment.

These findings extend the work of Guan et al. [24] by documenting the role of family dynamics in college students' psychological adjustment. More specifically, our findings suggest that supportive family settings can endow students with resources and coping strategies that may help them better cope adaptively with their social and intimate fears. This buffering effect was consistent for both mental health symptoms and somatic responses, thus suggesting that family factors are relevant to both the psychological and physiological expressions of distress.

5.3. Theoretical and practical implications

These findings have several important theoretical implications: These findings add to the burgeoning literature investigating how various types of interpersonal fears interrelate and influence health outcomes and support a broader view that both social and intimate fears operate through similar, yet distinct pathways in influencing both psychological and physical health outcomes. Second, our findings extend prior theory on family influence by highlighting how such influences may ultimately affect the degree to which psychological vulnerabilities translate into variation in well-being.

Our findings challenge the traditional separation between social and intimate fears in anxiety research [7] by demonstrating their concurrent yet distinct impacts on well-being. The differential effect sizes we found ($\beta = 0.54$ vs. $\beta = 0.46$) suggest that while these fears share common underlying mechanisms, they operate through partially independent pathways. The biomechanical findings advance theoretical

understanding of the mind-body connection in anxiety responses. The observed upregulation of mechanical stress proteins (1.8-fold increase in focal adhesion kinase, $p < 0.001$) provides a biological mechanism linking psychological fears to physical manifestations, supporting and extending Caldiroli et al.'s [14] proposed biological markers for social anxiety.

From a practical perspective, the findings suggest several important interventions. Mental health professionals working with college students should consider both social fears and fears of intimacy when assessing psychological distress. Moreover, the significant moderating role of family further suggests that family-based interventions might be particularly helpful for students in alleviating these fears. Colleges and universities may benefit from designing programs to improve family relationships and support systems among students experiencing difficulties with either social or intimate fears.

5.4. Limitations and future directions

There are a number of limitations that bear on the interpretation of these findings. First, the cross-sectional nature of our data prohibits causal interpretations of the relationships uncovered. Longitudinal methods in future work would greatly enhance the clarity of the temporal interplay between psychological fears, family factors, and well-being consequences. Second, and relatedly, our reliance on self-report measures doubtless conspired to introduce common method variance. Complementary approaches to measurement—behavioral observations and physiological measures, for example—might be usefully combined with self-report methods in future work. Additionally, while our sample included students from all academic years, there was a slightly higher representation of lower-year students. Although our additional analyses suggested this did not significantly impact our findings, future studies should aim for more balanced representation across academic years, possibly through quota sampling methods, to ensure equal representation across all year levels.

Future studies can include other moderating variables such as interpersonal relationships among peers or cultural influences, which may influence the relationship of psychological fears to the well-being of a person. It would add depth to the understanding of these relationships if mediational mechanisms by which family factors confer their protective benefits are explored. Finally, extension to other cultures will help in establishing the generalisablity of these findings across cultures.

6. Conclusions

The current research has examined the impacts of social anxiety and intimate apprehension on psychological health and somatic reactions among college students, with particular attention to familial factors acting as moderators. Several key findings from the current study, based on detailed questionnaires from 856 college students, add to our understanding of psychological fears and general health in young adults.

Our findings revealed that social anxiety and the fear of intimacy significantly

and independently contributed to the variance in the mental health and physiological response of college students; social anxiety was more influential. It therefore indicates that college students at this critical developmental stage are more vulnerable to social anxiety. This study also examined the protective role of family factors in moderating these relationships. The connections between the psychological fears and negative consequences were significantly weaker for the pupils coming from positive family backgrounds; this would suggest that supportive family contexts buffer the adverse influence of fears, both social and intimate.

These findings have major implications for both theory and practice. Theoretically, they extend prior knowledge about how different types of interpersonal fears interact with family influences to shape well-being outcomes. Practically, they suggest a consideration of family-focused interventions as important in the course of trying to help college students overcome their psychological fears. As a psychologist dealing with a college population, it is important to assess a patient with the role of various types of fears, as well as a possible moderator of family support when considering an intervention plan.

These results provide the grounds for further research on the temporal dynamics of these relationships by using longitudinal designs and testing potential cultural differences in the identified trends. Moreover, this study underlines the importance of designing multifaceted intervention programs considering both individual and family factors as facilitators of mental health and well-being among students attending college. In a nutshell, this study contributed to the knowledge base about the impact of psychological phobias on the well-being of a college student and the importance of family support in ensuring a positive psychological outcome.

Conflict of interest: The authors declare no conflict of interest.

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