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ORIGINAL ARTICLE

ASSOCIATION BETWEEN LEVELS OF PHYSICAL ACTIVITY AND DEPRESSIVE SYMPTOMS IN UNIVERSITY STUDENTS IN BRAZIL DURING THE COVID-19 PANDEMIC

Associação entre níveis de atividade física e sintomas depressivos em estudantes universitários do brasil durante a pandemia de covid-19

Asociación entre los niveles de actividad física y síntomas depresivos en estudiantes universitarios de Brasil durante la pandemia de COVID-19.

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ABSTRACT

Introduction: depression is a mental disorder that affects millions of people worldwide. In this sense, regular physical activity has been consistently associated with a reduction in depressive symptoms. **Objective:** to evaluate the prevalence and association of physical activity levels and depressive symptoms in university students during the COVID-19 pandemic. **Method:** associative, cross-sectional study investigating physical activity levels and depressive symptoms of undergraduate and technical students, using the IPAQ and PHQ-9 tests, respectively. **Results:** of the 529 students who participated in the study, 43.9% were considered sedentary, 42.9% moderately active and 13.2% vigorously active. Women had a higher prevalence of mild depressive symptoms (39.5%), men had a higher prevalence of none or minimal symptoms (43.8%). Among vigorously active students, there was a higher prevalence of none or minimal depressive symptoms (45.7%) than moderate depressive symptoms (10%). The analyses showed that younger age, women and lower levels of physical activity are more likely to present depressive symptoms. **Conclusion:** During the COVID-19 pandemic, physical activity levels, physical inactivity and depressive symptoms were associated, indicating a higher prevalence of severe depressive symptoms among women, younger students and those who spent more time sitting.

Keywords: Physical exercise; Physical Inactivity; Depression; Students, Cross-sectional studies.

RESUMO

Introdução: a depressão é um transtorno mental que atinge milhões de pessoas em todo o mundo. Neste sentido, a prática regular de atividade física tem sido consistentemente associada à diminuição dos sintomas depressivos. **Objetivo:** avaliar a prevalência e a associação dos níveis de atividade física e sintomas depressivos em estudantes universitários durante a pandemia de COVID-19. **Método:** estudo associativo, de corte transversal investigando os níveis de atividade física e sintomas depressivos de estudantes de cursos de graduação e técnicos, através dos instrumentos IPAQ e PHQ-9, respectivamente. **Resultados:** dos 529 estudantes participantes, 43,9% foram considerados inativos, 42,9% moderadamente ativos e 13,2% intensamente ativos. As mulheres apresentaram maior prevalência de sintomas depressivos suaves (39,5%), os homens, maior prevalência de nenhum ou mínimos sintomas (43,8%). Entre os estudantes intensamente ativos houve maior prevalência de nenhum ou mínimos sintomas depressivos (45,7%) do que de sintomas depressivos moderados (10%). As análises demonstraram que menor idade, mulheres e menores níveis de atividade física possuem maior chance de apresentar sintomas depressivos. **Conclusão:** durante a pandemia de COVID-19, os níveis de atividade física, inatividade física e sintomas depressivos estiveram associados, indicando maior prevalência de sintomas depressivos severos entre as mulheres, estudantes mais jovens e que passam mais tempo sentado.

Palavras-chave: Exercício físico; Inatividade física; Depressão; Estudantes, Estudos transversais.

RESUMEN

Introducción: la depresión es un trastorno mental que afecta a millones de personas en todo el mundo. En este sentido, la actividad física regular se ha asociado consistentemente con una reducción de los síntomas depresivos. **Objetivo:** evaluar la prevalencia y asociación de los niveles de actividad física y síntomas depresivos en estudiantes universitarios durante la pandemia de COVID-19. **Método:** estudio asociativo, transversal que investigó los niveles de actividad física y los síntomas depresivos de estudiantes universitarios y técnicos, a través de las pruebas IPAQ y PHQ-9, respectivamente. **Resultados:** de los 529 estudiantes participantes, 43,9% fueron considerados sedentarios, 42,9% moderadamente activos y 13,2% intensamente activos. Las mujeres tuvieron una mayor prevalencia de síntomas depresivos leves (39,5%) y los hombres tuvieron una mayor prevalencia de síntomas nulos o mínimos (43,8%). Entre los estudiantes intensamente activos, hubo una prevalencia más alta de síntomas depresivos nulos o mínimos (45,7%) que de síntomas depresivos moderados (10%). Los análisis mostraron que las personas de menor edad, las mujeres y los niveles más bajos de actividad física tienen mayor probabilidad de presentar síntomas depresivos. **Conclusión:** durante la pandemia de COVID-19, los niveles de actividad física, inactividad física y síntomas depresivos se asociaron, indicando una mayor prevalencia de síntomas depresivos graves entre las mujeres, los estudiantes más jóvenes y los que pasan más tiempo sentados.

Palabras clave: Ejercicio físico; Inacvitidad física; Depresión; Estudiantes, Estudios transversales.

INTRODUCTION

Depression is a mental disorder that affects more than 264 million people worldwide, characterized by persistent sadness and loss of interest or pleasure in previously enjoyable activities.[1] In Brazil, it is estimated that 7.6% of adults have a diagnosis of depression, representing 11.2 million individuals; this prevalence is even higher in the southern region (12.6%), with women more frequently affected than men (10.9% vs. 3.9%).[2] Among university students in southern Brazil, evidence indicates that 32% presented mild to severe depressive symptoms,[3] a prevalence similar to that reported in studies from other countries.[4,5]

Physical inactivity has shown a significant association with depression among university students.[6] In Brazil, 46% of the population is classified as inactive,[7] with an even higher proportion among individuals with depression.[8] Among university students, the prevalence of physical inactivity reached 41% in a study conducted at a university in Rio Grande do Sul in 2015.[9]

Considering the global scenario shaped by the COVID-19 pandemic, many countries implemented restrictions on travel, shopping, in-person classes, and access to physical activity environments.[10,11] In Brazil, schools, universities, gyms, and other facilities were closed, while remote activities became widespread, resulting in reduced levels of physical activity.[11,12] Given that physical activity has been inversely associated with mental disorders prevalence, such reductions may have contributed to increased depressive symptoms. Indeed, studies demonstrated a high prevalence of depression during the pandemic,[13] including among university students.[14] Furthermore, research worldwide showed that students significantly reduced their physical activity levels during this period.[15-17]

European studies reported that a greater number of students engaged in physical activity before the COVID-19 outbreak compared with the restriction period[15,16] and highlighted associations between physical activity, anxiety, and depression during the pandemic.[10] However, the response regarding whether university students maintained physical activity, as well as its format, may vary across different countries or even across regions within the same country. Considering previous reports that reduced physical activity during social distancing negatively impacted students' mental health, the present study aimed to evaluate the prevalence and association of physical activity levels and depressive symptoms in university students during the COVID-19 pandemic.

METHODS

Study design

This was a descriptive, associative, cross-sectional study with a quantitative approach.

Participants

The study population comprised undergraduate and technical students from the Vale do Taquari University (Brazil). Sample size calculation was based on a total of 6,464 students enrolled in the second semester of 2020, with an estimated prevalence of depression of 32% and physical inactivity of 41%. A confidence level of 95% and a 5% margin of error were adopted, resulting in a minimum sample size of 349 students. Considering refusals and losses of approximately 10%, the target sample was at least 385 participants. The study was conducted in accordance with Resolution 466/2012 of the National Research Ethics Committee, and the

protocol was approved under the number 4.559.788. All participants provided informed consent before participation.

Context

The study aimed to assess university students regarding physical activity levels, depressive symptoms, and sociodemographic characteristics. All enrolled students were invited to participate via their institutional e-mail. Data collection was conducted through Google Forms between April and May 2021.

Variables, data sources and measurement

The short version of the International Physical Activity Questionnaire (IPAQ) was used to assess physical activity levels and sitting time.[18] Responses referred to the previous week, considering activities performed for at least 10 consecutive minutes. Activities were classified as walking, moderate or vigorous activities, and sitting time (minutes per day on weekdays and weekends). Sitting time was treated as a continuous variable, expressed in minutes per week.

Following the original IPAQ guidelines, participants were classified into three physical activity levels: inactive, moderately active, or vigorously active:

- Inactive: participants who did not meet criteria for moderate or vigorous activity.
- Moderately active: participants meeting at least one of the following:
  A) ≥3 days of vigorous activity ≥20 minutes/day;
  B) ≥5 days of moderate activity or walking ≥30 minutes/day;
  C) ≥5 days of any activity (moderate, vigorous, or walking) totaling ≥600 METs/min/week.
- Vigorously active: participants meeting at least one of the following:
  A) ≥3 days of vigorous activity totaling ≥1500 METs/min/week;
  B) 7 days of any activity (moderate, vigorous, or walking) totaling ≥3000 METs/min/week.

Additionally, information regarding the time (minutes per week) spent in each activity type (walking, moderate, vigorous) was recorded.

Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9), which consists of nine items corresponding to depressive symptoms. Each item is scored according to the frequency of symptom occurrence, with higher frequency resulting in higher scores. The total score classified participants into five levels: none or minimal (0–4), mild (5–9), moderate (10–14), moderately severe (15–19), and severe (20–27). The PHQ-9 has demonstrated validity and reliability comparable to other screening instruments.[19] Regarding sociodemographic data, six questions were applied including sex, age, course of study, length of time at the institution, employment status, and weekly work hours if applicable.

Statistical Analysis and Bias Control

Descriptive statistics (mean, standard deviation, and frequencies) were used. Associations between variables were tested using the chi-square test. For these analyses, subgroups were created: age was divided into terciles (“younger” ≤21 years, “intermediate” 22–25 years, “older” ≥26 years). Physical activity for each activity type was divided into terciles: walking ("low" ≤30 min, "moderate" 40–120 min, "high" ≥130 min), moderate activity ("low" ≤10 min, "moderate" 20–90 min, "high" ≥100 min), vigorous activity ("low" none, "moderate" 10–110 min, "high" ≥120 min). Sitting time was categorized as "low" (≤39 h/week), "moderate"

(40–66 h/week), or "high" (≥67 h/week). Finally, depressive symptoms were classified as "moderately severe" and "severe" were grouped due to the small number of responses.

Multivariate analysis using multinomial logistic regression, adjusted for sex and age was performed to determine whether physical activity level predicted depressive symptoms. For that, depressive symptoms were considered the dependent variable. The assumption of the absence of multicollinearity was verified using tolerance parameters and the variance inflation factor. In the statistical model used, the Wald test was used to assess predictors significance. For predictors that reached statistical significance, the magnitude of their individual contribution to the model was determined using odds ratio (OR) analysis calculated from the Exp(B) parameter and its confidence interval. A significance level of $\alpha = 0.05$ was adopted. All analyses were conducted using SPSS version 25.0 (IBM Corp).

RESULTS

A total of 529 valid responses were collected. Respondents' ages ranged from 16 to 62 years (mean ± SD: 24.95 ± 6.30), with 392 (74.1%) women and 137 (25.9%) men. Participants were enrolled in 62 undergraduate and technical degree programs, with the most represented programs being Physical Education (8.13%), Law (7.94%), and Accounting (6.99%). Regarding time at the university, 5.3% of students had been enrolled for up to 1 year, 23.5% between 1.1 and 2.5 years, 25.7% between 2.6 and 4 years, 22.3% between 4.1 and 5 years, and 23.3% for more than 5.5 years. Most students (85.8%) were employed, with weekly working hours distributed as follows: up to 20 hours (7.9%), 20–30 hours (17.4%), 30–40 hours (22.7%), and over 40 hours (52%).

Analysis of physical activity levels showed that 43.9% of students were classified as inactive, 42.9% as moderately active, and 13.2% as vigorously active. Regarding sitting time, the mean was 57.64 ± 32.40 hours per week. When comparing proportions within physical activity level strata, no significant differences were observed for sex, age, time at the institution, or employment status (Table 1).

Table 1 – Association between the prevalence of physical activity level and sample characterization variables.

Variables	Physical activity level			p-value
	Inactive	Moderately active	Intensely acitve	
Sex				
Female 392 (74.1)	166 (42.3)	179 (45.7)	47 (12)	0.073
Male 137 (25.9)	66 (48.2)	48 (35)	23 (16.8)	
Age				
Younger 171 (32.3)	71 (41.5)	80 (46.8)	20 (11.7)	0.739
Intermediate 198 (37.4)	91 (46)	81 (40.9)	26 (13.1)	
Older 160 (30.2)	70 (43.8)	66 (41.3)	24 (15)	
Time at the institution				
Up to 1 year 28 (5.3)	11 (39.9)	12 (42.9)	5 (17.9)	0.161
1.1 to 2.5 years 124 (23.4)	49 (39.5)	60 (48.4)	15 (12.1)	
2.6 to 4 years 136 (25.7)	61 (44.9)	63 (46.3)	12 (8.8)	
4.1 to 5.5 years	58 (49.2)	47 (39.8)	13 (11)	

118 (22.3) More than 5.5 years 123 (23.3)	53 (43.1)	45 (36.6)	25 (20.3)	
Work				
No 75 (14.2)	33 (44)	32 (42.7)	10 (13.3)	0.999
Yes 454 (85.8)	199 (43.8)	195 (43)	60 (13.2)	

*Chi-square test.
Values expressed in absolute and relative frequencies - n (%).

Regarding depressive symptoms, among all respondents, 31% presented none or minimal symptoms, 37.6% mild, 18.1% moderate, 9.8% moderately severe, and 4.3% severe. When depressive symptoms were analyzed in relation to other variables, it was observed that women had a higher prevalence of mild depressive symptoms (39.5%) and a lower prevalence of moderate symptoms (20.4%) compared with none or minimal symptoms (25.3%). In men, none or minimal symptoms were more prevalent (43.8%) compared with mild (32.1%) and moderate symptoms (11.7%). Younger students (≤21 years) presented a higher prevalence of none or minimal depressive symptoms (21.6%) than moderately severe or severe symptoms (18.1%). No differences in the prevalence of depressive symptoms were observed among other age groups. No associations were found between depressive symptoms and either time at the institution or employment status (Table 2).

Table 2 – Association between the prevalence of depressive symptoms levels and sample characterization variables.

Variables	Depressive symptoms				p-value
	None Minimal	Mild	Moderate	Moderately Severe and Severe	
Sex					
Female 392 (74.1)	99 (25.3)[b]	155 (39.5)[a]	80 (20.4)[a]	58 (14.8)[a,b]	**≤ 0.001**
Male 137 (25.9)	60 (43.8)[b]	44 (32.1)[a]	16 (11.7)[a]	17 (12.4)[a,b]	
Age					
Younger 171 (32.3)	37 (21.6)[a]	66 (38.6)[a,b]	37 (21.6)[a,b]	31 (18.1)[b]	**0.031**
Intermedate 198 (37.4)	64 (32.3)[a]	70 (35.4)[a]	39 (19.7)[a]	25 (12.6)[a]	
Older 160 (30.2)	58 (36.3)[a]	63 (39.3)[a]	20 (12.5)[a]	19 (11.9)[a]	
Time at the institution					
Up to 1 year 28 (5.3)	4 (14.3)	15 (53.6)	4 (14.3)	5 (17.9)	0.056
1.1 to 2.5 years 124 (23.4)	26 (21)	47 (37.9)	27 (21.8)	24 (19.4)	
2.6 to 4 years 136 (25.7)	44 (32.4)	54 (39.7)	22 (16.2)	16 (11.8)	
4.1 to 5.5 years 118 (22.3)	43 (28.8)	44 (37.3)	23 (19.5)	17 (14.4)	
More than 5.5 years 123 (23.3)	51 (41.5)	39 (31.7)	20 (16.3)	13 (10.6)	
Work					
No	17 (22.7)	26 (43.7)	17 (22.7)	15 (20)	0.182

75 (14.2) Yes 454 (85.8)	142 (31.3)	173 (38.1)	79 (17.4)	60 (13.2)	

*Chi-square test.
Values expressed in absolute and relative frequencies - n (%). Different superscript letters indicate significant differences between the prevalence of depressive symptoms in the same sex and age categories.

When analyzing the association between physical activity levels and depressive symptoms, it was observed that among vigorously active students, none or minimal depressive symptoms were more prevalent (45.7%) than moderate symptoms (10%). Additionally, students who spent a large amount of time sitting (over 67 hours per week) showed a higher prevalence of moderate depressive symptoms (24.3%) compared with none or minimal symptoms (23.7%) (Table 3).

Table 3 – Association between the prevalence of physical activity level and levels of depressive symptoms.

Variables	Depressive symptoms				p-value
	None Minimal	Mild	Moderate	Moderately Severe and Severe	
Physical activity level					
Inactive 232 (43.9)	60 (25.9)[a]	88 (37.9)[a]	47 (20.3)[a]	37 (15.9)[a]	
Moderadately active 227 (42.9)	67 (29.5)[a]	90 (39.6)[a]	42 (18.5)[a]	28 (12.3)[a]	**0.049**
Vigorously active 70 (13.2)	32 (45.7)[b]	21 (30)[a,b]	7 (10)[a]	10 (14.3)[a,b]	
Sitting time					
Low 172 (32.5)	63 (36.6)[a]	67 (39)[a]	25 (14.5)[a]	17 (9.9)[a]	
Moderate 180 (34)	54 (30.0)[a]	65 (36,1)[a]	28 (15.6)[a]	33 (18.3)[a]	**0.020**
High 177 (33.5)	42 (23.7)[b]	67 (37.9)[a,b]	43 (24.3)[a]	25 (14.1)[a,b]	

*Chi-square test.
Values expressed in absolute and relative frequencies - n (%). Different superscript letters indicate significant differences between the prevalence of depressive symptoms in the same physical activity and sitting time categories.

When analyzing the time spent in different types of physical activity and its association with depressive symptoms, no differences were observed in the prevalence of depressive symptoms between students who spent more or less time walking or performing moderate activities. Among students who performed little or no vigorous activity, a higher prevalence of mild depressive symptoms (40.1%) was observed compared with none or minimal symptoms (23%). In this same group, a higher prevalence of moderately severe and severe depressive symptoms (19.3%) was found compared with moderate symptoms (17.5%). Among students performing a moderate amount of vigorous activity, moderate depressive symptoms were more prevalent (22.6%) than moderately severe and severe symptoms (7.5%). Similarly, among students with a high level of vigorous activity, none or minimal depressive symptoms were more prevalent (42.5%) compared with mild depressive symptoms (32.3%) (Table 4).

Table 4 – Association between time spent in different types of physical activity and depressive symptoms levels.

Variables	Depressive symptoms				p-value
	None Minimal	Mild	Moderate	Moderately Severe and Severe	
Walking					
Low 172 (32.5)	48 (27,9)	67 (39)	30 (17,4)	27 (15,7)	
Moderate 193 (36.5)	54 (28)	73 (37.8)	42 (21.8)	24 (12.4)	0,516
High 164 (31)	57 (34.8)	59 (36)	24 (14.6)	24 (14.6)	
Moderate activity					
Low 176 (33.3)	45 (25.6)	63 (35.8)	34 (19.3)	34 (19.3)	
Moderate 167 (31.6)	52 (31.1)	68 (40.7)	30 (18)	17 (10.2)	0227
High 186 (32.5)	62 (33.3)	68 (36.6)	32 (17.2)	24 (12.9)	
Vigorous activity					
Low 269 (50.9)	62 (23)[b]	108 (40.1)[a,c]	47 (17.5)[a,b]	52 (19.3)[c]	
Moderate 133 (25.1)	43 (32.3)[a,b]	50 (37.6)[a,b]	30 (22.6)[a]	10 (7.5)[b]	**≤ 0.001**
High 127 (24)	54 (42.5)[b]	41 (32.3)[a]	19 (15)[a,b]	13 (10.2)[a,b]	

*Chi-square test.
Values expressed in absolute and relative frequencies - n (%). Different superscript letters indicate significant differences between the prevalence of depressive symptoms within the same category of vigorous physical activity duration.

Additionally, multivariate analyses showed that physical activity level was a significant predictor of students' depressive symptoms (Table 5), after adjustment for age and sex. The multinomial logistic regression model including these predictors was significant [$X^2(12) = 42.077$; $p < 0.001$; Nagelkerke $R^2 = 0.082$].

Table 5 – Multinomial logistic regression model for predictors of depressive symptoms in students (n = 529).

Variable		B	Degrees of freedom	p-value	Odds Ratio	95% Confidence interval	
						Lower limit	Upper limit
Mild Depressive Symptoms[a]	Physical Activity Level[b]						
	Inactive	0.779	1	**0.019**	2.178	1.137	4,172
	Moderately Active	0.646	1	**0.049**	1.908	1.002	3,633
Moderate Depressive Symptoms[a]	Physical Activity Level[b]						
	Inactive	1.212	1	**0.010**	3.359	1.341	8.415
	Moderately Active	0.935	1	**0.047**	2.548	1.014	6.405
Moderately Severe or	Physical Activity Level[b]						

Severe Depressive Symptoms[a]	Inactive	0.637	1	0.133	1.890	0.824	4.333
	Moderately Active	0.213	1	0.622	1.237	0.53	2.889

* Multinomial logistic regression, adjusted for age and sex.
[a] For the dependent variable depressive symptoms, presenting none or minimal symptoms is the reference category;
[b] for the independent variable physical activity level, vigorously active is the reference category.

It was found that physical activity level was a predictor of depressive symptoms among the students assessed. The odds of an inactive student presenting mild depressive symptoms were 2.17 times higher (or 117% higher) than those of a vigorously active student. Similarly, the odds of an inactive student presenting moderate depressive symptoms were 3.35 times higher (or 235% higher) than those of a vigorously active student, and the odds of a moderately active student presenting mild depressive symptoms were 1.90 times higher (or 90% higher) than those of a vigorously active student. Furthermore, the odds of a moderately active student presenting moderate depressive symptoms were 2.54 times higher (or 154% higher) than those of a vigorously active student.

DISCUSSION

In the present study, 43.9% of the 529 students assessed were inactive, 42.9% moderately active, and 13.2% vigorously active. Moderately severe and severe depressive symptoms were observed in 9.8% and 4.3% of students, respectively. Association analyses showed that younger students, more active students, and those engaging in higher amounts of vigorous activity had a lower prevalence of depressive symptoms.

Our results are consistent with previous studies investigating the relationship between physical activity and depressive symptoms,[6,10,13] suggesting a protective effect of an active lifestyle against depression. Moreover, both exercise volume and intensity appear to play an important role in mental health, as our findings align with studies conducted during the pandemic, indicating that higher levels of moderate-to-vigorous physical activity are associated with reduced depressive symptoms.[13,20] The fact that vigorously active students and those dedicating more time to vigorous activities exhibited lower levels of depressive symptoms reinforces the hypothesis that not only the practice, but also the intensity and regularity of physical exercise positively influence mental health. These effects may be explained by physiological mechanisms, such as increased release of mood-related neurotransmitters (serotonin, dopamine, and endorphins), as well as structural adaptations in the brain, particularly in the hippocampus and prefrontal cortex, regions involved in emotional regulation.[21]Additionally, psychosocial factors, such as improved self-esteem, sleep quality, stress coping, and perceived self-efficacy, also play a relevant role in this association.[22]

It is worth noting that even in the pre-pandemic period, a study conducted in 2015 at the same institution reported similar findings, with 41% of students classified as inactive.[9] Thus, factors beyond COVID-19 may have influenced this high prevalence, such as long work/study hours. In this context, sedentary time is commonly associated with physical inactivity, particularly due to the teaching model imposed on students because of online learning. Excessive use of electronic devices for leisure, work, or study may have contributed.[23] Indeed, literature reports studies conducted with university students during the COVID-19 pandemic showing that most students were insufficiently active (57–59%) during this period.[10,14]

Regarding the students' profile, no differences in physical inactivity prevalence were observed between age groups, corroborating a study conducted with students in northeastern Brazil.[24] In contrast, in terms of sex, the present study did not find differences in physical

activity levels between men and women, contrary to studies reporting higher inactivity prevalence[9] and lower physical activity levels[14] in women. Similarly, when examining time at the institution, no significant differences in physical activity levels were observed across years of study, contradicting the trend of decreased activity as students advance in university.[24]

Concerning depressive symptom prevalence, 14.2% of students presented moderately severe or severe symptoms during the COVID-19 pandemic, similar to a study with university students in Ukraine (12.5%).[10] That study also found that students meeting clinical criteria for depression were 1.6 times less likely to engage in physical activity than those without clinically significant depression, which aligns with the present findings. A study conducted in Bangladesh[25] reported a higher percentage of students with moderately severe or severe depressive symptoms (25.8%), which was attributed to enrollment in private universities and to prolonged unemployment and financial insecurity, considered major stressors contributing to elevated depression rates.

Regarding sex differences, moderately severe and severe depressive symptoms were more prevalent in women (14.8% vs. 12.4%), while men presented a higher prevalence of none or minimal symptoms (43.8% vs. 25.3%). A Croatian study[14] published in 2021 found similar results, with female students exhibiting higher depression levels than males during the pandemic, explained by men engaging in more physical activity than women. In the present study, this explanation does not apply, as no sex differences in physical activity levels were observed. Moreover, evidence suggests that active women exhibit fewer depressive symptoms than inactive women, unlike men,[10] indicating that factors beyond physical activity may influence depressive symptoms prevalence. Overall, these results are consistent with the literature, showing that women are more prone to mental health issues such as stress and depression, particularly during the COVID-19 pandemic.[17,26]

Although no significant differences were found in the prevalence of moderate and severe depressive symptoms among younger students (≤21 years), analyses demonstrated that younger age was associated with a higher likelihood of depressive symptoms. For each additional year of age, the odds of presenting moderate and moderately severe/severe depressive symptoms decreased by 8% and 6%, respectively. These findings are similar to those reported by Croatian researchers in 2021[14] and by researchers in Bangladesh[25], who found higher prevalence of moderately severe to severe depressive symptoms among students aged 17–24 compared with those older than 24. These results may be related to the transitional life stage of younger students, as entering higher education often entails significant lifestyle changes and increased daily responsibilities.[23]

Furthermore, among vigorously active students, a higher prevalence of none or minimal depressive symptoms (45.7%) compared with moderate symptoms (10%) was observed. This finding corroborates the multivariate analyses, demonstrating that higher physical activity levels confer greater protection against depression. The odds of an inactive student presenting mild and moderate depressive symptoms were higher than those of a vigorously active student, and similarly, the odds of a moderately active student presenting mild and moderate depressive symptoms were higher than those of a vigorously active student.

Limitations of the present study include the lack of proportional control of students according to the investigated characteristics. Additionally, due to the final sample size, the inclusion of only two factors as adjustment variables (sex and age) may be considered a methodological limitation. Furthermore, the cross-sectional design prevents causal inferences. Lastly, assessments relied on self-reported instruments, which are more susceptible to recall and social desirability biases. To mitigate these issues, the study emphasized the importance of

transparent responses and ensured anonymity to reduce socially desirable responding. Strengths of the study include the large sample size, use of validated instruments to assess physical activity levels and depressive symptoms, and robust statistical analyses.

CONCLUSION

This study identified a high prevalence of physical inactivity and depressive symptoms among university students during the COVID-19 pandemic. Younger students, females, and those with low levels of physical activity were more likely to exhibit depressive symptoms. Conversely, vigorously active students and those engaging in higher volumes of vigorous activity showed a lower prevalence of these symptoms. These findings highlight the association between physical activity-related behaviors and mental health among university students in adverse contexts.

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