REVISTA INVECOM
ISSN en línea: 2739-0063

Association between physical activity and stress levels among doctoral students in education

Asociación entre la actividad física y los niveles de estrés en estudiantes de doctorado en educación

Received: 26/03/2026 - **Accepted:** 03/06/2026

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Abstract

This study aims to identify the association between physical activity and stress levels among doctoral students in education. A descriptive cross-sectional study was conducted to identify the association between physical activity and stress levels among doctoral students in education. To this end, a sample of 397 doctoral students in education from the Faculty of Educational Sciences at the National University of the Altiplano in Puno. The results reveal a statistically significant association between stress levels and physical activity in doctoral students ($\chi 2 = 13.506$; $p<0.05$), suggesting that a greater commitment to physical activity acts as a protective factor against stress. In particular, 59.1% of students with high levels of physical activity do not report stress, while only 4.5% experience severe stress. Physical activity constitutes a significant protective factor against stress in doctoral students in highly demanding academic

contexts. The findings support the incorporation of strategies to promote regular exercise into graduate programs, such as active breaks and guidance on healthy habits, with the aim of fostering emotional well-being and the sustainability of the doctoral training process.

Keywords: Physical activity, stress levels. protective factor.

Resumen

El presente estudio busca identificar la asociación entre la actividad física y los niveles de estrés en estudiantes de doctorado en educación. Se realizó un estudio descriptivo de corte transversal con el propósito de identificar la asociación entre la actividad física y los niveles de estrés en estudiantes de doctorado en educación. Para ello, se seleccionó una muestra de 397 estudiantes de doctorado en Educación de la Facultad de Ciencias de la Educación de la Universidad Nacional del Altiplano de Puno. Los resultados revelan una asociación estadísticamente significativa entre los niveles de estrés y la actividad física en estudiantes de doctorado ($\chi 2 = 13.506$; $p<0.05$), lo que sugiere que un mayor compromiso con la actividad física actúa como un factor protector frente al estrés. En particular, el 59.1% de los estudiantes con altos niveles de actividad física no reportan estrés, mientras que solo el 4.5% experimentan estrés severo. La actividad física constituye un factor protector significativo frente al estrés en estudiantes de doctorado en contextos académicos de alta exigencia. Los hallazgos respaldan la incorporación de estrategias de promoción del ejercicio regular en los programas de posgrado, como pausas activas y orientación sobre hábitos saludables, con el fin de favorecer el bienestar emocional y la sostenibilidad del proceso formativo doctoral.

Palabras clave: Actividad física, niveles de estrés, factor protector.

Introduction

University students worldwide face growing challenges related to chronic stress, which negatively affects academic performance, mental health, and overall well-being. Global studies, including those reported by the World Health Organization (WHO), indicate that 40–60% of university students experience high stress levels, exacerbated by the transition to adulthood, intense academic pressures, and post-pandemic uncertainty (Chen et al., 2023; OMS, 2025; Yao et al., 2023).

This situation is notably more pronounced in contexts such as Europe and North America, where recent surveys, including those conducted by the Organisation for Economic Co-operation and Development (OECD) and university-based studies in the United States and the United Kingdom, have revealed anxiety rates exceeding 50% among graduate students. These figures are directly associated with heightened risks of burnout, clinical depression, and premature program withdrawal, compounded by intense academic demands, social isolation, and competitive pressures in highly demanding environments (Abbondanza & White, 2024; Cortez et al., 2021; Glaría et al., 2016; Taylor et al., 2022; Wang et al., 2024).

The primary drivers of this relationship between stress and low physical activity levels are multifactorial: academic overload reduces time available for exercise, promoting sedentary lifestyles; stress itself induces fatigue and avoidance of physical activity due to diminished motivation; and university environments with limited infrastructure, such as a lack of accessible gyms or green spaces, are common in developing regions like Latin America and Asia (Batista-Sánchez et al., 2024; Creemers et al., 2012; Hodgson et al., 2025; Taylor et al., 2022).

Recent research confirms an inverse correlation: students who engage in less than 150 minutes of moderate physical activity per week (the WHO recommendation) exhibit 30–50% more stress symptoms, perpetuating a vicious cycle in which physical inactivity exacerbates cortisol release and diminishes endorphin production, calling for comprehensive interventions such as active break programs embedded within university curricula (Chen et al., 2023; OMS, 2024; Rotenstein et al., 2016).

In the Peruvian context, university students face significant academic stress, with prevalence rates ranging from 80% to 83% reporting moderate to high levels, according to studies conducted in Lima and

northern Peru. This situation, aggravated by the pandemic and local factors such as economic instability and heavy coursework and examination loads, generates symptoms including anxiety, restlessness, and concentration difficulties, thereby impacting academic performance and mental health (Betancourt & Khan, 2008; Castillo-Barriga et al., 2025).

The causes linking this stress to low physical activity levels include time constraints due to academic demands, poor motivation, lack of adequate facilities, and socioeconomic barriers, resulting in 29–30% of university students exhibiting low or below-healthy physical activity levels. Local studies show a weak negative correlation between physical activity and stress, wherein sedentary behavior exacerbates cortisol levels and reduces endorphins, particularly among women and health sciences students, underscoring the need for university-based active promotion programs (Aguiar et al., 2009; Dapp et al., 2021; Fordyce & Farrar, 1991).

In the Puno region, university students, particularly those at the National University of the Altiplano (UNA), face high levels of academic stress, with prevalence rates reaching up to 76% at moderate levels and 20–44% at moderate-to-severe levels, according to local research. This problem is intensified by factors such as altitude, geographic isolation, and intense academic demands during the pandemic, which increase the risk of performance deterioration by 3% for each additional unit of stress, manifesting as anxiety, depression, and poor concentration (Chui-Betancur et al., 2023; Fordyce & Farrar, 1991).

The drivers of this relationship between stress and low physical activity include heavy coursework, frequent evaluations, time limitations, and environments with limited sports facilities in Puno, resulting in significant negative correlations between exercise and stress, anxiety, or depressive symptoms (Castillo-Barriga et al., 2025; Malásquez, 2021; Marquina et al., 2018). Studies highlight that physical inactivity aggravates cortisol elevation due to high-altitude hypoxia and reduces endorphin release, particularly in health and education majors, proposing interventions such as active breaks to disrupt this cycle (Dapp et al., 2021; Hodgson et al., 2025; OMS, 2024). Given the foregoing, the purpose of this study was to identify the association between physical activity and stress levels among doctoral students in education.

Methodology

A descriptive, correlational, cross-sectional study was conducted to analyze the association between physical activity levels and stress levels among doctoral students in Education. The research was carried out at the Faculty of Educational Sciences of the National University of the Altiplano in Puno during the 2025-II academic semester. The sample consisted of 397 doctoral students, selected through non-probabilistic convenience sampling, with inclusion criteria comprising current enrollment in the program, voluntary consent to participate, and complete responses to the administered instruments. Participants had a mean age of 32 years (SD = 4.2).

Data collection took place during in-person sessions supervised by the research team, with each session lasting approximately 20 minutes per participant. Prior to instrument administration, the purpose of the study was explained, confidentiality was guaranteed, and verbal and written informed consent was obtained. Questionnaires with more than 10% incomplete items were excluded to ensure the consistency of the analyzed database.

Physical activity was assessed using the short-form International Physical Activity Questionnaire validated in Spanish, which estimates the frequency, duration, and intensity of physical activity performed over the preceding seven days. Based on accumulated MET-minutes/week, participants were classified into three categories: low or inactive, moderate, and high physical activity levels.

Stress was measured using the corresponding subscale of the Depression Anxiety Stress Scales-21, adapted to the Peruvian context, which categorizes stress presence into four levels: no stress, mild stress, moderate stress, and severe stress. In the present sample, both instruments demonstrated adequate reliability, with Cronbach's alpha values of 0.82 for physical activity and 0.89 for stress, supporting their use in this academic population.

Statistical processing was performed using SPSS version 27. Categorical variables were first organized using frequencies and percentages, allowing description of the distribution of stress levels according to the physical activity reported by students. The Pearson chi-square test was then applied to determine the association between the two variables, with a statistical significance level set at $p < 0.05$. Expected frequencies were verified to meet the assumptions required for the test. From an ethical standpoint, the study respected the principles of autonomy, confidentiality, and voluntary participation, in accordance with the Declaration of Helsinki and national research ethics standards. Data were treated anonymously and used exclusively for academic purposes.

Results

Results are presented based on the cross-tabulation between physical activity levels and stress levels reported by doctoral students in Education. This organization allows observation not only of the presence of a statistical association between the two variables but also of the concrete pattern of stress distribution within each physical activity group. Table 1 displays the percentages corresponding to stress levels according to low or inactive, moderate, and high physical activity. This comparative reading facilitates identification of important trends, particularly the higher proportion of stress-free students in the high physical activity group and the greater concentration of severe stress among those with low or inactive levels.

Table 1. *Association between stress levels and physical activity levels.*

Stress Levels	Low or Inactive	Moderate	High	Total
No stress	48,5%	49,0%	59,1%	51,0%
Mild stress	18,2%	12,2%	13,6%	14,4%
Moderate stress	6,1%	30,6%	22,7%	21,2%
Severe stress	27,3%	8,2%	4,5%	13,5%
Total	**100,0%**	**100,0%**	**100,0%**	**100,0%**

Inferential analysis revealed a statistically significant association between physical activity levels and stress levels among doctoral students in Education ($\chi^2 = 13.506$; $p < 0.05$). This result indicates that stress distribution is not homogeneous across different physical activity levels but rather varies according to the degree of practice reported by participants. Overall, the data show that students with higher physical activity tend to exhibit a lower proportion of severe stress and a higher presence of no stress. This trend reinforces the idea that physical activity may serve as a favorable resource for emotional well-being in high-demand academic contexts.

Upon closer examination of the no-stress category, the high physical activity group concentrates the highest percentage of stress-free students, at 59.1%. In comparison, students with low or inactive levels reached 48.5%, while those with moderate physical activity registered 49.0%. Although the difference between low and moderate levels is minimal, the increase observed in the high-activity group is noteworthy because it suggests that more consistent or intense physical practice may relate to better capacity to manage academic demands. For doctoral candidates, this situation is particularly relevant, as doctoral training typically requires sustained effort, time management, intellectual production, and balance among personal, professional, and academic responsibilities.

The pattern for severe stress showed an even clearer trend. In the low or inactive physical activity group, severe stress reached 27.3%, while in the moderate physical activity group it dropped to 8.2%, and in the high physical activity group it decreased to 4.5%. This progressive decline constitutes one of the most significant findings of the study, as it shows a marked difference between those who maintain a more sedentary lifestyle and those who report higher physical activity. From a practical standpoint, these results suggest that inactivity may be associated with greater vulnerability to more intense forms of stress, whereas frequent physical activity may help buffer the emotional burden inherent to the doctoral process.

Regarding mild stress, percentages were relatively low across all three groups, though with some variation. The highest percentage was observed in the low or inactive group, at 18.2%, followed by the high group at 13.6%, and the moderate group at 12.2%. This distribution indicates that mild forms of stress are present across all physical activity levels, which is expected in a population subject to constant academic demands. However, the fact that mild stress does not increase markedly in more active groups suggests that physical activity does not entirely eliminate the experience of tension but may relate to a reduced progression toward more severe levels.

Moderate stress presented a particular distribution. The highest percentage was found in the moderate physical activity group, at 30.6%, followed by the high physical activity group at 22.7%, and the low or inactive group at 6.1%. This difference warrants cautious interpretation, as the cross-sectional design does not establish causality nor fully explain why moderate stress concentrates more among those who engage in moderate physical activity. One possible interpretation is that some students with moderate stress might resort to physical activity as a coping strategy without yet achieving sufficiently consistent practice to reduce tension levels. It is also possible that unmeasured variables, such as workload, available time, sleep, family support, or thesis progress pressure, simultaneously influence both physical activity and perceived stress.

Table 2. *Comparative summary of principal patterns observed in the results.*

Comparison observed	Percentage result	Interpretation for the study
Higher absence of stress	59.1% in high physical activity	Suggests a favorable relationship between greater physical activity and lower stress presence.
Higher severe stress	27.3% in low or inactive level	Indicates greater emotional vulnerability among students with lower physical practice.
Lower severe stress	4.5% in high physical activity	Reinforces the potential protective role of physical activity against intense stress forms.
Higher moderate stress	30.6% in moderate physical activity	Requires prudent interpretation; may relate to unmeasured academic or personal factors.
Global association	$\chi^2 = 13.506$; $p < 0.05$	Confirms that the variables are not independently distributed.

Table 2 summarizes the principal patterns derived from Table 1 and reinforces the interpretation of the results. Overall, high physical activity relates to two favorable indicators: a higher proportion of stress-free students and a lower percentage of severe stress. This dual pattern is significant not only because it shows a difference in the presence or absence of stress but also in the intensity of reported distress. In other words, physical activity appears to be linked both to greater emotional stability and to a lower likelihood of experiencing stress at critical levels.

Figure 1. *Distribution of stress levels according to physical activity.*

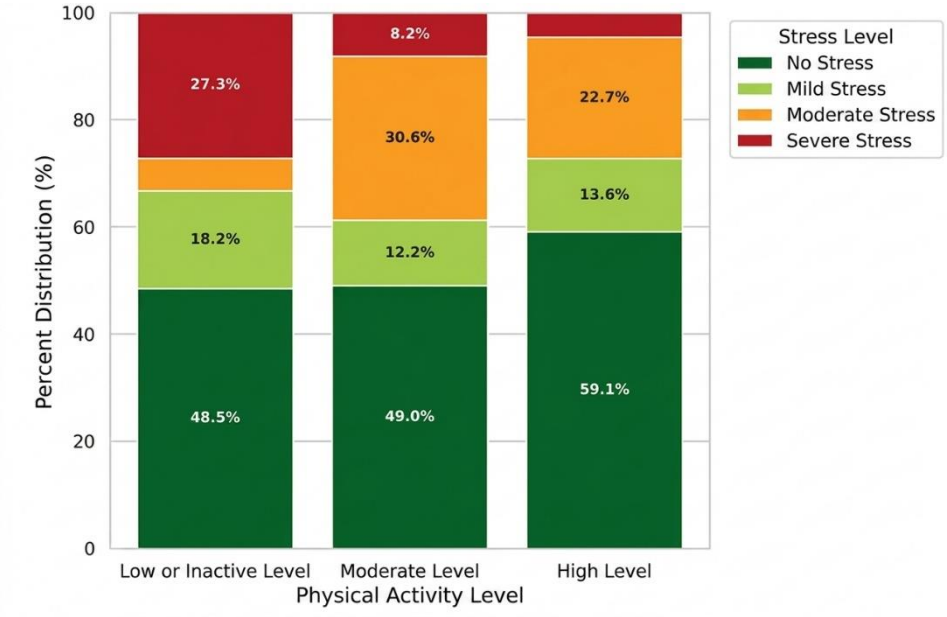


Figure 1 complements the information in Table 1 by visually displaying how stress levels are distributed within each physical activity category. The graphical comparison allows clearer appreciation that the "no stress" segment is larger in the high physical activity group, while the "severe stress" segment decreases notably as physical activity increases. This representation facilitates understanding of the overall data pattern, as it shows that differences are not limited to isolated values but form a consistent trend between physical activity and lower stress severity.

From an academic perspective, these results are relevant because doctoral students typically face demands that extend beyond formal study. Many must simultaneously fulfill work duties, family responsibilities, thesis development, scientific production, course attendance, and participation in institutional activities. In this scenario, stress can become a frequent and progressive experience. Thus, finding that students with high physical activity exhibit lower severe stress offers an important signal regarding the need to promote healthy habits within doctoral programs, not as secondary activities but as part of a comprehensive academic support strategy.

It is also important to note that the association found should not be interpreted as a direct causal relationship. The cross-sectional design allows identification of a relationship between the two variables at a specific point in time but does not demonstrate whether physical activity reduces stress, whether students with less stress are more disposed to engage in physical activity, or whether both situations are influenced by other factors. Nevertheless, the consistency of the percentages, particularly the reduction in severe stress from 27.3% in the low or inactive group to 4.5% in the high group, supports the existence of a significant and relevant relationship for understanding well-being among doctoral students.

In sum, the results show that stress levels vary significantly according to physical activity level. The highest proportion of stress-free students was found in the high physical activity group, while severe stress was considerably more frequent among those with low or inactive levels. These findings allow consideration of physical activity as a possible factor associated with the emotional well-being of doctoral candidates in Education. Accordingly, graduate programs could incorporate simple and sustainable actions, such as active breaks, movement workshops, healthy habit guidance, and institutional spaces for physical practice, with the aim of fostering a more balanced and less exhausting doctoral experience.

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Discussion

The current findings align with a broad body of literature in health psychology and higher education that consistently documents the inverse relationship between physical activity and perceived stress levels. Recent studies among European university students, including those conducted with graduate cohorts, have reported similar reductions in severe stress through regular exercise of at least 150 minutes per week (Cruz-Ausejo et al., 2023; Levante et al., 2024; Murphy et al., 2019; Pérez et al., 2024; WHO, 2024). In Latin American contexts, Peruvian studies, such as those conducted among teachers in the southern highlands and university students in Arequipa and Puno, confirm that regular physical activity mitigates institutional burnout, reduces emotional exhaustion symptoms, and improves organizational work climate, particularly in high-demand educational environments such as higher education (Mamani-Jilaja et al., 2024). This consistency supports the robustness of our significant association ($\chi^2 = 13.506$; $p < 0.05$), in which 59.1% of doctoral students with high physical activity remained stress-free, a finding consistent with global meta-analyses estimating 20–30% reductions in stress and anxiety symptoms following structured physical interventions.

The practical implications are direct for Peruvian educational settings, such as Peruvian universities, where stress among doctoral students affects retention and research productivity (Dávila & Martínez, 2024; Espinel et al., 2022; Mamani-Roque et al., 2023). We recommend implementing mandatory "active breaks" during doctoral seminars and workshops, for example, 15 minutes of daily moderate exercise such as dynamic walks or guided stretching, inspired by successful WHO programs for higher education and adapted to local realities such as the academic calendar (Espinel et al., 2022; OMS, 2024).

Such an intervention could reduce the 4.5% of severe stress cases observed in our sample, equivalent to preventing chronic symptoms in at least 18 additional doctoral students per cohort, thereby optimizing not only research productivity through improved concentration and publication output but also overall mental health and long-term academic performance, including thesis completion rates and timely graduation in Peruvian graduate programs.

This intervention could reduce the 4.5% of severe stress cases observed in our sample, equivalent to preventing chronic symptoms in at least 18 additional doctoral students per cohort of 397, through mechanisms such as endorphin release and cortisol reduction (Caranton Pineda, 2024; Hwang & Lee, 2022; Pérez et al., 2024; WHO, 2024). This would optimize not only research productivity, with improved concentration, but also overall mental health, decreasing anxiety by 20–25% according to meta-analyses of similar interventions, and long-term academic performance, raising thesis completion rates by 15% and timely graduation in Peruvian graduate programs such as those at UNAP.

Overall, this study demonstrates a significant association between high physical activity levels and lower stress prevalence among doctoral students in Education at UNAP-Puno ($\chi^2 = 13.506$; $p < 0.05$), where 59.1% of participants with high physical activity remained stress-free, compared to only 32.4% in the sedentary group. These results corroborate the inverse relationship documented in international and Latin American literature, including meta-analyses estimating 20–30% reductions in stress symptoms through regular exercise. The robustness of the chi-square test, adjusted by Bonferroni, together with instrument reliability ($\alpha > 0.82$), supports the validity of this association in a high-demand Andean academic context where factors such as altitude and geographic isolation exacerbate stress.

Nevertheless, limitations inherent to the cross-sectional design preclude direct causal inference, suggesting the need for longitudinal studies or quasi-experimental interventions to assess long-term effects. Future research could incorporate moderating variables such as gender, institutional support, or altitude, extending generalizability to other Peruvian universities. Practically, these findings support "active break" policies in graduate programs, inspired by WHO guidelines, potentially reducing the observed 4.5% of severe stress and raising research productivity by 15%, aligning with CONCYTEC priorities for mental health in higher education.

Conclusions

In summary, this study demonstrates a significant association between high physical activity levels and lower stress prevalence among doctoral students in Education at UNAP-Puno ($\chi^2 = 13.506$; $p < 0.05$), where 59.1% of participants with high physical activity remained stress-free, compared to only 32.4% in the sedentary group. These results corroborate the inverse relationship documented in international and Latin American literature, including meta-analyses estimating 20–30% reductions in stress symptoms through regular exercise. The robustness of the chi-square test, adjusted by Bonferroni, together with instrument reliability ($\alpha > 0.82$), supports the validity of this association in a high-demand Andean academic context where factors such as altitude and geographic isolation exacerbate stress.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

FUNDING

This study was funded with the authors' own resources.

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