

ORIGINAL RESEARCH ARTICLE

Relationship between physical activity, lifestyles, and symptoms of stress, anxiety, and depression among chemical sciences students

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Abstract

Mental health problems among university students have increased and now constitute a public health concern. Unhealthy lifestyles and academic pressure may influence the emotional well-being of this population. This exploratory analytical, observational, cross-sectional study examined the relationships among physical activity (PA), lifestyle, and symptoms of anxiety, depression, and stress in 60 chemical sciences students (25 men and 35 women; mean age = 22 years, SD = 2.33). Participants completed the Depression Anxiety Stress Scales-21 (DASS-21), the FANTASTIC Lifestyle Questionnaire, and the short form of the International Physical Activity Questionnaire (IPAQ). Analyses included descriptive statistics, chi-square tests, and Spearman rank-order correlations. The results showed that 90% of participants met the World Health Organization recommendations for PA. PA was not significantly associated with emotional symptoms. In contrast, lifestyle was significantly associated with symptoms of depression ($p = .003$), anxiety ($p = .035$), and stress ($p = .004$). Students who reported an excellent lifestyle had higher proportions of moderate-to-severe symptoms across all three subscales. Although this finding is limited by the sample size ($N = 60$), it indicates a need to explore whether the lifestyle patterns and characteristics of chemical sciences students may constitute psychological risk factors in this population. Within the sample studied, lifestyle showed a stronger association with mental health outcomes than PA.

Keywords:

physical activity, lifestyles, stress, anxiety, depression, university students

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Introduction

Mental health problems among university students have increased worldwide, and students report higher levels of anxiety and stress than other populations (Barrera-Herrera & San Martín, 2021). Depression is reported to be 12.9% more prevalent at this stage of life than in the general population (Sheldon et al., 2021), representing a serious public health concern. Rapidly changing lifestyles may contribute to these conditions (Hasan et al., 2022). Ramón-Arbués et al. (2020) reported a moderate-to-high prevalence of depression, anxiety, and stress across university student samples. In Mexico, Silva-Ramos et al. (2020) found that 86.3% of the

students in their sample experienced academic stress. López Herrera et al. (2024) further noted that academic stress may trigger or intensify anxiety symptoms.

Physical activity (PA) is important for maintaining both physical and mental health (World Health Organization [WHO], 2024). However, the relationship between PA and negative emotions among university students may not be linear because other factors may influence this association (Liu et al., 2024).

Lifestyle is shaped by interactions between individual and contextual factors, which produce patterns of behaviour. These habits and behaviours can significantly influence physical and mental health (Rahimi et al., 2024). Wang et al. (2025) found a high prevalence of poor mental health among university students in association with lifestyle factors such as insufficient sleep, limited knowledge of health and exercise, inadequate breakfast consumption, and smoking.

University students are particularly vulnerable to emotional problems such as anxiety, depression, and stress because of academic pressure, lifestyle changes, and the transition to adulthood (Kamruzzaman et al., 2024).

Symptoms of depression, anxiety, and stress may vary according to sociodemographic characteristics such as sex and area of professional training (Angelucci et al., 2017). Programmes in the natural and exact sciences, including chemistry, are characterised by rigorous academic workloads that may compromise students' emotional well-being (González-Benítez et al., 2020). Medicine and dentistry have historically been associated with perfectionistic profiles (Rezaei-Gazki et al., 2024) and higher levels of stress and anxiety than other fields (Mirza et al., 2021), and recent research has extended this concern to other health and science disciplines. For example, curricular complexity, deadline pressure, and unclear teaching practices can generate substantial stress and anxiety among nursing students (Martínez Cruz et al., 2023).

Within science, technology, engineering, and mathematics (STEM), maladaptive perfectionism may be an important risk factor. Rice et al. (2013) indicated that it can contribute to disappointment with academic performance, particularly among women. Rice et al. (2015) similarly found that STEM students with maladaptive perfectionistic traits were more likely to experience moderate-to-high stress. They therefore recommended implementing prevention and intervention strategies from the beginning of university study.

Despite growing interest in university students' mental health, previous research has often examined these variables separately or within general student populations, with limited attention to academic environments involving heavy course loads, experimental rigour, and discipline-specific risks. Chemistry students face combined theoretical demands and extensive laboratory sessions that may restrict the time available for healthy lifestyles and PA. Few studies have examined how sedentary behaviour and daily habits interact with the severity of stress, anxiety, and depression symptoms in this educational context. The present study addresses this gap by evaluating these dimensions together in a specific student population and examining the potential role of PA within a demanding academic environment.

Nola Pender's Health Promotion Model explains the adoption of health-promoting behaviours through interactions among individual characteristics and experiences, behaviour-specific thoughts and feelings, commitment to action, immediate competing demands and preferences, and health-promoting behaviour. This model provides a theoretical foundation for understanding and guiding interventions that promote healthy lifestyles (Aristizábal Hoyos et al., 2011).

Bustamante Acaro et al. (2025) analysed lifestyle dimensions among university students classified as having unhealthy lifestyles according to Pender's model. Exercise was among the dimensions most frequently classified as unhealthy (86.1%). The authors identified barriers including disinterest, anxiety, academic workload, competing personal priorities, financial

limitations, and limited access to facilities. These perceived barriers may reduce self-efficacy and hinder commitment to regular exercise (Bustamante Acaro et al., 2025).

Therefore, the present study aimed to analyse the relationships among PA, lifestyle, and mental health symptoms, specifically anxiety, depression, and stress, in a sample of chemistry students.

Materials and Methods

This exploratory analytical, observational, cross-sectional study used a convenience sample of 60 chemical sciences students, comprising 25 men and 35 women (mean age = 22 years, $SD = 2.33$). Although convenience sampling was used, the sample size was considered appropriate for the exploratory nature of the study. Methodological research on pilot studies indicates that similarly sized samples may be suitable for assessing design feasibility, generating preliminary evidence, and informing future studies with larger samples and greater statistical power (Billingham et al., 2013). Participants were recruited based on availability and accessibility, which facilitated data collection during the initial phase of the study. Questionnaires were completed with interviewer guidance, and responses were anonymised after collection. Data were collected during the summer, which is a design limitation because students' routines, academic stress, and lifestyles may differ temporarily from those experienced during the regular academic year. The use of self-report instruments also introduced potential self-report and social desirability biases.

The inclusion criteria were current undergraduate enrolment, an age of 18 years or older, and provision of informed consent. Participants with incomplete questionnaires or inconsistent responses that prevented statistical analysis were excluded.

Ethical Considerations

Before data collection, participants were informed about the purpose and conditions of the study. Those who agreed to participate provided written informed consent. The study was approved by the ethics committee (C.E.I. 250826). Data confidentiality and protection were maintained throughout the study, and access to the database was restricted to the research team. No identifiable information was retained, and no identifiable individual-level data were disclosed. Data were stored securely and will be retained in accordance with the Federal Law on the Protection of Personal Data Held by Private Parties (Ley Federal de Protección de Datos Personales en Posesión de los Particulares [LFPDPPP], 2025).

Participants were recruited through a formal invitation sent to the Coordinator of the Chemical Sciences Department at the Benemérita Universidad Autónoma de Puebla (Meritorious Autonomous University of Puebla, Mexico). The coordinator distributed the invitation to students participating in the summer research programme, which receives students from institutions across Mexico. The invitation specified that participants must be currently enrolled in the Chemical Sciences Department and that participation would be anonymous.

Instruments

Mental health symptoms were assessed using the Depression Anxiety Stress Scales-21 (DASS-21), a validated and reliable instrument comprising 21 items across three seven-item subscales: depression, anxiety, and stress. Items are rated on a 4-point Likert-type scale ranging from 0, indicating the absence of symptoms, to 3, indicating high frequency (Estrada-Araoz et al., 2024; Román et al., 2016). Each subscale score is calculated by summing the seven corresponding items and multiplying the total by two. Scores are then compared with validated cut-off points to classify the severity of depression, anxiety, and stress as normal, mild, moderate, severe, or extremely severe (Salinas-Muñoz et al., 2024).

Lifestyle habits were assessed using version 3 of the FANTASTIC Lifestyle Questionnaire. The instrument, validated by Wilson et al. (1984), has been translated, adapted, and psychometrically validated in countries including Colombia, Cuba, Mexico, and Venezuela (Betancurth Loaiza et al., 2015). Its 30 items assess social relationships, PA, diet, tobacco use, alcohol consumption, sleep quality, stress management, personality traits, and health-related behaviours. Each item has three response options, and total scores range from 0 to 100. Lifestyle is classified as dangerous (<39), poor (40–59), regular (60–69), good (70–84), or excellent (≥ 85) (Espinosa Méndez et al., 2023).

PA levels were assessed using the Spanish short form of the International Physical Activity Questionnaire (IPAQ; Mantilla Toloza & Gómez-Conesa, 2007; Palma-Leal et al., 2022). The instrument assesses PA undertaken during the previous seven days, from walking to vigorous activity. Days and minutes of activity are used to calculate energy expenditure in MET-min/week, with standard values of 3.3 METs for walking, 4 METs for moderate activity, and 8 METs for vigorous activity. Each value is multiplied by the duration and number of days of activity per week, and the results are summed to determine PA level. Three categories are then applied: high, involving vigorous PA exceeding 1,500 MET-min/week; moderate, involving at least 600 MET-min/week; and low, involving less than 600 MET-min/week (Alarcón Meza & Hall-López, 2021).

Procedure

Data were collected over four weeks in individually scheduled, interviewer-guided sessions. Participants completed the questionnaires through Google Forms under the direct guidance of a trained interviewer. This approach enabled the immediate clarification of ambiguous items and helped prevent missing data, thereby supporting consistent and standardised administration.

Data Analysis

Data analysis was conducted in two stages. First, descriptive statistics were used to summarise and characterise the study variables. Second, inferential tests were used to explore relationships among the variables. Chi-square tests assessed significant associations, and nonparametric Spearman rank-order correlations assessed the strength and direction of relationships.

Given the exploratory nature of the study and its focus on identifying preliminary associations, the analysis primarily examined statistical significance. Cramér's V was also calculated as an effect-size measure. Analyses were performed using JASP version 0.19.3.

Results

Table 1 presents the distribution of lifestyle categories across PA levels. Table 2 provides the corresponding descriptive statistics, and Table 3 summarises PA levels by Sex. Moderate or high PA was reported by 92% of men and 77% of women. Figure 1 illustrates the relationship between PA level and perceived lifestyle. Chi-square tests showed no significant association between PA and symptoms of depression ($p = .584$), anxiety ($p = .313$), or stress ($p = .629$).

Table 1. Physical Activity Levels by Lifestyle Category

PA level	FANTASTIC interpretation	Frequency	Percent	Valid percent	Cumulative percent
Low	Regular	0	0.000	0.000	0.000
	Good	6	60.000	60.000	60.000
	Excellent	4	40.000	40.000	100.000
	Missing	0	0.000		
	Total	10	100.000		
Moderate	Regular	0	0.000	0.000	0.000
	Good	13	59.091	59.091	59.091
	Excellent	9	40.909	40.909	100.000
	Missing	0	0.000		
	Total	22	100.000		
High	Regular	6	21.429	21.429	21.429
	Good	17	60.714	60.714	82.143
	Excellent	5	17.857	17.857	100.000
	Missing	0	0.000		
	Total	28	100.000		

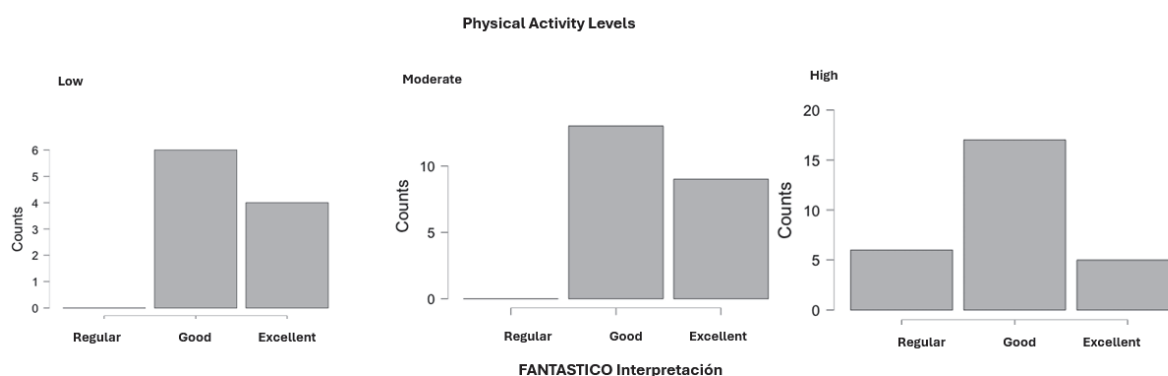
Table 2. Descriptive Statistics by Physical Activity Level

	Low	Moderate	High
Valid	10	22	28
Missing	0	0	0
Mean	1.400	1.409	0.964
Std. Deviation	0.516	0.503	0.637
Minimum	1.000	1.000	0.000
Maximum	2.000	2.000	2.000

Table 3. Physical Activity Levels by Sex

Sex	Physical activity level	Frequency	Percent	Valid percent	Cumulative percent
Men	Low	2	8.000	8.000	8.000
	Moderate	8	32.000	32.000	40.000
	High	15	60.000	60.000	100.000
	Missing	0	0.000		
	Total	25	100.000		
Women	Low	8	22.857	22.857	22.857
	Moderate	14	40.000	40.000	62.857
	High	13	37.143	37.143	100.000
	Missing	0	0.000		
	Total	35	100.000		

Figure 1. Relationship Between Physical Activity Level and Lifestyle Perception



Note. The figure comprises three panels based on PA level: low (left), moderate (middle), and high (right). The y-axis (Counts) represents the number of students in each group. The x-axis (FANTASTICO Interpretation) displays the lifestyle categories regular, good, and excellent according to the FANTASTIC Lifestyle Questionnaire scoring guidelines.

Lifestyle and Depression Symptoms

Lifestyle was significantly associated with depression symptoms ($p = .003$). Among participants with a regular lifestyle, 66.7% reported no symptoms of depression. Among those with a good lifestyle, 47.2% reported no symptoms, 25.0% reported mild symptoms, and 22.2% reported moderate symptoms. Among participants with an excellent lifestyle, 11.1% reported no symptoms, whereas 33.3% reported moderate symptoms and 33.3% reported severe symptoms (Table 4). Cramér's V indicated a large effect size ($V = .44$), suggesting a strong association between lifestyle category and depressive symptom severity in this sample.

Table 4. Relationship Between Lifestyle and Depression Levels

Lifestyle category (FANTASTIC)	No depression (%)	Mild (%)	Moderate (%)	Severe (%)	Extremely severe (%)	Total (%)
Regular	4 (66.7%)	1 (16.7%)	1 (16.7%)	0 (0.0%)	0 (0.0%)	6 (100.0%)
Good	17 (47.2%)	9 (25.0%)	8 (22.2%)	1 (2.8%)	1 (2.8%)	36 (100.0%)
Excellent	2 (11.1%)	1 (5.6%)	6 (33.3%)	6 (33.3%)	3 (16.7%)	18 (100.0%)
Total	23 (38.3%)	11 (18.3%)	15 (25.0%)	7 (11.7%)	4 (6.7%)	60 (100.0%)

Lifestyle and Anxiety Symptoms

A contingency analysis assessed the association between self-reported lifestyle categories and anxiety symptom levels. The chi-square test showed a statistically significant association ($p = .035$). A high proportion of participants who reported an excellent lifestyle had moderate or severe-to-extremely-severe anxiety, whereas most participants who reported a regular lifestyle had no or low anxiety (Table 5). Cramér's V indicated a large effect size ($V = .37$), suggesting a strong association between lifestyle category and anxiety symptoms.

Table 5. Relationship Between Lifestyle and Anxiety Levels

Lifestyle category (FANTASTIC)	No/low anxiety (%)	Moderate (%)	Severe/extremely severe (%)	Total (%)
Regular	5 (83.3%)	0 (0.0%)	1 (16.7%)	6 (100.0%)
Good	19 (52.8%)	5 (13.9%)	12 (33.3%)	36 (100.0%)
Excellent	2 (11.1%)	5 (27.8%)	11 (61.1%)	18 (100.0%)
Total	26 (43.3%)	10 (16.7%)	24 (40.0%)	60 (100.0%)

Lifestyle and Stress Symptoms

Lifestyle was significantly associated with stress level, $\chi^2(8) = 22.281$, $p = .004$. Among participants with a regular lifestyle, 83.3% had no or mild stress, 16.7% had moderate stress, and none had severe or extremely severe stress. Among those with a good lifestyle, 55.5% had no or mild stress, 33.3% had moderate stress, and 11.1% had severe or extremely severe stress. In contrast, among participants with an excellent lifestyle, 22.2% had no or mild stress, 16.7% had moderate stress, and 61.1% had severe or extremely severe stress (Table 6). Cramér's V indicated a large effect size ($V = .43$), suggesting a strong association between lifestyle category and stress level.

Table 6. Relationship Between Lifestyle and Stress Levels

Lifestyle category (FANTASTIC)	No/mild stress (%)	Moderate (%)	Severe/extremely severe (%)	Total (%)
Regular	5 (83.3%)	1 (16.7%)	0 (0.0%)	6 (100.0%)
Good	20 (55.5%)	12 (33.3%)	4 (11.1%)	36 (100.0%)
Excellent	4 (22.2%)	3 (16.7%)	11 (61.1%)	18 (100.0%)
Total	29 (48.3%)	16 (26.7%)	15 (25.0%)	60 (100.0%)

Physical Activity and Lifestyles

A nonparametric Spearman rank-order correlation was used to assess the relationship between PA and lifestyle. The results indicated a weak-to-moderate negative correlation that was statistically significant, $r_s = -.333$, $p < .05$, 95% CI [-.537, -.084].

Discussion

Most participants reported meeting the WHO recommendations for PA. However, this high prevalence contrasts with studies reporting low adherence in similar populations (Moral Moreno et al., 2024). The difference may reflect the use of a self-report instrument, which is susceptible to overestimation, and the summer data-collection period, when PA may increase. These factors may also help explain the absence of a significant association between PA and mental health symptoms in this sample, unlike findings reported elsewhere (Rodríguez-Romo et al., 2022; Wei et al., 2024).

In contrast, lifestyle was significantly associated with symptoms of stress, depression, and anxiety. Participants who reported an excellent lifestyle had higher proportions of moderate or severe symptoms than those who reported regular or good lifestyles. Anxiety symptoms also differed across self-reported lifestyle categories. Although research has linked PA and mental health in various populations, relatively little work has focused on chemical sciences students (Xu et al., 2024). The broader literature has documented relationships between lifestyle and psychological well-being (Zimmer-Gembeck & Skinner, 2024), consistent with the present finding that lifestyle was more strongly associated with psychological symptoms than PA. One possible explanation is that Pender's model treats lifestyle as a multidimensional construct encompassing nutrition, health responsibility, stress management, interpersonal support, self-actualisation, and exercise, all of which may influence mental health in daily life. By comparison, PA represents one component of overall behaviour and is itself influenced by other lifestyle dimensions. Lifestyle may therefore provide a broader representation of the psychosocial context of well-being (Bustamante Acaro et al., 2025).

Participants with excellent lifestyles reported higher stress levels, which may be related to self-imposed demands, perfectionism (Kealy et al., 2025), and the pressure of maintaining highly structured routines. In demanding academic contexts, healthy behaviours may coexist with perfectionistic patterns and rigid routines, particularly in fields with high performance standards (Mirza et al., 2021; Rezaei-Gazki et al., 2024). Although perfectionism was not measured in this study, maladaptive perfectionism has been identified as relevant among science and technology students and may help explain the observed association. This explanation is offered only as a hypothesis-generating interpretation: a persistent pursuit of control and achievement may increase psychological burden even when healthy habits are maintained (Kealy et al., 2025). These findings support a comprehensive approach to lifestyle that considers both physical health behaviours and the psychological processes that may influence their relationship with mental health.

A similar pattern was observed for depressive symptoms: participants who reported good or regular lifestyles had lower proportions of symptoms (Araripe et al., 2025), whereas highly structured lifestyles were associated with greater emotional vulnerability. Anxiety followed a comparable pattern, although unhealthy lifestyles may also contribute to anxiety symptoms (Kwon et al., 2024).

These trends may be understood through self-efficacy theory (Powers et al., 2024) and psychological flexibility theory (Kulandaiammal et al., 2024). A high level of organisation may enhance motivation and performance, but it may also increase pressure and reduce adaptability. Conversely, balanced, flexible, and sustainable lifestyles are associated with better indicators of well-being, consistent with positive health theory (Martín-Díaz & Fernández-Abascal, 2024) and research highlighting the benefits of positive well-being practices (Bhargava et al., 2024).

Finally, PA was inversely related to perceived lifestyle, indicating that higher PA was associated with lower perceived well-being in this dimension. Although PA is generally associated with better physical, psychological, and social well-being (Buecker et al., 2021), participants in this sample may have experienced it as an additional demand requiring time, effort, and energy or causing physical discomfort, thereby lowering their assessment of a healthy lifestyle. Bobo-Arce et al. (2024) identified lack of time, lack of energy, and insufficient resources as major barriers to PA and found that women perceived these barriers more strongly. When PA occurs alongside substantial academic, work, or family demands, it may be perceived as an additional obligation rather than solely as a health-promoting behaviour. Gómez-Mazorra et al. (2020) similarly reported greater autonomy frustration, demotivation, and external regulation among students in health and education programmes and those involved in developmental sport. When physical activities are driven by institutional, academic, or performance demands, intrinsic motivation may decline and perceptions of lifestyle habits may become less positive. Pender's Health Promotion Model explains these findings through interactions among individual experiences, behaviour-specific thoughts and feelings, and immediate competing demands, all of which affect commitment to health-promoting behaviour. Perceived barriers, limited time, and low motivation may therefore reduce the perceived benefits of PA and influence overall lifestyle assessments, even when PA remains protective for health (Bobo-Arce et al., 2024; Gómez-Mazorra et al., 2020).

Overall, lifestyle more fully reflects interactions among habits, personal demands, and psychological well-being and was therefore more strongly associated with mental health than PA alone in this sample. Future research should incorporate moderating and qualitative variables to clarify why some students reporting excellent lifestyles may nevertheless experience greater stress or emotional vulnerability.

Conclusion

This exploratory study identified a significant association between lifestyle and mental health and revealed an unexpected pattern: students who reported an excellent lifestyle had higher proportions of moderate-to-severe symptoms of stress, anxiety, and depression. Within the analysed sample, characteristics related to the students' field of study may be associated with these psychological symptoms, challenging the assumption of a simple linear relationship between healthy habits and emotional well-being. However, specific academic demands were not measured, and the sample was small and selected by convenience. The findings should therefore be interpreted cautiously and used primarily to generate hypotheses rather than generalised to the wider university population.

Limitations

This study is limited by convenience sampling, which introduces selection bias, and by the small sample size, which restricts the generalisability of the findings. Reliance on self-reported data also increases the risk of social desirability bias and response misclassification. Finally, the study design did not permit control of potentially important confounding factors, including academic workload, sleep patterns, and socioeconomic status. These limitations should be considered when interpreting the magnitude of the observed associations.

Future research should address these limitations through probability sampling and substantially larger samples to improve generalisability and reduce bias. Study designs should also measure and statistically control relevant confounding factors to strengthen internal validity and support more robust causal inference. Mediating variables such as self-efficacy, social support, and motivation towards PA should also be examined to clarify these complex relationships.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this manuscript, the authors used Google Translate to assist with improving language clarity. The authors carefully reviewed and revised the output to ensure accuracy and take full responsibility for the content of the final manuscript.

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