Physical fitness is associated with perceived quality of life and mental health among adults enrolling in a university extension program: a cross-sectional study

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https://doi.org/10.1590/SciELOPreprints.15988

Submitted on: 2026-04-30
Posted on: 2026-06-03 (version 1)
(YYYY-MM-DD)

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Physical fitness is associated with perceived quality of life and mental health among adults enrolling in a university extension program: a cross-sectional study

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ABSTRACT

Background: Overweight and obesity are chronic conditions that could be associated with poorer mental health and perceived quality of life across physical, social, and other domains. Lifestyle-related factors such as physical activity (PA) and physical fitness may influence this association. This study aimed to evaluate whether body mass index (BMI), PA level, and physical fitness are associated with perceived quality of life and mental health among adults enrolling in a university extension program.

Methods: This cross-sectional study included 149 adults (48.17±8.67 years). BMI was used as an indicator of nutritional status (31.80±7.00 kg/m^2). Validated instruments were used to assess quality of life, mental health, and PA level. Physical fitness was measured using motor tests. Statistical analyses included simple and multiple linear regression with bootstrap procedures.

Results: In the univariate analysis, PA level was positively associated with perceived quality of life only in the vitality, where individuals with high PA levels had better scores (β = 10.90; [95% CI: 0.54; 20.58]). Regarding BMI, individuals with overweight showed higher scores in physical functioning (11.67 [3.37; 19.69]) and general health (8.80 [2.81; 14.97]) compared with those with obesity. Physical fitness indicators showed consistent associations with several quality of life domains, particularly outcomes related to muscular strength and agility. In multivariate analyses, no interaction was observed between BMI and PA level. However, interactions between BMI and physical fitness indicated that, among individuals with overweight compared with obesity, better

chair stand performance was associated with lower risk of depression (−0.87 [−1.69; −0.15)]) and stress (−0.86 [−1.73; −0.14]), while better performance in the 6-minute walk test was associated with lower depression (−0.08 [−0.14; −0.03)] and stress (−0.08 [−0.14; −0.03]).

Conclusion: Physical fitness showed more consistent associations with perceived quality of life and mental health than BMI or PA level. Better physical fitness outcomes may have a stronger relationship with perceived well-being, particularly among individuals with overweight. From clinical and public health perspectives, these findings reinforce the importance of integrated strategies that combine improvements in physical fitness with broader lifestyle and weight management approaches. Multidisciplinary interventions may be more effective in promoting quality of life and mental health among individuals with excess body weight.

Keywords: Body Composition. Quality of Life. Mental Health. Physical Fitness. Obesity.

INTRODUCTION

According to the World Obesity Atlas (2025) (1) approximately 68% of the Brazilian population was projected to have a high BMI (≥25 kg/m^2), with 31% classified as obese. In the same report, projections through 2030 indicate that the prevalence of chronic conditions, including overweight and obesity, is expected to continue rising at both national and global levels (1), failing to meet the targets for reducing chronic conditions by 2030.

Overweight and obesity are chronic health conditions characterized by excessive accumulation of body fat. They are traditionally classified using body mass index (BMI), a metric that, although indirect, is highly relevant for assessing mortality risk (2). According to current guidelines, overweight is defined as a BMI between 25.0 and 29.9 kg/m^2, and obesity as a BMI of 30.0 kg/m^2 or higher (3).

Elevated BMI adversely could affect multiple physiological systems and increase the risk of chronic conditions, such as diabetes, cardiovascular diseases, and impairments in mental health and perceived quality of life (4,5). Overweight and obesity have been associated with poorer mental health and perceived quality of life, affecting not only physical well-being but also social, and other domains. Studies indicate that individuals with excessive body weight tend to report higher levels of body image dissatisfaction, functional limitations, and greater social stigma, which may negatively impact their emotional well-being (6)

Perceived quality of life is a broad and multidimensional construct whose definition encompasses interrelated physical, psychological, social, and environmental aspects (7). This perception may vary according to the context in which an individual is embedded and is influenced by factors such as culture, personal values, life experiences, and social position, being defined by the World Health Organization as

an individual's perception of their position in life within the cultural and value systems in which they live, and in relation to their goals, expectations, standards, and concerns (8).

On the other hand, physical activity (PA) engagement is an important component not only for body weight management but also for improving physical fitness and aspects of perceived quality of life and mental health (9, 10)Clique ou toque aqui para inserir o texto.. Physical fitness is classically defined as a set of factors that an individual possesses or develops in relation to the capacity to perform PA, and it can be divided into components related to health and to sports performance (11).

Higher PA levels have been associated with better physical fitness, which may represent an important mechanism potentially linking PA to physical, psychological, and social well-being (12). Examining the integrated relationships between BMI, PA, physical fitness, and perceived quality of life and mental health is particularly relevant in community-dwelling adults participating in university extension programs, because it allows a more comprehensive understanding of how these factors interact and are associated with individuals' health

Considering the current evidence in the literature, which typically highlights associations between two of the variables examined in this study, as well as the limited findings that connect perceived quality of life and mental health with PA and aspects related to physical fitness in adults, this study aims to evaluate the relationships among BMI, PA levels, and physical fitness in relation to perceived quality of life and mental health among participants in a university extension PA program. It is expected that perceived quality of life and mental health will be associated with BMI and may be influenced by PA level and physical fitness. Adults with overweight and obesity who are physically active or have better physical fitness may present better perceived quality

of life and mental health outcomes than those who are physically inactive or have poorer physical fitness.

METHODOLOGICAL PROCEDURES

Study Design

This is a cross-sectional study with a quantitative approach, approved by the Research Ethics Committee of the School of Physical Education and Sport of Ribeirão Preto, University of São Paulo, Brazil (CAAE: 58595122.0.0000.5659; approval number: 5.441.442). Although causal inferences cannot be established, this design allows the identification of clinically relevant patterns that may inform future longitudinal or interventional studies.

Before starting the extension program, all participants signed an Informed Consent Form and an Image Use Authorization Form.

Type of Study and Design

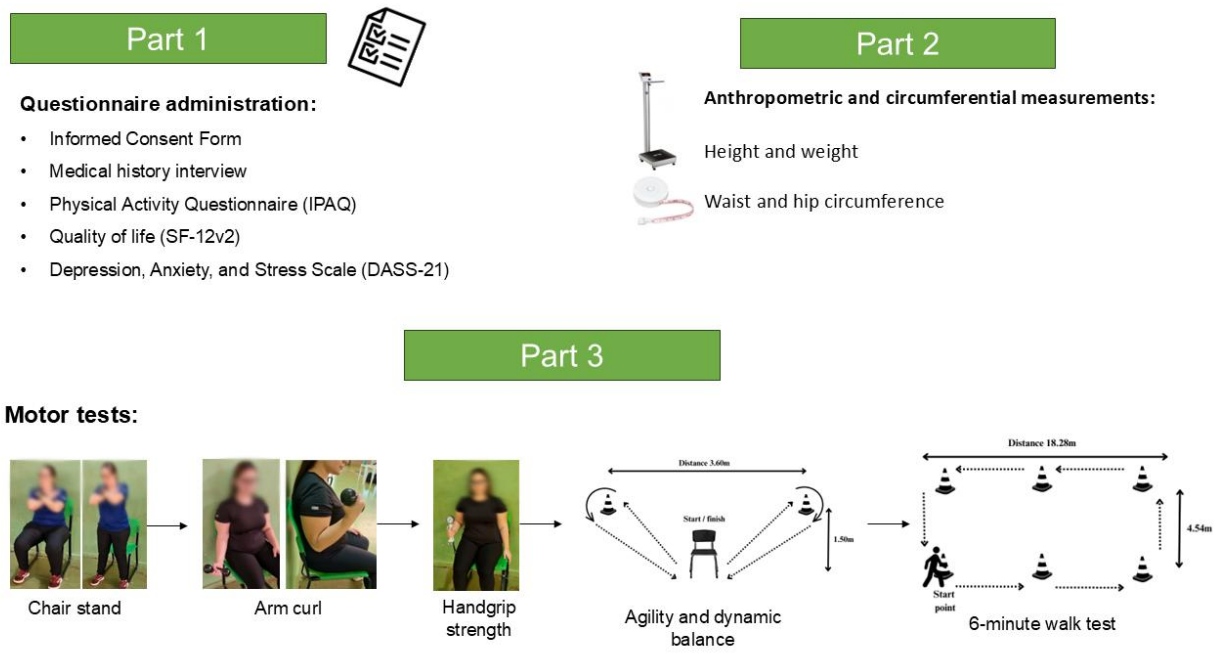
This study was conducted with participants enrolled in the university extension project “Integrated Training Program for Adults” at the School of Physical Education and Sport at the University of Sao Paulo, Ribeirao Preto. The project began in October 2022. Until December 2024, recruitment of new participants occurred every three months, and from May 2025 onward, every six months. Although the extension program offers continuous enrollment, for the present study, data collected between October 2022 and December 2024 – at participants’ entry – were included.

A form was administered that included a questionnaire and a health history interview to collect sociodemographic data and information on habits and health status (sample characterization), as well as validated instruments for this population to assess

PA levels, perceived quality of life, and mental health. Anthropometric measurements, including body weight and height, were also collected to calculate BMI. Motor tests were also conducted to evaluate physical fitness. The assessments were divided into three parts, and the sequence is presented in Figure 1. This study is part of a broader umbrella project, and full details of the evaluation procedures can be found in previous publications (13,14).

The article was structured in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies.

Figure 1 - Diagram of the evaluations carried out in the university extension project



IPAQ: International Physical Activity Questionnaire; SF-12v2: 12-Item Short-Form Health Survey version 2; DASS-21: Depression, Anxiety, and Stress Scale.

Source: own work.

Participants

The study was conducted with adult individuals from the city of Ribeirao Preto, Sao Paulo, who enrolled in the School of Physical Education and Sport of Ribeirao Preto, University of Sao Paulo extension project. Inclusion criteria were men and women aged 30 to 69 years. Exclusion criteria included significant physical conditions that could impair assessment performance or participation in the intervention, as well as acute or chronic clinical conditions without medical follow-up.

Variables

In all models, quality of life and mental health domains were defined as dependent variables, which can also be referred to as outcome variables. BMI, PA level, and physical fitness were entered as independent variables, which can also be referred to as exposure variables. Interaction terms between BMI and PA level, as well as between BMI and physical fitness indicators, were tested to explore potential effect modification.

Perceived Quality of Life

Perceived quality of life was assessed using version 2 of the 12-Item Short Form Health Survey (SF-12v2), which has been translated and validated for the Brazilian population (15) and has demonstrated adequate psychometric properties (16). The instrument consists of 12 items that assess the following quality of life domains: physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health (17). Scores are transformed to a 0–100 scale, with higher values indicating better quality of life.

Perceived Mental Health

Mental health status was assessed using the Depression, Anxiety, and Stress Scale (DASS-21), and score calculation was based on a previously published study (DASS-21) (18). This instrument consists of 21 items, divided into seven questions for each symptom domain: depression, anxiety, and stress (19). Lower scores on the mental health scale indicate a lower risk of the corresponding symptomatology.

Estimation of Physical Activity Level

PA level was estimated using the short version of the International Physical Activity Questionnaire (IPAQ), which has been validated for the Brazilian population (20). Participants were classified into three levels: low (no reported PA or some activity reported); moderate (three or more days of vigorous-intensity PA of at least 20 minutes per day; or five or more days of moderate-intensity PA and/or walking of at least 30 minutes per day; or five or more days of any combination of walking, moderate-, or vigorous-intensity PA achieving a minimum of 600 MET-minutes/week); or high (vigorous-intensity PA on at least three days accumulating at least 1.500 MET-minutes/week; or seven or more days of any combination of walking, moderate-, or vigorous-intensity PA accumulating at least 3.000 MET-minutes/week) (21).

Anthropometric Measures

BMI (kg/m^2), calculated as body weight divided by height squared, was used as an indicator of nutritional status, as recommended by the World Health Organization (WHO) (22), with classifications adjusted for older adults (23), when necessary.

Physical fitness

Using the tests proposed by Rikli and Jones (24) the following components were assessed: lower-limb muscular endurance using the 30-second chair stand test performed on a chair with an approximate height of 43 cm; and upper-limb muscular endurance using the seated elbow flexion and extension test, with the use of a hand-held weight (dumbbell) of 2.27 kg for women and 3.36 kg for men. In both muscular endurance tests, participants performed three practice repetitions, and the test outcome was the number of complete movements performed within 30 seconds.

Upper-limb strength was assessed using handgrip strength with a dynamometer; three isometric strength trials were performed, and the best result was recorded (25). The agility and dynamic balance test, proposed by Osness (26) began with the participant seated in a chair. The participant stood, walked around a cone positioned to the right, and returned to sit. Immediately thereafter, they lifted their feet off the floor and repeated the movement to the opposite side, completing one cycle. One trial consisted of two cycles in this circuit. Two trials were conducted, and the final result was the shortest time achieved across both trials (26). Finally, aerobic capacity was assessed using the six-minute walk test, with the distance covered recorded along a rectangular course measuring 4.57 m by 18.28 m. Participants were instructed and encouraged to walk as fast as possible without running (24).

Statistical Procedures

The database initially contained 204 sampling units; after filtering to match the variables, 149 sampling units remained and were included in the analysis.

Quantitative variables are expressed as means [95% confidence interval (CI) for the mean], minimum, and maximum values, while categorical variables are presented as absolute and relative frequencies [95% CI for the proportion].

Data were analyzed using univariate and multivariate generalized linear regression models with a Gaussian distribution and identity link function. Given the distributional characteristics of the dependent variables (quality of life and mental health) and the robustness of the bootstrap approach, a nonparametric bootstrap procedure was applied to improve their distribution. Figures 2, 3 and 4 illustrate the distribution of one quality of life variable and one mental health variable before and after bootstrap resampling. The nonparametric bootstrap technique consists of resampling with replacement for each constructed model (regression); the beta coefficient of the model corresponds to the mean of the resampled coefficients, and the 2.5th and 97.5th percentiles of the resampling distribution define the 95% confidence interval.

Univariate linear regression models were initially performed to examine the independent associations between each predictor variable (BMI, PA level, and physical fitness tests) and the outcomes related to perceived quality of life and mental health. Subsequently, multivariate regression models were constructed to simultaneously include these variables and to examine potential interaction effects between BMI and PA level, as well as between BMI and physical fitness. This approach allowed us to investigate whether the associations between lifestyle and functional variables and the outcomes differed according to BMI categories.

The interpretation of direct effects in the models is based on each unit of measurement of the independent variable. For example, for each additional repetition

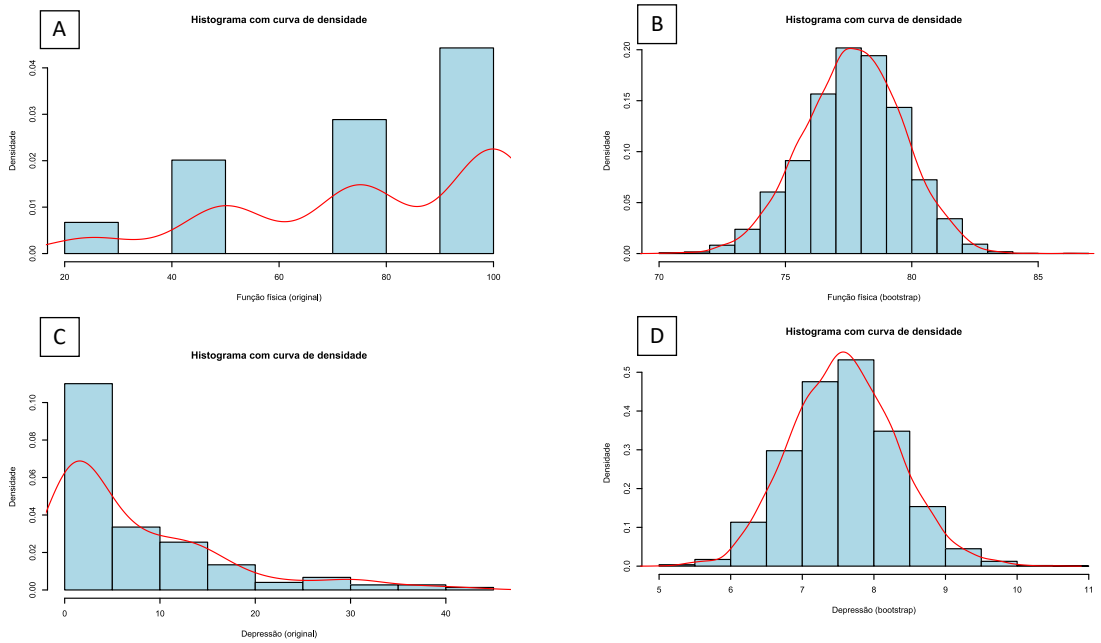
in the chair stand test, the outcome (quality of life or mental health domain) increases or decreases by β points.

The interpretation of interaction effects in the models is based on differences between categories (e.g., normal weight vs. obesity) for each unit of the independent variable. For instance, for each additional repetition in the chair stand test, individuals with normal weight have β points more or less on the outcome than individuals with obesity. For the agility and dynamic balance test, interpretation is inversely proportional: better performance corresponds to a shorter time to complete the circuit rather than a higher number of repetitions, greater load, or longer distance, as observed in the muscular endurance, handgrip strength, and walking tests, respectively.

Inferences were drawn based on the 95% CI, and variables that showed significant associations are highlighted in the tables (in bold).

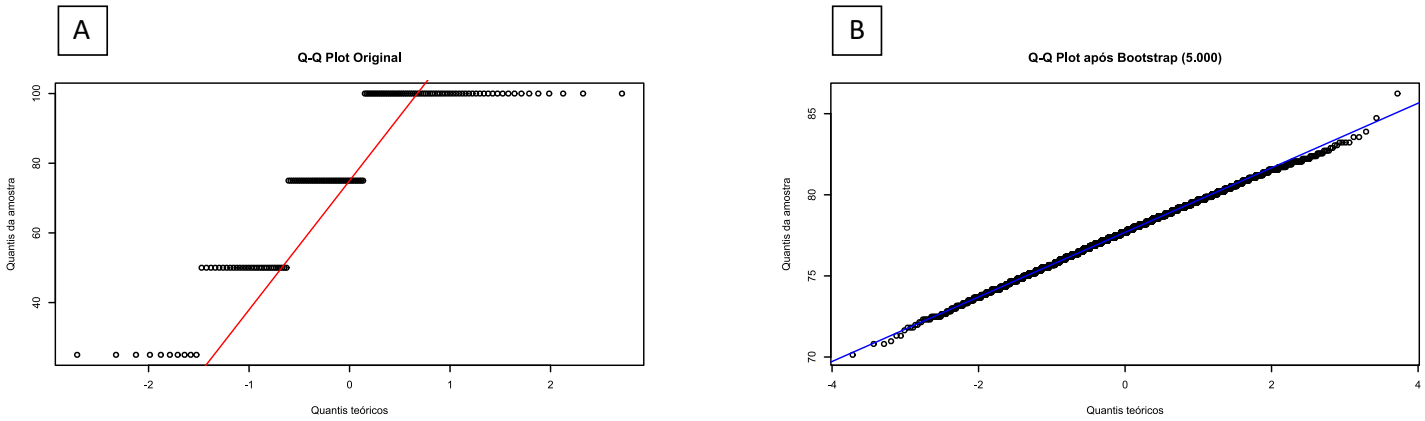
All analyses were performed using the R programming language (v. 4.4.2) through the RStudio Integrated Development Environment (v. 2024.12.0), employing the following packages: lmtest (0.9.40), car (3.1.3), boot (1.3.31), ggplot2 (3.5.1), MASS (7.3.64), sandwich (3.1.1), robustbase (0.99.4.1), dplyr (1.1.4), purrr (1.0.2), broom (1.0.7), tidyr (1.3.1), knitr (1.49), kableExtra (1.4.0), openxlsx (4.2.7.1), Hmisc (5.2.2), performance (0.12.4), interactions (1.2.0), and emmeans (1.10.6).

Figure 1 – Histogram with density curve of the physical function and depression variables



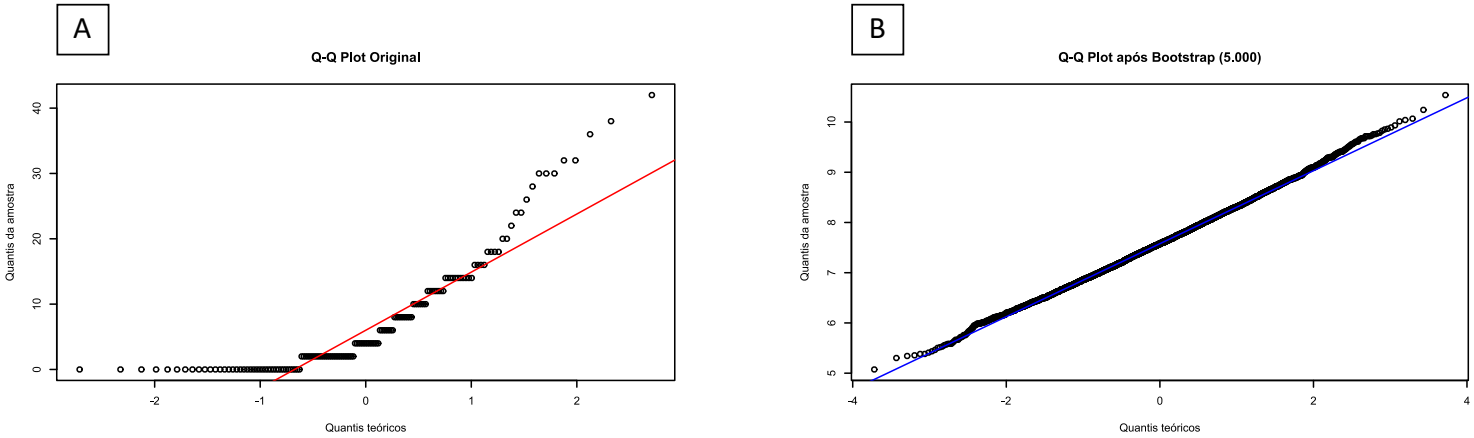
Physical function (A and B) and Depression (C and D) without (A and C) and with bootstrap (B and D).
Source: Author.

Figure 2 – Q-Q plot of the physical function variable without and with bootstrap



Physical function without bootstrap (A); Physical function with bootstrap (B).
Source: Author..

Figure 3 – Q-Q plot of the depression variable without and with bootstrap



Depression without bootstrap (A); Depression with bootstrap (B).
Source: Author.

RESULTS

Demographic characterization of the participants

Participants included in the sample had a mean age of 48.17 (SD = 8.63) years, and 97 (65.10%) were women. Of the total participants, 97 (65.10%) had an educational level at or above the level of completed high school.

Table 1 presents the absolute and relative frequencies, along with their respective 95% CI, for BMI and PA level variables. It also presents the means with corresponding 95% CI, as well as the minimum and maximum values for quality of life domains, mental health, and physical fitness measures.

Of the 149 participants, 85.23% had excess body weight, with 32.21% classified as overweight and 53.02% as having obesity, whereas 14.77% had normal weight. This distribution indicates a predominance of obesity within the sample. PA levels were mainly low to moderate (40.94% and 40.27%, respectively), with only 18.79% of participants classified as highly active (Table 1).

Table 1. Descriptive characteristics of the sample

Categorical variables	f	f_r [95% CI]	
BMI			
Normal weight	22	14.77 [9.07; 20.47]	
Overweight	48	32.21 [24.71; 39.71]	
Obesity	79	53.02 [45.01; 61.03]	
PA LEVEL			
Low	61	40.94 [33.04; 48.84]	
Moderate	60	40.27 [32.40; 48.14]	
High	28	18.79 [12.52; 25.06]	
Continuous variables	$\bar{x}$ [95% CI]	Minimum	Maximum
SF-12v2			
Physical functioning (points)	77.68 [73.83; 81.53]	25	100
Role physical (points)	80.79 [77.27; 84.31]	0	100
Bodily pain (points)	81.04 [77.09; 84.99]	0	100
General health (points)	64.53 [61.60; 67.46]	25	100
Vitality (points)	50.50 [46.78; 54.22]	0	100
Social functioning (points)	71.81 [67.03; 76.59]	0	100
Role emotional (points)	78.94 [75.42; 82.46]	12.5	100
Mental health (points)	63.42 [59.95; 66.89]	12.5	100
DASS-21			
Depression (points)	7.58 [6.11; 9.05]	0	42
Anxiety (points)	5.11 [4.03; 6.19]	0	36
Stress (points)	10.15 [8.68; 11.62]	0	42
PHYSICAL FITNESS			
Chair stand (rep)	13.64 [12.99; 14.29]	7	30
Arm curl (rep)	16.48 [15.81; 17.15]	8	27
Handgrip strength, dominant (kgf)	32.15 [30.64; 33.66]	15	60
Handgrip strength, non-dominant (kgf)	28.54 [27.07; 30.01]	12	50
Agility and dynamic balance (s)	25.78 [25.11; 26.45]	18.1	40.9
6-minute walk test (m)	557.61 [545.43; 569.79]	308.48	726.63

f: Absolute frequency; f_r: relative frequency; $\bar{x}$: mean; 95% CI: 95% confidence interval; BMI: body mass index; PA: physical activity; SF-12v2: 12-item Health Survey; DASS-21: Depression, Anxiety, and Stress Scale. Rep: repetition; kgf: kilogram-force; s: seconds; m: meters.

Perceived Quality of Life

Analyses of the associations between perceived quality of life and BMI, PA level, and physical fitness are presented in Table 2.

Regarding PA level, an association was observed only between high PA level and vitality (β = 10.90 [95% CI: 0.54; 20.58]) when compared with low PA level.

Associations were observed between BMI and two quality of life domains. Compared with individuals with obesity, both normal weight (β = 11.95 [0.90; 22.21]) and overweight participants (β = 11.67 [3.37; 19.69]) showed higher scores in physical functioning. Additionally, overweight individuals had higher general health scores (β = 8.80 [2.81; 14.97]) than those with obesity.

Analysis of motor tests used to assess physical fitness showed significant associations with all quality of life domains. Greater chair stand and arm curl tests results were positively associated with physical functioning, respectively, (1.87 [0.78; 2.98]; 2.02 [1.15; 2.92]), general health (0.83 [0.19; 1.54]; 0.90 [0.20; 1.58]), vitality (1.29 [0.43; 2.25]; 1.32 [0.45; 2.23]), role emotional (1.00 [0.21; 1.81]; 1.60 [0.83; 2.40]), mental health (1.16 [0.27; 2.06]; 1.30 [0.49; 2.15]), and role physical (arm curl only: 1.44 [0.61; 2.34]).

Dominant handgrip strength was positively associated with physical functioning (0.77 [0.36; 1.17]), role physical (0.40 [0.01; 0.78]), pain (0.46 [0.01; 0.88]), vitality (0.71 [0.31; 1.08]), social functioning (0.69 [0.20; 1.18]), role emotional (0.76 [0.45; 1.07]), and mental health (0.83 [0.51; 1.15]), while non-dominant handgrip strength was associated with physical functioning (0.66 [0.22; 1.08]), pain (0.48 [0.1; 0.85]), vitality (0.59 [0.18; 0.98]), social functioning (0.59 [0.18; 0.98]), role emotional (0.7 [0.39; 1.02]) and mental health (0.71 [0.38; 1.03]).

The agility and dynamic balance test showed an inverse association, indicating that shorter completion time was associated with higher scores in physical functioning (-1.78 [-2.56; -0.89]), role physical (-1.04 [-2.07; -0.04]), and role emotional (-1.02 [-1.88; -0.12]).

The 6-minute walk test was positively associated with physical functioning (0.13 [0.09; 0.17]), role physical (0.05 [0.01; 0.10]), pain (0.05 [0.01; 0.10]), and role emotional (0.05 [0.01; 0.10]).

Table 2. Univariate analysis of the associations between body mass index and physical fitness with the eight domains of quality of life

Variables	Physical Function β (95% CI)	Role Physical β (95% CI)	Pain β (95% CI)	General Health β (95% CI)	Vitality β (95% CI)	Social Functioning β (95% CI)	Role Emotional β (95% CI)	Mental Health β (95% CI)
BMI								
Normal weight-Obesity	**11.95 [0.90; 22.21]**	0.68 [-8.83; 9.83]	2.32 [-8.27; 12.90]	-1.06 [-9.68; 7.65]	2.42 [-7.96; 13.13]	-4.41 [-19.28; 10.04]	-4.72 [-15.80; 6.16]	-6.65 [-16.59; 2.70]
Overweight-Obesity	**11.67 [3.37; 19.69]**	3.9 [-4.83; 11.95]	6.87 [-2.61; 15.68]	**8.8 [2.81; 14.97]**	4.34 [-4.30; 12.34]	2.86 [-7.72; 13.50]	-2.22 [-10.01; 5.62]	0.96 [-7.52; 9.14]
PA LEVEL								
Moderate-Low	-1.17 [-9.43; 7.27]	7.2 [-0.44; 14.99]	-2.01 [-10.67; 6.94]	2.71 [-3.35; 8.64]	3.27 [-4.81; 10.94]	-2.99 [-13.68; 7.75]	4.96 [-3.11; 12.62]	1.87 [-5.53; 9.46]
High-Low	3.88 [-7.80; 14.86]	4.07 [-6.00; 13.89]	1.41 [-8.28; 11.85]	6.72 [-1.91; 15.00]	**10.90 [0.54; 20.58]**	0.24 [-12.95; 12.4]	3.63 [-6.30; 13.32]	6.37 [-3.73; 16.35]
PHYSICAL FITNESS								
Chair stand (rep)	**1.87 [0.78; 2.98]**	0.82 [-0.26; 1.93]	0.21 [-1.15; 1.50]	**0.83 [0.19; 1.54]**	**1.29 [0.43; 2.25]**	0.69 [-0.46; 1.89]	**1.00 [0.21; 1.81]**	**1.16 [0.27; 2.06]**
Arm curl (rep)	**2.02 [1.15; 2.92]**	**1.44 [0.61; 2.34]**	**1.00 [0.15; 1.88]**	**0.90 [0.20; 1.58]**	**1.32 [0.45; 2.23]**	**1.31 [0.27; 2.37]**	**1.60 [0.83; 2.40]**	**1.30 [0.49; 2.15]**
Dominant handgrip strength (kgf)	**0.77 [0.36; 1.17]**	**0.40 [0.01; 0.78]**	**0.46 [0.01; 0.88]**	0.23 [-0.08; 0.54]	**0.71 [0.31; 1.08]**	**0.69 [0.20; 1.18]**	**0.76 [0.45; 1.07]**	**0.83 [0.51; 1.15]**
Non-dominant handgrip strength (kgf)	**0.66 [0.22; 1.08]**	0.33 [-0.06; 0.71]	**0.48 [0.1; 0.85]**	0.22 [-0.09; 0.53]	**0.59 [0.18; 0.98]**	**0.61 [0.10; 1.11]**	**0.7 [0.39; 1.02]**	**0.71 [0.38; 1.03]**
Agility and dynamic balance (s)	**-1.78 [-2.56; -0.89]**	**-1.04 [-2.07; -0.04]**	-0.27 [-1.29; 0.72]	-0.13 [-0.79; 0.55]	-0.45 [-1.37; 0.42]	-0.39 [-1.59; 0.78]	**-1.02 [-1.88; -0.12]**	-0.73 [-1.64; 0.12]
6-minute walk test (m)	**0.13 [0.09; 0.17]**	**0.05 [0.01; 0.10]**	**0.05 [0.01; 0.10]**	0.03 [-0.01; 0.07]	0.05 [-0.01; 0.09]	0.02 [-0.04; 0.09]	**0.05 [0.01; 0.10]**	0.04 [-0.01; 0.08]

β: beta coefficient; 95% CI: 95% confidence interval; BMI: body mass index; PA: physical activity; Rep: repetitions; kgf: kilogram-force; s: seconds; m: meters.

Bold values indicate statistically significant associations (95% CI does not include zero).

Table 3 presents the results of multivariate analyses examining interactions between BMI and PA level or physical fitness variables, considering quality of life domains as outcomes. In the interaction between BMI and PA levels, no associations were observed with quality of life domains.

The chair stand test, in interaction with BMI, showed associations among individuals with overweight compared with those with obesity in the role emotional (β = 2.69 [0.71; 4.95]) and mental health (β = 2.83 [0.68; 5.31]) domains. This indicates that, among individuals who are overweight, for every additional repetition on the chair stand test, there is an average score that is 2.69 and 2.83 points higher than that of individuals with obesity in the role emotional and mental health domains. For this test, an additional association was observed in the mental health domain when comparing individuals with normal weight to those with obesity (β = 2.47 [0.16; 5.16]). For the elbow flexion test, unlike the univariate analysis which showed associations with all quality of life domains the multivariate analysis (Table 3) revealed an association only in the mental health domain among individuals with overweight compared with those with obesity (β = 2.77 [0.88; 4.81]).

For dominant handgrip strength, individuals with overweight showed associations with social functioning (β = 1.10 [0.03; 2.23]) and mental health (β = 0.74 [0.01; 1.47]) compared with individuals with obesity, whereas no associations with quality of life domains were observed for nondominant handgrip strength. For the agility and dynamic balance test, comparisons between individuals with overweight and those with obesity revealed a negative relationship with statistical evidence in five of the eight quality of life domains: general health (β = −1.90 [−3.60; −0.30]), vitality (β = −3.73 [−5.62; −1.67]), social functioning (β = −4.37 [−7.02; −1.20]), role emotional (β = −4.21 [−6.34; −2.08]), and mental health (β = −5.07 [−6.85; −2.91]).

Similar associations in five of the eight quality of life domains were observed for the 6-minute walk test, showing positive associations when comparing individuals with overweight and those with obesity for general health (β = 0.12 [0.03; 0.22]), vitality (β = 0.18 [0.06; 0.30]), social functioning (β = 0.21 [0.04; 0.40]), role emotional (β = 0.17 [0.06; 0.29]), and mental health (β = 0.22 [0.08; 0.36]).

Table 3 – Multivariate analysis of the interaction between body mass index and physical fitness and their association with the eight domains of quality of life

Variables	Physical Function (β [95% CI])	Physical Aspects (β [95% CI])	Pain (β [95% CI])	General Health (β [95% CI])	Vitality (β [95% CI])	Social Functioning (β [95% CI])	Role Emotional (β [95% CI])	Mental Health (β [95% CI])
BMI*PA LEVEL								
Normal weight-Obesity* Moderate-Low	-2.36 [-24.87; 19.67]	1.18 [-20.96; 22.53]	10.5 [-14.95; 37.85]	4.06 [-15.37; 22.99]	-11.26 [-37.50; 12.41]	12.71 [-22.06; 47.68]	-4.97 [-31.07; 20.28]	-11.51 [-33.78; 11.41]
Overweight-Obesity* Moderate-Low	1.92 [-16.73; 19.93]	8.51 [-10.77; 27.72]	5.62 [-14.84; 27.06]	2.1 [-10.97; 14.48]	-10.97 [-30.15; 7.56]	4.71 [-20.71; 29.11]	-6.59 [-25.91; 11.63]	-8.33 [-26.64; 9.69]
Normal weight-Obesity* High-Low	-8.08 [-49.19; 24.11]	8.08 [-19.97; 34.64]	4.47 [-26.22; 35.70]	-5.07 [-29.25; 19.21]	-2.43 [-37.24; 27.31]	12.73 [-28.91; 54.50]	0.09 [-37.11; 32.60]	-6.67 [-36.22; 22.32]
Overweight-Obesity* High-Low	12.86 [-9.69; 35.51]	14.89 [-7.47; 37.17]	10.5 [-12.07; 33.39]	11.25 [-8.83; 27.80]	-3.87 [-25.77; 18.25]	12.19 [-14.00; 39.24]	-0.35 [-22.32; 20.64]	0.42 [-24.62; 24.79]
BMI*Chair stand (rep)								
Normal weight-Obesity* Chair stand	0.95 [-1.76; 3.95]	-0.35 [-3.32; 2.55]	0.97 [-1.55; 3.34]	0.39 [-1,46; 2,53]	0.95 [-2.19; 4.49]	1.11 [-3.15; 5.87]	1.58 [-1.39; 5.20]	**2.47 [0.16; 5.16]**
Overweight-Obesity* Chair stand	-0.43 [-2.86; 2.59]	-0.06 [-2.56; 2.77]	-1.21 [-4.06; 1.96]	0,27 [-1.49; 2.21]	1.37 [-0.78; 3.70]	2,57 [-0.48; 5.76]	**2.69 [0.71; 4.95]**	**2.83 [0.68; 5.31]**
BMI*Arm curl (rep)								
Normal weight-Obesity*Arm curl	0.57 [-2.24; 4.01]	0 [-2.54; 2.41]	0.31 [-1.75; 2.60]	0.44 [-1.44; 2.53]	1.39 [-1.36; 4.09]	0.39 [-3.03; 4.61]	1.39 [-1.47; 4.6]	1.72 [-0.29; 4.08]
Overweight-Obesity*Arm curl	0.53 [-1.38; 2.37]	1.00 [-0.93; 3.01]	-0,99 [-3.06; 0.98]	0.96 [-0.53; 2.49]	1,79 [-0.16; 3.71]	1.67 [-0.74; 4.13]	1.75 [-0.07; 3.52]	**2.77 [0.88; 4.81]**
BMI*Dominant handgrip strength (kgf)								
Normal weight-Obesity* Dominant handgrip strength	-0.41 [-1.65; 0.83]	-0.01 [-1.38; 1.17]	-0.29 [-1.63; 0.93]	0.47 [-0.56; 1.41]	0.83 [-0.35; 1.99]	-0.05 [-2.43; 1.86]	0.79 [-0.51; 2.06]	0.13 [-0.94; 1.35]
Overweight-Obesity* Dominant handgrip strength	-0.07 [-0.86; 0.72]	0.06 [-0.91; 1.02]	-0.65 [-1.78; 0.36]	0.14 [-0.53; 0.88]	0.60 [-0.25; 1.43]	**1.10 [0.03; 2.23]**	0.35 [-0.34; 1.07]	**0.74 [0.01; 1.47]**
BMI*Non-dominant handgrip strength (kgf)								
Normal weight-Obesity* Non-dominant handgrip strength	-0.18 [-1.45; 1.15]	-0.17 [-1.79; 1.01]	-0.10 [-1.37; 1.05]	0.91 [-0.07; 1.81]	0.58 [-0.59; 1.75]	-0.14 [-2.69; 1.49]	0.55 [-0.85; 1.90]	0.17 [-0.84; 1.36]
Overweight-Obesity* Non-dominant handgrip strength	-0.21 [-1.08; 0.65]	0.18 [-0.77; 1.22]	-0.59 [-1.51; 0.32]	0.20 [-0.44; 0.90]	0.51 [-0.43; 1.43]	0.91 [-0.19; 2.04]	0.07 [-0.72; 0.86]	0.47 [-0.34; 1.28]
BMI*Agility and dynamic balance (s)								

Normal weight-Obesity*	-0.54	0.11	-0.13	0.06	-2.23	-0.22	-0.1	-1.62
Agility and dynamic balance	[-3.74; 3.71]	[-3.15; 5.10]	[-3.29; 4.43]	[-1.98; 2.68]	[-6.21; 3.33]	[-5.8; 7.85]	[-3.6; 4.61]	[-4.45; 2.01]
Overweight-Obesity*	-1.62	-2.17	0.87	**-1.9**	**-3.73**	**-4.37**	**-4.21**	**-5.07**
Agility and dynamic balance	[-3.75; 0.50]	[-5.25; 1.19]	[-1.70; 3.56]	**[-3.6; -0.3]**	**[-5.62; -1.67]**	**[-7.02; -1.20]**	**[-6.34; -2.08]**	**[-6.85; -2.91]**
BMI*6-minute walk test (m)								
Normal weight-Obesity*	-0.04	0.03	0.04	0.01	0.10	-0.01	0.03	0.03
6-minute walk test	[-0.28; 0.15]	[-0.16; 0.17]	[-0.13; 0.24]	[-0.16; 0.18]	[-0.10; 0.27]	[-0.33; 0.22]	[-0.19; 0.22]	[-0.15; 0.18]
Overweight-Obesity*	0.04	0.06	-0.02	**0.12**	**0.18**	**0.21**	**0.17**	**0.22**
6-minute walk test	[-0.09; 0.17]	[-0.09; 0.20]	[-0.19; 0.12]	**[0.03; 0.22]**	**[0.06; 0.30]**	**[0.04; 0.40]**	**[0.06; 0.29]**	**[0.08; 0.36]**

β: beta coefficient; 95% CI: 95% confidence interval; BMI: body mass index; PA: physical activity; Rep: repetitions; kgf: kilogram-force; s: seconds; m: meters.

Bold values indicate statistically significant associations (95% CI does not include zero).

Mental Health

Table 4 presents the univariate associations between BMI, PA level, physical fitness, and mental health outcomes. No significant associations were observed for BMI or PA level. In contrast, greater muscular strength assessed by the chair stand, arm curl, and handgrip strength tests was consistently associated with lower symptoms of depression and anxiety and, for upper body and handgrip strength, with lower stress scores. Additionally, better performance on the 6-minute walk test was associated with lower anxiety scores. Conversely, longer completion time in the agility and dynamic balance test was associated with higher anxiety levels.

Consistent with these findings, most physical fitness measures showed inverse associations with mental health indicators, indicating that better performance was related to lower symptom scores. For example, performance in the arm curl test was inversely associated with all three outcomes, with each additional repetition corresponding to lower depression (β = −0.49 [−0.81; −0.18]), anxiety (β = −0.40 [−0.62; −0.18]), and stress scores (β = −0.37 [−0.70; −0.06]).

Table 4 – Univariate analysis of the associations between body mass index and physical fitness with the three domains of mental health

Variables	Depression (β [95% CI])	Anxiety (β [95% CI])	Stress (β [95% CI])
BMI			
Normal weight-Obesity	2.23 [-2.71; 7.84]	4.05 [-0.07; 8.64]	4.50 [-0.46; 9.87]
Overweight-Obesity	-0.86 [-3.87; 2.33]	-0.52 [-2.55; 1.51]	0.45 [-2.62; 3.57]
PA LEVEL			
Moderate-Low	0.89 [-2.52; 4.19]	1.42 [-0.96; 3.88]	1.45 [-1.83; 4.75]
High-Low	-1.23 [-4,86; 2.54]	0.43 [-2.22; 3.26]	-0.06 [-3.67; 3.71]
PHYSICAL FITNESS			
Chair stand (rep)	**-0.34 [-0.66; -0.04]**	**-0.28 [-0.55; -0.04]**	-0.20 [-0.55; 0.10]
Arm curl (rep)	**-0.49 [-0.81; -0.18]**	**-0.4 [-0.62; -0.18]**	**-0.37 [-0.7; -0.06]**
Dominant handgrip strength (kgf)	**-0.25 [-0.39; -0.11]**	**-0.24 [-0.33; -0.15]**	**-0.32 [-0.46; -0.18]**
Non-dominant handgrip strength (kgf)	**-0.22 [-0.36; -0.08]**	**-0.21 [-0.30; -0.12]**	**-0.29 [-0.42; -0.15]**
Agility and dynamic balance (s)	0.20 [-0.16; 0.59]	**0.30 [0.02; 0.62]**	0.07 [-0.29; 0.47]
6-minute walk test (m)	-0.02 [-0.04; 0.01]	**-0.02 [-0.04; -0.01]**	-0.01 [-0.03; 0.02]

β: beta coefficient; 95% CI: 95% confidence interval; BMI: body mass index; PA: physical activity; Rep: repetitions; kgf: kilogram-force; s: seconds; m: meters.

Bold values indicate statistically significant associations (95% CI does not include zero).

In the multivariate analysis (Table 5), no interaction between BMI and PA levels was observed; however, other associations were identified. In the chair stand test, individuals with overweight, when compared with those with obesity, showed associations with depression (β = −0.87 [−1.69; −0.15]) and stress (β = −0.86 [−1.73; −0.14]). Similarly, in the elbow flexion test, individuals with overweight compared with those with obesity were associated with depression (β = −0.85 [−1.59; −0.12]) and stress (β = −0.85 [−1.59; −0.12]).

In the agility and dynamic balance test, individuals with overweight compared with those with obesity showed positive associations with all three mental health risk indicators: depression (β = 1.72 [0.69; 2.63]), anxiety (β = 0.75 [0.10; 1.33]), and stress (β = 1.73 [0.71; 2.62]). In the 6-minute walk test, associations were observed with depression (β = −0.08 [−0.14; −0.03]) and stress (β = −0.08 [−0.14; −0.03]) among individuals with overweight compared with those with obesity.

Table 5 - Multivariate analysis of the interaction between body mass index and physical fitness and their association with the three domains of mental health

Variables	Depression (β [95% CI])	Anxiety (β [95% CI])	Stress (β [95% CI])
BMI*PA LEVEL			
Normal weight-Obesity*Moderate-Low	-0.67 [-15.57; 11.90]	4.66 [-5.82; 15.05]	-0.41 [-15.21; 12.36]
Overweight*Obesity*Moderate-Low	0.53 [-6.84; 8.13]	0.01 [-4.44; 4.66]	0.54 [-6.65; 7.96]
Normal weight-Obesity*High-Low	-4.71 [-19.27; 8.92]	-2.26 [-12.00; 8.07]	-4.49 [-19.77; 8.79]
Overweight-Obesity*High-Low	-1.47 [-9.44; 6.09]	0.42 [-5.32; 6.14]	-1.53 [-9.53; 6.18]
BMI*Chair stand (rep)			
Normal weight-Obesity*Chair stand	-0.75 [-1.97; 0.36]	-0.67 [-1.86; 0.38]	-0.76 [-1.95; 0.37]
Overweight-Obesity*Chair stand	**-0.87 [-1.69; -0.15]**	-0.14 [-0.80; 0.46]	**-0.86 [-1.73; -0.14]**
BMI*Arm curl (rep)			
Normal weight-Obesity*Arm curl	-0.78 [-2.03; 0.22]	-0.73 [-1.97; 0.25]	-0.79 [-2.04; 0.23]
Overweight-Obesity*Arm curl	**-0.85 [-1.59; -0.12]**	-0.18 [-0.67; 0.31]	**-0.85 [-1.59; -0.12]**
BMI*Dominant handgrip strength (kgf)			
Normal weight-Obesity*Dominant handgrip strength	0.07 [-0.49; 0.73]	0.00 [-0.50; 0.65]	0.07 [-0.51; 0.75]
Overweight-Obesity*Dominant handgrip strength	-0.05 [-0.35; 0.25]	0.04 [-0.15; 0.23]	-0.05 [-0.35; 0.26]
BMI*Non-dominant handgrip strength (kgf)			
Normal weight-Obesity*Non-dominant handgrip strength	0.06 [-0.41; 0.80]	-0.02 [-0.47; 0.65]	0.07 [-0.43; 0.81]
Overweight-Obesity*Non-dominant handgrip strength	0.00 [-0.34; 0.34]	0.05 [-0.16; 0.26]	0.00 [-0.35; 0.36]
BMI*Agility and dynamic balance (s)			
Normal weight-Obesity*Agility and dynamic balance	0.54 [-2.06; 2.46]	1.02 [-1,41; 2,76]	0.51 [-2.16; 2.39]
Overweight-Obesity*Agility and dynamic balance	**1.72 [0.69; 2.63]**	**0,75 [0,10; 1,33]**	**1.73 [0.71; 2.62]**
BMI*6-minute walk test (m)			
Normal weight-Obesity*6-minute walk test	-0.03 [-0.11; 0.07]	-0.04 [-0.11; 0.06]	-0.03 [-0.11; 0.07]
Overweight-Obesity*6-minute walk test	**-0.08 [-0.14; -0.03]**	-0.03 [-0.06; 0.01]	**-0.08 [-0.14; -0.03]**

β: beta coefficient; 95% CI: 95% confidence interval; BMI: body mass index; PA: physical activity; Rep: repetitions; kgf: kilogram-force; s: seconds; m: meters.

Bold values indicate statistically significant associations (95% CI does not include zero).

DISCUSSION

The present study aimed to evaluate whether BMI, PA level, and physical fitness are associated with quality of life and mental health among participants enrolling in a university extension PA program. Physical fitness showed more consistent and independent associations with perceived quality of life and mental health than BMI or PA level. Whereas BMI was associated with only specific domains and PA level demonstrated limited relationships, physical fitness was more broadly related to the outcomes assessed at program entry. These findings suggest that functional capacity may be more closely linked to perceived well-being than BMI or self-reported PA in this population. In line with the interaction analyses performed, physical fitness may also play a potential effect-modifying role in the association between BMI and perceived outcomes.

More than 85% of the participants were classified as overweight or obese, meaning that approximately 17 out of every 20 individuals entering the program presented excess body weight. Despite this high prevalence, BMI showed few associations with perceived quality of life and mental health outcomes. In contrast, physical fitness emerged as a relevant factor, suggesting that functional capacity may play a more important role in perceived health and psychological well-being than body weight status alone, regardless of BMI category or self-reported PA level.

PA is widely recognized as an important determinant of both physical and mental health, contributing to improvements in perceived quality of life and psychological well-being (26,27). In the present study, however, PA level showed limited associations with the outcomes investigated. One possible explanation is that self-reported measures of PA, such as the IPAQ, capture the reported frequency and duration of activities but

may not fully reflect the physiological adaptations and functional capacity resulting from long-term engagement in PA (20).

Additionally, the short version of the IPAQ was used in the present study, which does not distinguish between different domains of PA (e.g., leisure-time, occupational, transportation, and household activities). This limitation may reduce the sensitivity of the instrument to detect domain-specific associations with perceived quality of life and mental health, as different types of PA may have distinct relationships with these outcomes. Thus, the stronger associations observed for physical fitness in the present study may indicate that the benefits of an active lifestyle become more evident when they are expressed through improvements in functional capacity.

Physical fitness encompasses health-related components that reflect an individual's capacity to perform daily activities with autonomy and reduced risk of adverse health outcomes (11). In this context, the consistent associations observed in the present study suggest that functional capacity may play a central role in shaping perceived quality of life and mental health among adults entering a PA program (11, 28)

In univariate analyses, better physical fitness was consistently associated with higher perceived quality of life outcomes and lower perceived levels of depression, anxiety, and stress, indicating that higher functional capacity corresponded to better perceived well-being and lower levels of these indicators. However, in the multivariate models that included interaction terms between BMI and physical fitness (30), these associations were modified, suggesting a potential effect-modifying role of physical fitness in the relationship between BMI and the outcomes. This finding indicates that the relationship between physical fitness and the outcomes may vary according to BMI category, rather than operating independently of body weight, consistent with the

concept of effect modification described in epidemiological research (31). In other words, the impact of functional capacity on perceived quality of life and the risk of depression, anxiety, and stress appears to differ across weight status groups. Notably, associations were more evident when comparing individuals with overweight to those with obesity, particularly for outcomes related to physical functioning and general health perception. This pattern indicates that, among individuals with excess body weight, differences in functional capacity may be especially relevant to perceived well-being.

Regarding mental health, a similar pattern was observed: no associations were found between physical fitness and mental health when comparing individuals with normal weight and obesity. In contrast, when comparing individuals with overweight and those with obesity, nine associations were identified in the interaction between physical fitness and mental health. The agility and dynamic balance test was the only assessment associated with depression, anxiety, and stress. In contrast, the sit-to-stand and elbow flexion tests were associated with depression and stress.

Obesity can impact the perception of quality of life and increase the risk of symptoms of depression, anxiety, and stress (32). Tozetto *et al.* (2021) explain that this may be due to the stress imposed on the body, particularly on the joints, which makes basic activities of daily living more difficult, potentially leading to demotivation and osteoarticular pain. The authors also point out that, in addition to physiological and biomechanical factors, excess body fat may contribute to experiences of prejudice and social isolation (33). In a cross-sectional study, the impact of obesity on physical capacity, osteoarticular symptoms, and overall quality of life was evaluated, showing that obesity led to a significant loss of physical capacity, impaired gait, and a negative impact on overall quality of life (34).

Higher physical fitness levels are positively associated with perceived quality of life and mental health scores. In this sense, it is important to highlight that engaging individuals in regular PA can be an important stimulus not only for physical health, but also for mental health. According to our findings, a systematic review and meta-analysis that aimed to evaluate the effect of physical training on psychological outcomes in adults with overweight and obesity showed that physical training promotes positive effects on quality of life outcomes, with effect sizes of 0.90 for the overall physical component (large effect), 0.41 for vitality, and 0.22 for mental health (small to moderate effects) (35). These results support the association between higher physical fitness and better perceptions of quality of life and psychological well-being.

Few associations were observed between BMI and the perception of quality of life and mental health, indicating that this measure alone may not be sufficient to assess overweight and obesity conditions (36). Weeldreyer *et al.* (2024), in a review study (37) demonstrated a relationship between cardiorespiratory fitness, BMI, and mortality was studied, showing that individuals with overweight and obesity did not present a higher risk of mortality when compared to individuals with normal weight; a high level of cardiorespiratory fitness was able to reduce the risks associated with excess body weight. The results of this recent study reinforce the importance of a multidimensional perspective when evaluating this health condition, as it considers multiple health-related aspects.

Classifying individuals' nutritional status based on BMI, when used as a diagnostic strategy for this health condition, becomes insufficient when the comprehensiveness of individuals is considered, including their lived experiences, interactions, behaviors, and other factors. Therefore, as suggested by Rubino (38), complementary measures are recommended to better understand individuals’ living

conditions, including not only BMI assessment but also waist circumference measurements and laboratory tests, to achieve a more in-depth evaluation of people with this condition.

In the present study, health-related physical fitness was examined as a multidimensional construct encompassing muscular endurance, strength, agility, balance, and aerobic capacity. No inverse associations were found between obesity and mental health or quality of life. This finding reinforces that analyses adopting a more sensitive approach, namely, considering individuals in their comprehensiveness rather than focusing solely on body weight, are necessary to evaluate these factors.

This study has some limitations. One of them is the imbalance in the proportions of the categories of the variables under analysis, possibly resulting from sample heterogeneity. Such differences may inflate estimation errors and limit inferences, making it advisable to conduct studies with more homogeneous samples or larger sample sizes; however, this limitation is common in cross-sectional studies. In addition, other variables that may influence the perception of quality of life and mental health, such as psychosocial, economic, and environmental factors, were not considered. Furthermore, due to the cross-sectional design, the associations observed cannot be interpreted as causal relationships. Therefore, it is not possible to determine whether differences in BMI or improvements in physical fitness lead to changes in perceived quality of life or mental health. Longitudinal studies are needed to better understand the temporal relationships between these variables.

Regarding the strengths of the present study, the instruments used allowed for a multidimensional assessment of the health of individuals entering the program, including BMI, PA level, perception of quality of life, and mental health. This provided a broad view of the relationships among these variables. Moreover, objective

measures were used to assess physical fitness, including six tests, going beyond the self-reported PA level assessed by the IPAQ. Although the IPAQ does not provide a direct measure of PA, it is widely used due to its practicality, ease of administration, and low cost. The use of univariate and multivariate analyses with the bootstrap method adds statistical rigor and greater precision to the investigation of associations. In addition, this study is part of a university extension project that reinforces the university's three pillars by integrating teaching, research, and extension activities.

The associations found between physical fitness and perceived quality of life and mental health support further studies of exercise-based interventions to improve physical fitness. Therefore, future studies are recommended to explore these aspects further to determine whether physical training can improve physical fitness and enhance perceptions of quality of life and mental health.

CONCLUSION

Physical fitness was associated with perceived quality of life and mental health, with these associations more pronounced among individuals with overweight or obesity than among eutrophic individuals. In this context, the interaction between BMI and physical fitness underscores the importance of maintaining or achieving adequate levels of physical fitness to support better perceptions of quality of life and mental health. From clinical and public health perspectives, these findings reinforce the importance of integrated strategies that combine improvements in physical fitness with broader lifestyle and weight management approaches. Multidisciplinary interventions may be more effective in promoting quality of life and mental health among individuals with overweight and obesity.

LIST OF ABBREVIATIONS

BMI: Body Mass Index; PA: physical activity; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology; SF-12: 12-Item Short-Form Health Survey; DASS-21: Depression, Anxiety, and Stress Scale; IPAQ: International Physical Activity.

DECLARATIONS

Ethics approval and consent to participate

The present study was approved by the Ethics Committee of the School of Physical Education and Sport of Ribeirao Preto, University of Sao Paulo (CAAE: 58595122.0.0000.5659; approval number 5.441.442). Before enrolling in the extension project, participants signed the Informed Consent Form and the Image Use Consent Form.

Consent for publication

Not applicable.

Research data availability statement

The dataset supporting the findings of this study is not publicly available.

Competing interests

The authors declare no conflicts of interest.

Funding

Not applicable.

Authors' contributions

JCSO contributed to writing the original draft and visualization. GPC contributed to formal analysis and to writing, review, and editing. AAT contributed to supervision and project administration. GPC, AAT, and CM contributed to writing, review, and editing. All authors read and approved the final manuscript.

Acknowledgements

The authors thank all study participants, the Study and Research Group in Physical Education and Collective Health, the National Council for Scientific and Technological Development (CNPq), and the School of Physical Education and Sport of Ribeirao Preto, University of Sao Paulo.

REFERENCES

1. Obesity Atlas 2025 | World Obesity Federation Global Obesity Observatory.

2. Original A, Canaan FA, Lina R, Frandsen E, Lima P, Sylvia R, Castro C, Gilberto F, Rosado P, De Cássia R, et al. Aplicabilidade do índice de massa corporal na avaliação da gordura corporal. Revista Brasileira de Medicina do Esporte. 2010; 16:90–94. doi: 10.1590/S1517-86922010000200002.

3. Diretrizes Brasileiras de Obesidade 2016 4ª edição.

4. Dwivedi AK, Dubey P, Cistola DP, Reddy SY. Association Between Obesity and Cardiovascular Outcomes: Updated Evidence from Meta-analysis Studies. Curr Cardiol Rep. 2020;22. doi: 10.1007/S11886-020-1273-Y.

5. Abiri B, Hosseinpanah F, Banihashem S, Madinehzad SA, Valizadeh M. Mental health and quality of life in different obesity phenotypes: a systematic review. Health Qual Life Outcomes. 2022;20:1–14. doi: 10.1186/S12955-022-01974-2.

6. Kolotkin RL, Meter K, Williams GR. Quality of life and obesity. Wiley Online LibraryRL Kolotkin, K Meter, GR WilliamsObesity reviews. 2001; 2:219–229. doi: 10.1046/J.1467-789X.2001.

7. Haraldstad K, Wahl A, Andenæs R, Andersen JR, Andersen MH, Beisland E, Borge CR, Engebretsen E, Eisemann M, Halvorsrud L, et al. A systematic review of quality of life research in medicine and health sciences. SpringerK Haraldstad. 2019;28:2641–2650. doi: 10.1007/S11136-019-02214-9.

8. The World Health Organization quality of life assessment (WHOQOL): Position paper from the World Health Organization. Soc Sci Med. 1995; 41:1403–1409. doi: 10.1016/0277-9536(95)00112-K.

9. Jakicic JM, Davis KK. Obesity and physical activity. Psychiatric Clinics. 2011; *34*(4), 829-840.

10. Oppert JM, Ciangura C, Bellicha A. Health-enhancing physical activity in obesity management: the need to (seriously) go beyond weight loss. International Journal of Obesity. 2025, *49*(2), 211-213.

11. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Reports. 1985; 100(2), 126-131.

12. Ortega FB, Ruiz JR, Castillo MJ. Actividad física, condición física y sobrepeso en niños y adolescentes: evidencia procedente de estudios epidemiológicos. Endocrinología y Nutrición. 2013;60:458–469.

13. Costa GP, Develey LD, Silva AP da, Oliveira JCS, Carrijo GML, Moreira MM, Moraes C de, Trapé ÁA. Programa para Adultos de Treinamento Integrado da EEFERP-USP: da articulação entre extensão e pesquisa às ações extramuros. Extensão Universitária: criando e transformando conhecimento em ação. 2025;78-90. doi: 10.47247/ev/6063.075.8.6.

14. Costa GP, Develey LD, Silva AP da, Oliveira JCS, Carrijo GML, Moreira MM, Moraes C de, Trapé ÁA. Integrated Training Program for Adults at EEFERP-USP: from the articulation between extension and research to outreach actions. 2026; doi: 10.1590/SCIELOPREPRINTS.15893.

15. Camelier AA. Avaliação da qualidade de vida relacionada a saúde em pacientes com DPOC: estudo de base populacional com o SF-12 na cidade de São Paulo. Universidade Federal de São Paulo (UNIFESP); 2004.

16. Damásio BF, Andrade TF, Koller SH. Psychometric Properties of the Brazilian 12-Item Short-Form Health Survey Version 2 (SF-12v2). Paidéia (Ribeirão Preto). 2015;25:29–37. doi: 10.1590/1982-43272560201505.

17. Noronha DD, Martins AME de BL, Dias D dos S, Silveira MF, de Paula AMB, Haikal DSA. Qualidade de vida relacionada à saúde entre adultos e fatores associados: um estudo de base populacional. Cien Saude Colet. 2016;21:463–474. doi: 10.1590/1413-81232015212.01102015.

18. Vignola RCB, Tucci AM. Adaptation and validation of the depression, anxiety and stress scale (DASS) to Brazilian Portuguese. J Affect Disord. 2014;155:104–109. doi: 10.1016/J.JAD.2013.10.031.

19. Martins BG, Da Silva WR, Maroco J, Campos JADB. Escala de Depressão, Ansiedade e Estresse: propriedades psicométricas e prevalência das afetividades. J Bras Psiquiatr. 2019;68:32–41. doi: 10.1590/0047-2085000000222.

20. Matsudo S, Araújo T, Matsudo V, Andrade D, Andrade E, Oliveira LC, Braggion G. Questionário Internacional de Atividade Física (IPAQ): Estudo de validade e reprodutibilidade no Brasil. Revista Brasileira de Atividade Física & Saúde. 2001;6:5–18. doi: 10.12820/RBAFS.V.6N2P5-18.

21. Marcucci LR, de Azevedo MJ, Costa GP, Andrella JL, da Silva Lizzi EA, Trapé ÁA. Associação entre prática de atividade física com a saúde mental e a percepção da qualidade de vida em profissionais de enfermagem de Ribeirão Preto e região durante a pandemia da covid-19. Medicina (Ribeirão Preto). 2023;56. doi: 10.11606/ISSN.2176-7262.RMRP.2023.197591.

22. A healthy lifestyle - WHO recommendations. 2025.

23. Lebrão ML, Laurenti R. Saúde, bem-estar e envelhecimento: o estudo SABE no Município de São Paulo. Revista Brasileira de Epidemiologia. 2005;8:127–141. doi: 10.1590/S1415-790X2005000200005.

24. Rikli RE, Jones CJ. Teste de aptidão física para idosos. Barueri (SP): Manole; 2008.

25. de Lima TR, Silva DAS, Kovaleski DF, González-Chica DA. Associação da força muscular com fatores sociodemográficos e estilo de vida em adultos e idosos jovens no Sul do Brasil. Cien Saude Colet. 2018;23:3811–3820. doi: 10.1590/1413-812320182311.27792016.

26. Osness W, et al. Functional Fitness Assessment for Adults Over 60 Years (A Field Based Assessment). AAHPERD Publication Sales Office, 1900 Association Drive, Reston, VA 22091., 1990.

27. Warburton DER, Bredin SSD. Health benefits of physical activity: a systematic review of current systematic reviews. Curr Opin Cardiol. 2017;32:541–556. doi: 10.1097/HCO.0000000000000437.

28. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, Alkandari JR, Andersen LB, Bauman AE, Brownson RC, et al. Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. The Lancet [Internet]. 2012 [cited 2026 Mar 5];380:219–229. doi: 10.1016/S0140-6736(12)61031-9. Cited in PMID: 22818936.

29. Brasil. Ministério da Saúde. Secretaria de Atenção Primária à Saúde. Departamento de Promoção da Saúde. Guia de Atividade Física para a População Brasileira [recurso eletrônico] / Ministério da Saúde, Secretaria de Atenção Primária à Saúde, Departamento de Promoção da Saúde. – Brasília: Ministério da Saúde, 2021.

30. Maia KP, da Silva GA, Libânio M. Aplicação de análise multivariada no estudo da frequência de amostragem e do número de estações de monitoramento de qualidade da água. Engenharia Sanitaria e Ambiental. 2019;24:1013–1025. doi: 10.1590/S1413-41522019175743.

31. Knol MJ, VanderWeele TJ. Recommendations for presenting analyses of effect modification and interaction. Int J Epidemiol. 2012;41:514. doi: 10.1093/ije/dyr218.

32. Blasco BV, García-Jiménez J, Bodoano I, Gutiérrez-Rojas L. Obesity and Depression: Its Prevalence and Influence as a Prognostic Factor: A Systematic Review. Psychiatry Investig. 2020;17:715. doi: 10.30773/PI.2020.0099.

33. Tozetto WR, dos Santos Leonel L, Benedet J, Duca GF Del. Quality of life and its relationship with different anthropometric indicators in adults with obesity. Fisioterapia em Movimento. 2021;34:e34102. doi: 10.1590/FM.2021.34102.

34. Tamura LS, Cazzo E, Chaim EA, Piedade SR. Influence of morbid obesity on physical capacity, knee-related symptoms and overall quality of life: A cross-sectional study. Rev Assoc Med Bras. 2017;63:142–147. doi: 10.1590/1806-9282.63.02.142.

35. Carraça E V., Encantado J, Battista F, Beaulieu K, Blundell JE, Busetto L, van Baak M, Dicker D, Ermolao A, Farpour-Lambert N, et al. Effect of exercise training on psychological outcomes in adults with overweight or obesity: A systematic review and meta-analysis. Obesity Reviews. 2021;22. doi: 10.1111/OBR.13261.

36. Perez-Sousa MA, Olivares PR, Escobar-Alvarez JA, Parraça JA, Gusi N. Fitness as mediator between weight status and dimensions of health-related quality of life. Health Qual Life Outcomes. 2018;16. doi: 10.1186/S12955-018-0981-0.

37. Weeldreyer NR, De Guzman JC, Paterson C, Allen JD, Gaesser GA, Angadi SS. Cardiorespiratory fitness, body mass index and mortality: a systematic review and meta-analysis. Br J Sports Med. 2024;59. doi: 10.1136/BJSPORTS-2024-108748.

38. Rubino F, Cummings DE, Eckel RH, Cohen R V, Wilding JPH, Brown WA, Stanford FC, Batterham RL, Farooqi IS, Farpour-Lambert NJ, et al. Definition and diagnostic criteria of clinical obesity. Lancet Diabetes Endocrinol. 2025;13. doi: 10.1016/S2213-8587(24)00316-4.

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