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RELATIONSHIP BETWEEN PHYSICAL ACTIVITY, PERCEIVED STRESS, AND PSYCHOLOGICAL WELL-BEING IN UNIVERSITY STUDENTS

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Abstract

Introduction. Perceived stress has reached concerning levels among university students, and physical activity (PA) has emerged as a relevant strategy for mitigation. This study aimed to examine whether perceived stress mediates the relationship between physical activity (PA), assessed as total volume, and IPAQ-SF intensity components (vigorous, moderate, and walking), and psychological well-being (PWB) in university students. ***Material and methods.*** A cross-sectional study was conducted with 103 students from the University of Málaga (21.7 ± 2.3 years). PA was assessed using the IPAQ-SF (MET-min/week), stress with the PSS-14, and PWB with the Ryff-39. Analyses included descriptive statistics, ANOVA/t-tests, Pearson/Spearman correlations, and a simple mediation model (PROCESS macro). ***Results.*** Overall, 66.99% of participants reported high PA levels (≥3,000 MET-min/week). Total PA averaged 4,860 ± 3,497 MET-min/week (range = 0–12,852). Perceived stress (PSS-14) was 27.31 ± 9.30 points (range = 6-56), and global psychological well-being (RYFF_GLOBAL) averaged 4.40 ± 0.58 on a 1-6 scale. Total PA was negatively associated with perceived stress ($r = -0.28$; $p = 0.005$), and perceived stress was negatively associated with PWB ($r = -0.46$; $p < 0.001$). The indirect effect of PA on well-being through stress was significant (ab = 0.13; 95% CI [0.04, 0.24]). Students with high PA levels (≥3,000 MET-min/week) reported significantly lower perceived stress than those with low-to-moderate PA ($p = 0.021$). ***Conclusions.*** Physical activity appears to contribute to university students' psychological well-being primarily through its association with reduced perceived stress. University-based interventions should integrate regular exercise with stress-management strategies to optimize students' psychological well-being.

Keywords: physical activity, perceived stress, psychological well-being, university students

Introduction

The university years represent a period of heightened vulnerability for mental health, as students are exposed to major academic, social, and personal demands while adapting to new routines and responsibilities. In Spain, multicenter evidence suggests that approximately 36% of first-year university students meet criteria for a common mental disorder within a 12-month period, with nearly one-third reporting severe functional impairment, while only a minority receive specialized care [1]. In this context, identifying modifiable factors linked to psychological distress and perceived stress has become a priority for university health promotion. Perceived stress – defined as the global appraisal of unpredictability, lack of control, and overload of daily demands – has been associated with poorer academic performance, increased substance use, and a higher risk of anxiety and depressive disorders [2]. The PSS-14 is a widely used and psychometrically sound instrument for assessing this construct in university populations.

Physical activity (PA) is widely regarded as an accessible and low-cost behavioral strategy to support mental health and stress regulation. Current World Health Organization guidelines recommend that adults accumulate 150-300 minutes per week of moderate-intensity aerobic activity (approximately ≥600 MET-min/week) [3, 4], yet a substantial proportion of young adults do not meet these recommendations. In university populations, PA is commonly assessed through self-report questionnaires such as the IPAQ-SF, which allows estimation of weekly energy expenditure in MET-min/week and facilitates comparisons across studies [5, 6, 7]. Evidence indicates modest positive associations between PA and subjective well-being ($d \approx 0.36$), although with considerable heterogeneity across studies [8]. In university students, PA interventions have been shown to produce small reductions in stress, anxiety, and depressive symptoms [9, 10]. However, evidence regarding perceived stress as a potential mechanism linking PA to psychological well-being remains limited [11].

Psychological well-being (PWB) is frequently assessed using hedonic indicators such as happiness or life satisfaction, which may overlook key eudaimonic aspects of optimal functioning. Ryff's model conceptualizes PWB as a multidimensional construct including self-acceptance, positive relations, autonomy, environmental mastery, personal growth, and purpose in life (12,13), and has demonstrated solid validity in Spanish-speaking populations [14, 15, 16]. Despite this, relatively few studies in Spanish university samples have simultaneously examined physical activity, perceived stress, and multidimensional eudaimonic well-being, particularly when considering stress as a potential explanatory mechanism linking PA to psychological functioning. Within this framework, evidence published in Polish Journal of Sport and Tourism suggests that physical activity – especially when combined with complementary self-regulation practices such as meditation – may support dimensions of eudaimonic well-being such as purpose in life [17].

From a theoretical perspective, PA may influence PWB indirectly through stress reduction and psychosocial resources [18]. In fact, perceived stress has been shown to mediate the association between PA and other health outcomes, including sleep quality [19]. Additionally, examining whether very high levels of physical activity (≥3,000 MET-min/week) provide additional benefits for stress regulation and psychological well-being is particularly relevant in active university populations [20].

In this context, the present cross-sectional study aimed to: (a) analyze the relationship between total PA, perceived stress, and eudaimonic PWB in Andalusian university students, and (b) evaluate whether perceived stress mediates the PA-PWB association. Stress levels were additionally compared between students with high PA and those with low-to-moderate PA. Based on previous literature, the hypotheses were: H1 – higher total PA is associated with lower perceived stress; H2 – perceived stress is negatively associated with global PWB and its six dimensions; H3 – perceived stress fully mediates the PA-PWB relationship; and H4 – students with high PA show lower stress than those with low-to-moderate PA.

Material and methods

Study Design

An observational cross-sectional study was conducted to examine the relationships between total physical activity (PA; MET-min/week), perceived stress, and psychological well-being (PWB) in university students. In addition, the study tested whether perceived stress mediated the association between PA and global psychological well-being. This design was chosen to provide an initial snapshot of these relationships within an Andalusian university context and to inform future longitudinal or intervention-based research.

Participants

The sample comprised 103 students from the University of Málaga, with a mean age of 21.7 ± 2.3 years (range 18-28). Participants were recruited using a non-probabilistic convenience sampling method during face-to-face classes at the university.

The inclusion criteria were: (1) active enrollment at the University of Málaga, (2) age ≥ 18 years, and (3) provision of electronic informed consent.

No incomplete questionnaires or participant dropouts were recorded; therefore, all 103 cases were included in the analyses.

Table 1. Instruments used to assess PA, perceived stress, and PWB

Variable	Instrument	No. of items	Scoring range	Reliability (α in this sample*)
Physical activity	International Physical Activity Questionnaire, short form (IPAQ-SF)	7	MET-min/ week	–
Perceived stress	Perceived Stress Scale, 14-item version (PSS-14)	14	0-56	0.84
Psychological well-being	Ryff Psychological Well-Being Scale, short version (39 items)	39	1-6	Global = 0.90; subscales = 0.59-0.82

Physical Activity (IPAQ-SF)

Physical activity was assessed using the International Physical Activity Questionnaire–Short Form (IPAQ-SF). The questionnaire records the frequency (days/week) and duration (minutes/day) of vigorous (≥6 MET), moderate (3-5.9 MET), and walking activities lasting at least ten continuous minutes during the previous seven days. Minutes in each category were converted into MET-min/week using standard metabolic equivalents: 8 MET for vigorous activity, 4 MET for moderate activity, and 3.3 MET for walking. Total physical activity (MET_TOTAL) was calculated by summing the three components.

Three classification criteria were applied:

1. Official IPAQ categories: low (<600 MET-min/week), moderate (600–<3,000 MET-min/week), and high (≥3,000 MET-min/week).
2. Empirical tertiles: cut-offs at the 33rd percentile (3,533 MET-min/week) and 66th percentile (6,690 MET-min/week).
3. Dichotomous classification: "low-to-moderate activity" (<3,000 MET-min/week) versus "high activity" (≥3,000 MET-min/week).

Following standard IPAQ-SF scoring procedures, daily duration values were truncated at 180 minutes to reduce the influence of extreme responses. MET-min/week values were calculated separately for vigorous (MET_VIG = 8.0 × minutes/day × days/week), moderate (MET_MOD = 4.0 × minutes/day × days/week), and walking activity (MET_WALK = 3.3 × minutes/day × days/week), and subsequently summed to obtain total physical activity (MET_TOTAL).

Perceived Stress (PSS-14)

Perceived stress was measured using the 14-item Perceived Stress Scale (PSS-14). Items were rated on a five-point Likert scale ranging from 0 ("never") to 4 ("very often"). Following the Spanish adaptation (21), positively worded items were reverse-scored and summed with the remaining items to obtain a total stress score (PSS_TOTAL), with a theoretical range of 0-56. Internal consistency in this sample was adequate (Cronbach's α = 0.84).

Psychological Well-Being (Ryff-39)

Psychological well-being was assessed using the 39-item short version of Ryff's Psychological Well-Being Scales. The instrument evaluates six dimensions: Autonomy (8 items), Environmental Mastery (6 items), Positive Relations (6 items), Personal Growth (7 items), Purpose in Life (6 items), and Self-Acceptance (6 items), totaling 39 items. Responses were scored on a six-point Likert scale (1–6), with 17 negatively worded items reverse-coded (7 – x).

Dimension scores were calculated as the mean of the items within each subscale, and a global psychological well-being index (RYFF_GLOBAL) was computed as the mean of the six subscales. Reliability in the present sample was excellent for the global score (Cronbach's α = 0.90) and adequate for all subscales except Environmental Mastery (α = 0.59).

Procedure

Data were collected between April and May 2025 using an online questionnaire administered via Google Forms. The survey link was distributed at the end of face-to-face classes across several courses at the University of Málaga.

The questionnaire included:

1. Study information;
2. Electronic informed consent;
3. Sociodemographic questions;
4. The IPAQ-SF, PSS-14, and Ryff-39 scales, presented in this order.

Completion time was approximately 15-20 minutes. All items were set as mandatory in the online form to prevent miss-

ing responses. Data screening did not reveal extreme values requiring exclusion; therefore, all 103 cases were retained for analysis.

Data Analysis

Statistical analyses were conducted using IBM SPSS Statistics. Descriptive statistics (mean, standard deviation, range, skewness, and kurtosis) were calculated for the main study variables, and distributions were visually inspected using histograms. Internal consistency was assessed using Cronbach's alpha for the PSS-14, each Ryff subscale, and the global well-being index (RYFF_GLOBAL).

Differences in perceived stress across physical activity levels were initially described using the three official IPAQ-SF categories (low, moderate, high). However, given the small size of the low-PA subgroup in this sample, inferential comparisons were conducted using MET_TOTAL tertiles and a dichotomous grouping (low-to-moderate activity <3,000 MET-min/week vs high activity ≥3,000 MET-min/week). Stress scores between the two dichotomous groups were compared using Welch's independent-samples t-test.

Associations between physical activity (PA), perceived stress (PSS_TOTAL), and psychological well-being (RYFF_GLOBAL) were evaluated using Pearson and Spearman correlation coefficients. PA was analyzed both as total volume (MET_TOTAL) and as IPAQ-SF intensity components (vigorous, moderate, and walking MET-min/week).

Mediation analyses were conducted using the PROCESS macro. Separate simple mediation models were tested with each PA indicator (MET_TOTAL and each intensity component) as the independent variable (X), perceived stress (PSS_TOTAL) as the mediator (M), and global psychological well-being (RYFF_GLOBAL) as the outcome variable (Y). Path coefficients (a, b, c, and c') and the indirect effect (ab) were reported.

Given the cross-sectional design, mediation results were interpreted as statistical indirect associations rather than evidence of temporal or causal relationships. Statistical significance was set at $p < .05$ (two-tailed).

Ethical Considerations

The study protocol was approved by the Ethics Committee for Experimentation of the University of Málaga (Comité Ético de Experimentación de la Universidad de Málaga, CEUMA; Project ID: 1-2025-H; approval date: April 2, 2025). The study adhered to the principles of the Declaration of Helsinki (1975, revised 2013) and the European General Data Protection Regulation (EU 2016/679). Participation was voluntary, anonymous, and unpaid. All participants provided electronic informed consent before accessing the questionnaire.

Results

The final sample consisted of 103 university students, with a mean age of 21.7 ± 2.3 years (range 18-28). According to the official IPAQ-SF MET-based categories, 66.99% of participants were classified as having high physical activity (PA) levels (≥3,000 MET-min/week), 20.39% as moderate (600-2,999 MET-min/week), and 12.62% as low (<600 MET-min/week).

Total PA (MET_TOTAL) averaged 4,860.03 ± 3,496.92 MET-min/week (range = 0-12,852), showing a positively skewed distribution. PA intensity components derived from the IPAQ-SF were as follows: vigorous activity averaged 2,904.40 ± 2,504.09 MET-min/week, moderate activity averaged 1,055.59 ± 1,162.88 MET-min/week, and walking averaged 1,417.30 ± 1,235.37 MET-min/week.

Perceived stress (PSS-14) was 27.31 ± 9.30 points (range = 6-56), indicating moderate-to-high stress. Global psychological well-being (RYFF_GLOBAL) averaged 4.40 ± 0.58 on a 1-6 scale (range = 2.74-5.77), reflecting above-midpoint well-being.

Official IPAQ-SF categories (low, moderate, high) were used descriptively; therefore, inferential comparisons focused on MET_TOTAL tertiles and the low-to-moderate vs high dichotomy. A significant difference in perceived stress was observed across MET_TOTAL tertiles ($F(2,100) = 4.08$; $p = 0.020$; $\eta^2 = 0.076$). Mean stress scores were 30.47 ± 9.82, 27.29 ± 8.20, and 24.26 ± 9.00 points in the first, second, and third tertiles, respectively. When PA was dichotomized into "low-to-moderate activity" (<3,000 MET-min/week) versus "high activity" (≥3,000 MET-min/week), Welch's t-test indicated a significant difference ($t(59.09) = -2.38$; $p = 0.021$; $d = 0.52$), with lower perceived stress in the high PA group (25.75 ± 8.68) compared with the low-to-moderate PA group (30.47 ± 9.82) (Tab. 2).

Table 2. Comparison of perceived stress (PSS-14) by physical activity level

PA Comparison	Statistic	p	Effect size
MET_TOTAL tertiles (1st vs 2nd vs 3rd)	$F(2,100) = 4.08$	0.020	$\eta^2 = 0.076$
Low-to-moderate (<3,000) vs High (≥3,000 MET-min/week)	$t(59.09) = -2.38$	0.021	$d = 0.52$

Bivariate correlations showed a small negative association between total PA and perceived stress ($r = -0.277$; $p = 0.005$) and a moderate negative association between perceived stress and global psychological well-being ($r = -0.462$; $p < 0.001$). The correlation between total PA and well-being was not significant ($r = 0.167$; $p = 0.093$). Spearman coefficients reproduced the same pattern (PA–stress: $\rho = -0.291$; $p = 0.003$; stress–well-being: $\rho = -0.457$; $p < 0.001$; PA–well-being: $\rho = 0.141$; $p = 0.154$). When examining IPAQ-SF intensity components, vigorous and moderate PA were negatively associated with stress (vigorous: $r = -0.230$; $p = 0.020$; moderate: $r = -0.210$; $p = 0.033$), whereas walking was not ($r = 0.073$; $p = 0.466$). The complete correlation matrix is presented in Table 3.

Table 3. Pearson and Spearman correlations between physical activity variables, perceived stress, and psychological well-being (n = 103). Pearson correlations are shown above the diagonal and Spearman correlations below the diagonal.

Variable	1	2	3	4	5
1. MET_TOTAL	—	0.86***	0.63***	-0.28**	0.17
2. MET_VIG	0.84***	—	0.34***	-0.23*	0.14
3. MET_MOD	0.61***	0.32***	—	-0.21*	0.12
4. PSS_TOTAL	-0.29**	-0.22*	-0.20*	—	–0.46***
5. RYFF_GLOBAL	0.14	0.12	0.10	-0.46***	—

Note: MET_TOTAL – total physical activity (MET-min/week); MET_VIG – vigorous physical activity; MET_MOD – moderate physical activity; PSS_TOTAL – perceived stress score; RYFF_GLOBAL – global psychological well-being score, * – $p < .05$; ** – $p < .01$; *** – $p < .001$.

A simple mediation model was tested with total PA (MET_TOTAL) as the independent variable, perceived stress (PSS_TOTAL) as the mediator, and global well-being (RYFF_GLOBAL) as the outcome. Total PA was significantly associated with lower

perceived stress (path a, β = -0.277; p = 0.005), and perceived stress was significantly associated with lower well-being (path b, β = -0.451; p < 0.001). The indirect effect of PA on well-being through stress was significant (ab = 0.125; 95% CI [0.037, 0.240]; p = 0.002), whereas the direct effect remained non-significant (path c', β = 0.042; p = 0.652). The total effect was not significant (path c, β = 0.167; p = 0.093).

Additional mediation models were tested using each IPAQ-SF intensity component as the independent variable. The indirect effect through perceived stress was significant for vigorous PA (ab = 0.109; 95% CI [0.015, 0.232]; p = 0.019), but not for moderate PA (ab = 0.095; 95% CI [-0.009, 0.212]; p = 0.072) or walking (ab = -0.034; 95% CI [-0.121, 0.043]; p = 0.397).

Discussion

This study examined the associations between physical activity, perceived stress, and eudaimonic psychological well-being in university students, and tested whether stress could account for the link between PA and well-being. Despite generally high PA levels and well-being above the scale midpoint, students still reported moderate-to-high perceived stress. Higher PA was linked to lower perceived stress, and stress showed a clear negative association with well-being, whereas PA was not directly associated with global well-being. Overall, the findings suggest that the mental health relevance of PA in this sample is better understood through its relationship with perceived stress rather than through a direct PA-well-being link.

An additional contribution of the present study is the examination of the IPAQ-SF intensity components. Vigorous and moderate physical activity showed small but significant negative associations with perceived stress, whereas walking did not. These findings suggest that higher-intensity physical activity may play a more relevant role in stress regulation among university students. This pattern is consistent with evidence indicating that moderate-to-vigorous physical activity may produce stronger psychophysiological benefits, including improved stress regulation and emotional resilience.

These findings align with literature highlighting PA as a protective factor against stress in university populations. Çerezci-Duygu et al. [22] found that higher PA predicted lower stress during COVID-19, and Liu et al. [23] showed PA interventions reduce depression, anxiety, and stress, partly via resilience and coping. Regarding PWB, our results accord with Ryff's eudaimonic framework; Ugwueze et al. [24] reported higher PA linked to higher PWB, especially self-acceptance, purpose, and positive relations. In our study, the association was fully mediated by stress, consistent with meta-analytic evidence of small direct PA-well-being effects [8], underscoring the role of intermediate mechanisms. Comparing "low-to-moderate" vs. "high" revealed significant stress differences, suggesting a minimum threshold of approximately 3,000 MET-min/week above WHO recommendations may be required for notable benefits. This threshold corresponds to the "high physical activity" category proposed in the IPAQ scoring guidelines, commonly used in epidemiological studies. Full mediation supports the hypothesis that PA improves psychological well-being mainly through reductions in perceived stress.

Applied implications include integrating physical activity (PA) programs into university mental health strategies. The four-point difference in perceived stress between students with high and low-to-moderate suggests potentially meaningful differences; however, exercise alone may not be sufficient to optimize psychological well-being. In this regard, evidence from university settings indicates that short, structured PA interventions implemented within academic contexts are feasible and can positively influence students' psychological engagement and affective states, supporting the implementation of "active campus" approaches [25]. Therefore, combining regular PA with psychoeducational stress-management interventions (e.g., mindfulness, emotion regulation, or academic coping strategies) may enhance their impact on students' psychological well-being.

Strengths of this study include validated instruments with adequate-to-excellent reliability, mediation analysis (PROCESS macro), and a multidimensional eudaimonic PWB approach. Limitations include self-reported PA, single-campus convenience sampling, small low-PA group, and moderate reliability of Environmental Mastery (α = 0.59). Future research should use longitudinal or experimental designs, include objective PA and stress measures, and examine other mediators (sleep, social support, positive affect) or moderators (sex, age, SES), as well as different PA doses to identify optimal stress-reducing profiles.

Overall, results support that PA contributes to university students' PWB primarily through stress reduction, highlighting the need for integrated PA and stress-management strategies in campus mental health policies.

Conclusions

This study shows that physical activity is related to university students' mental health primarily through its association with perceived stress. While most students reported high levels of physical activity and eudaimonic well-being, perceived stress remained moderate to high. Physical activity was negatively associated with perceived stress but not directly with psychological well-being, whereas stress showed a moderate negative association with well-being. Mediation analysis supported a full mediation model, indicating that higher volumes of physical activity, particularly moderate-to-vigorous activity, may play a relevant role in stress regulation among university students.

Furthermore, significant stress differences were observed between students with high physical activity levels (≥3,000 MET-min/week) and those with lower activity levels, suggesting that higher volumes of physical activity may be required to obtain meaningful stress-related benefits. These findings support the integration of physical activity promotion into university health policies, while emphasizing that exercise alone may be insufficient to enhance eudaimonic well-being unless combined with stress-regulation strategies.

Future research should employ longitudinal or experimental designs and incorporate objective measures of physical activity and stress to clarify optimal activity profiles for improving mental health in university students.

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