Pharmacy Education (2024) 24(1) 382 - 393
https://doi.org/10.46542/pe.2024.241.382393

RESEARCH ARTICLE

Assessment of pharmacy students' anxiety towards graduation research during their undergraduate degree in Saudi Arabia

Sarah M. Khayyat[1], Bayan E. Ainousah[2]

[1] Pharmacy Practices Department, College of Pharmacy, Umm Al-Qura University, Makkah, Saudi Arabia
[2] Pharmaceutical Science Department, College of Pharmacy, Umm Al-Qura University, Makkah, Saudi Arabia

Keywords
Anxiety
Pharmacy education
Pharmacy student
Project management
Undergraduate

Correspondence
Sarah M Khayyat
Pharmacy Practices Department
College of Pharmacy
Umm Al-Qura University
Al Abdeyah
Makkah
Saudi Arabia
smkhayat@uqu.edu.sa

Abstract

Background: The benefits of undergraduate research are far-reaching; however, acquiring research experience can be challenging. Recently, students' mental health has garnered attention as it can impact academic outcomes. Therefore, this study aimed to assess anxiety levels related to research among undergraduate pharmacy students and identify contributing factors. **Methods:** A cross-sectional online survey was administered to pharmacy students from various Saudi universities between January 9, and February 28, 2023. The eligible participants were sixth- or fifth-year students who had completed at least 50% of their research project. **Results:** Of the 273 respondents, most had a B grade point average (51.6%) and lacked prior research experience (86.8%). The study revealed that 68.1% of students experienced anxiety about their research. Among the 20 factors examined, five were identified as significantly and strongly associated with students' anxiety: data collection methods, challenges in writing research reports, time constraints for completing research, academic workload, and the availability of supportive individuals for discussing problems. However, anxious students also reported higher positive views towards their supervisor's feedback on the research report. **Conclusion:** The findings highlight a considerable prevalence of anxiety among undergraduate pharmacy students during their research endeavours. Addressing these challenges is crucial for fostering a supportive academic environment conducive to students' research and educational success.

Introduction

Employers and graduate programmes highly value the practical skills students gain through experiential learning opportunities, such as internships and research experiences (Orsillo, 2022). Research engagement equips students with teamwork abilities, fosters critical thinking, and enhances data analysis and interpretation skills (Finley, 2021; University of San Diego, 2023). In the pharmacy field, pharmacists' role has evolved from traditional dispensing to providing medicine optimisation and other patient clinical services. These services should be integrated with evidence-based practice to effectively interpret and utilise research findings, ultimately informing everyday practice and improving healthcare. Hence, involvement in research at an early stage can improve the scholarly abilities of pharmacy students and trainees and better equip them for their future professional endeavours (Lee *et al.,* 2017). Consequently, research experience became a vital component of both undergraduate and postgraduate programmes, often integrated into curricula as a graduation requirement by many universities (Lee *et al.,* 2017; Fakeeh College for Medical Science, 2023; King Abdulaziz University Faculty of Pharmacy, 2023; Umm Al-Qura University College of Pharmacy, 2023). However, even with the manifold advantages of undergraduate research, obtaining research experience can pose challenges for students (Orsillo, 2022). Several studies have examined the obstacles medical and pharmacy students

encounter when conducting research. Commonly reported barriers include mental health concerns, limited access to scientific databases, inadequate availability of research mentors, and knowledge gaps (Maharajan *et al.,* 2017; Kyaw Soe *et al.,* 2018; Kumar *et al.,* 2019).

Recent educational research has highlighted the mental health of college students, generally, and that of students studying health-related courses, specifically. A recent annual report by the American Centre for Collegiate Mental Health underscores a significant rise in psychological problems among college students, with 207,818 students seeking mental health treatment and scheduling 1,580,951 appointments (Center for Collegiate Mental Health, 2020). Both anxiety and depression were of particular interest, given their detrimental impact on academic outcomes and increasing prevalence among health and pharmacy students (Castillo & Schwartz, 2013; Maharajan *et al.,* 2017; Aluh *et al.,* 2020; Frajerman *et al.,* 2022; Isiogugu et al., 2022). For example, anxiety has been shown to disrupt academic performance by impairing thinking capabilities, diminishing information-processing skills, and causing inattention and negative thoughts (Einbinder, 2014). A recent systematic review and meta-analysis reported varying prevalence rates of anxiety symptoms among students across different countries, with figures such as 40% in the United States (US), 10.6% among medical students in Pakistan, and 62.9% among nursing students in Brazil (Li *et al.,* 2022). The study also revealed that medical students exhibit the highest prevalence of anxiety compared to other college students (Li *et al.,* 2022). However, when comparing students studying health-related courses with each other, pharmacy students experienced significantly more anxiety symptoms and burnout compared to dental and preclinical medical students (Frajerman *et al.,* 2022). Therefore, there is a pressing need to address pharmacy students' mental health to enhance their academic performance, quality of life, and future care provision.

Previous research has advocated the implementation of effective prevention and intervention strategies to mitigate mental health disorders among college students (Li *et al.,* 2022). However, to develop these strategies, researchers and educators must first identify the incidence rate of these mental disorders and identify associated precipitating factors, many of which are modifiable and context-based. These factors could also help identify pharmacy students at risk of developing anxiety symptoms. Notably, in Saudi Arabia, no previous studies have investigated anxiety rates among pharmacy students or the factors contributing to anxiety. Therefore, this study aimed to assess pharmacy students' anxiety levels regarding their graduation research and explore associated factors.

Methods

Study design

A cross-sectional study employing a web-based survey was conducted from January 9 to February 28, 2023. Participants over 18 years old were recruited from pharmacy programmes in Saudi universities using convenience sampling. Eligible students were either in their sixth or fifth year and had completed at least 50% of their research project. Those from the first to the fourth year were excluded from the study as they had no research projects. The questionnaire was distributed to 24 Saudi governmental and private universities by the end of the second term, where pharmacy students were supposed to have finished more than 50% of their graduation research.

Participant recruitment

Students were recruited directly through email or WhatsApp groups (common among students) or indirectly through academic staff. At least two academic staff from the pharmacy department at different universities were contacted to facilitate recruitment. An initial email outlining the study details and providing the questionnaire link to be shared with their students was sent to these staff, with follow-up reminders for interested staff and volunteers.

Instrument development

Survey items were selected based on a literature review (Maharajan *et al.,* 2017; Kumar *et al.,* 2019; Li *et al.,* 2022). Two pharmacy education experts discussed and reviewed the survey items extensively. The survey aimed for simplicity, clarity, and relevance to pharmacy students. Items/questions were grouped into domains and then refined for an inclusive assessment of the students' perspectives. The final self-administered survey comprised six domains: (1) student characteristics; (2) the student's anxiety towards graduation research; (3) research project details; (4) the supervisor's characteristics/guidance; (5) the received academic support towards research; and (6) the academic effort of the participant during research. Most questions featured closed-ended responses (multiple options or yes/no), whereas others employed Likert scale options ranging from 1 (strongly agree) to 5 (strongly disagree). The 5-point Likert scale was mainly used for two domains, i.e. the supervisor's

characteristics/guidance and the student's anxiety towards research (Supplementary A).

The questionnaire underwent validation for construct, face, and content validity by three pharmacy education experts with PhD degrees and 10 years of research experience. It was then piloted with ten randomly selected students from different pharmacy schools. Students' opinions on the questionnaire were considered, and necessary adjustments were made before distributing the final version.

This study was conducted following the guidelines of the Declaration of Helsinki. Ethics approval was obtained from the Biomedical Research Ethics Committee of Umm Al-Qura University (HAPO-02-K-012-2023-01-1385). Participants received an electronic consent form via Google Forms and a cover letter detailing the study's purpose.

Statistical analysis

The data were downloaded and reviewed using Microsoft Excel version 365. Participants' responses were coded, checked for accuracy, and analysed using the Statistical Package for Social Sciences (SPSS) software, version 26.0. A descriptive analysis was conducted for students' characteristics and anxiety towards graduation projects. The Chi-square test was employed to compare nominal data and identify variables significantly impacting students' anxiety. However, when the expected value of the cell(s) was less than 5, the p-value of Fisher's exact test was reported. Cramer's V test was also used to determine and interpret the effect sizes for each variable analysed using the Chi-square test (Kim, 2017).

Results

A total of 273 fifth and sixth-year pharmacy students from eight universities, who had completed at least 50% of their research project, participated in the online survey. Their baseline characteristics are detailed in Supplementary B. Participants were predominantly female (70.3%), held a B grade point average (GPA) (51.6%), and lacked prior research experience (86.8%). Most repsondents were from Umm Al-Qura University and Al Qassim University (38.5% and 24.2%, respectively).

The nature of students' anxiety

Table I presents the incidence of anxiety among participating students and the nature of their feelings.

Table I: Nature of students' anxiety toward research

Factors		Number (%)
Feeling anxious while doing research	Yes	186 (68.1)
	No	87 (31.9)
Nature of anxiety		
Feeling awful and unable to succeed or pass	Strongly agree	36 (13.2)
	Agree	93 (34.1)
	Neutral	105 (38.5)
	Disagree	33 (12.1)
	Strongly disagree	6 (2.1)
Losing focus on research and forgetting important aspects	Strongly agree	51 (18.7)
	Agree	75 (27.5)
	Neutral	72 (26.4)
	Disagree	51 (18.7)
	Strongly disagree	24 (8.8)
Feeling worried and unsatisfied after completing the research project	Strongly agree	93 (34.1)
	Agree	90 (33)
	Neutral	57 (20.9)
	Disagree	24 (8.8)
	Strongly disagree	9 (3.2)

A considerable portion of senior pharmacy students anticipating graduation experienced anxiety concerning their research projects (n = 186, 68.1%). Many indicated strong feelings of inadequacy and inability to succeed (n = 129, 47.3%) and reported a loss of focus and forgetfulness regarding key research aspects (n = 126, 46.2%). They were also worried and unsatisfied after completing their research (n = 183, 67.1%).

For the demographic characteristics, the analysis shows that female students were significantly more anxious about their graduation project (n = 141, 52%) than male students (n = 45, 16%) (p = 0.005). The rest of the students did not report having anxiety while conducting their research (n = 87, 32%). However, other students' characteristics, such as the year of study (p = 0.09), GPA (p = 0.06), or research experience (p = 0.57), had no significant impact on anxiety levels.

The nature of the research project

Table II provides details on all project-related factors influencing students' anxiety.

Table II: Project-related factors

Factors	Having anxiety (N = 186)	No anxiety (N = 87)	*P* value	Effect size
Subject-related project				
Clinical Pharmacy/Pharmacy Practice	96 (35.2)	51 (18.7)	0.03*	0.2[a]
Pharmacology & toxicology	42 (15.4)	15 (5.5)		
Pharmaceutics	21 (7.7)	9 (3.3)		
Chemistry (medicinal/analytical/organic)	21 (7.7)	3 (1.1)		
Pharmacognosy	6 (2.2)	9 (3.3)		
Project involving laboratory work				
Yes	51 (18.7)	36 (13.2)	0.02*	0.14[b]
No	135 (49.5)	51 (18.7)		
Method of data collection				
Retrospective data collection from records	60 (22)	24 (8.8)	<0.001*	0.3[c]
Online survey or questionnaire	48 (17.6)	27 (9.9)		
Lab experiment	39 (14.3)	30 (11)		
Prospective data collection from files	21 (7.7)	0 (0)		
Paper form survey or questionnaire	12 (4.4)	3 (1.1)		
Qualitative data collection	0 (0)	3 (1.1)		
Systematic review	3 (1.1)	0 (0)		
Both lab work and prospective data collection from patient's file	3 (1.1)	0 (0)		
Struggles with writing research reports				
Strongly agree	42 (15.4)	6 (2.2)	<0.001*	0.27[a]
Agree	66 (24.2)	24 (8.8)		
Neutral	45 (16.5)	30 (11)		
Disagree	33 (12.1)	24 (8.8)		
Strongly disagree	0 (0)	3 (1.1)		
Struggles with the timeframe to finalise/submit the work				
Strongly agree	57 (20.9)	12 (4.4)	<0.001*	0.3[a]
Agree	78 (28.6)	33 (12.1)		
Neutral	27 (9.9)	33 (12.1)		
Disagree	18 (6.6)	9 (3.3)		
Strongly disagree	6 (2.2)	0 (0)		
Number of courses during the academic year increased student's anxiety				
Strongly agree	108 (39.6)	27 (9.9)	<0.001*	0.31[d]
Agree	48 (17.6)	24 (8.8)		
Neutral	27 (9.9)	27 (9.9)		
Disagree	3 (1.1)	9 (3.3)		
Strongly disagree	0 (0)	0 (0)		

* Indicates significant results with *P* value < 0.05. [a] degree of freedom (df) = 4, [b] df = 1, [c] df = 7, [d] df = 3.

Most anxious students were engaged in clinical pharmacy projects (n = 96, 35.2%), conducted retrospective data collection (n = 60, 22%), utilised online surveys or questionnaires (n = 48, 17.6%), and reported struggling with writing research reports (n = 108, 39.6%) and submitting the final work within the timeframe (n = 135, 49.5%). They also indicated that having many academic courses increased their anxiety and impaired their ability to complete the research work (n = 156, 57.2%).

All project-related variables demonstrated a significant difference between anxious and non-anxious students, but with varying effect sizes. Some variables had a large effect size and increased students' anxiety during their research work. These include data collection methods ($p < 0.001$, V = 0.3, df = 7), challenges in report writing ($p < 0.001$, V = 0.27, df = 4), struggles with research completion timelines ($p < 0.001$, V = 0.3, df = 4), and academic course load ($p < 0.001$, V = 0.31, df = 3).

Conversely, the other variables had a lower effect. For instance, the subject-related project or field of research (e.g. conducting clinical pharmacy or pharmaceutic research) had a medium to large effect size ($p = 0.03$, V = 0.2, df = 4), while the inclusion of laboratory work in the graduation project exhibited the lowest impact on the development of students' anxiety (small to medium effect size) ($p = 0.02$, V = 0.14, df = 1).

Supervisor's characteristics and guidance

Table III outlines various supervisor-related factors.

Table III: Supervisor-related factors

Factors	Having anxiety (N = 186)	No anxiety (N = 87)	*P* value	Effect size
Number of supervisors				
One	141 (51.6)	75 (27.5)	0.1	0.13[a]
Two	39 (14.3)	9 (3.3)		
More than two supervisors	6 (2.2)	3 (1.1)		
Difficulties dealing with more than one supervisor				
Yes	15 (5.5)	9 (3.3)	0.82	0.03[a]
No	60 (22)	27 (9.9)		
I had only one supervisor	111 (40.7)	51 (18.7)		
Gender of the primary supervisor				
Same as me	129 (47.3)	69 (25.3)	0.08	0.1[b]
Different from me	57 (20.8)	18 (6.6)		
Supervisor's charisma				
Easy to deal with	108 (39.6)	45 (16.5)	0.03*	0.15[a]
Neutral	51 (18.6)	36 (13.2)		
Tough	27 (9.9)	6 (2.2)		
Communication difficulties with supervisor(s)				
Strongly Agree	18 (6.6)	0 (0)	0.001*	0.24[c]
Agree	24 (8.8)	6 (2.2)		
Neutral	48 (17.6)	21 (7.7)		
Disagree	57 (20.9)	27 (9.9)		
Strongly disagree	39 (14.3)	33 (12)		
Frequency of meeting with supervisor				
Every week	66 (24.2)	30 (11)	0.003*	0.24[c]
Every two weeks	42 (15.4)	33 (12)		
Every three weeks	21 (7.7)	3 (1.1)		
Every four weeks	9 (3.3)	9 (3.3)		
Not frequent	48 (17.6)	12 (4.4)		
Setting unofficial deadline				
Strongly Agree	15 (5.5)	6 (2.2)	0.13	0.16[c]
Agree	36 (13.1)	9 (3.3)		
Neutral	27 (9.9)	21 (7.7)		
Disagree	66 (24.2)	27 (9.9)		
Strongly disagree	42 (15.4)	24 (8.8)		
Supervisor quick response				
Strongly agree	72 (26.4)	45 (16.5)	0.02*	0.2[c]
Agree	66 (24.1)	30 (11)		
Neutral	30 (11)	12 (4.4)		
Disagree	6 (2.2)	0 (0)		
Strongly disagree	12 (4.4)	0 (0)		
Supervisor's comments/corrections on the research report				
Excellent	75 (27.5)	45 (16.5)	0.01*	0.23[d]
Good	57 (20.9)	15 (5.5)		
Fair	33 (12)	18 (6.6)		
Bad	15 (5.5)	3 (1.1)		
Very bad	6 (2.2)	3 (1.1)		
My supervisor did not give me any comments or make any correction	0 (0)	3 (1.1)		

* Indicates significant results with *P* value < 0.05. [a] degree of freedom (df) = 2, [b] df = 1, [c] df = 4, [d] df = 5.

Most students were optimistic about their supervisor's attributes and experienced minimal communication difficulties with their supervisor(s). They reported regular and weekly supervision meetings and quick responses from their supervisor(s) when seeking assistance or clarification. Moreover, students reported that their supervisors' comments and corrections on research reports were of high quality. However, most of them did not have official deadlines to facilitate their submission and organise their work. Despite their positive views of their supervisor(s), many students expressed feelings of anxiety. Students experiencing anxiety during research endeavours significantly appreciated five out of nine supervisor-related factors compared to their non-anxious peers.

Anxious students highly appreciated the quality of their supervisor's comments and corrections on the research report compared to non-anxious students (p = 0.01, V = 0.23, df = 5). They also reported high satisfaction with the frequency of supervisor meetings (p = 0.003, V = 0.24, df = 4), fewer complaints of having communication difficulties with the supervisor (p = 0.002, V = 0.24, df = 4), and the supervisor's quick response to students' queries (p = 0.02, V = 0.2, df = 4), all exhibiting medium to large effect sizes. Conversely, the supervisor's character was the least influential factor in anxiety development, but with a significant difference between study groups (p = 0.03, V = 0.15, df = 2). Other variables, including the number of supervisors, challenges dealing with multiple supervisors, and having unofficial deadlines, did not significantly correlate with student anxiety.

Academic support for research

Table IV presents all the people who helped students during their research and their relationship to the incidence of anxiety.

Table IV: Academic support of participants towards research

Factors	Having anxiety (N = 186)	No anxiety (N = 87)	*P* value	Effect size
Personnel who have helped/supported you				
My supervisor(s)	105 (38.5)	57 (20.9)	0.09	0.18[a]
My friend	42 (15.4)	21 (7.7)		
A family member	24 (8.8)	6 (2.2)		
An academic doctor at my university	6 (2.2)	0 (0)		
Healthcare professionals working in hospitals or other medical institutes	3 (1.1)	3 (1.1)		
Another personnel	6 (2.2)	0 (0)		
Personnel with whom you discuss your problems				
My supervisor(s)	75 (27.5)	51 (18.7)	< 0.001*	0.3[a]
My friend	60 (22)	24 (8.8)		
A family member	39 (14.3)	3 (1.1)		
An academic doctor at my university	3 (1.1)	6 (2.2)		
Healthcare professionals working in hospitals or other medical institutes	6 (2.2)	0 (0)		
Another personnel	3 (1.1)	3 (1.1)		

* Indicates significant results with *P* value < 0.05. [a] degree of freedom (df) = 5.

Students primarily relied on their supervisors to assist (n = 162, 59.4%) and discuss research-related issues (n = 126, 46.2%). The choice of individuals with whom students preferred to discuss problems significantly influenced their anxiety levels during research (p < 0.001, V = 0.3, df = 5). However, seeking help and support from various sources did not have a significant impact on students' anxiety levels (p = 0.09, V = 0.18, df = 5).

Academic efforts of participants

Students were asked about their academic efforts to develop their skills and improve their research work (Table V).

Several students reported positive efforts to develop their skills and improve their research work. However, factors related to student's academic efforts showed no significant association with anxiety complaints. Despite their small effect, students' efforts to prepare for research methods and statistics were the only factor that showed a significant difference (p = 0.04, V = 0.12, df = 1).

Table V: Academic efforts of participants towards research

Factors	Having anxiety (N = 186)	No anxiety (N = 87)	*P* value	Effect size
Training or workshops on research to conduct				
Yes	102 (37.4)	51 (18.7)	0.55	0.03[a]
No	84 (30.7)	36 (13.2)		
Preparing for research method and statistics				
Yes	141 (51.6)	75 (27.5)	0.04*	0.12[a]
No	45 (16.5)	12 (4.4)		
Having extra exercises and readings related to research and statistics				
Yes	111 (40.7)	54 (19.8)	0.7	0.02[a]
No	75 (27.5)	33 (12)		

* Indicates significant results with *P* value < 0.05. [a] degree of freedom (df) = 1.

Discussion

This study underscores the prevalence of anxiety among pharmacy students during their graduation project, with various factors contributing to their anxiety, albeit with varying effect sizes. Demographic data showed significant gender differences, with female students being more anxious than male students. However, while most previous studies on pharmacy and medical students aligned with this finding (Kunwar *et al.,* 2016; Hanna *et al.,* 2018), others found no gender differences related to anxiety (Aluh *et al.,* 2020). The variation in findings could be attributed to cultural contexts where, in some cultures, men are less likely to express their negative feelings (Shaikh *et al.,* 2004).

Of the 20 factors examined across different domains, five exhibited significant high effects on students' anxiety: data collection methods, challenges in writing research reports, struggles with project completion within the timeframe, academic course load, and the availability of support personnel with whom students can discuss their problems. Students experiencing anxiety also reported significantly higher but positive views towards the supervisor's feedback on the research report.

The current study identified project-related factors, such as time management and writing difficulties, as significant contributors to the high incidence of anxiety. Additionally, approximately 87% of participants lacked prior research experience, suggesting that their first research experience likely magnified their anxiety as they navigated novel challenges, such as collecting data, writing the thesis, and managing their time between research and academic coursework. A study among undergraduate and postgraduate students similarly found that students experienced anxiety during their graduation research, owing mainly to the lack of time, mentor support, and other supervisor-related aspects (Abushouk *et al.,* 2016). Other Saudi single-centre studies among medical students also reported similar results (Mina *et al.,* 2016; Alyousefi *et al.,* 2023). At King Saud University, for example, 74.6% of students indicated that lack of time was the main reason for their anxiety while conducting research, impeding research participation (Alyousefi *et al.,* 2023).

Another aspect identified is that universities were not offering sufficient courses or programmes on stress management, time management, and research conduct that could address and reduce student anxiety. This finding aligns with that of a study exploring medical students' attitudes and perceived barriers towards clinical research (Abushouk *et al.,* 2016). The study reported low research knowledge scores among enrolled students, wherein only 42.3% could define the concept of clinical research, and 18.6% could differentiate the necessary parts of scientific papers. Consequently, most students (74.2%) agreed that clinical research methodology should be provided as a mandatory course for all medical students (Abushouk *et al.,* 2016). However, it must be noted that authors enrolled students from different academic years, with senior students (4th-year students) achieving better scores than those in other academic years (Abushouk *et al.,* 2016). Therefore, implementing courses on research methodologies for undergraduates is essential, especially if students lack experience in research and writing theses. Such courses or interventions would reduce students' anxiety and improve their attitudes towards research. For example, one randomised control trial identified that time management training improved anxiety, depression, and sleep quality among participants (Wang & Wang, 2018).

Participants in this study experienced positive feelings towards their supervisors, which led to frequent meetings, ease of communication, and high appreciation of supervisors' feedback and guidance. This finding could be related to the fact that criticism from the supervisor is an intrinsic factor in good research work and a well-written thesis, as feedback from an experienced person could aid in filling the knowledge gaps. Building solid relationships with supervisors with extensive experience in tutoring and teaching undergraduate students could also explain the reported positive feelings towards supervisors. However, this result contrasts with previous local and international studies, where inadequate supervisor comments, supervisory meetings, and mentoring were the main significant factors related to increased student anxiety towards clinical research (Abushouk *et al.,* 2016; Alyousefi *et al.,* 2023; Friedrich *et al.,* 2023). These conflicting findings could be attributed to the variation in the studied sample, where some studies evaluated anxiety in undergraduate medical students (Abushouk *et al.,* 2016; Alyousefi *et al.,* 2023) or postgraduate, mainly non-medical students (Friedrich *et al.,* 2023).

The present findings necessitate recommendations from academic medical staff and other stakeholders working at Saudi universities. First, academic supervisors should provide additional support and guidance to students and facilitate data collection. Second, courses and workshops related to stress and anxiety management, time management, report writing, and clinical research concepts should be incorporated into senior pharmacy students' curricula before undergraduate research commencement. Third, curriculum planners should ensure the equitable distribution of courses, especially in the last academic year, to prevent overburdening students with concurrent research and academic commitments. Fourth, early exposure to clinical research aspects (in the third or fourth year), such as research methodology and biostatistics, could be beneficial. Encouraging junior pharmacy students to participate in data collection and other research tasks during their summer vacations could also improve students' research skills and time management before undertaking formal undergraduate research projects. Lastly, building solid trust and communication with the supervisors would facilitate the research process among undergraduate pharmacy students and consequently might impact anxiety levels.

Limitations

This study is subject to some limitations. Firstly, volunteering participants might have more optimistic perspectives and make more efforts to improve their skills and research work, potentially affecting their reported anxiety levels. Secondly, the online survey format resulted in a low response rate. Thirdly, participation was limited to eight governmental universities due to the researchers' established connections with pharmacy staff at these institutions, which may have introduced potential response variations compared to non-participating universities. However, the impact of these limitations on generalizability may be minimal, as all Saudi universities adhere to the Saudi Education and Training Evaluation Commission standards, which should mitigate primary institutional differences. In addition, the authors highlighted factors with high effect sizes, enhancing the study's generalisability. Lastly, certain factors, such as the duration of obtaining ethics approval, were challenging to investigate. In most Saudi universities, the principal investigator is responsible for completing and submitting the ethics approval application, potentially limiting students' ability to assess related challenges accurately.

Conclusion

This study highlighted the prevalence of anxiety among undergraduate pharmacy students during their research endeavours and identified significant factors with a large effect size contributing to heightened anxiety levels across various Saudi universities. The findings underscore the importance of enhancing research-related courses within university curricula to address students' weaknesses and mitigate anxiety. By addressing these factors, universities can provide better support to students and improve the overall quality of their academic output. Future studies should consider evaluating the variation in students' perspectives based on essential characteristics, such as their universities, research project fields (e.g. clinical pharmacy and chemistry), and involvement in laboratory work.

Conflict of interest

The authors declare no conflict of interest.

Source of funding

This research received no external funding.

References

Abushouk, A., Hatata, A., Omran, I., Youniss, M., Elmansy, K., & Meawad, A. (2016). Attitudes and perceived barriers among medical students towards clinical research: A cross-sectional study in an Egyptian medical school. *Journal of Biomedical Education,* **2016**, 1–7. https://doi.org/10.1155/2016/5490575

Aluh, D. O., Abba, A., & Afosi, A. B. (2020). Prevalence and correlates of depression, anxiety and stress among undergraduate pharmacy students in Nigeria. *Pharmacy Education,* **20**(1), 236–248. https://doi.org/10.46542/pe.2020.201.236248

Alyousefi, N., Alnojaidi, J., Almohsen, A., Alghanoum, S., Alassiry, G., Alsanad, L., & Alzeer, S. (2023). How do medical students perceive their research experiences and associated challenges? *Advances in Medical Education and Practice,* **14**, 9–20. https://doi.org/10.2147/AMEP.S395235

Castillo, L. G., & Schwartz, S. J. (2013). Introduction to the special issue on college student mental health. *Journal of Clinical Psychology,* **69**(4), 291–297. https://doi.org/10.1002/jclp.21972

Center for Collegiate Mental Health. (2020). *2019 annual report.* https://ccmh.memberclicks.net/assets/docs/2019-CCMH- Annual-Report_3.17.20.pdf

Einbinder, S. D. (2014). Reducing research anxiety among MSW students. *Journal of Teaching in Social Work,* **34**(1), 2–16. https://doi.org/10.1080/08841233.2013.863263

Fakeeh College for Medical Science. (2023). *Pharm-D, Bachelor of Doctor of Pharmacy.* https://fakeehcollege.edu.sa/pharm-d-bachelor-of-doctor-of-pharmacy/

Finley, A. (2021). How college contributes "to" workforce success: Employer views on what matters most. In *Association of American Colleges and Universities.* https://eric.ed.gov/?id=ED616977

Frajerman, A., Chaumette, B., Krebs, M.-O., & Morvan, Y. (2022). Mental health in medical, dental and pharmacy students: A cross-sectional study. *Journal of Affective Disorders Reports,* **10**, 100404. https://doi.org/10.1016/j.jadr.2022.100404

Friedrich, J., Bareis, A., Bross, M., Bürger, Z., Cortés Rodríguez, Á., Effenberger, N., Kleinhansl, M., Kremer, F., & Schröder, C. (2023). "How is your thesis going?"–Ph.D. students' perspectives on mental health and stress in academia. *PLOS ONE,* **18**(7), e0288103. https://doi.org/10.1371/journal.pone.0288103

Hanna, L.-A., Wilson, M., Hall, M., & Hanna, A. (2018). A questionnaire study to investigate stress among future pharmacists by gender and year group. *Pharmacy,* **6**(3), 75. https://doi.org/10.3390/pharmacy6030075

Isiogugu, O. N., Anosike, C., Okoye, C. R., & Mmirikwe, I. J. (2022). Pharmacy students' perceptions of the impact of mental disorders on pharmacy education in Nigeria. *Pharmacy Education,* **22**(1), 323–330. https://doi.org/10.46542/pe.2022.221.323330

Kim, H.-Y. (2017). Statistical notes for clinical researchers: Chi-squared test and Fisher's exact test. *Restorative Dentistry & Endodontics,* **42**(2), 152. https://doi.org/10.5395/rde.2017.42.2.152

King Abdulaziz University Faculty of Pharmacy. (2023). *Course Distribution.* https://pharmacy.kau.edu.sa/Pages-05112-courseDistribution-en.aspx

Kumar, J., Memon, A., Kumar, A., Kumari, R., Kumar, B., & Fareed, S. (2019). Barriers experienced by medical students in conducting research at undergraduate level. *Cureus,* **11**(4), e4452. https://doi.org/10.7759/cureus.4452

Kunwar, D., Risal, A., & Koirala, S. (2016). Study of Depression, anxiety and stress among the medical students in two medical colleges of Nepal. *Kathmandu University Medical Journal (KUMJ),* **14**(53), 22–26. https://pubmed.ncbi.nlm.nih.gov/27892436/

Kyaw Soe, H., Than, N., Lwin, H., Nu Htay, M., Phyu, K., & Abas, A. (2018). Knowledge, attitudes, and barriers toward research: The perspectives of undergraduate medical and dental students. *Journal of Education and Health Promotion,* **7**(1), 23. https://doi.org/10.4103/jehp.jehp_61_17

Lee, B. J., Rhodes, N. J., Scheetz, M. H., & McLaughlin, M. M. (2017). Engaging pharmacy students in research through near-peer training. *American Journal of Pharmaceutical Education,* **81**(9), 6340. https://doi.org/10.5688/ajpe6340

Li, W., Zhao, Z., Chen, D., Peng, Y., & Lu, Z. (2022). Prevalence and associated factors of depression and anxiety symptoms among college students: a systematic review and meta-analysis. *Journal of Child Psychology and Psychiatry,* **63**(11), 1222–1230. https://doi.org/10.1111/jcpp.13606

Maharajan, M. K., Rajiah, K., Tam, A. M., Chaw, S. L., Ang, M. J., & Yong, M. W. (2017). Pharmacy students' anxiety towards research during their undergraduate degree; How to reduce it? *PLOS ONE,* **12**(4), e0176095. https://doi.org/10.1371/journal.pone.0176095

Mina, S., Mostafa, S., Albarqawi, H. T., Alnajjar, A., Obeidat, A. S., Alkattan, W., & Abu-Zaid, A. (2016). Perceived influential factors toward participation in undergraduate research activities among medical students at Alfaisal University—College of Medicine: A Saudi Arabian perspective. *Medical Teacher,* **38**(sup1), S31–S36. https://doi.org/10.3109/0142159X.2016.1142508

Orsillo, S. (2022). Undergraduate research experience: A roadmap to guide your journey. *Psychology Student Network.* https://www.apa.org/ed/precollege/psn/2022/09/undergrad-research

Shaikh, B., Kahloon, A., Kazmi, M., Khalid, H., Nawaz, K., Khan, N., & Khan, S. (2004). Students, stress and coping strategies: A case of Pakistani medical school. *Education for Health: Change in Learning & Practice,* **17**(3), 346–353. https://doi.org/10.1080/13576280400002585

Umm Al-Qura University College of Pharmacy. (2023). *Study plan: Major's study plans: Doctor of Pharmacy (745).* https://uqu.edu.sa/en/phhdcp/App/Plans?major=745&type=1&edition=33

University of San Diego. (2023). *Undergraduate research.* https://www.sandiego.edu/ugresearch/about/benefits.php

Wang, P., & Wang, X. (2018). Effect of time management training on anxiety, depression, and sleep quality. *Iranian Journal of Public Health,* **47**(12), 1822–1831. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6379615/

Supplementary A: Anxiey questionnaire

No	Question	Answer
Student characteristics		
1.	What is your gender?	- Male - Female
2.	What is the name of your registered university?	- King Saud University - King Abdulaziz University - King Khalid University - Alfaisal University - Umm Al-Qura University - Effat University - Qassim University - King Faisal University - Prince Sultan University - Imam Abdulrahman Bin Faisal University - Taibah University - Prince Mohammad Bin Fahd University - Taif University - University of Hail - Jazan University - Majmaah University - Islamic University of Madinah - Al-Yamamah University - Al Jouf University - University of Tabuk - Najran University - Prince Sattam Bin Abdulaziz University - Dar Al-Hekma University - Princess Nourah Bint Abdul Rahman University - Other
3.	What is your GPA (Grade point average)?	- A (4 - 3.7 out of 4) or (5 - 4.50 out of 5) - B (3.5 - 2.7 out of 4) or (4.51 - 3.50 out of 5) - C (2.5 - 2 out of 4) or (3.51 - 2.50 out of 5) - D (1.8 - 1.3 out of 4) or (2.51 - 1 out of 5) - F (0 out of 4) or (1.01 - 0 out of 5)
4.	Have you conducted any pharmacy-related research projects before?	- Yes - No
Project-related factors		
5.	Your project was related to which subject?	- Clinical Pharmacy (Pharmacy practice) - Pharmacology & toxicology - Chemistry (medicinal, analytical, organic) - Pharmacognosy - Pharmaceutics
6.	Did your project involve any laboratory work?	- Yes - No
7.	What was the method of your data collection?	- Online survey or questionnaire - Paper form survey or questionnaire - Retrospective data collection from certain records - Prospective data collection from patient's file/lab test - Lab experiment - Others (specify) ……..
8.	Did you struggle with writing research reports or avoiding them as long as possible?	- Strongly agree - Agree - Neutral - Disagree

		- Strongly disagree
9.	Did you struggle with the timeframe you have to finalize and submit your work? (i.e. the time shortage added some pressure on you)	- Strongly agree - Agree - Neutral - Disagree - Strongly disagree
10.	Did the number of courses you had during the academic year add some pressure on you? (i.e. you had many courses during the semester, which affected the quality of your work or limited you from meeting your submission deadline)	- Strongly agree - Agree - Neutral - Disagree - Strongly disagree
Supervisor-related factors		
11.	How many supervisors have you had?	- One supervisor - Two supervisors - More than two supervisors
12.	Have you had any problems or difficulties dealing with more than one supervisor?	- Yes - No - I had only one supervisor
13.	What was the gender of your first (main) supervisor?	- Same as me - Different to me
14.	How would you describe your supervisor's charisma?	- Tough - Neutral - Easy to deal with
15.	How often did you meet with your supervisor(s)?	- Every week - Every 2 weeks - Every 3 weeks - Every 4 weeks - Not frequent
16.	Have you had any communication difficulties with your supervisor(s)?	- Strongly agree - Agree - Neutral - Disagree - Strongly disagree
17.	Did your supervisor(s) give you some unofficial deadlines to put you on track and prepare you for the official submission date?	- Strongly agree - Agree - Neutral - Disagree - Strongly disagree
18.	Did your supervisor quickly responded to your emails and messages when you had questions?	- Strongly agree - Agree - Neutral - Disagree - Strongly disagree
19.	How would you describe the comments and corrections you receive from your supervisor on your work?	- Excellent - Good - Fair - Bad - Very bad - My supervisor did not give me any comments or made any correction
Academic support of participant towards research		
20.	Of the following personnel, who have helped and supported you during the research?	- My supervisor(s) - An academic doctor in my university (not in my research team) - An academic doctor in another university - Healthcare professional working in hospitals or other medical institutes - My friend - A family member - Another personnel
21.	Who did you discuss your problems and concerns with?	- My supervisor(s) - An academic doctor in my university (not in my research team) - An academic doctor in another university - Healthcare professional working in hospitals or other medical institutes - My friend

		- A family member - Another personnel
Academic effort of participants towards research		
22.	Have you received any training or attended any courses/workshops on how to conduct research?	- Yes - No
23.	Apart from your academic courses, did you make extra exercises and readings related to research and statistics (in general)?	- Yes - No
24.	Did you work hard and prepare well for your research methods and statistics?	- Yes - No
Participants' anxiety towards research		
25.	In general, did you feel anxious while doing your research project?	- Yes - No
26.	During data analysis, did you feel that you are doing awful or that you may fail?	- Strongly agree - Agree - Neutral - Disagree - Strongly disagree
27.	Did you lose focus on research and could not remember important aspects?	- Strongly agree - Agree - Neutral - Disagree - Strongly disagree
28.	After completing your research project, did you worry about whether you did well enough?	- Strongly agree - Agree - Neutral - Disagree - Strongly disagree

Supplementary B: Student characteristics (n = 273)

Student characteristics			Number (%)
Gender	-	Male	81 (29.7)
	-	Female	192 (70.3)
Registered university	-	Umm Al-Qura University	105 (38.5)
	-	Al Qassim University	66 (24.2)
	-	King Saud University	30 (11)
	-	Taif University	30 (11)
	-	University of Tabuk	18 (6.6)
	-	King Abdulaziz University	15 (5.4)
	-	Princess Nourah Bint Abdul Rahman University	6 (2.2)
	-	Alfaisal University	3 (1.1)
School year	-	Fifth year student	245 (89.7)
	-	Sixth year student	28 (10.3)
Student GPA (Grade point average)	-	A (4 - 3.7 out of 4) or (5 - 4.50 out of 5)	114 (41.8)
	-	B (3.5 - 2.7 out of 4) or (4.51 - 3.50 out of 5)	141 (51.6)
	-	C (2.5 - 2 out of 4) or (3.51 - 2.50 out of 5)	15 (5.5)
	-	D (1.8 - 1.3 out of 4) or (2.51 - 1 out of 5)	3 (1.1)
	-	F (0 out of 4) or (1.01 - 0 out of 5)	0 (0)
Previous experience in conducting research	-	Yes	36 (13.2)
	-	No	237 (86.8)