Physical activity practice and negative self-rated health among university students during COVID-19

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Graphical Abstract

Highlights

• NSRH was higher among female university students during the pandemic.
• In both sexes, increased MSPA was associated with lower odds of NSRH.
• Maintaining MSPA levels reduced the odds of NSRH among men.
• MSPA showed a protective effect on perceived health during the pandemic.
• Promoting MSPA is an important strategy for protecting university students' health.

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Objective
To determine the prevalence of negative self-rated health (NSRH) among students and to analyze its association with the practice of moderate-intensity aerobic physical activity (MPA) and muscle-strengthening physical activity (MSPA) during the pandemic.

Methodology
- Cross-sectional study
- n= 1150, both sexes
- Self-rated health question
- Physical activity practice: PERMEV
- Binary logistic regression
- Odds Ratio
- Significance level: 5%

Results
- Overall prevalence of NSRH: 38.6%
- NSRH higher among women (42%)
- Increased MSPA was associated with lower odds of NSRH in both sexes
- Among men, maintaining MSPA was also associated with lower odds of NSRH.

Conclusions
There was a significant relationship between MSPA and NSRH in both sexes during a pandemic.
Increasing and maintaining MSPA may reduce the negative impacts on health perception during prolonged crisis periods, such as a pandemic.

Abstract

During the pandemic, significant changes in university students' routines affected their lifestyle and health. This study aimed to determine the prevalence of negative self-rated health (NSRH) among university students and to analyze its association with moderate-intensity aerobic physical activity (MPA) and muscle-strengthening physical activity (MSPA) during the pandemic. A cross-sectional study was conducted with 1,150 students from Estácio de Sá University, Rio de Janeiro, with a mean age of 31.43 years (SD: 11.07), of whom 63.8% were women. Self-rated health was assessed through a single question, with "fair," "poor," and "very poor" considered negative responses. MPA and MSPA practices were assessed using the PERMEV instrument between August 2021 and April 2022. Descriptive analyses and binary logistic regression were performed to estimate associations, with calculation of Odds Ratios (OR) and 95% confidence intervals (95% CI), in both crude and adjusted analyses. The significance level adopted was 5%. The prevalence of NSRH was 38.6%, higher among women (42%) than men (32.5%). Increased MSPA was associated with lower odds of NSRH in both sexes, while maintaining MSPA showed an additional protective effect among men. There was a significant relationship between MSPA and NSRH in both sexes during the pandemic, suggesting that MSPA may reduce negative impacts on health perception during prolonged crisis periods, highlighting the importance of strategies to encourage this type of exercise in situations of physical and social distancing.

Keywords: General Health Status. Aerobic Training. Strength Training. University Student. COVID-19.

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INTRODUCTION

Over the years, the concept of health has been interpreted through various theoretical models that seek to understand the determinants of health promotion[1]. Among the tools available to assess health across different populations, self-rated health (SRH) stands out for its simplicity and applicability[2,3], and is widely used in epidemiological research as a predictor of morbidity and mortality[3].

Negative self-rated health (NSRH) is associated with sociodemographic and behavioral factors, as well as with the presence of noncommunicable chronic diseases (NCDs)[4,5,6,7]. Studies conducted in Brazil indicate a higher prevalence of NSRH among women[4,5,6,7], older individuals[4,5], those with lower educational levels[4,5] and those with less healthy lifestyles[4,5,6,7]. The practice of physical activity, both aerobic and muscle-strengthening, has been identified as a protective factor, promoting overall well-being, preventing diseases[8], and contributing to a more positive health evaluation[9,10,11].

With the COVID-19 pandemic, social distancing and the closure of spaces designated for physical activity significantly changed lifestyle habits, particularly among university students[12,13,14]. In addition to being affected by routine changes, such as remote learning, this group also faced increased challenges related to mental health[15] and the rise in sedentary behavior[16,17,18], which may have contributed to a more negative perception of health status.

Given the central role of the university population in the future workforce and the relevance of identifying health-related factors within this group, the present study aimed to: a) determine the prevalence of negative self-rated health (NSRH) among male and female university students; and b) analyze the association between NSRH and the practice of moderate-intensity aerobic physical activity (MPA) and muscle-strengthening physical activity (MSPA) during the pandemic period among students at a private higher education institution in Brazil.

METHODOLOGY

This was a cross-sectional study involving university students from Estácio de Sá University (UNESA), in Rio de Janeiro. Data were collected during a period of remote learning due to the pandemic, between August 2021 and April 2022, using an electronic questionnaire that ensured participant confidentiality. The study protocol was approved by the Research Ethics Committee for Human Beings at Estácio de Sá University under approval number 4.844.578.

The target population consisted of undergraduate students aged 18 or older, actively enrolled in in-person programs at UNESA during the second academic semester of 2021 and the first semester of 2022. According to data from May 2021, this population comprised a total of 110,023 students (N = 110,023).

The sample size was calculated using the finite population formula[19], considering the reference population, a 95% confidence level, a 3-percentage-point sampling error margin, and an expected prevalence of 50%, with an additional 20% to account for possible losses. This resulted in an estimated sample size of 1,057 university students.

The final sample comprised 1,150 students who completed the electronic questionnaire hosted on the Google platform. Participants were invited to take part by UNESA undergraduate program coordinators via a messaging application (WhatsApp) and/or email.

Data collection included a general survey with sociodemographic questions, questions regarding institutional affiliation, self-rated health (SRH), and the questionnaire "Perception of lifestyle changes during social distancing" (PERMEV)[20], which has demonstrated high internal consistency and consists of thirty-four questions on lifestyle in its modified version, based on factorial structure validity[21].

In this study, the dependent variable was SRH, measured through the question: "In general, how do you rate your health status?". The main category of investigation was negative self-rated health (NSRH), defined as the sum of the responses "fair", "poor", and, "very poor", following the classification adopted in previous studies involving university students[22]. These response options are also understood to reflect a greater likelihood of dissatisfaction with physical and/or mental functioning, indicating perceptions of health below ideal levels and potentially predicting health risks.

The independent variables were moderate-intensity aerobic physical activity (MPA) and muscle-strengthening physical activity (MSPA), assessed using the following questions from the PERMEV questionnaire: *"Compared to the period before the pandemic, in the past seven days have you engaged during your free time in moderate physical activities such as walking, running, cycling, dancing, or something similar that makes you breathe a bit harder than usual, at a frequency of…"*; and *"Compared to the period before the pandemic, in the past seven days have you performed physical activities involving muscular strength (using your own*

body weight or weights, dumbbells, resistance bands, or household items such as plastic bottles or bags of food), at a frequency of..."; with the following response options: much less than before, less than before, same as before, more than before, much more than before, and do not practice. For statistical analysis purposes, these responses were categorized as: does not practice; same as before; increase (more and much more); and reduction (less and much less).

The control variables in the adjusted analyses were: place of residence (capital or countryside), academic field (health-related or other areas), class schedule (daytime or evening), and number of courses enrolled (up to 3 or 4 or more); along with the following variables obtained from the PERMEV questionnaire, categorized similarly to the independent variables in this study: stress management (reduction, increase, maintenance, and I do not feel stressed), sedentary behavior (reduction, increase, maintenance, and I do not usually use a notebook/computer), and preventive behavior (reduction, increase, maintenance, and I do not monitor my blood pressure).

Statistical analysis was performed using SPSS software version 23, employing descriptive analyses of absolute and relative frequencies, mean, and standard deviation. To estimate the association between the dependent variable and the independent variables, Odds Ratios (OR) were calculated for both crude and adjusted analyses, along with 95% confidence intervals (95% CI), using binary logistic regression. The adjusted analysis included all control variables and independent variables simultaneously. All analyses were conducted separately for male and female participants. The significance level adopted was 5%.

RESULTS

The mean age of male participants was 29.52 years (± 10.17), while for female participants, the mean age was 31.43 years (± 11.07). There was a higher proportion of female university students (63.8%), with 61.5% aged 25 years or older. Most students attended evening classes, representing 65.5% of men and 66.8% of women. Regarding the number of courses enrolled, 83.9% of men and 84.7% of women were taking four or more. As for place of residence, 86.1% of men and 83.5% of women lived in the state capital. Among male students, 61% were enrolled in Health-related programs, whereas among female students, the majority (52.5%) were pursuing degrees in other academic fields.

All detailed information on the control variables is presented in Table 1, which shows the frequency of responses disaggregated by sex. Concerning the dependent variable, 38.6% of university students self-rated their health as negative, with a higher prevalence among females (42% of women and 32.5% of men), as shown in Figure 1.

Table 1 - Relative frequency of control variables among students from a private institution in Brazil, 2021–2022.

Control Variables	Male (n=416)	Female (n=734)
Place of residence		
Capital	86.1%	83.5%
Countryside	13.9%	16.5%
Academic field		
Health-related	61%	47.5%
Other fields	39%	52.5%
Class schedule		
Daytime	34.5%	33.2%
Evening	65.5%	66.8%
Number of courses enrolled		
Up to 3	16.1%	15.3%
4 or more	83.9%	84.7%
Stress management		
Reduction	11.7%	14.8%
Increase	31.8%	42.3%
Maintenance	36.9%	23.8%
I do not feel stressed	19.7%	19.1%

to be continued...

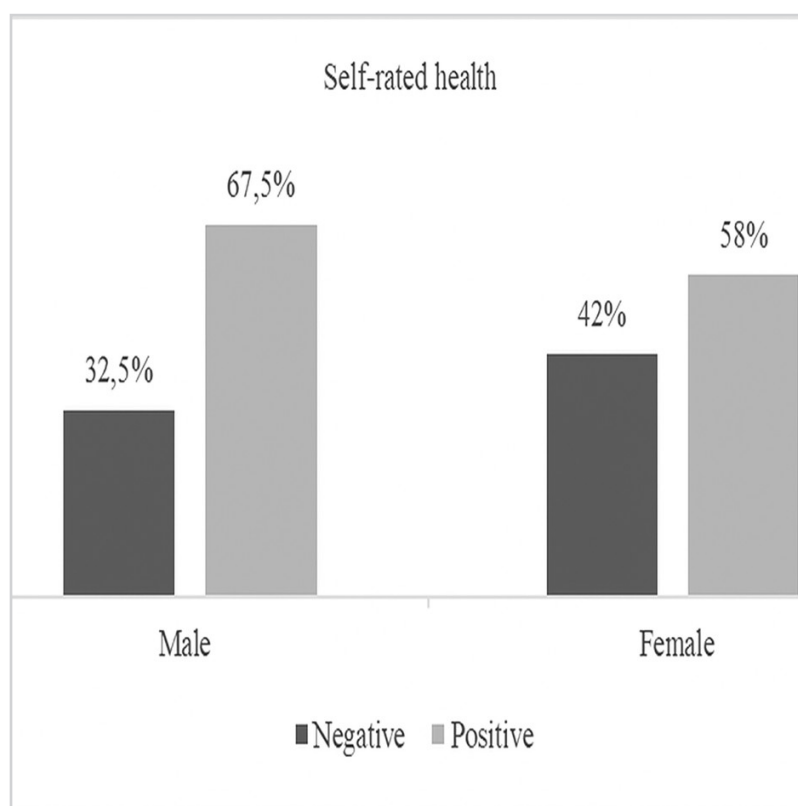| Control Variables	Male (n=416)	Female (n=734)
Sedentary behavior		
Reduction	12.4%	10.1%
Increase	54.1%	68.1%
Maintenance	29.6%	18.7%
I do not usually use a phone/tablet	3.9%	3.1%
Preventive behavior		
Reduction	10.8%	9.7%
Increase	13.3%	14.1%
Maintenance	42.7%	29.6%
I do not monitor my blood pressure	33.3%	46.6%

Figure 1 - Relative frequency of self-rated health among university students.

The results of the crude and adjusted analyses between MSPA and MPA and NSRH for female participants are detailed in Table 2. Among women, the crude analysis showed higher odds of NSRH among students who reduced their MPA (OR = 1.74; 95% CI: 1.03–2.94) and lower odds among those who increased it (OR = 0.44; 95% CI: 0.26–0.74). However, after adjustment, no significant associations were found between MPA and NSRH.

Regarding muscle-strengthening physical activity (MSPA), the crude analysis indicated that students who increased or maintained this behavior had lower odds of rating their health as negative (OR = 0.38; 95% CI: 0.25–0.57 and OR = 0.55; 95% CI: 0.36–0.85, respectively). In the adjusted analysis, women who increased MSPA continued to show lower odds (OR = 0.45; 95% CI: 0.25–0.80) of NSRH.

Table 2 - Crude and adjusted analyses between MSPA and MPA and NSRH among female university students from a private institution in Brazil, 2021-2022.

Variable	n	%	Crude Analysis	p	Adjusted Analysis**	p
			OR (95% CI)		OR (95% CI)	
MPA						
Does not practice	83	11.3	1		1	
Reduction	192	26.2	1.74 (1.03-2.94)*	0.04	1.92 (0.97-3.82)	0.06
Increase	253	34.6	0.44 (0.26-0.74)*	0.01	0.80 (0.40-1.60)	0.53
Maintenance	204	27.9	0.68 (0.40-1.14)	0.15	1.12 (0.57-2.21)	0.73
MSPA						
Does not practice	178	24.3	1		1	
Reduction	170	23.2	1.48 (0.97-2.26)	0.07	0.81 (0.46-1.43)	0.47
Increase	218	29.7	0.38 (0.25-0.57)*	0.01	0.45 (0.25-0.80)*	0.01
Maintenance	168	22.9	0.55 (0.36-0.85)*	0.01	0.57 (0.32-1.01)	0.05

a) *Association with p-value < 0.05.
b) **Results adjusted for control variables: place of residence, academic field, class schedule, number of courses enrolled, stress management, sedentary behavior, and preventive behavior. The adjusted analysis simultaneously considered both independent variables.

The results of the crude and adjusted analyses between MSPA and MPA and NSRH for male participants are detailed in Table 3. In the crude analysis, lower odds of NSRH were observed among university students who increased (OR = 0.28; 95% CI: 0.11–0.71) or maintained (OR = 0.35; 95% CI: 0.14–0.89) MPA. However, in the adjusted analysis, no significant associations were identified between MPA and NSRH.

Regarding MSPA, both the crude and adjusted analyses showed lower odds of NSRH among university students who increased or maintained this behavior. In the crude analysis, increased MSPA resulted in an OR of 0.32 (95% CI: 0.16–0.64) and maintenance in an OR of 0.30 (95% CI: 0.15–0.60). After adjustment, increased MSPA showed an OR of 0.36 (95% CI: 0.13–0.96) and maintenance showed an OR of 0.36 (95% CI: 0.14–0.92).

Table 3 - Crude and adjusted analyses between MSPA and MPA and NSRH among male university students from a private institution in Brazil, 2021–2022.

Variable	n	%	Crude Analysis	p	Adjusted Analysis**	p
			OR (95% CI)		OR (95% CI)	
MPA						
Does not practice	21	5.1	1		1	
Reduction	102	24.6	0.87 (0.34-2.24)	0.78	1.03 (0.29-3.66)	0.96
Increase	154	37.2	0.28 (0.11-0.71)*	0.01	0.70 (0.19-2.64)	0.60
Maintenance	137	33.1	0.35 (0.14-0.89)*	0.03	0.83 (0.23-3.01)	0.78
MSPA						
Does not practice	48	11.6	1		1	
Reduction	87	21	1.47 (0.72-2.98)	0.29	0.95 (0.38-2.42)	0.92
Increase	133	32	0.32 (0.16-0.64)*	0.00	0.36 (0.13-0.96)*	0.04
Maintenance	147	35.4	0.30 (0.15-0.60)*	0.00	0.36 (0.14-0.92)*	0.03

a) *Association with p-value < 0.05.
b) **Results adjusted for control variables: place of residence. academic field. class schedule. number of courses enrolled. stress management. sedentary behavior. and preventive behavior. The adjusted analysis simultaneously considered both independent variables.

DISCUSSION

In this study, 38.6% of university students self-rated their health as negative. This result is lower than those reported in the study conducted by Ferreira et al.[23], in which 47.3% of students rated their health negatively, and in the research by Li et al.[24], which reported a 71% prevalence of NSRH. The findings of the present study are higher than those identified by Sousa[25], who reported a 14.3% prevalence of NSRH among Physical Education students. It is possible that both the familiarity with physical activity inherent to that academic field and the inclusion of subjects related to health literacy may explain the significantly lower percentages compared to those found in the present study and the studies by Ferreira et al. and Li et al.[23,24].

A higher percentage of NSRH was recorded among female students (42%), while 32.5% of male participants self-rated their health as negative. The higher prevalence of NSRH among women has also been reported in other studies conducted with the adult and elderly population in Brazil[4,5,6] as well as among university students[7,22,23,25]. The prevalence of NSRH among female students in the present study is lower than that reported by Ferreira et al.[23], in which 51.7% of female students from a higher education institution in the state of Minas Gerais (Brazil) self-rated their health negatively, and higher than that reported among female students in the state of Santa Catarina (Brazil), which was 36.4%[7].

A recent analysis of gender differences in SRH showed that women consider a broad range of factors in their self-assessment, including not only physical function but also mental health, life satisfaction, socioeconomic status, and interpersonal relationships[26]. Furthermore, it is possible that, for many female university students, the demands of academic performance are compounded by household responsibilities, child care, and work obligations, con-

tributing to increased stress and, consequently, a tendency to rate their health more negatively.

This study identified an association between MPA and MSPA and university students' self-rated health, finding that increased muscle-strengthening activity during the pandemic was associated with lower odds of NSRH. Among male students, this was also observed in those who maintained their MSPA levels.

Both aerobic and strength training have been recognized as health-promoting factors for the general population[8], as they are associated with reduced morbidity and mortality rates, increased well-being, and improvements in physical and mental functioning[27]. Engaging in these forms of physical activity can enhance body composition, mobility, cognitive function, and metabolic health. Additionally, strength training is linked to increased muscular strength and may help minimize the loss of muscle mass typically observed with aging[28].

Physical exercise, especially aerobic exercise, is credited with important benefits for the sense of well-being, as it stimulates the release of endorphins in the brain. Endorphins act as natural painkillers and promote a sensation of euphoria and well-being. Physical activity is also associated with increased production of serotonin, a neurotransmitter that regulates mood, sleep, and appetite. Low serotonin levels are linked to depression and anxiety, and increased serotonin production can help alleviate these symptoms. Furthermore, physical activity stimulates the dopaminergic system in the brain, contributing to feelings of pleasure and reward[29].

It is speculated that the lower odds of negative self-rated health found in this study among students of both sexes who increased their MSPA levels, and also among men who maintained their pre-pandemic levels, may be related to gains in muscular strength and improved body composition, leading to greater self-confidence[30], particularly given the significant changes in routine caused by university closures and the shift to remote learning during the pandemic.

Increased muscular strength improves physical function, making it easier to perform daily life activities[28]. It is assumed that, upon realizing their enhanced capacity for routine movements, strength training practitioners experience increased self-confidence and well-being, which may contribute to lower odds of NSRH.

Additionally, it is possible that participants in this study regard MSPA as essential for achieving aesthetic goals related to improved body composition and, consequently, satisfaction with their body im-age. Among university students, significant relationships have been found between body composition and mental health[31,32,33], as well as between body composition and NSRH[23,33,34], highlighting the importance of body image for this population group.

It is possible that, despite restrictive measures such as the closure of spaces dedicated to MSPA, such as gyms and clubs, at the onset of the pandemic, and the implementation of protocols in those facilities (mask use, minimum distancing between users, mandatory equipment sanitization, and limited occupancy per time slot), which may have discouraged continued practice in formal settings, it was still feasible to maintain or even increase MSPA levels by following recommendations for at-home physical exercise[35]. MSPA can be performed in domestic environments using body weight or small implements such as dumbbells and household product containers to provide muscular overload. This may have been a strategy adopted by participants in the present study to maintain muscular strength, body composition, and enhanced well-being.

This study has some limitations. The use of a convenience sample may introduce bias in representing the broader university student population. Additionally, the online administration of the questionnaire may have restricted participation, as access to the necessary technologies, such as computers and messaging applications (WhatsApp), although widespread, may not have been available to all students. Specifically regarding the data collected, no questions related to body composition (body weight and height) were included; body mass index could have enriched the statistical analysis and reinforced associations already identified by other authors[23,33,34].

The questions assessing physical activity practice, both aerobic and muscle-strengthening, relied solely on participants' perceptions of their activity levels (maintenance, increase, or reduction); it is believed that more objective measures, such as the use of accelerometers or detailed daily logs, could provide more accurate data on the influence of physical activity on self-rated health.

These limitations may affect the generalizability of the results. The sample was drawn from a single higher education institution in one Brazilian state, and the unique context of the pandemic suggests that the findings should be interpreted cautiously when applied to other populations or time periods. Additionally, the absence of objective health and physical activity indicators may limit a more precise understanding of the relationship between healthy behaviors and NSRH.

CONCLUSIONS

This study, conducted with Brazilian university students, identified a prevalence of negative self-rated health (NSRH) of 38.6%, with a higher rate among women (42%) than men (32.5%). Increased MSPA during the pandemic was associated with lower odds of NSRH in both men and women; additionally, among men, maintaining pre-pandemic MSPA levels also contributed to this outcome.

The results reveal a significant relationship between MSPA and NSRH in both sexes during a pandemic.

These findings suggest that both increasing and maintaining MSPA can act as protective strategies, reducing the negative impacts on health perception during prolonged crisis periods, such as a pandemic. They also highlight the importance of developing and disseminating strategies for engaging in MSPA at home, especially during periods of social isolation. Therefore, policies to promote physical activity, particularly strength training, are essential to expand access to exercise and to foster the health and well-being of university students.

CRediT author statement

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All authors have read and agreed to the published version of the manuscript.

Declaration of competing 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 paper.

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