

Physical activity as a predictor of cardiorespiratory fitness in medical students in Lima, Peru

-  **Pedro Juan Cazorla Salinas.** *Doctoral Program in Nutrition and Food. School of Medicine. Faculty of Health Sciences. San Ignacio de Loyola University. Lima, Peru.*
-  **Carlos Eduardo Alvarado Ortiz Ureta†.** *Doctoral Program in Nutrition and Food. San Ignacio de Loyola University. Lima, Peru.*
† Deceased author.
-  **María Mercedes Saravia Bartra.** *School of Medicine. Faculty of Health Sciences. San Ignacio de Loyola University. Lima, Peru.*
-  **Felipe León Ignacio Cconchoy** . *School of Medicine. Faculty of Health Sciences. San Ignacio de Loyola University. Lima, Peru.*
Internal Medicine Service. Alberto Sabogal Sologuren National Hospital. Lima, Peru.
-  **Vicente Aleixandre Benites Zapata.** *Research Unit for the Generation and Synthesis of Health Evidence. Vice- Rectorate for Research. San Ignacio de Loyola University. Lima, Peru.*
-  **Wilver Omero Rodríguez López.** *School of Medicine. Faculty of Health Sciences. San Ignacio de Loyola University. Lima, Peru.*
-  **Patrick Sebastian Cazorla Saravia.** *Department of Sport, Health and Exercise Sciences. College of Health, Medicine and Life Sciences. Brunel University of London. Uxbridge, United Kingdom.*

ABSTRACT

Background: Cardiorespiratory fitness (CRF) is a key indicator of cardiovascular health, particularly in young populations such as medical students, who face high academic stress and sedentary lifestyles. This study aimed to evaluate the association between physical activity (PA) and CRF among medical students in Lima, Peru. **Methods:** A cross-sectional study was conducted with 92 medical students (57 women and 35 men). PA was assessed using the International Physical Activity Questionnaire, and CRF was measured using the Bruce protocol. Logistic regression analyses (crude and adjusted) were performed to assess the association between PA and CRF, adjusting for sex, age group, and body mass index (BMI). **Results:** A total of 78.3% of participants exhibited reduced CRF. Low and moderate PA levels were observed in 33.7% and 39.1% of students, respectively. Low PA was significantly associated with reduced CRF in both crude (OR = 12.69; 95% CI: 2.19–73.42; $p = .005$) and adjusted analyses (aOR = 9.66 (95% CI: 1.70–54.91; $p = .011$)). Moderate PA was also associated with reduced CRF in the adjusted model (aOR = 2.77 (95% CI: 0.77–9.95; $p = .118$)). Female sex was associated with a higher likelihood of reduced CRF in the adjusted model (aOR = 6.06 (95% CI: 1.81–20.33; $p = .004$)). **Conclusions:** Physical activity is associated with cardiorespiratory fitness in medical students, although the cross-sectional design and wide confidence intervals preclude strong causal interpretation.

Keywords: sport medicine; exercise; physical fitness; exercise test; sedentary behaviour; young adult.

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 **Corresponding author.** *School of Medicine. Faculty of Health Sciences. San Ignacio de Loyola University. Lima, Peru.*

E-mail: ignaciocc1105@gmail.com

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INTRODUCTION

Cardiorespiratory fitness (CRF) is a key indicator of cardiovascular health, defined as the body's capacity to transport and utilize oxygen during sustained exercise. It is a stronger predictor of mortality than traditional risk factors such as smoking, hypertension, and diabetes mellitus (Myers et al., 2002; Kaminsky et al., 2013), leading the American Heart Association to propose CRF as a clinical vital sign (Ross et al., 2016).

Over the past six decades, CRF has declined globally (Tomkinson et al., 2019), with only 40% of young Americans achieving healthy levels (Raghuveer et al., 2020). Low CRF is associated with a two- to three-fold higher risk of premature cardiovascular death (Franklin & Jae, 2024), and each 1-MET increase in CRF reduces all-cause mortality by approximately 13% (Kodama et al., 2009). In young populations, CRF is also linked to cardiometabolic health, academic performance, and mental well-being (Lubans et al., 2016).

Medical students are particularly vulnerable to adopting sedentary and unhealthy lifestyles during their training, with increased academic stress, poor dietary habits, and reduced physical activity (PA) (Fan et al., 2020; Bhatti et al., 2020). These factors contribute to a decline in CRF, which is concerning given that both low PA and reduced CRF are associated with higher cardiovascular morbidity and mortality (DeFina et al., 2015; Lee et al., 2012). In Latin America, the prevalence of low CRF is growing, especially among adolescents (Prieto-Benavides et al., 2019), yet evidence on the PA–CRF relationship in medical students from this region remains scarce. No previous study has examined this association in Peru.

Promoting sustained healthy behaviours during medical training may help reduce future cardiovascular and cerebrovascular risk, particularly in contexts where sedentary habits begin early and persist into adulthood (Zyriax & Windler, 2023).

This cross-sectional study aimed to evaluate whether PA levels are associated with CRF in medical students at a university in Lima, Peru, after adjusting for sex, age group, and body mass index.

METHODS

Participants

An observational cross-sectional study was conducted between July and September 2023. A total of 92 second and third year medical students from the Faculty of Health Sciences at San Ignacio de Loyola University, Lima, Peru (mean age: 19.31 ± 3.04 years; 62% female), were recruited through convenience sampling and voluntarily participated. All second- and third-year medical students enrolled at the institution during the study period were invited to participate, and those who met the eligibility criteria and agreed to participate were included in the final sample. For descriptive and adjustment purposes, age was additionally categorized into two groups (16–19 and ≥ 20 years).

Prior to the start of the study, participants were informed about the objectives of the research and invited to participate voluntarily by signing an informed consent form. Inclusion criteria were: second and third year medical students of both sexes, aged 16 and 35 years, without documented medical conditions that would contraindicate an exercise stress test.

Participants with pre-existing medical conditions or any disability that would prevent maximal effort, as well as those who did not complete the questionnaire, the cardiorespiratory fitness test, or the exercise data records, were excluded. Anonymity was ensured, and participation had no influence on academic performance.

Measurements

Physical activity (PA)

Physical activity (PA) was assessed using the short version of the International Physical Activity Questionnaire (IPAQ) (Mantilla Toloza & Gómez-Conesa, 2007), administered virtually via Google Forms. This instrument consists of seven questions that evaluate the frequency, duration, and intensity of activities performed over the past seven days, including walking time and sedentary time. PA was classified into low, moderate, and high levels. The IPAQ short form has demonstrated moderate-to-good test-retest reliability, with Spearman's ρ values clustering around .8 across countries, and acceptable criterion validity against accelerometry, with median correlations of approximately $\rho \approx .30$ (Craig et al., 2003).

Body mass index (BMI)

Weight (kg) and height (meters) were measured using a scale and a stadiometer by trained personnel at an authorized clinic. Measurements were taken twice, and if differences exceeded 5%, a third measurement was conducted. The average of the two closest measurements was used.

The BMI was calculated using the formula $\text{weight (kg)} / \text{height (m)}^2$ and classified according to World Health Organization (WHO) criteria as normal weight (18.5–24.9 kg/m²), overweight (25–29.9 kg/m²), and obesity (≥ 30 kg/m²) (World Health Organization, 2000). For analysis, elevated BMI was defined as overweight or obesity.

Cardiorespiratory Fitness (CRF)

CRF was assessed using the Bruce treadmill protocol, which consists of three-minute stages with progressive increases in speed and incline. The test started at 2.7 km/h with a 10% incline and continued until one of the predefined termination criteria was met.

Maximum speed achieved, total distance covered, and total test duration were recorded. To estimate maximal oxygen uptake ($\text{VO}_{2\text{max}}$), we used the equations derived by Foster et al. (1984) and Pollock et al. (1982) for the Bruce treadmill protocol:

- For men: $\text{VO}_{2\text{max}} \text{ (mL/kg/min)} = 14.76 - (1.379 \times T) + (0.451 \times T^2) - (0.012 \times T^3)$
- For women: $\text{VO}_{2\text{max}} \text{ (mL/kg/min)} = 4.38 \times T - 3.9$

where T is the total test time in minutes.

All participants were encouraged to exert maximal effort. Test termination criteria included: (a) reaching $\geq 85\%$ of age-predicted maximum heart rate ($220 - \text{age}$), (b) a rating of perceived exertion (RPE) ≥ 17 on the Borg 6–20 scale, or (c) voluntary exhaustion. No adverse events occurred.

Functional capacity was evaluated based on metabolic equivalents (METs). For descriptive purposes, we categorized fitness as <5 METs (poor), 5–8 METs (average), 9–11 METs (good), and ≥ 12 METs (excellent), using commonly reported Bruce protocol norms.

For the purposes of this study, reduced cardiorespiratory fitness was operationally defined as achieving <8 METs on the Bruce treadmill protocol. This pragmatic threshold was informed by the exercise-capacity strata reported by Myers et al. (2002), who demonstrated progressively higher mortality risk at lower exercise capacities (<5 and 5–8 METs) compared with individuals achieving >8 METs. Importantly, <8 METs was not established by Myers et al. as a diagnostic threshold for reduced CRF but was adopted in the present study as an operational cutoff. This approach is broadly consistent with evidence summarized by the American

Heart Association identifying low CRF as an important clinical risk marker (Ross et al., 2016). However, <8 METs is not an established age- or sex-specific diagnostic threshold, and the source evidence was derived from older, clinically referred populations rather than healthy young adults. Given the young and presumably healthy profile of medical students in the present sample, this fixed cutoff should therefore be interpreted as a pragmatic operational definition rather than a validated normative criterion for this age group.

Procedures

Data collection was conducted in a controlled clinical setting under the supervision of a medical professional, with an automated external defibrillator (AED) available on site. To minimize measurement bias, all anthropometric measurements and treadmill assessments were performed by trained personnel using standardized equipment and protocols, and the same IPAQ questionnaire and Bruce protocol procedures were applied uniformly to all participants.

The evaluation process was carried out in a single session per participant. Initially, participants completed the IPAQ questionnaire virtually through the Google Forms platform. Subsequently, anthropometric measurements, including weight and height, were obtained following the procedures previously described. Finally, participants performed the treadmill exercise test using the Bruce protocol, as described in the measures section.

The study was approved by the Research Ethics Committee of San Ignacio de Loyola University (code: 2021004) and was conducted in accordance with the principles of the Declaration of Helsinki. Confidentiality and anonymity of the participants were ensured throughout the entire process.

Statistical analysis

Means and standard deviations were calculated for continuous variables, while frequencies and percentages were used for categorical variables.

Sample size was calculated based on the events per variable (EPV > 10) criterion. Considering an expected prevalence of reduced CRF greater than 80% and four predictor variables, a minimum of 50 participants was required. Ultimately, 92 participants were included to ensure adequate statistical power.

To assess the association between PA and CRF, binary logistic regression was applied. Additionally, multivariable logistic regression was performed adjusting for sex, age group, and BMI. Odds ratios (ORs) with 95% confidence intervals were calculated, and a p -value < .05 was considered statistically significant.

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS), version 25 for Windows.

This study is reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies (von Elm et al., 2007). The completed STROBE checklist is provided as Supplementary Table 1 (Appendix 1).

RESULTS

Participant characteristics

A total of 92 medical students participated in the study; 57 (62%) were female and 35 (38%) were male, with a mean age of 19.31 ± 3.04 years. Among all participants, 31 (33.7%) had low levels of physical activity (PA),

36 (39.1%) had moderate PA, 25 (27.2%) had high PA, 72 (78.3%) presented reduced cardiorespiratory fitness (CRF), and 33 (35.9%) had elevated body mass index (BMI) (Table 1). No missing data were recorded for any of the variables of interest, as participants with incomplete questionnaires or exercise test data were excluded prior to analysis (see Participants section). In terms of fitness categories, 20 students (21.7%) achieved <5 METs, 58 (63.0%) achieved 5–8 METs, 8 (8.7%) achieved 9–11 METs, and 6 (6.5%) achieved ≥12 METs.

Table 1. Participant characteristics.

Variable	N = 92	%
Age (years)	19.31 (± 3.04)	
Sex		
Female	57	62.0
Male	35	38.0
Age Group		
≥20 years	29	31.5
16–19 years	63	68.5
BMI (kg/m²)		
Elevated	33	35.9
Normal	59	64.1
Physical activity		
Low	31	33.7
Moderate	36	39.1
High	25	27.2
Cardiorespiratory fitness		
Reduced	72	78.3
Normal	20	21.7

Note. Values for age are presented as mean $\pm$ standard deviation. BMI = Body Mass Index.

Table 2. Bivariate analysis of physical activity, sex, age group, BMI and cardiorespiratory fitness.

Variable	Reduced CRF n = 72	Normal CRF n = 20	Total n = 92	Crude OR	95% CI	p
Physical activity						
Low	29 (93.5%)	2 (6.5%)	31	9.67	1.87–49.89	.007
Moderate	28 (77.8%)	8 (22.2%)	36	2.33	0.76–7.16	.139
High	15 (60.0%)	10 (40.0%)	25	Reference		
Sex						
Female	51 (89.5%)	6 (10.5%)	57	5.67	1.92–16.74	.002
Male	21 (60.0%)	14 (40.0%)	35	Reference		
Age group						
≥20 years	24 (82.8%)	5 (17.2%)	29	1.50	0.49–4.62	.480
16–19 years	48 (76.2%)	15 (23.8%)	63	Reference		
BMI (kg/m²)						
Elevated	27 (81.8%)	6 (18.2%)	33	1.40	0.48–4.08	.537
Normal	45 (76.3%)	14 (23.7%)	59	Reference		

Note. CRF: Cardiorespiratory Fitness. BMI: Body Mass Index. OR = Odds Ratio. CI = 95% Confidence Interval.

Table 3. Multivariable logistic regression for the association between physical activity and cardiorespiratory fitness, adjusted for sex, age group, and body mass index.

Variable	Reduced CRF	Normal CRF	Total	Adjusted OR	95% CI	p
Physical activity						
Low	29 (93.5%)	2 (6.5%)	31	9.66	1.70–54.91	.011
Moderate	28 (77.8%)	8 (22.2%)	36	2.77	0.77–9.95	.118
High	15 (60.0%)	10 (40.0%)	25	Reference		
Sex						
Female	51 (89.5%)	6 (10.5%)	57	6.06	1.81–20.33	.004
Male	21 (60.0%)	14 (40.0%)	35	Reference		
Age group						
≥20 years	24 (82.8%)	5 (17.2%)	29	1.82	0.51–6.44	.353
16–19 years	48 (76.2%)	15 (23.8%)	63	Reference		
BMI (kg/m²)						
Elevated	27 (81.8%)	6 (18.2%)	33	2.08	0.55–7.81	.278
Normal	45 (76.3%)	14 (23.7%)	59	Reference		

Note. CRF: Cardiorespiratory Fitness. BMI: Body Mass Index. OR = Odds Ratio. CI = 95% Confidence Interval.

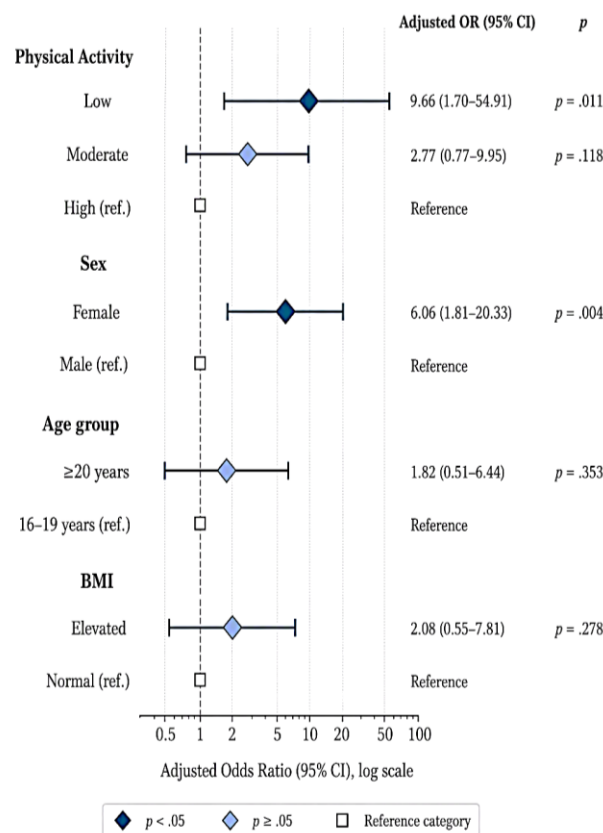


Figure 1. Adjusted odds ratios for reduced cardiorespiratory fitness (multivariable logistic regression, n = 92).

Bivariate and multivariable analysis of physical activity, sex, age group, body mass index, and cardiorespiratory fitness

Bivariate analysis showed that low levels of physical activity, as well as female sex, were significantly associated with a higher likelihood of reduced cardiorespiratory fitness (CRF) (Table 2). Moderate PA was

not significantly associated with reduced CRF in either the crude or adjusted models. The association for low PA remained significant after multivariable adjustment (Table 3), although the wide confidence interval indicates limited precision. No significant associations were found for body mass index (BMI) or age group. Adjusted odds ratios with 95% confidence intervals are summarized graphically in Figure 1.

DISCUSSION

The main finding of this cross-sectional study is a statistically significant association between low self-reported PA and reduced CRF among Peruvian medical students, with an adjusted OR of 9.66 (95% CI: 1.70–54.91). The confidence interval remains wide, reflecting limited precision given the sample size, although substantially narrower than in preliminary analyses following correction of a physical activity classification error identified during data verification. This association should therefore be interpreted with caution. Comparisons with previous studies in other countries (Franklin & Jae, 2024; Tatiús et al., 2024) are limited by differences in design, population, and cardiorespiratory fitness assessment methods, including the use of different protocols and prediction equations. Given the small number of participants in the high-activity category and the high prevalence of reduced CRF, the logistic regression estimates are likely unstable. Therefore, the observed effect size should be interpreted as an exploratory signal rather than a precise quantification of the association.

The observed association is biologically plausible. Regular PA induces well-documented cardiovascular adaptations, including improved endothelial function and increased stroke volume (Nystoriak & Bhatnagar, 2018). Conversely, chronic stress, common in medical training, may activate the hypothalamic-pituitary-adrenal axis and potentially counteract some exercise-induced benefits (Hackney, 2006). However, our cross-sectional design cannot establish whether the association is mediated by these pathways. Recent systematic reviews have confirmed the positive association between physical activity and cardiorespiratory fitness in young populations (Peralta et al., 2020).

The practical implications of these findings are particularly relevant for the design of educational and health policies. The curricular integration of physical activity, the improvement of sports infrastructure, and the implementation of active breaks during academic schedules emerge as priority strategies (Kapoor et al., 2022; Zyriax & Windler, 2023). Likewise, regular monitoring of cardiorespiratory fitness using standardized protocols could serve as an early indicator of cardiovascular risk in this population.

Regarding physical activity levels, 33.7% of students were found to have low PA levels, 39.1% moderate PA levels, and 27.2% high PA levels. This finding is consistent with the World Health Organization's Global Action Plan on Physical Activity 2018–2030, which indicates that approximately one in five adults and four in five adolescents worldwide have insufficient levels of physical activity (WHO, 2018). Previous research has identified multiple barriers to PA among university students, including lack of time, academic stress, and limited access to facilities (Ferreira Silva et al., 2022). Although we did not measure barriers directly, these factors may contribute to the low PA levels observed in our sample.

On the other hand, 78.3% of students presented reduced cardiorespiratory fitness. This finding is consistent with studies conducted in different parts of the world. For instance, a systematic review indicates that, over recent decades, CRF has significantly declined among adolescents globally (Fühner et al., 2021). Various factors that may influence CRF in medical students have been identified. These include widely recognized non-modifiable factors, such as age, sex, and race or ethnicity (Howard et al., 2013), as well as modifiable factors, including physical activity, dietary patterns (Júdice et al., 2017), obesity (Mendelson et al., 2016),

sedentary behavior (Santos et al., 2014), and socioeconomic status (Ombrellaro et al., 2018). In adults, for example, VO_{2max} has been observed to be higher in Caucasians compared to African Americans (Swift et al., 2017). Young individuals with obesity who are less physically active tend to have lower VO_{2max} (mL/kg/min) compared to their normal-weight peers (Pate et al., 2006). These findings suggest that medical students with low levels of physical activity and reduced CRF may have a higher risk of developing cardiometabolic diseases in the future.

In our study, 62% of the evaluated students were female. This distribution reflects a trend observed in our country over recent decades, where a predominance of women in medical careers has been reported. This trend has also been documented globally, with survey analyses by field and country showing a female predominance across all categories (Herreros-Irarrázabal et al., 2024). Our results confirm that female sex is associated with lower CRF, with a 6.06-fold higher likelihood of presenting reduced CRF. This sex difference is well-documented in normative CRF data; for example, sex differences in VO_{2max} of approximately 15–20% persist even when values are normalized for body mass (Ogawa et al., 1992). Our finding of a 6.06-fold higher odds of reduced CRF in women is consistent with these physiological differences. However, because we did not adjust for fat-free mass, we cannot determine whether this association reflects true sex differences in cardiorespiratory capacity or differences in body composition. Residual confounding by unmeasured variables cannot be excluded.

The present study has certain limitations that should be considered when interpreting the results. The assessment of physical activity through self-administered questionnaires, although methodologically valid, introduces potential biases such as social desirability and limitations in recall accuracy. The cross-sectional design does not allow for the establishment of definitive causal relationships between the analyzed variables. Additionally, the use of a sample from a single university limits the generalizability of the findings. The sample is relatively small and drawn from a single private university in Lima; thus, the findings should not be extrapolated directly to all medical students in Peru or other countries, but rather viewed as a context-specific snapshot that requires confirmation in larger, more diverse cohorts. Furthermore, although all eligible students enrolled during the study period were invited to participate, the exact number of students approached and the corresponding response rate were not formally recorded, which precludes a precise assessment of potential non-participation bias. Uncontrolled variables such as sleep patterns and diet, which are known to influence cardiorespiratory capacity, may have affected the results. Finally, the post-pandemic context in which the data were collected may have influenced the physical activity patterns reported by participants.

Another limitation relates to the operational definition of reduced cardiorespiratory fitness (CRF). Although we used a MET-based cutoff (<8 METs) to define reduced CRF—a pragmatic choice informed by the exercise-capacity categories described by Myers et al. (2002) and the AHA's emphasis on CRF as a clinical vital sign (Ross et al., 2016)—we acknowledge that percentile-based norms specific for age and sex (e.g., FRIEND registry; Kaminsky et al., 2015) would provide greater precision. However, the absence of validated percentile tables for Peruvian young adults and the sample size constraints prevented us from applying this approach. We therefore emphasize that our definition of reduced CRF is an operational categorization for this study, not a clinical diagnostic standard.

Additionally, we did not measure several potential confounders, including sleep duration, dietary patterns, stress levels, smoking, alcohol and other substance use, and screen time. These lifestyle factors are known to influence both PA and CRF in young adult populations, and their omission may have resulted in residual confounding.

The use of a self-reported PA questionnaire (IPAQ short version) is susceptible to recall bias and social desirability bias, which typically lead to overestimation of PA levels. This misclassification could have attenuated or inflated the observed associations.

CONCLUSION

In this cross-sectional study of medical students in Lima, Peru, low self-reported physical activity was associated with higher odds of reduced cardiorespiratory fitness. Female sex was also independently associated with markedly higher odds of reduced CRF, a secondary finding that warrants further investigation given its precision relative to the primary exposure. However, the wide confidence intervals and the observational design preclude strong causal inferences and precise effect estimation. Residual confounding by unmeasured lifestyle factors (e.g., sleep, diet, stress) and the use of a self-reported PA questionnaire further limit the findings.

These results highlight the need for prospective studies with objective measurements of both physical activity (e.g., accelerometry) and cardiorespiratory fitness (e.g., direct gas analysis), as well as larger, multicentric samples. Interventions to promote active lifestyles during medical training should be evaluated in randomized controlled trials before widespread implementation.

AUTHOR CONTRIBUTIONS

All authors meet the criteria for authorship in accordance with established ethical guidelines. Contributions are specified according to the CRediT (Contributor Roles Taxonomy) as follows:

Conceptualisation: Pedro Juan Cazorla Salinas, Carlos Eduardo Alvarado Ortiz Ureta. Methodology: Felipe León Ignacio Cconchoy, Patrick Sebastian Cazorla Saravia, Vicente Aleixandre Benites Zapata, Wilver Omero Rodriguez López. Formal analysis: Felipe León Ignacio Cconchoy, Patrick Sebastian Cazorla Saravia, Vicente Aleixandre Benites Zapata, Wilver Omero Rodriguez López. Investigation: Pedro Juan Cazorla Salinas, María Mercedes Saravia Bartra. Data curation: Felipe León Ignacio Cconchoy, Patrick Sebastian Cazorla Saravia. Writing – original draft: Felipe León Ignacio Cconchoy, Pedro Juan Cazorla Salinas, María Mercedes Saravia Bartra, Carlos Eduardo Alvarado Ortiz Ureta. Writing – review & editing: Felipe León Ignacio Cconchoy, Pedro Juan Cazorla Salinas, María Mercedes Saravia Bartra, Vicente Aleixandre Benites Zapata. Supervision: Pedro Juan Cazorla Salinas, María Mercedes Saravia Bartra.

All authors have critically reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

AI USE DISCLOSURE

In accordance with current publishing ethics and transparency recommendations, artificial intelligence (AI) tools were used solely to assist with translation and language editing, with the aim of improving clarity and readability. No AI tools were used in the generation of scientific content, including the study design, data collection, analysis, interpretation of results, or the formulation of conclusions. The authors retain full responsibility for the content of the manuscript and confirm its originality, integrity, and accuracy.

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APPENDIX 1

Supplementary Table 1. STROBE Statement—Checklist of items that should be included in reports of cross-sectional studies.

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	2
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	2
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	3-4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	3-4
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	2-4
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	5-6
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	2
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	2 (partial — see limitation, p.9)
		(b) Give reasons for non-participation at each stage	9-10
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	6
Outcome data	15*	Report numbers of outcome events or summary measures	6
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	6-7
		(b) Report category boundaries when continuous variables were categorized	3-4
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	7
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9–10
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	7–10
Generalisability	21	Discuss the generalisability (external validity) of the study results	9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	11



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