



Associations between physical fitness, body composition, and health-related quality of life among inactive university students

Asociaciones entre condición física, composición corporal y calidad de vida relacionada con la salud en estudiantes universitarios inactivos

Authors

Juan Pablo Zavala Crichton ¹
 Astrid Titus-Cabrera ¹
 Felipe Navarro-Henríquez ¹
 José Joaquín Álvarez-Opazo ¹
 Rodrigo Yáñez-Sepúlveda ¹
 Paula Ortiz-Marholz ¹
 Claudio Hinojosa-Torres ¹
 Carlos Cristi-Montero ²
 Patricio Solís-Urra ^{3,1}
 José Francisco López-Gil ^{4,5}

¹ Universidad Andres Bello (Chile)
² Pontificia Universidad Católica de Valparaíso (Chile)
³ AdventHealth Research Institute, Neuroscience Institute, Orlando, FL (USA)
⁴ Universidad Espíritu Santo (Ecuador)
⁵ Universidad de Los Lagos (Chile)

Corresponding author:
 José Francisco López-Gil
josefranciscolopezgil@gmail.com

Received: 02-09-25
 Accepted: 06-10-25

How to cite in APA

Zavala Crichton, J. P., Titus-Cabrera, A., Navarro-Henríquez, F., Álvarez-Opazo, J. J., Yáñez-Sepúlveda, R., Ortiz-Marholz, P., Hinojosa-Torres, C., Cristi-Montero, C., Solís-Urra, P., & López-Gil, J. F. (2025). Associations between physical fitness, body composition, and health-related quality of life among inactive university students. *Retos*, 73, 757-769.
<https://doi.org/10.47197/retos.v73.117510>

Abstract

Background: The COVID-19 pandemic worsened physical inactivity and unhealthy habits among university students, yet evidence on physically inactive populations in Latin America remains scarce. **Objective:** To examine associations between physical fitness, body composition, and health-related quality of life (HRQoL) in physically inactive Chilean university students in the post-pandemic period.

Methods: Cross-sectional study including 139 physically inactive students (mean age = 22.5 ± 3.1 years). Physical fitness comprised cardiorespiratory fitness (CRF), handgrip strength, standing long jump (SLJ), and agility, assessed with the ALPHA-Fitness battery. Body composition was evaluated using body mass index (BMI), waist-to-height ratio, and neck circumference. HRQoL was measured with the 36-Item Short Form Health Survey (SF-36), including physical functioning, role physical, general health, social functioning, and role emotional. Associations were analyzed using multiple linear regressions.

Results: Higher CRF was associated with better physical functioning ($B = 0.372$; $p < 0.001$), general health ($\beta = 0.349$; $p < 0.001$), and social functioning ($\beta = 0.244$; $p = 0.031$). SLJ was positively related to physical functioning ($\beta = 0.386$; $p = 0.001$), as was agility ($\beta = 0.215$; $p = 0.028$). BMI showed inverse associations with physical functioning ($\beta = -0.171$; $p = 0.045$), general health ($\beta = -0.168$; $p = 0.042$), and social functioning ($\beta = -0.218$; $p = 0.013$). Neck circumference was negatively associated with social functioning ($\beta = -0.289$; $p = 0.024$).

Conclusions: Higher CRF, SLJ performance, and agility were linked to better HRQoL domains, whereas higher BMI and neck circumference predicted poorer outcomes. These results highlight the importance of structured physical activity programs in universities to improve student health and well-being in the post-pandemic context.

Keywords

Health promotion; mental health; physical fitness; university students.

Resumen

Antecedentes: La pandemia de COVID-19 incrementó la inactividad física y conductas no saludables en universitarios. En América Latina existe escasa evidencia en estudiantes físicamente inactivos. **Objetivo:** Examinar las asociaciones entre condición física, composición corporal y calidad de vida relacionada con la salud (CVRS) en universitarios inactivos de Chile en el periodo pospandémico.

Métodos: Estudio transversal con 139 estudiantes inactivos (22.5 ± 3.1 años). La condición física incluyó aptitud cardiorrespiratoria (CRF), fuerza de prensión manual, salto horizontal desde parado (SLJ) y agilidad, evaluadas con la batería ALPHA-Fitness. La composición corporal se estimó mediante índice de masa corporal (IMC), relación cintura-estatura y circunferencia de cuello. La CVRS se midió con el SF-36 (función física, rol físico, salud general, función social y rol emocional). Las asociaciones se analizaron con regresiones lineales múltiples.

Resultados: La CRF se asoció positivamente con función física ($B = 0.372$; $p < 0.001$), salud general ($\beta = 0.349$; $p < 0.001$) y función social ($\beta = 0.244$; $p = 0.031$). El SLJ ($\beta = 0.386$; $p = 0.001$) y la agilidad ($\beta = 0.215$; $p = 0.028$) se relacionaron con mejor función física. El IMC se asoció inversamente con función física ($\beta = -0.171$; $p = 0.045$), salud general ($\beta = -0.168$; $p = 0.042$) y función social ($\beta = -0.218$; $p = 0.013$). La circunferencia de cuello se asoció negativamente con la función social ($\beta = -0.289$; $p = 0.024$).

Conclusiones: Una mayor CRF, SLJ y agilidad se vinculan con mejores dominios de la CVRS, mientras que un IMC y una circunferencia de cuello elevados se asocian con peores resultados. Se recomienda integrar programas estructurados de actividad física y estrategias preventivas en el entorno universitario.

Palabras clave

Promoción de la salud; salud mental; condición física; estudiantes universitarios.



Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has had a profound and lasting impact on global health, particularly affecting mental health and well-being across all educational levels of society. University students have experienced heightened vulnerability due to academic disruptions, social isolation, and increased psychological distress during and after the pandemic (Wang et al., 2020; Liu et al., 2020). These effects tend to persist long after the return to face-to-face learning, with many students reporting ongoing symptoms of anxiety, depression, and decreased quality of life (Son et al., 2020).

Building on these global health concerns, promoting comprehensive health and well-being has renewed urgency in global policy agendas. This is reflected in the United Nations 2030 Agenda for Sustainable Development, particularly Sustainable Development Goal (SDG) 3: "Ensure healthy lives and promote well-being for all at all ages" (United Nations, 2015). This goal becomes especially pertinent in higher education settings, where students are exposed to multiple stressors that affect both physical and mental health, including academic demands, insufficient physical activity, and poor dietary habits (Cai et al., 2025; Kljajević et al., 2021; Marquez et al., 2020).

University students represent a growing and vulnerable population. In 2024, global enrollment reached 254 million (42%), more than double that of two decades ago (UNESCO, 2024). In Chile, higher education enrollment reached approximately 1,341,439 students in 2023, representing a 3% increase compared to the previous year (Higher Education Information Service, 2023). While these figures illustrate the growing relevance of higher education, less is known about health-related behaviors in the Latin American region. A multinational study by Pengpid et al. (2015) highlighted a high prevalence of physical inactivity (41.4%) among university students, with differences in socioeconomic status. Inactivity has been linked to poorer physical and psychological health, reinforcing the need for institutional strategies to promote active lifestyles. The study included four Latin American countries, but not Chile, leaving an important research gap where sedentary behavior is highly prevalent and wellness policies are still developing.

Physically inactive students are particularly at risk in the post-pandemic period, as they often lack exercise habits and face additional barriers such as academic stress and limited resources. Evidence suggests that inactivity levels have persisted in this subgroup, underscoring the need for tailored interventions to protect fitness and Health-Related Quality of Life (HRQoL) (Abrantes et al., 2022).

HRQoL is a key indicator of student well-being (Abdullah et al., 2021; Li et al., 2022), especially given the prevalence of unhealthy habits such as poor diet, stress, and sedentary lifestyles. Studies highlight the urgency of addressing student well-being as a public health issue (Cai et al., 2025; Bersia et al., 2024; Esposito et al., 2024).

Physical activity is consistently recognized as a protective factor for physical and mental health, particularly in young adults (White et al., 2024; Pearce et al., 2022). In university students, especially post-pandemic, regular activity enhances functional capacity, prevents disease, and helps regulate emotional responses and stress (Medrano-Ureña et al., 2020). Within this framework, cardiorespiratory fitness (CRF) has emerged as one of the most robust indicators of health, strongly linked to both physical (Lang et al., 2024) and psychosocial outcomes. Higher CRF levels have been associated with lower risks of noncommunicable diseases (Lang et al., 2024) and improved quality of life, making it a key target for intervention in university populations (Franklin et al., 2023). Body composition also plays a role: higher fat and lower muscle mass are associated with anxiety, depression, and poorer mental health (Torres et al., 2023).

Despite the growing body of international evidence supporting the role of physical fitness in promoting mental and physical well-being (Medrano-Ureña et al., 2020; Kljajević et al., 2021), research on Chilean university populations remains limited, particularly in students who are physically inactive and vulnerable to the long-term effects of the COVID-19 pandemic. Although national studies have been conducted, their scope in university students has often been limited (Muñoz-Strale et al., 2024; Yuing et al., 2021). This gap in the literature is especially relevant, given the increasing prevalence of physical inactivity and psychological distress in this population. University life is often accompanied by significant psychosocial challenges, including academic pressure, limited financial resources, and lifestyle changes, which can negatively affect students' physical and mental well-being.



However, despite international advances in understanding the role of physical fitness and body composition on student mental health, there is a notable lack of studies addressing these relationships in the Chilean context, particularly among physically inactive university students. While some research has examined these variables separately (Muñoz-Strale et al., 2024), no studies have simultaneously analyzed fitness indicators, body composition metrics, and multidimensional HRQoL using validated instruments, which constitutes a key knowledge gap that this study seeks to address.

In this context, the present study aims to analyze the relationships among physical fitness, body composition, and HRQoL in physically inactive university students in Chile. By incorporating standardized fitness assessments and a validated multidimensional HRQoL instrument, this study seeks to generate robust evidence to inform the design of effective institutional strategies. It is hoped that these results will provide relevant information for the development of educational policies to ensure mental health through physical activity in post-pandemic university education.

Method

The study was conducted with 139 university students, with a mean age of 22.5 ± 3.1 years, of whom 79 were female and 60 were male. A calculation was made for infinite samples with a confidence level of 95 % and assuming maximum variability ($p = 0.5$), the sample size used ($n = 139$) allows estimating proportions with an approximate margin of error of ± 8.3 %. Although this margin exceeds the conventional threshold of 5 %, it is considered acceptable in exploratory studies and allows us to identify relevant associations within the sample. The inclusion criteria established that participants should be physically inactive university students, defined according to the World Health Organization (WHO) recommendations: less than 150 minutes per week of moderate physical activity, 75 minutes of vigorous physical activity, or their equivalent combination (Bull et al., 2020). Moderate to vigorous physical activity (MVPA) refers to the range of exercise intensity between an effort that requires an energy expenditure of 3 to 6 metabolic equivalents (METs) for moderate activities and greater than 6 METs for vigorous activities (MacIntosh et al., 2021). Students from sports-related programs, such as Pedagogy in Physical Education or Sports Coaching, were excluded, as were those with clinical contraindications to physical fitness testing. All participants signed an informed consent form, and the study was approved by the Center for Youth Studies (CEJ) of Andres Bello University, which adheres to the ethical principles of the Declaration of Helsinki (World Medical Association, 2013).

Population and study design

An observational, cross-sectional study was conducted. An open call was made through social networks and e-mails addressed to students from various universities in the Valparaíso Region, Chile. Those interested were registered through a Google form, providing basic data to verify compliance with the inclusion and exclusion criteria of the study. The selected participants were subsequently contacted via e-mail, where they were given detailed information about the place, dates, and recommendations prior to the evaluations. The importance of following certain indications to guarantee the accuracy of the results was emphasized. These included staying adequately hydrated, ensuring sufficient rest before the tests, and consuming the last meal at least 90 minutes before the tests. They were also asked to avoid any strenuous physical activity in the 24 hours prior to testing. On the testing day, participants initially completed self-administered quality-of-life questionnaires on computers set up on-site. Assessments were conducted in a gymnasium set up to meet the study requirements. The procedures began with an explanatory introduction and supervised warm-up routine.

Evaluations

Physical fitness

The extended version of the Assessing Levels of Physical Activity and Fitness (ALPHA-Fit) test battery (Ruiz et al., 2011) was used to evaluate the health-related components of physical fitness. The tests included CRF, which was evaluated via the 20-meter round-trip test, and maximal oxygen consumption (VO_{2max}) was calculated via the formula: $VO_{2max} = 5.857 \times \text{speed (km/h)} - 19.458$ (Léger & Lambert, 1982). Handgrip strength was assessed using a digital hand dynamometer (Jamar Plus+ Digital Hand

Dynamometer, Sammons Preston, Rolyan) calibrated to the participant's hand size. Although this adjustment is particularly emphasized in women due to smaller hand dimensions, previous research has shown that calibration improves the accuracy and reliability of measurements in both sexes (Ruiz et al., 2011; Suni, Husu, & Raitanen, 2009; España-Romero et al., 2010). This procedure ensured standardized assessments across the study population. The device measures in the range of 0 to 90 kg with an accuracy of 0.1 kg. Lower body muscular strength was evaluated using the standing long jump test (two-footed takeoff), which measures explosive leg power. Motor skills and agility were assessed using the 4 × 10-meter shuttle run test, which evaluates speed, coordination, and change-of-direction ability. Although the ALPHA-Fit test battery was originally developed for children and adolescents (Ruiz et al., 2011), it has also been validated and widely applied in adults and university populations, proving to be a reliable tool for assessing health-related fitness in young adults (Suni et al., 2009; American College of Sports Medicine [ACSM], 2013; Calestine et al., 2017).

Body composition

Body composition was evaluated using parameters based on the ALPHA-Fit test battery (Ruiz et al., 2011), including weight, height, neck circumference and waist circumference. Body weight was evaluated using a SECA® model 803 scale with an accuracy of 0.1 kg, and height was measured using a SECA® portable stadiometer. With these data, the body mass index (BMI) of the participants was calculated with the formula $\text{weight (kg)} / \text{height}^2 \text{ (m)}$. Neck and waist circumferences were measured using a LUFKIN® metal tape, following the protocols recommended by the ALPHA-Fit test battery. The waist-to-height ratio (WHR) was calculated by dividing the waist circumference (cm) by the height (cm).

Health-related quality of life

The Short-Form Health Survey (SF-36) is a widely validated instrument for determining physical and mental well-being in diverse populations (Ware & Sherbourne, 1992; McHorney, Ware, & Raczek, 1993), was used to assess HRQoL. It is a generic measure and not a measure directed at a specific age, disease, or treatment group (Ware et al., 2000). This instrument consists of 36 items that assess eight dimensions: health, physical function, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health (Ware et al., 1993). Additionally, the SF-36 includes a transition item that asks about the change in general health status from the previous year (Vilagut, et al., 2005), which is not used for the calculation of any of the scales but provides useful information about the perceived change in health status during the year prior to the application of the instrument (Ware, et al., 1993). Each dimension is scored on a scale from 0 to 100, with higher scores indicating a greater perception of HRQoL (Gandek et al., 1998). The questionnaire was adapted for the purposes of this study, considering only the physical function (10 items), assesses limitations in performing daily physical activities, such as walking, climbing stairs, carrying objects or caring for oneself. Reflects overall functional ability. Physical role (4 items) measures the impact of physical problems on work performance or other daily activities (e.g., limitations in the amount or quality of work performed). General health (5 items), reflects the individual's overall perception of their health status, including expectations for future health and susceptibility to illness. Social function (2 items) assesses the extent to which physical or emotional health interferes with social activities, such as interacting with friends and family or participating in social events. Finally, the emotional role (3 items), Assesses the extent to which physical or emotional health interferes with social activities, such as interacting with friends and family or participating in social events. The assessment instrument was self-administered to the participants in a controlled environment to ensure confidentiality of their responses. The results obtained from this questionnaire were used to calculate the scores for each individual dimension to generate an overall HRQoL score.

Statistical analysis

The data collected were processed using JAMOVI® software version 23.1.1 for Windows®, and the results are presented as means and standard deviations. The Shapiro–Wilk test was used to assess the normality of the data. The results from both tests confirmed the assumption of a normal distribution. Given that preliminary analyses showed no significant interaction between the independent variable and sex or age in relation to the outcome ($p > 0.05$ for all), analyses were conducted using the overall sample without stratification. Consequently, the dataset was deemed suitable for parametric statistical analyses. All missing values were removed via listwise deletion. Outliers, identified using z-scores ($>$

± 3.5), were also excluded to ensure data quality and analytic consistency. To evaluate the impact of listwise deletion, a sensitivity analysis was conducted using only the SF-36 variables. Although certain dimensions—such as Emotional role (26.4%), Physical role (17.5%), and General Health (7.3%)—had moderate levels of missing data, the comparison of mean scores between the full dataset and the complete-case subset revealed no absolute differences. These findings suggest that listwise deletion did not bias the central tendency estimates for SF-36 outcomes, supporting the validity of subsequent analyses based on complete cases. Initial descriptive analyses were performed to group quantitative variables. To ensure the validity of the multiple linear regression analyses, all key statistical assumptions were rigorously evaluated, including normality, homoscedasticity, independence of errors, linearity, and the normal distribution of residuals. Normality of the variables was assessed using the Shapiro–Wilk test, which confirmed approximately normal distributions across all variables ($p > 0.05$), supporting the use of parametric procedures. Multicollinearity was examined through the variance inflation factor (VIF), with all values falling below the accepted threshold ($VIF < 5$), indicating no substantial collinearity among predictors. Residual diagnostics, including visual inspection of scatter and Q-Q plots, showed no evidence of heteroscedasticity and confirmed a random and normally distributed error structure. Collectively, these results supported the appropriateness of linear regression models to examine the associations between physical fitness, body composition, and health-related quality of life dimensions. To explore the relationships between physical fitness, body composition, and HRQoL dimensions, two multiple linear regression models. The first model included variables related to physical fitness, such as average manual handgrip strength, relative handgrip strength, SLJ, agility, and CRF. The second model considered body composition variables, including BMI, WHR and neck circumference. Before fitting the models, collinearity between the independent variables was assessed to ensure the validity of the results. Beta values (β) and significance levels (p) were reported, classifying the magnitude of β as trivial (< 0.10), small (0.10-0.29), moderate (0.30-0.49), high (0.50-0.69), very high (0.70-0.89) and nearly perfect (≥ 0.90) according to Hopkins et al. (2009). Statistical significance was set at $p < 0.05$.

Results

Table 1 presents the descriptive statistics for the main anthropometric characteristics and physical fitness variables of the study sample, expressed as means (M) and standard deviations (SD):

Regarding anthropometric measures, participants had a mean age of 22.5 ± 3.1 years, with an average body weight of 70.1 ± 13.0 kg and height of 1.63 ± 0.17 m. Neck circumference averaged 34.1 ± 3.3 cm, while waist circumference was 79.8 ± 9.7 cm. The mean BMI was 25.7 ± 4.0 kg/m², and the WHR was 0.485 ± 0.06 , suggesting a moderate level of abdominal fat distribution within the sample.

In terms of physical fitness, estimated CRF, expressed in ml/kg/min, was 31.9 ± 6.6 , indicating generally low to moderate aerobic capacity based on international standards. Agility, measured via a timed test, averaged 12.9 ± 1.4 seconds. Average handgrip strength was 37.6 ± 11.0 kg, while relative handgrip strength (normalized to body weight) was 0.540 ± 0.13 kg/kg. The mean SLJ distance was 160.0 ± 37.7 cm, reflecting variability in lower-body explosive strength.

Table 1. Anthropometric and physical fitness characteristics of the participants.

Variable	All		Women		Men	
	Mean	SD	Mean	SD	Mean	SD
Anthropometric characteristics						
Age (years)	22.5	± 3.1	23.4	± 2.9	22.1	± 3.3
Weight (kg)	70.1	± 13.0	66.8	± 13.2	76.5	± 7.7
Height (m)	1.63	± 0.17	1.59	± 0.17	1.75	± 0.17
Neck circumference (cm)	34.1	± 3.3	32.2	± 2.0	36.7	± 12.7
Waist circumference (cm)	79.8	± 9.7	76.9	± 9.5	81.2	± 4.6
BMI (Weight [kg] / height [m ²])	25.7	± 4.0	26.3	± 4.8	24.9	± 2.4
WHR (Waist [cm] / height [cm])	0.485	± 0.06	0.484	± 0.1	0.464	± 0.1
Physical Fitness						
CRF (ml/kg/min)	31.9	± 6.6	28.5	± 3.4	41.0	± 4.2
Agility (s)	12.9	± 1.4	13.9	± 1.1	11.3	± 0.4
Average Handgrip (kg)	37.6	± 11.0	30.2	± 5.8	54.8	± 11.3
Relative Handgrip (kg/weight)	0.540	± 0.13	0.452	± 0.19	0.716	± 0.24
SLJ (cm)	160.0	± 37.7	130.6	± 31.4	202.8	± 18.1

CRF: cardiorespiratory fitness. M: mean. SD: standard deviation.
 BMI: body mass index. SLJ: standing long jump. WHR: waist-to-height ratio

Table 2. Results of the SF-36 health-related quality of life questionnaire.

Variable	All		Women		Men	
	M	SD	M	SD	M	SD
Physical function	90.8	± 12.1	89.5	± 12.6	97.3	± 3.4
Physical role	40.3	± 34.1	34.1	± 34.1	55.6	± 30.0
General health	60.1	± 57.5	53.8	± 20.0	71.0	± 14.0
Social function	73.6	± 23.9	74.4	± 23.9	75.0	± 29.0
Emotional role	30.2	± 41.5	36.4	± 43.5	36.4	± 50.4

M: mean; SD: standard deviation.

Table 2 shows the results obtained from the sample using the SF-36 health-related quality of life questionnaire. The item with the highest score was physical function, with an average score of 90.8 ± 12.1 , whereas the item with the lowest score was emotional role, with an average score of 30.2 ± 41.5 .

Table 3. Linear regression of health-related quality of life. Body composition model.

Body composition Variable	Physical function		Physical role		General health		Social function		Emotional role	
	β	<i>p</i>	β	<i>p</i>	β	<i>p</i>	β	<i>p</i>	β	<i>p</i>
NC	-0.240	0.055	-0.053	0.671	-0.221	0.068	-0.289	0.024	0.169	0.178
BMI	-0.171	0.045	-0.025	0.775	-0.168	0.042	-0.218	0.013	0.050	0.558
WHR	-0.178	0.035	-0.066	0.438	-0.185	0.023	-0.210	0.015	0.054	0.527

BMI: body mass index. NC: Neck circumference. WHR: waist-to-height ratio.

Table 3 shows that certain body composition measures were significantly associated with specific dimensions of health-related quality of life. Notably, NC was negatively associated with social function. Both BMI and WHR were negatively related to physical function, general health, and social function. No significant associations were observed for the remaining variables.

Table 4. Linear regression of health-related quality of life. Physical fitness model.

Variable	Physical fitness									
	Physical function		Physical role		General health		Social function		Emotional role	
	β	<i>p</i>	β	<i>p</i>	β	<i>p</i>	β	<i>p</i>	β	<i>p</i>
AH	0.084	0.564	-0.021	0.886	0.191	0.174	-0.096	0.522	0.013	0.929
RH	0.221	0.057	0.007	0.955	0.246	0.029	0.140	0.245	-0.024	0.836
SLJ	0.386	0.001	0.104	0.384	0.134	0.263	0.190	0.136	0.103	0.401
Agility	0.215	0.028	0.037	0.708	0.037	0.702	0.133	0.189	-0.104	0.293
CRF	0.372	<0.001	0.021	0.854	0.349	<0.001	0.244	0.031	0.121	0.273

AH: average handgrip. CRF: cardiorespiratory fitness. RH: relative handgrip. SLJ: standing long jump.

Table 4 shows that several physical fitness components were significantly associated with specific dimensions of health-related quality of life. While AH strength showed no significant associations, RH strength was positively related to general health. SLJ, agility, and CRF were significantly associated with physical function. Additionally, CRF was also positively associated with general health and social function. Among all fitness variables, CRF displayed the strongest and most consistent associations, significantly related to physical function ($\beta = 0.372$, $p < 0.001$), general health ($\beta = 0.349$, $p < 0.001$), and social function ($\beta = 0.244$, $p = 0.031$). This highlights CRF as the central determinant of HRQoL in this sample.

Discussion

The findings of this study reveal a significant association between physical fitness, body composition, and HRQoL in physically inactive university students. Specifically, higher levels of CRF, SLJ, and agility were positively associated with physical function and general health, while elevated BMI and WHR were inversely associated with HRQoL scores. These results underscore the critical role of physical fitness and body composition in determining perceived well-being among young adults with sedentary lifestyles.



The COVID-19 pandemic created unprecedented disruptions to physical activity routines. Social restrictions and confinement measures contributed to a global decline in physical fitness and HRQoL (Pinho et al., 2020; Carlile et al., 2024). Although some recovery was noted by late 2020, physical activity levels remained approximately 10% below pre-pandemic baselines, with wide regional variability (Tison et al., 2020; Tison et al., 2022). Importantly, emerging evidence indicates that physically active individuals may have experienced more substantial declines in fitness performance than their inactive peers—possibly due to greater disruption of structured routines (Feng et al., 2023). While our results align with this trajectory, caution is warranted when interpreting this link as causal, since multiple confounding factors, including preexisting fitness levels, mental health, and socio-environmental stressors, influence the association between lockdown-induced inactivity and quality of life.

Our data extend these findings by highlighting the differential associations between specific fitness components and HRQoL domains. While CRF was the strongest and most consistent predictor, significantly associated with physical function, general health, and social function, SLJ and agility were also positively related to physical function—an observation less explored in prior literature. This underscores the pivotal role of CRF in shaping both physical and psychosocial aspects of well-being among inactive university students, aligning with evidence that recognizes it as a central determinant of health outcomes and quality of life (Engberg et al., 2018; Flesaker et al., 2021; Sloan et al., 2009).

The novelty of this study lies in its focus on physically inactive Chilean university students in the post-pandemic period. This population has been scarcely examined despite its structural vulnerability and high prevalence of sedentary behaviors. Moreover, this research considered fitness indicators such as agility and body composition markers such as neck circumference, which have received limited attention in previous studies. By integrating these variables with multidimensional HRQoL assessments, the study provides an innovative perspective that broadens current knowledge and contributes unique evidence for designing targeted health promotion strategies in higher education settings.

From an applied perspective, these findings suggest that university health promotion programs should go beyond a sole focus on anthropometric reduction and prioritize interventions that enhance cardio-respiratory fitness, explosive strength, and agility. Integrating structured physical activity initiatives that address these dimensions can improve both physical and psychosocial aspects of HRQoL in inactive students. Moreover, embedding such interventions within university curricula and aligning them with public health policies could strengthen preventive strategies and foster healthier lifestyles during higher education.

Body composition markers, particularly BMI and WHR, were inversely related to general health, physical function, and social function, corroborating prior research by Muñoz-Strale et al. (2024), Bravo et al. (2021), and Palomino-Devia et al. (2018). Despite their simple calculation, these indices capture adiposity-related burden, which may affect both physical capability and psychosocial well-being. Our findings also revealed a significant inverse relationship between BMI and social functioning, suggesting that higher adiposity may impair participation in social activities or negatively affect perceptions of interpersonal well-being. Along these lines, a recent study by Lalović et al. (2025) showed that BMI is related to psychological health in university students. This association may be influenced by psychological factors, such as body image dissatisfaction and stigma, as well as physical discomfort that limit social engagement. Supporting this, Kolotkin et al. (2001) found that women with overweight or obesity had significantly lower social functioning scores on the SF-36, while Lu et al. (2021) observed that abnormal BMI was linked to poorer social communication skills in school-aged children. These findings highlight the importance of addressing both physical and psychosocial dimensions of health when designing interventions for university populations.

Although our results support a positive association between CRF and HRQoL, Ali et al. (2020) reported an inverse relationship between aerobic capacity and subjective HRQoL. Such divergence may stem from methodological or cultural differences, particularly in distinguishing between occupational and leisure-time physical activity. For instance, a population-based study of older adults found that physically active behavior at work was associated with poorer self-perceived health, whereas leisure-time and transport-related activity were beneficial (Min et al., 2023). In contrast, our study measured structured CRF and leisure-time physical activity with validated instruments, aligning with the majority of evidence supporting a positive CRF-HRQoL relationship.



Further insight is offered by Kotarska et al. (2021), who observed positive associations between physical activity and both physical and psychological dimensions of HRQoL, particularly among students and their families. While our study did not find significant effects on emotional or physical role domains, these differences warrant further exploration. Additionally, Nowak et al. (2019) found that individuals who engaged in even low-intensity physical activity, such as household chores, reported higher levels of HRQoL, whereas prolonged sedentary behavior during weekends was negatively associated with HRQoL. In the context of our sample—composed of physically inactive students, these findings suggest that their HRQoL outcomes may reflect those of sedentary individuals as characterized by Nowak et al. However, it is also possible that the reduced emotional and role functioning scores observed in our participants stem not solely from inactivity, but from other contributing factors such as lower physical fitness. This would suggest an alternative explanatory pathway distinct from that proposed by Nowak et al., in which the quality-of-life deficits are more closely linked to limited physical conditioning rather than sedentary behavior per se.

While our findings emphasize the role of fitness and body composition in HRQoL, it is essential to acknowledge additional confounding variables. Poor dietary quality, inadequate sleep, and academic stress have all been associated with reduced HRQoL in university students (Parsons et al., 2024; Moussa-Chamari et al., 2024; AlHamlan et al., 2025). Although our analysis focused on fitness and anthropometric factors, future research should incorporate these contextual variables to improve interpretability.

In addition to CRF and BMI, our findings highlight the relevance of WHR, SLJ, and agility for HRQoL. WHR, a robust marker of central adiposity, was inversely associated with physical and social functioning, consistent with prior research demonstrating its predictive value for metabolic and cardiovascular risk (Ashwell & Gibson, 2014; Lee et al., 2008). SLJ and agility, reflecting neuromuscular power and motor coordination, also emerged as meaningful predictors. SLJ has been strongly correlated with lower-limb strength and is a reliable proxy for overall fitness in youth and adults (Ramirez-Campillo et al., 2023), while agility has shown predictive value across athletic and non-athletic populations (Thieschäfer & Büsch, 2022; Mackala et al., 2020). Including these measures in future research may provide a more comprehensive understanding of the links between physical function, body composition, and HRQoL.

In summary, the interplay between physical fitness, body composition, and HRQoL suggests a multidimensional influence of these factors on well-being. Our findings emphasize the importance of developing comprehensive strategies within higher education to strengthen protective fitness components and mitigate the long-term consequences of inactivity in the post-pandemic context.

Strengths and Limitations of the Study

A key strength of this study is its comprehensive approach to evaluating physical fitness and body composition in relation to HRQoL, offering a broader perspective on well-being in young adults. Standardized protocols were used for data collection, enhancing the reliability of the findings. Among the limitations, the cross-sectional design precludes causal inferences, and the sample—restricted to students from one region and of modest size ($n = 139$)—may limit generalizability. Larger and more diverse samples and longitudinal designs would allow for greater statistical power and better exploration of subgroup differences.

Conclusions

CRF was the strongest determinant of HRQoL in physically inactive university students, showing consistent associations with physical function, general health, and social function. SLJ and agility were also positively related to physical function, whereas higher BMI and WHR were linked to poorer HRQoL outcomes.

These findings emphasize the need to design and implement university-based strategies that promote active lifestyles and strengthen protective fitness components. By focusing on CRF, explosive strength, and agility, higher education institutions can help improve students' well-being and reduce long-term health risks in the post-pandemic context. Future studies with more diverse samples are warranted to confirm these associations and explore their causal pathways.



Acknowledgements

We would like to thank the MOVED Science Academy for their support throughout the data collection process and each of the academics who participated in the project.

Conflict of interest declaration

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

Author Contributions

JPZ-C contributed to conceptualization, formal analysis, methodology, project administration, supervision, validation, visualization, and the original drafting, review, and editing of the manuscript. AT-C, FN-H, JJA-O, and PS-U contributed to the conceptualization, methodology, data curation, investigation, formal analysis, and writing of the original draft. PO-M, CH-T, and CC-M were involved in writing the original draft and contributing to the manuscript's review and editing. RY-S participated in data curation, methodology, validation, original drafting, review, and editing. JFL-G contributed to the original draft, review, and editing. All authors approved the final version of the manuscript.

Financing

The author(s) declare that financial support was received for this article's research and/or publication. The work is primarily funded by the Centro de Estudios de la Juventud de la Universidad Andres Bello (CEJ-UNAB).

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Authors' and translators' details:

Juan Pablo Zavala Crichton	jzavala@unab.cl	Autor/a
Astrid Titus-Cabrera	astridtitusc@gmail.com	Autor/a
Felipe Navarro-Henríquez	felipenavarro1408@gmail.com	Autor/a
José Joaquín Álvarez-Opazo	jose.alvarez@uandresbello.edu	Autor/a
Rodrigo Yáñez-Sepúlveda	rodrigo.yanez.s@unab.cl	Autor/a
Paula Ortiz-Marholz	paula.ortiz@unab.cl	Autor/a
Claudio Hinojosa-Torres	claudio.hinojosa@unab.cl	Autor/a
Carlos Cristi-Montero	carlos.cristi.montero@gmail.com	Autor/a
Patricio Solís-Urra	patricio.solis.u@gmail.com	Autor/a
José Francisco López-Gil	josefranciscolopezgil@gmail.com	Autor/a