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Associations between physical activity and quality of life, mental health indicators, burnout, and vocal fatigue in Spanish university professors

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Abstract

Introduction The teaching profession requires a high level of dedication and involvement. The high work demands they are subjected to become risk factors for their physical and emotional health. Regular physical activity becomes a key protective factor in coping with such demands.

Purpose The aim of the study was to analyse the relationship between the level of physical activity and different dimensions of well-being of university professors in Spain.

Method The study was carried out on a sample of 1560 university professors (47.39 ± 11.29 years) from thirteen universities belonging to the Spanish Network of Health Promoting Universities. Physical activity, burnout, health-related quality of life, stress, anxiety and depression, vocal fatigue and various sociodemographic factors were assessed.

Results 15.33% of university professors have low levels of PA, 56.47% have moderate levels, and only 28.20% achieve high levels. Men had a higher proportion of high levels of physical activity than women. Furthermore, the regression analysis identified positive associations between physical activity levels and all dimensions of quality of life. In addition, a higher level of physical activity was associated with lower rates of stress, anxiety, emotional exhaustion, vocal fatigue and physical discomfort in the voice.

Conclusions These results highlight physical activity as an essential tool for promoting general health in the university workplace, enabling university professors to adapt more positively to the demands of the academic environment.

Keywords Health, University professors, Physical activity, Lifestyle habits, Mental disorders

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Introduction

The health of university professors has become a growing area of interest in educational research, as their exposure to risk factors inherent in teaching, such as the high cognitive, emotional and administrative demands of the university environment, can have a negative impact on multiple dimensions of well-being, from physical, mental and emotional health to the perception of quality of life [1–3]. Furthermore, this vulnerability is exacerbated by intensive voice use, accumulated stress, and poor adherence to healthy lifestyle habits such as regular physical activity (PA) [4–6].

At a broader level, European evidence indicates that teaching professionals experience substantially higher levels of work-related stress, anxiety, fatigue, sleep disturbances and verbal harassment than employees in other occupational sectors, despite often reporting greater job satisfaction [7]. Within the Spanish context, this trend is reinforced by studies documenting a progressive deterioration in the psychosocial working conditions of university faculty, characterised by high psychological demands, limited social support, job insecurity and marked emotional strain [8]. Likewise, exploratory analyses of Spanish teaching and research staff have identified stress, perceived injustice and accreditation-related pressures as key contributors to declining health indicators among professors [9]. Data from the International Barometer of Education Personnel Health and Wellbeing (I-BEST 2023) further underscore the magnitude of these challenges among Spanish educators [10]. Specifically, 93% report moderate to high levels of work-related stress at the beginning of the school year, 61% have been unable to work at some point in the past 12 months due to voice-related problems, and 18% rate their overall health as poor or fairly poor. Moreover, 39% experience negative emotions such as anxiety, depression or hopelessness often or very often, while only 28% report being satisfied with their sleep quality. Additionally, 59% report limitations in daily activities due to health problems, most commonly associated with fatigue, migraines, mental disorders and sleep-related difficulties.

PA is understood as any bodily movement that involves energy expenditure and constitutes a key factor in promoting health and preventing numerous physical and psychological disorders [11]. Scientific evidence has demonstrated its broad benefits for cardiovascular health, overall physical functioning and the prevention of chronic non-communicable diseases [12]. Furthermore, PA plays a central role in emotional regulation, stress reduction and mood enhancement, making it a particularly valuable resource for coping with the high professional demands that characterise university environments [13]. In addition, moderate to high levels of PA are associated with more positive subjective assessments of physical fitness, greater vitality and more favourable attitudes towards self-care and health. By contrast, insufficient PA has been linked to poorer perceptions of physical fitness, a higher prevalence of physical discomfort and symptoms related to fatigue, musculoskeletal pain and low energy levels [14–16]. Despite these well-documented benefits, physical inactivity has continued to rise globally, increasing from 23.4% in 2000 to 31.3% in 2022, with the sharpest growth observed in high-income countries [17]. Consistently, national data from Spain show that 37.3% of adults spend most of their main daily activity seated, a sedentary pattern that has remained stable since 2011 [18]. Moreover, occupational differences further illustrate this trend. As reported by Steele and Mummery [19], workers in physically demanding jobs, such as manual labour, maintenance or industrial work, typically meet recommended PA levels through their daily tasks. In contrast, individuals in predominantly sedentary occupations, including teaching, administrative or technical roles, report significantly lower PA levels during working hours and must compensate by engaging in additional activity outside the workplace to meet World Health Organization guidelines.

The relationship between PA and mental health has been widely supported by scientific literature, highlighting that regular exercise is associated with lower levels of stress, anxiety and depression, as well as greater emotional stability and improved coping strategies [20–22]. In the university setting, where university professors are under considerable pressure due to the academic demands of their work, PA has been shown to be a key tool for improving mood and reducing work-related stress [13]. Other studies, such as that by Gao and Yin [23], albeit with secondary school teachers, have shown that PA has positive effects on mental health by reducing emotional exhaustion and stress levels and promoting emotional balance.

Furthermore, other studies on students in a university setting show that PA is associated with greater resilience and positive coping styles, while also reducing negative emotions [24]. Similarly, Ngalagou et al. [25] point out that PA can play a key preventive role against Burnout Syndrome in university professors, because, in highly demanding work contexts, physical exercise acts as a protector of general psychological well-being and reduces the risk of professional burnout. In this regard, an inverse association has been described between PA levels and indicators of teacher burnout, even when controlling for variables such as age, gender, and work experience [26]. Furthermore, PA directly influences the perception of quality of life, understood as a multidimensional construct that integrates physical, emotional, social and environmental components [27, 28]. In the case of university professors, maintaining an active lifestyle and

good physical condition can translate into greater job satisfaction, a better organisational climate and higher productivity [29].

Lastly, with regard to vocal health, a particularly relevant aspect in the teaching context, potential benefits associated with regular PA have also been identified [30]. In this sense, the intensive use of the voice, common in this profession, can cause symptoms of vocal fatigue and physical discomfort in the vocal cords of university professors [4, 31]. Although evidence is limited, a study of Brazilian teachers found that those who engaged in PA at least three times a week had a lower prevalence of dysphonia, suggesting a possible protective effect of exercise against vocal disorders [32].

Given this reality, the present study aims to analyse the relationship between the level of PA and different dimensions of well-being among university professors in Spain. Specifically, associations between weekly PA and health-related quality of life (physical, mental, social and environmental), mental health indicators (symptoms of stress, anxiety and depression), vocal fatigue (tiredness, physical discomfort and perception of improvement) and burnout (emotional exhaustion, depersonalisation and personal fulfilment) are examined. Unlike previous studies focused on isolated variables or teachers at other educational stages, this study adopts a comprehensive approach that examines associations between physical activity and several health-related indicators across physical, psychological, vocal and psychosocial domains, without modelling the interrelations between these dimensions. In this regard, its main contribution lies in the simultaneous inclusion of physical, emotional, vocal and psychosocial indicators, as well as in the choice of university professors as the target population, a group that has been little explored in scientific literature despite its high exposure to psychosocial risk factors and its key role in the higher education system.

Methodology

Study design and participants

A descriptive–correlational, cross-sectional study was conducted using an online survey. Participants were recruited through a non-probabilistic convenience sampling strategy. This approach was selected because the target population (professors from the Spanish Network of Health Promoting Universities) constitutes a naturally bounded and institutionally defined group, for which access depends on voluntary institutional collaboration. A total of 13,343 professors from thirteen universities belonging to the network were invited to participate in the survey.

The inclusion criteria were: (a) being an active professor at one of the universities belonging to the Spanish Network of Health Promoting Universities; (b) being assigned teaching duties; (c) not being on leave, extended absence, or partial retirement; (d) belonging to an official teaching category recognised by the Ministry of Science, Innovation and Universities; and (e) agreeing to participate voluntarily in the study by signing the informed consent form. As an exclusion criterion, questionnaires that were not completed properly or contained omissions in key items were discarded. A total of 1,796 questionnaires were received, of which those that did not meet the established quality criteria were eliminated, resulting in a final sample of 1,560 professors from thirteen participating Spanish universities and a final response rate of 11.69%. The final sample consisted of 779 men (49.9%) and 781 women (50.1%), aged between 23 and 74 years (M = 47.39; SD = 11.29).

Procedure

The ethical principles of the Declaration of Helsinki were respected at all times during the research process, and approval was obtained from the Research Ethics Committee of the University of La Rioja before the study began. Participants were invited to complete the survey by email. Information about the purpose of the study was provided and informed consent was requested online before accessing the questionnaire. Participation was voluntary and anonymous. The questionnaire was sent to professors from the participating universities via their institutional teaching email addresses, presenting the study and providing access to the survey through a link to the SurveyMonkey platform. Potential participants had 90 days to respond, during which two reminder emails with the survey link were sent to those who had not yet replied. Data collection took place between November 2023 and January 2024.

Variables

For data collection, an instrument was specifically developed for this study, comprising sociodemographic items and five previously published and validated instruments. All of them have references and solid evidence of validity and reliability, as detailed below. The English version of the complete questionnaire used in this study is provided as supplementary material.

To estimate physical activity levels, the abbreviated version of the International Physical Activity Questionnaire Short Form (IPAQ-SF) was used, validated in 12 countries, including Spain [33]. This instrument allows the intensity, frequency and duration of PA performed during the seven days prior to completing the questionnaire to be estimated. Information is obtained through seven questions regarding the number of days on which intense or moderate PA or walking was performed, as well as the daily time spent on each activity. The total weekly PA volume was calculated in MET minutes per week, following

the data analysis and processing instructions established by the IPAQ developers [34]. In accordance with standard IPAQ scoring procedures, extreme values were treated using the recommended truncation rules: bouts exceeding 180 min per day for any intensity were truncated to 180 min to reduce the influence of improbable or outlier reports. Based on these values, three categories were established for PA levels: low (< 600 MET-minutes/week), moderate (between 600 and 3000 MET-minutes/week) and high (> 3000 MET-minutes/week).

Health-related quality of life was assessed using the World Health Organisation's (WHO) quality of life scale in its abbreviated version (WHOQOL-BREF), developed by the WHO itself [35]. This questionnaire assesses people's perceptions of their health status, psychosocial situation and other aspects related to quality of life during the two weeks prior to completion. The instrument consists of 26 items that are answered using a five-point Likert scale. The items are grouped into four dimensions: physical health (7 items), psychological health (6 items), social relationships (3 items) and environment (8 items). It also includes two initial questions that assess the participant's overall perception of their quality of life and state of health. In accordance with WHO guidelines, the raw scores obtained in each dimension were converted to a scale of 0 to 100, where higher values indicate a higher perceived quality of life. In the present study, Cronbach's alpha coefficients were adequate in all areas: 0.754 for physical well-being, 0.834 for mental well-being, 0.744 for social well-being, and 0.807 for the environment.

Vocal fatigue was assessed using the Vocal Fatigue Index (VFI), developed by Nanjundeswaran et al. [36] and validated in Spanish university professors by Contreras-Regatero [37]. This questionnaire consists of 19 items that collect possible symptoms associated with vocal fatigue as a result of continuous use of the voice. The items are grouped into three factors: "vocal fatigue and avoidance of voice use" (Factor 1; 11 items), "physical discomfort" (Factor 2; 5 items) and "improvement of symptoms with rest" (Factor 3; 3 items). Each item is rated on a scale of five response options: never (0), almost never (1), sometimes (2), almost always (3) and always (4). The scores are obtained by adding the values of the items corresponding to each dimension. A higher score on factors 1 and 2 indicates greater severity of vocal fatigue, while a high score on factor 3 reflects greater recovery of symptoms after rest. In the present study, Cronbach's alpha coefficients were 0.942 for the vocal fatigue and voice use avoidance factor, 0.921 for physical discomfort, and 0.942 for improvement with rest, indicating excellent internal consistency in the three factors evaluated.

Emotional symptoms were assessed using the Depression, Anxiety and Stress Scale (DASS-21), developed by Lovibond and Lovibond [38] and validated in the Spanish population by Fonseca-Pedrero [39]. This questionnaire analyses negative emotional states experienced during the week prior to completion, through 21 items rated on a scale from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). The instrument is organised into three subscales of seven items each, which independently assess levels of depression, anxiety and stress. The scores for each subscale are obtained by adding the corresponding values and multiplying the result by two, in order to match the results with the extended version of the questionnaire (DASS-42). Thus, the final scores range from 0 to 42 in each dimension, with higher values indicating greater symptomatology. In the present study, Cronbach's alpha coefficients were 0.894 for stress, 0.791 for anxiety, and 0.907 for depression, reflecting excellent internal consistency in the dimensions of stress and depression, and acceptable consistency in the case of anxiety.

Burnout syndrome was analysed using the Maslach Burnout Inventory Educators Survey (MBI-ES), designed by Maslach and Jackson [40] and adapted for Spanish professors [41]. The instrument was administered under the corresponding license. This instrument measures professional burnout in the teaching field through 22 items answered on a seven-point Likert scale ranging from 0 (never) to 6 (every day). The questionnaire is structured into three independent subscales: emotional exhaustion, depersonalisation, and personal fulfilment. Scores are obtained by adding the values of each subscale. A high score on the emotional exhaustion and depersonalisation dimensions, together with a low score on personal fulfilment, are indicative of the presence of burnout. In the present study, Cronbach's alpha coefficients were 0.919 for emotional exhaustion, 0.740 for depersonalisation, and 0.906 for personal fulfilment, reflecting excellent internal consistency in the dimensions of exhaustion and personal fulfilment, and acceptable consistency in the dimension of depersonalisation.

Statistical analysis

Quantitative variables were described using means and standard deviations, whereas qualitative variables were summarised using absolute frequencies and percentages. The normality of distributions was assessed using the Kolmogorov–Smirnov test, and homogeneity of variances using Levene's test. Comparisons of means between the three groups defined according to weekly PA level (low, moderate, and high) were performed using one-way analysis of variance (ANOVA) when assumptions were met, or the non-parametric Kruskal–Wallis test otherwise. Associations between qualitative variables were analysed using Pearson's chi-square test.

To improve the interpretability of the results, effect sizes were calculated for all group comparisons.

Table 1 Socio-demographic factors according to physical activity level

		Low *N* = 239		Moderate *N* = 881		High *N* = 440		*P* Value	Effect Size
		%		%		%			
Gender	Male	14.35		51.00		34.65		< 0.001	0.144
	Female	16.20		62.00		21.80			
		M	SD	M	SD	M	SD		
Age		47.01	10.70	47.91	11.38	46.57	11.40	0.101	0.003
Years of experience		15.51	11.36	16.78	12.08	15.95	11.92	0.335	0.002

Notes. *p*-values correspond to Pearson's chi-square test for categorical variables (gender) and one-way ANOVA or Kruskal–Wallis tests for continuous variables (age and years of experience), depending on distributional assumptions. Effect sizes are reported as Cramer's V for categorical variables and as eta-squared (η^2) for normally distributed continuous variables or epsilon-squared (ε^2) for Kruskal–Wallis tests

Table 2 Quality of life indicators and vocal condition based on physical activity level

	Low *N* = 239		Moderate *N* = 881		High *N* = 440		*P* Value	Effect Size
	M	SD	M	SD	M	SD		
Physical wellbeing	66.17	16.68	72.40	15.08	74.69	14.99	< 0.001	0.030
Mental wellbeing	61.54	17.69	68.30	16.65	68.66	17.78	< 0.001	0.021
Environment	64.53	16.29	70.05	14.59	70.80	15.44	< 0.001	0.019
Social relationships	58.54	20.27	63.51	20.17	64.17	21.32	0.001	0.008
Vocal fatigue	10.53	9.00	9.66	8.92	8.84	8.81	0.016	0.004
Physical voice discomfort	3.21	3.96	2.90	3.84	2.59	3.72	0.024	0.003
Improvement voice symptoms with rest	4.91	3.90	5.08	3.88	4.65	3.96	0.150	0.002

Notes. *p*-values correspond to one-way ANOVA or Kruskal–Wallis tests, depending on whether normality and homoscedasticity assumptions were met. Effect sizes are reported as eta-squared (η^2) for ANOVA or epsilon-squared (ε^2) for Kruskal–Wallis

Eta-squared (η^2) was reported as the effect size for ANOVA models, whereas epsilon-squared (ε^2) was calculated as the non-parametric equivalent for Kruskal–Wallis tests. For associations between categorical variables, Cramer's V was used. Effect sizes were interpreted following established benchmarks in health sciences. For η^2 and ε^2, values of approximately 0.01, 0.06 and ≥ 0.14 were considered small, medium and large, respectively [42]. For Cramer's V, interpretation was adjusted according to the degrees of freedom of each contingency table, with values below 0.05 considered very small, around 0.07 small, around 0.21 moderate and above 0.35 large [43].

In addition, linear regression analyses were conducted to examine the associations between PA level (expressed in MET-minutes/week) and the dependent variables related to quality of life, vocal health, mental health indicators (symptoms of stress, anxiety, and depression), and burnout. Two models were estimated for each outcome: Model 1 included PA as the sole predictor (unadjusted), and Model 2 was a multivariable model adjusted for age, gender, and years of teaching experience, selected a priori based on theoretical relevance and data availability. For each model, the unstandardised coefficient (B), standardised coefficient (β), 95% confidence interval (CI), p-value, and coefficient of determination (R^2) were reported. All analyses were performed using IBM SPSS® version 27 (IBM Corp., Armonk, NY, USA). Statistical significance was set at $p < 0.05$.

Results

Table 1 presents different sociodemographic factors according to PA level. Significant differences were observed in the distribution by gender ($p < 0.001$), with a higher proportion of women in the moderate activity group and a higher presence of men in the high activity group. In contrast, no statistically significant differences in age and years of professional experience were found between the three levels of PA.

Table 2 shows the dimensions of quality of life and vocal health according to PA level. Specifically, higher levels of PA were associated with higher scores in physical, mental, environmental, and social well-being ($p < 0.001$). In terms of vocal condition, the participating professors with higher levels of PA showed lower levels of vocal fatigue and physical voice discomfort.

Table 3 presents various mental health symptoms and burnout syndrome according to PA level. Higher levels of PA were associated with lower scores on stress, anxiety, and depression. With regard to burnout syndrome, only the emotional exhaustion dimension showed significant differences depending on the level of PA, with higher scores among less active professors. No differences were found in the dimensions of depersonalisation or personal fulfilment.

Table 4 presents the results of the linear regression analyses, showing both unadjusted (Model 1) and adjusted models (Model 2) for age, gender, and years of teaching experience. In Model 1, physical activity

Table 3 Symptoms of stress, anxiety, depression and burnout according to physical activity level

	Low *N* = 239		Moderate *N* = 881		High *N* = 440		*P* Value	Effect Size
	M	SD	M	SD	M	SD		
Stress	11.95	10.18	9.77	8.78	9.19	8.60	0.003	0.010
Anxiety	6.26	7.25	4.38	5.79	4.33	5.58	< 0.001	0.013
Depression	7.40	8.66	5.36	7.26	5.86	8.55	< 0.001	0.008
Emotional exhaustion	20.59	12.11	17.61	11.00	17.53	11.48	0.001	0.009
Depersonalization	2.85	4.07	2.63	3.12	3.02	3.78	0.550	0.002
Self-fulfilment	32.22	9.29	32.56	8.76	32.80	9.15	0.655	0.000

Notes. *p*-values correspond to one-way ANOVA or Kruskal–Wallis tests, depending on assumption checks. Effect sizes are reported as eta-squared (η^2) for ANOVA or epsilon-squared (ε^2) for Kruskal–Wallis

levels (METs) showed significant positive associations with physical well-being (β = 0.125, $p < 0.001$), mental well-being (β = 0.103, $p < 0.001$), environmental well-being (β = 0.086, $p = 0.001$), and social relationships (β = 0.083, $p = 0.001$). Negative associations were found with vocal fatigue (β = −0.075, $p = 0.003$), physical voice discomfort (β = −0.065, $p = 0.010$), stress (β = −0.094, $p < 0.001$), anxiety (β = −0.070, $p = 0.006$), and emotional exhaustion (β = −0.080, $p = 0.002$). Associations with depression, improvement of voice symptoms with rest, depersonalisation and self-fulfilment did not reach statistical significance.

In Model 2, the magnitude and direction of the coefficients remained largely stable. Physical activity continued to be associated with physical well-being (β = 0.117, $p < 0.001$), mental well-being (β = 0.103, $p < 0.001$), environmental well-being (β = 0.091, $p < 0.001$), and social relationships (β = 0.092, $p < 0.001$). Negative associations also persisted for vocal fatigue (β = −0.062, $p = 0.014$), physical voice discomfort (β = −0.049, $p = 0.049$), stress (β = −0.087, $p < 0.001$), and anxiety (β = −0.063, $p = 0.011$). As in the unadjusted model, depression, improvement of voice symptoms with rest, depersonalisation, and self-fulfilment did not show significant associations.

The adjustment led to a moderate increase in R^2 values for stress, anxiety, and emotional exhaustion, indicating that incorporating basic sociodemographic covariates adds explanatory power to these specific indicators, although the overall proportion of explained variance remains small.

Discussion

The results of this study show that 15.33% of the participating professors have low levels of PA, 56.47% have moderate levels, and only 28.20% achieve high levels. These figures reflect a worrying trend when compared with global population estimates, such as those of Guthold et al. [44], which placed the prevalence of physical inactivity at 27.5% in 2016, or those of Strain et al. [17], who pointed to an increase to 31.3% in 2022. However, when focusing on university professors, the literature shows considerable variability in PA levels, most likely determined by cultural, institutional and organisational factors. In Poland, a study of university professors revealed that 14.8% engaged in moderate PA and only 4.7% achieved high levels [45]. In contrast, the study by Barros-Rocha et al. [46] with Brazilian university professors reported that 31.7% had low PA levels, 34.7% moderate levels and 33.7% high levels. Similarly, in the United States, 8.69% of university professors had low levels of PA and 38.40% had moderate levels [47]. In the Spanish context, López-Bueno et al. [48] reported that 12% of university professors had low levels of PA and 28% had moderate levels. These differences highlight that PA among university faculty is insufficient and may be influenced by a multitude of structural, contextual and personal factors [13]. Importantly, when incorporating multivariable regression models adjusted for age, gender and years of teaching experience, the direction and magnitude of the associations between physical activity levels and the set of health-related indicators remained largely stable. This consistency between unadjusted and adjusted coefficients strengthens the robustness of the findings, suggesting that the observed associations are not merely attributable to basic sociodemographic differences. It is also important to note that, despite this consistency, the effect sizes were small and the proportion of explained variance was modest across outcomes. This indicates that PA accounts for only a limited fraction of the variability in well-being, mental health symptoms and vocal indicators, and therefore the findings should be interpreted as modest associations rather than strong or causal relationships.

When analysing sociodemographic variables, men presented higher frequencies of high PA levels. This pattern has been previously documented in both adolescents [34] and adults, where girls had higher rates of insufficient PA. Peng et al. [49] have highlighted the barriers to physical activity among adult women, noting that the main obstacles include lack of time due to workload, domestic tasks, family care, low motivation, lack of social support, and the perception that spaces are unsafe or unsuitable for sports. Structural barriers have also been identified, such as cultural norms, economic costs and the absence

Table 4 Linear regression models examining the associations between physical activity levels (METs) and well-being, mental health indicators (symptoms of stress, anxiety and depression), and vocal health indicators (Model 1: unadjusted; model 2: adjusted for age, gender, and teaching experience)

	MODEL 1						MODEL 2					
	B	β	CI 95%		P	R^2	B	β	CI 95%		P	R^2
Physical wellbeing	0.0007	0.125	0.0004	0.0009	< 0.001	0.015	0.0006	0.117	0.0004	0.0009	< 0.001	0.033
Mental wellbeing	0.0006	0.103	0.0003	0.0009	< 0.001	0.010	0.0006	0.103	0.0003	0.0009	< 0.001	0.042
Environment	0.0004	0.086	0.0002	0.0007	0.001	0.007	0.0005	0.091	0.0002	0.0007	< 0.001	0.073
Social relationships	0.0006	0.083	0.0002	0.0009	0.001	0.006	0.0006	0.092	0.0003	0.0010	< 0.001	0.025
Vocal fatigue	-0.0002	-0.075	-0.0004	-0.0001	0.003	0.005	-0.0002	-0.062	-0.00034	-0.00004	0.014	0.023
Physical voice discomfort	-0.00009	-0.065	-0.00015	-0.00002	0.01	0.040	-0.000064	-0.049	-0.000128	0.000001	0.049	0.032
Improvement voice symptoms with rest	−0.00003	-0.023	-0.00010	0.00004	0.361	0.001	-0.00002	-0.018	-0.00009	0.00004	0.490	0.001
Stress	-0.0003	-0.094	-0.0004	-0.0001	< 0.001	0.009	-0.0003	-0.087	-0.0004	-0.0001	< 0.001	0.122
Anxiety	-0.0001	-0.07	-0.00025	-0.00004	0.006	0.005	-0.0001	-0.063	-0.00023	-0.00003	0.011	0.071
Depression	-0.0001	-0.039	-0.00024	0.00003	0.121	0.002	-0.00011	-0.043	-0.00025	0.00002	0.092	0.021
Emotional exhaustion	-0.0003	-0.08	-0.0005	-0.0001	0.002	0.006	-0.0003	-0.075	-0.0005	-0.0001	0.002	0.070
Depersonalization	0.00003	0.026	-0.00003	0.00009	0.307	0.001	0.00002	0.014	-0.00004	0.00008	0.572	0.016
Self-fulfilment	0.00013	0.042	-0.00002	0.00028	0.095	0.002	0.0002	0.049	-0.000001	0.000303	0.050	0.009

Notes. *B* Unstandardised regression coefficient, *β* Standardised regression coefficient, *CI* Confidence interval, R^2 Coefficient of determination. Model 1 includes physical activity as the sole predictor

Model 1 includes physical activity as the sole predictor

Model 2 is adjusted for age, gender and years of teaching experience

of effective institutional policies. These factors, linked to gender inequalities, could partially explain why many women, including those in teaching, face greater difficulties in maintaining adequate levels of PA. Furthermore, in the university context, these differences can be accentuated by high academic competitiveness and a lack of work-life balance, which particularly affects women [50].

In terms of mental health symptoms, the participating professors with lower PA levels reported higher levels of stress, anxiety and depression. These results are consistent with previous research highlighting that PA is associated with an improvement in symptoms related to depression and anxiety [51, 52]. A possible explanation for these results can be found in the physiological and psychological mechanisms of PA in the human body. Exercise contributes to the release of neurotransmitters such as serotonin, dopamine and endorphins, which are linked to mood regulation [53], and has been associated with reduced cortisol levels [54]. Previous studies have also suggested that higher levels of PA may be linked to better stress management and greater psychological detachment from work-related demands [55, 56]. This may be particularly relevant in the case of university professors, a professional group that regularly faces high cognitive and emotional demands [57]. Along these lines, Zhao et al. [58] point out that increased PA may contribute to reducing stress, promote better emotional regulation and, ultimately, improve satisfaction with teaching work. This could also explain the results obtained in the present study in relation to Burnout Syndrome, where PA levels were significantly associated with lower rates of emotional exhaustion. It should further be noted that, as Maslach and Jackson [40] point out, professionals who work in direct care settings (such as professors, healthcare personnel, or social workers) are exposed to high emotional stress, which can lead to emotional exhaustion and burnout.

Regarding quality of life, professors with higher levels of PA had higher scores on all dimensions of health-related quality of life. These results are consistent with scientific literature highlighting the value of regular PA as a key strategy for improving quality of life and well-being [27, 59]. Specifically, it is among university professors, who are subject to a combination of research pressure, heavy teaching loads, administrative tasks and changing working conditions [1, 60], where PA can act as a regulating factor for psychosocial balance, promoting a more positive perception of the professional environment [61, 62]. Furthermore, PA among professors seems to contribute directly to overall perceived well-being, better emotional regulation and a reduction in musculoskeletal disorders and perceived stress [63–65]. In addition, PA promotes social interactions and social self-efficacy in terms of outcomes related to social well-being, which

could justify the results obtained in terms of social well-being in this study [66, 67]. However, given the small effect sizes and low explained variance, these associations should be interpreted with caution.

Lastly, in terms of vocal health, the participating professors with higher levels of PA reported lower levels of vocal fatigue and physical discomfort related to their voice. Previous studies with primary and secondary school teachers have indicated that the prevalence of vocal disorders such as dysphonia is associated with sustained vocal effort and teaching conditions [32, 68]. However, it is important to interpret these results with caution, as the current literature does not provide solid evidence confirming a direct relationship between PA levels and the onset or prevention of vocal disorders. Some studies suggest that PA may be indirectly related to vocal well-being through its associations with lower stress and improved emotional functioning [21], and stress has been associated with a higher likelihood of voice problems among teachers [69]. The voice is a central working tool in teaching and is therefore frequently exposed to conditions that may contribute to vocal difficulties [70, 71]. The modest associations observed in this study underline the need for future research to further examine the potential links between PA and vocal health in university professors and to clarify the mechanisms that may underlie these relationships.

These findings offer several practical implications for university policy and occupational health. First, the consistent associations between higher levels of PA and more favourable mental health indicators, higher quality of life, and lower emotional exhaustion suggest that universities should integrate structured PA promotion programmes within their institutional health strategies. Such initiatives could include flexible scheduling to support active breaks, access to on-campus exercise facilities, and tailored interventions for groups at higher risk of inactivity, particularly women. Second, given the associations between PA and reduced stress and emotional exhaustion, implementing PA-based stress-management workshops could help mitigate burnout among academic staff. Third, the potential links between PA and lower vocal fatigue highlight the value of combining voice-care training with PA promotion as part of broader occupational health plans. Overall, these measures may strengthen the capacity of Health-Promoting Universities to create healthier and more sustainable working environments for faculty.

This study has several strengths that are worth mentioning. Firstly, the study drew on a broad sample of 1,560 teachers from thirteen Spanish universities, all of which belonged to the Spanish Network of Health Promoting Universities, which allowed the subject matter to be analysed from a wide and diverse perspective of professors working in these institutions. Secondly, a multidimensional approach to health was established, taking into account variables related to physical and mental well-being, vocal health and quality of life, providing the study with results that lay a solid foundation for future interventions aimed at improving teacher well-being. Furthermore, the research focuses on a population that has been little studied in the field of health, namely university professors from these participating institutions.

However, the study is not without limitations. The first is based on its cross-sectional design, which prevents causal relationships from being established between PA and the variables analysed. However, this approach provides a solid foundation for future longitudinal research that analyses in depth the association between PA and various health indicators among professors in these universities. Furthermore, self-reported questionnaires were used to collect data, which implies a subjective assessment by participants. Moving forward, it is recommended to incorporate objective measures, such as clinical assessments or the use of accelerometers. However, it should be noted that the instruments used in this study have demonstrated validity and reliability in previous research conducted with similar populations. Additionally, the different instruments used in this study refer to slightly different time windows (e.g., last week, last two weeks, or more chronic states), which represents a minor limitation when interpreting results within a cross-sectional design.

Another relevant limitation concerns the sampling strategy and response rate. Since the study relied on a convenience sample drawn from universities belonging to the Spanish Network of Health Promoting Universities, and the response rate was approximately 11–12%, there is a possibility of selection and non-response bias. It is reasonable to assume that professors who are more health-conscious or physically active may have been more inclined to participate, which could have led to a slight overrepresentation of healthier profiles. Therefore, the findings should be interpreted within the context of those who responded in these specific institutions, avoiding direct generalisations to the broader university professoriate. Nevertheless, the large sample size and the institutional diversity included in the study provide substantial value and contribute meaningful evidence. Future research employing probabilistic sampling strategies and measures to enhance participation rates would help strengthen external validity. In addition, the large number of statistical tests performed across multiple outcomes increases the risk of Type I error. These analyses should therefore be interpreted with caution, and future studies should predefine primary outcomes or apply statistical procedures to address multiple comparisons.

Finally, another limitation concerns the absence of several contextual and professional variables that were not available for analysis, such as academic rank, teaching load, type of contract, subject area or baseline health status. Including these covariates could have provided a more comprehensive understanding of the associations observed. Although the regression models were adjusted for age, gender and teaching experience, the lack of these additional potential confounders may have limited the depth of the adjusted analyses and should be considered when interpreting the results.

Conclusions

The results of this study show that only 28.2% of the professors who participated in the study have high levels of PA, while 56.47% have moderate levels and 15.33% have low levels. In addition, significant differences were found based on gender, with men having a higher proportion of high PA levels. Furthermore, the regression analysis identified positive associations between PA levels and all dimensions of quality of life. A higher level of PA was also associated with lower levels of stress, anxiety, emotional exhaustion, vocal fatigue and physical discomfort in the voice. However, these associations were modest in magnitude, and the low R^2 values indicate that PA explains only a small proportion of the variance in these outcomes. These findings reinforce the role of PA as a key habit for promoting health in the academic workplace, acting as a psychosocial regulator that enables individuals to cope more positively with the demands of the teaching environment. Such strategies should be interpreted as exploratory, given the observational nature of the study.

Therefore, it is necessary to develop specific strategies to promote PA among professors in these institutions, through an interdisciplinary and multidisciplinary approach that considers the interaction between different areas of well-being. Universities, as health-promoting environments, should develop policies and interventions tailored to their context that encourage active lifestyles among their academic staff, which could contribute to improving well-being, reducing burnout and enhancing job satisfaction. Future research should also employ longitudinal designs to explore causal relationships between PA and health indicators among university professors in similar institutional settings. All of this will contribute to generating applied knowledge useful for improving the working environment and quality of life of academic staff in participating universities. Universities should take these findings into account when designing health-promotion policies aimed at fostering regular physical activity and supporting staff well-being.

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Authors' contributions

M.E.C.T. and R.J.B. performed the formal analysis and wrote the original draft of the manuscript. M.E.C.T., J.M.D.T., E.G.I., and R.J.B. contributed to the conceptualization, methodology, and investigation. J.M.D.T. and E.G.I. were responsible for project administration and supervision. All authors participated in funding acquisition and contributed to the review and editing of the manuscript. All authors read and approved the final version.

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Data availability

Data cannot be shared publicly because of the high risk of disclosure associated with the confidential data sets. Data are available from the Research Ethics Committee Universidad de La Rioja by email to [protecciondedatos@unirioja.es] , for researchers who meet the criteria for access to confidential data.

Declarations

Ethics approval and consent to participate

Written informed consent was requested from the university lecturers. Their collaboration in the present study was voluntary and all participants gave their written consent. The fundamental ethics of the Declaration of Helsinki were respected. In addition, the project was approved by the Clinical Research Ethics Committee of the University of La Rioja.

Consent for publication

Not required.

Competing interests

The authors declare no competing interests.

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