

The impact of physical activity on the mental health of university students: An epidemiological study from Paraguay

Julio Torales^{1,2,3} , Matías Franco Di Giuseppe⁴ , Marcos Almirón-Santacruz⁵ ,
Marcelo O'Higgins¹ , Diego Amarilla¹ , Tomás Caycho-Rodríguez⁶ , Antonio Ventriglio⁷ ,
João Mauricio Castaldelli-Maia^{8,9} , Iván Barrios^{3,10} ,
Red de Estudiantes Investigadores en Neurociencias⁴ 

¹ Universidad Nacional de Asunción, Facultad de Ciencias Médicas, Cátedra de Psicología Médica, San Lorenzo, Paraguay; ² Universidad Nacional de Caaguazú, Instituto Regional de Investigación en Salud, Coronel Oviedo, Paraguay; ³ Universidad Sudamericana, Facultad de Ciencias de la Salud, Pedro Juan Caballero, Paraguay; ⁴ Universidad Nacional de Asunción, Facultad de Ciencias Médicas, Red de Estudiantes Investigadores en Neurociencias, San Lorenzo, Paraguay; ⁵ Universidad Nacional de Asunción, Facultad de Ciencias Médicas, Carrera de Kinesiología y Fisioterapia, San Lorenzo, Paraguay; ⁶ Universidad Científica del Sur, Lima, Perú; ⁷ University of Foggia, Department of Clinical and Experimental Medicine, Foggia, Italy; ⁸ Fundação do ABC, Department of Neuroscience, Santo André, SP, Brazil; ⁹ University of São Paulo, Department of Psychiatry, São Paulo, SP, Brazil; ¹⁰ Universidad Nacional de Asunción, Facultad de Ciencias Médicas, Filial Santa Rosa del Aguairay, Cátedra de Bioestadística, Santa Rosa del Aguairay, Paraguay

Red de Estudiantes Investigadores en Neurociencias (Network of Student Researchers in Neuroscience):

Anthon Daniel Torres-Romero, Elías René Rolón-Méndez, Patricia Lorena Martínez-López, Katja Victoria Heinichen-Mansfeld, Basilio Ruiz Galeano, Martín Sánchez García de Zúñiga

Abstract

Study aim: This study aimed to investigate the impact of physical activity on the mental health characteristics of a sample of university students from Paraguay, assessing their daily physical activity and the prevalence of depression, anxiety, and stress.

Materials and methods: This observational, descriptive, prospective, cross-sectional study included 317 university students. Participants were assessed using the International Physical Activity Questionnaire (IPAQ) to categorize their physical activity levels and the Depression, Anxiety, and Stress Scale-21 (DASS-21) to measure mental health characteristics. Data analysis utilized descriptive statistics, Pearson's correlation, and chi-square tests to explore associations between physical activity and mental health outcomes.

Results: The results indicated that 49.5% of the participants were engaged in low levels of physical activity, while 20.2% and 30.3% reported high and moderate activity levels, respectively. Mental health assessments showed high prevalence rates for depression (65.3%), anxiety (68.5%), and stress (66.6%). Inverse correlations were found between total physical activity and each mental health parameter: depression ($r = -0.167$, $p = 0.003$), anxiety ($r = -0.141$, $p = 0.012$), and stress ($r = -0.133$, $p = 0.018$). Thus, higher levels of physical activity were associated with lower levels of depression, anxiety, and stress.

Conclusions: This study confirmed a significant inverse correlation between physical activity and common mental health issues. The promotion of physical activity may be a protective factor against depression, anxiety, and stress in this population. These findings support the need for university health programs to encourage physical activity as a strategic approach to enhance students' mental health.

Keywords: Physical activity – Undergraduate students – Mental health – Paraguay

Introduction

The relationship between physical activity and mental health among university students has been thoroughly researched and documented. Evidence has shown that physical activity may lead to numerous advantages such as improved mental health and overall well-being [31]. Specifically, students engaged in physical activity tend to experience improved overall and mental health, reporting being happier than their sedentary counterparts [21].

Enhancing physical activity levels during the COVID-19 pandemic was considered a strategy for protecting against mental illness among students, confirming a potential positive association between physical activity and mental health [30]. Additionally, there is evidence that physical activity helps maintain good spirits and a positive mood [35].

Regarding the impact of physical activity on depression, research evidence has suggested that there may be a positive impact on reducing depression, specifically among college students, more than the usual treatments without physical activity [12]. Murray et al. [22] similarly highlighted the effectiveness of aerobic resistance training and mindfulness yoga exercises in reducing the symptoms and severity of depression among college students. Zhang et al. [36] also found that regular physical exercise may predict a lower risk of depression in college students, consistent with previous findings.

Physically active individuals also generally report lower levels of anxiety, suggesting a potential positive relationship between physical activity and anxiety reduction among university students [14]. Some authors have suggested that physical activity and exercise are associated with lower levels of anxiety and stress among students [13]. Ji et al. stated that team exercise could alleviate anxiety among college students more effectively than individual physical activity [15].

Numerous studies have demonstrated a link between physical activity and stress levels among university students. University students are particularly susceptible to mental health issues, including depression, anxiety, and stress, and evidence suggests that physical fitness and regular exercise habits are strongly associated with overall mental health and wellbeing [13, 15]. Morrison and Pidgeon argued that physical activity may play a relevant role in fostering resilience and self-control among university students and may help improve their stress coping strategies and enhance their mental well-being [19].

In South America, the unique socio-economic challenges faced by university students may further compound the mental health impacts of physical inactivity. Evidence indicates that Latin American countries often grapple with limited mental health resources, which can lead to

a higher prevalence of mental health symptoms among students [37]. Furthermore, students in South America may face unique socio-cultural and economic challenges, such as political instability, high levels of inequality, and limited access to mental health services, which may influence their mental health outcomes differently than their peers in other regions. This context necessitates a focused investigation into how physical activity can be leveraged as a tool to enhance mental health among South American university students [33].

Limited research conducted on South American university students has shown that they are particularly vulnerable to mental health challenges. For example, in Chile, a cross-sectional study involving 469 university students during the COVID-19 pandemic concluded that a sedentary lifestyle negatively impacted mental health, emphasizing the importance of promoting physical activity in this population [26]. Similarly, a study in Brazil found an inverse correlation between physical activity levels and symptoms of depression and anxiety among 277 university students [29].

Paraguay remains largely underrepresented in the literature. A previous study assessed physical activity in the general population of Paraguay by measuring its association with anxiety and depression, but did not specifically address university students [23]. Given the high prevalence of mental health issues among Paraguayan students [34], combined with the socioeconomic factors that may exacerbate these issues [1], understanding how physical activity can mitigate these challenges is critical. Thus, our study aimed to explore and investigate the potential impact of physical activity on the mental well-being of Paraguayan university students, a vulnerable and under-researched population [34]. Our findings may have significant implications for prevention strategies aimed at reducing sedentary behavior and improving physical activity in this group.

Materials and methods

Design and sampling

This was an observational, descriptive, prospective, and cross-sectional study [32] conducted through an online survey launched between April 19 and 28, 2024. Sampling was nonprobabilistic for consecutive cases.

Participants and sample size

University students aged ≥ 18 years of both sexes were voluntarily recruited from public and private national universities in Paraguay. Only healthy individuals who had not been previously diagnosed with neurological or psychiatric disorders were included in the study. Participants who did not complete all questionnaire variables were

excluded from the analysis. The survey was delivered through messaging applications (WhatsApp, Telegram) and institutional mail lists. All participants received full information regarding the purpose of the study, privacy, and data processing. The Internet-based approach has been considered scientifically reliable, and responses to online surveys can provide results similar to those involving “in-person” samples [10].

The sample size was calculated using the epidemiological package Epidat 4.2 (Pan American Health Organization, Junta de Salud de Galicia, and Universidad CES de Colombia). Assuming an expected frequency of depression in university students of 60.3% [34], a confidence level of 95%, and a precision of 3%, the minimum sample size was set at 199 participants [20].

Finally, 317 university students (69.4% women) were included in the study. Participants were between 18 and 57 years old, with an average age of 24.6 ± 5.6 years. A total of 57.4% of the students were from the Central Department (cities around the Paraguayan capital, Asunción), 52.7% were students of health sciences, animal biology, or chemistry, and 56.8% were unemployed.

Measures

Mental health status

Participants reported their main sources of stress (money, work, family, and interpersonal relationships). Depression, anxiety, and stress were assessed using the Depression, Anxiety and Stress Scale-21 (DASS-21).

The DASS-21 is a set of three self-report scales designed to measure negative emotional states of depression, anxiety, and stress. Each of the three DASS-21 scales contains seven items. The depression scale assesses dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia, and inertia. The anxiety scale assesses autonomic arousal, musculoskeletal effects, situational anxiety, and the subjective experience of anxious affect. The stress scale is sensitive to the levels of chronic nonspecific arousal. It assesses difficulty relaxing, nervous arousal, and the ease of becoming upset/agitated, irritable/overreacting, and impatient [5].

Respondents are asked to use 4-point severity/frequency scales to assess the extent to which they have experienced each state during the past week. Depression, anxiety, and stress scores are calculated by summing the corresponding item scores: depression (items 3, 5, 10, 13, 16, 17, and 21), anxiety (items 2, 4, 7, 9, 15, 19, and 20), and stress (items 1, 6, 8, 11, 12, 14, and 18). To evaluate each subscale separately, the scores of the items corresponding to each subscale are added together. A general indicator of emotional symptoms can be obtained by adding the scores of all items; the higher the general score is, the greater is the degree of symptomatology. Commonly used cut-off

points are as follows: a. depression: 5–6 mild depression, 7–10 moderate depression, 11–13 severe depression; 14 or more extremely severe depression; b. anxiety: 4 mild anxiety, 5–7 moderate anxiety, 8–9 severe anxiety, 10 or more extremely severe anxiety; c. stress: 8–9 mild stress, 10–12 moderate stress, 13–16 severe stress, 17 or more extremely severe stress [5]. The Spanish version developed by Ruiz et al. was used in this study. This version has good psychometric properties, with Cronbach's $\alpha = 0.92$ to 0.95 for the total scale; 0.86 to 0.92 for the depression subscale; 0.80 to 0.87 for the anxiety subscale and 0.80 to 0.86 for the stress subscale [28].

Physical activity status

Physical activity (PA) was assessed using the International Physical Activity Questionnaire (IPAQ) – Short Form (IPAQ-SF). This questionnaire assesses PA in the last seven days in four generic items through seven questions related to work, physical sports, and transport (walking) activities, and to the time the person remains seated or lying down. It is designed to be administered by telephone or self-administered to young and middle-aged adults (15–69 years) [8]. The Spanish version, published on the official website of the instrument, was used in this study [38]. Based on the results of the IPAQ, individuals can be classified into three categories: low, moderate, and high PA levels according to the scoring protocol for the International Physical Activity Questionnaire [38]. The IPAQ has an additional question that inquiries about the time spent in sedentary activity and is not included as part of any summary score for physical activity. Data on this indicator should be reported as median values and interquartile ranges [2, 38]. For continuous scores, the median values and interquartile ranges are computed for walking, moderate-intensity activities, vigorous-intensity activities, and a combined total physical activity score. All continuous scores should be expressed in metabolic equivalents of task (MET)-min/week [2, 38].

Data analysis

The Jamovi and RStudio programs were used for data management and analysis. Descriptive statistics were used in the form of frequency tables to summarize categorical variables and measures of central tendency and dispersion for numerical variables. The chi-square test and Pearson's correlation were used to establish associations between variables, as appropriate. The significance level was set at 5%.

Ethical considerations

This study was conducted within the framework of the Program of Initiation to Scientific Research of the Network of Student Researchers in Neurosciences and was approved by the Department of Medical Psychology of the

School of Medical Sciences at the National University of Asuncion, Paraguay (Reference 004-002-2024). The data were treated with confidentiality, equality, and justice, in accordance with the principles of the Declaration of Helsinki. Participants who required feedback from the survey were invited to write their e-mail addresses to receive useful information or suggestions.

Results

Among the participants, based on the IPAQ, 64 individuals (20.2%) reported high levels of physical activity, 96 (30.3%) reported moderate levels, and 156 (49.5%) reported low levels. No significant association was observed between IPAQ physical activity levels and sociodemographic characteristics (Table 1).

According to dichotomized DASS-21 scores, 65.3% reported symptoms of depression, 68.5% anxiety, and 66.6% experienced stress. The severity levels of each diagnosis (i.e., extremely severe, severe, mild, moderate, and none) are presented in Table 2. A relationship between physical activity and anxiety levels was found as individuals with extremely severe anxiety tended to report low levels of physical activity ($p = 0.024$).

The median total METs was 753; therefore, 50% of the participants reported at least this value (interquartile range [IQR] = 2432). The activity with the lowest median value was vigorous activity, as more than 50% did not perform

this level of activity, whereas the highest median MET was reported for walking. The median sitting time per week was 240 min (IQR, 280 min).

The total physical activity in terms of metabolic equivalents per minute per week was negatively correlated with the three studied mental health components: depression ($r = -0.167$, $p = 0.003$), anxiety ($r = -0.141$, $p = 0.012$), and stress ($r = -0.133$, $p = 0.018$). All correlations were inverse, implying that higher levels of physical activity were associated with lower levels of depression, anxiety, and stress. This was also significant for intense physical activity, whereas moderate activity was associated with improvement in depressive symptoms (Table 4).

Discussion

The relationship between physical activity and mental health among university students is of increasing interest, especially in the context of educational programs and academic activities introduced to improve students' well-being after the COVID-19 pandemic [30]. The COVID-19 pandemic has significantly altered physical activity behaviors, with numerous studies reporting a global decline in physical activity levels due to lockdowns, social distancing, and the transition to online learning environments [4, 6]. This is particularly relevant to our study, as the pandemic likely contributed to the high prevalence of low physical activity levels observed among our participants. University

Table 1. Sociodemographic characteristics in relation to physical activity levels of participants (N = 317)

Characteristics	Total sample		Physical activity level						p-value
			Low		Moderate		High		
	n	%	n	%	n	%	n	%	
Gender									
Male	97	30.6	43	13.6	30	9.5	24	7.6	0.330
Female	220	69.4	114	36.0	66	20.8	40	12.6	
Residence									
Asunción	108	34.1	47	14.8	37	11.7	24	7.6	0.243
Central Department	182	57.4	92	29.0	55	17.4	35	11.0	
Rest of the country	27	8.5	18	5.7	4	1.3	5	1.6	
Area of Science									
Agricultural, Natural, and Botanical	34	10.7	19	6.0	8	2.5	7	2.2	0.913
Social Sciences and Humanities	57	18.0	30	9.5	17	5.4	10	3.2	
Health, Biology, and Chemistry	167	52.7	82	25.9	50	15.8	35	11.0	
Engineering, Mathematics, Informatics, and Physics	59	18.6	26	8.2	21	6.6	12	3.8	
Employment									
Studies and works	137	43.2	66	20.8	47	14.8	24	7.6	0.328
Only studies	180	56.8	91	28.7	49	15.5	40	12.6	

Table 2. Levels of depression, anxiety, and stress in relation to participants' physical activity (N = 317)

Characteristics	Total sample		Physical activity level						p-value
			Low		Moderate		High		
	n	%	n	%	n	%	n	%	
Depression									
Extremely severe	61	19.2	37	11.7	14	4.4	10	3.2	0.148
Severe	46	14.5	27	8.5	12	3.8	7	2.2	
Mild	23	7.3	9	2.8	11	3.5	3	0.9	
Moderate	77	24.3	39	12.3	23	7.3	15	4.7	
No depression	110	34.7	45	14.2	36	11.4	29	9.1	
Anxiety									
Extremely severe	80	25.2	54	17.0	15	4.7	11	3.5	0,024
Severe	40	12.6	16	5.0	12	3.8	12	3.8	
Mild	22	6.9	10	3.2	7	2.2	5	1.6	
Moderate	75	23.7	36	11.4	27	8.5	12	3.8	
No anxiety	100	31.5	41	12.9	35	11.0	24	7.6	
Stress									
Extremely severe	22	6.9	15	4.7	4	1.3	3	0.9	0.067
Severe	71	22.4	44	13.9	17	5.4	10	3.2	
Mild	54	17.0	19	6.0	22	6.9	13	4.1	
Moderate	64	20.2	32	10.1	21	6.6	11	3.5	
No stress	106	33.4	47	14.8	32	10.1	27	8.5	

Table 3. METs for physical activity (N = 317)

Physical activity	Median	Q1	Q3	Interquartile range
Sedentary activity (min/day)	240	120	400	280
Walking MET-min/week	165	0	396	396
Moderate MET-min/week	60	0	400	400
Vigorous MET-min/week	0	0	1920	1920
Total physical activity MET-min/week	743	158	2590	2432

MET: Metabolic Equivalent of Task.

Table 4. Correlation matrix of METs for physical activity in relation to participants' mental health scores (N=317)

Physical activity	Depression r (p-value)	Anxiety r (p-value)	Stress r (p-value)
Sedentary activity (min/day)	−0.09 (0.114)	−0.06 (0.300)	−0.10 (0.089)
Walking MET-min/week	−0.08 (0.138)	−0.07 (0.231)	−0.06 (0.258)
Moderate MET-min/week	−0.12 (0.034)	−0.10 (0.065)	−0.07 (0.192)
Vigorous MET-min/week	−0.16 (0.006)	−0.13 (0.020)	−0.13 (0.020)
Total physical activity MET-min/week	−0.17 (0.003)	−0.14 (0.012)	−0.13 (0.018)

MET: Metabolic Equivalent of Task; r = Pearson's correlation.

students may have faced additional barriers, such as limited access to sports facilities, restricted outdoor movement, and increased academic pressures during this period [9]. Unfortunately, owing to the absence of pre-pandemic data

on physical activity levels among university students in Paraguay, direct comparisons are not feasible. However, our findings can serve as a baseline for future studies on this population, enabling comparisons over time.

Our findings indicated that the most prevalent type of physical activity among the sample was low, according to the IPAQ. This is in contrast to a recent systematic review that found that university students typically engage in moderate levels of physical activity [16]. These discrepancies may reflect cultural and environmental differences, as well as variations in the academic programs in which students are engaged. For instance, a study in Paraguay targeting the general population found moderate levels of physical activity, suggesting that university students might differ significantly from the general population in their physical activity behaviors [23]. It is important to consider that physical activity levels during the pandemic decreased globally, with university students particularly affected by the closure of gyms, limitations on group sports, and restricted access to public spaces [18]. These restrictions could explain the low activity levels reported in our sample.

The fact that the majority of participants exhibited low levels of physical activity is concerning, given the high prevalence of depression (65.3%), anxiety (68.5%), and stress (66.6%), as measured with the DASS-21. However, these findings are consistent with global evidence indicating a robust inverse relationship between physical activity levels and the severity of mental health symptoms [13, 14, 31]. For example, research has emphasized the negative impact of the pandemic on both physical activity and mental health, with lockdowns and social isolation leading to increased sedentary behavior and heightened stress and anxiety [27]. Thus, the mental health challenges observed in our study may have been exacerbated by the pandemic, creating conditions that hindered both physical and mental well-being. In terms of institutional responses, Paraguayan universities implemented strategies to address the decline in general well-being during the pandemic. For example, the National University Asunción, early in 2020, established a Mental Health Department to provide counseling on healthy lifestyles, including physical activity, and mental health support and treatment to the student body [3]. However, the long-term effectiveness of these interventions remains to be evaluated, particularly in terms of their impact on mental health recovery after the pandemic.

No significant associations were found between sociodemographic factors and physical activity, suggesting that the observed mental health benefits of physical activity are potentially universal across different demographic groups [13, 21]. In contrast, in Norway, low activity levels were associated with higher rates of depression and self-harm, especially among women [11]. Furthermore, while it is reasonable to hypothesize that students from different academic areas might engage in different types or levels of physical activity due to the nature of their academic workload or field of study, our data showed no significant variation in physical activity levels based on academic

background, indicating that factors beyond the faculty of study may play a more influential role in determining physical activity patterns among students [17].

Consistent with broader research, our results showed high levels of depression, anxiety, and stress among students, with these conditions affecting 65.3%, 68.5%, and 66.6% of the students, respectively. Similar trends have been observed in university populations in Spain and other parts of Paraguay, reinforcing the widespread nature of these issues among students [24, 25]. Our results indicated that anxiety levels were particularly higher among students with lower physical activity levels. This is consistent with the findings of Ji et al. (2022), who noted a significant reduction in anxiety symptoms among college students who engaged in regular physical activities, particularly group exercises that provided social support and enhanced interpersonal connections [15]. The mediating role of physical activity in anxiety reduction underscores its potential as a preventive measure as well as a therapeutic intervention for mental health management among students. Our findings added a nuanced perspective that even low-to-moderate-intensity aerobic exercise may significantly improve mental health parameters, especially in alleviating depressive symptoms and perceived stress.

Vigorous physical activity in our study was the least common among participants, whereas walking was the most frequently reported. Despite the popularity of walking, it was not significantly correlated with mental health outcomes, suggesting that physical activity intensity may play a critical role in mediating psychological benefits. This is supported by the findings of Zhang et al., who reported that high-intensity physical activity had a more pronounced effect on improving mental health outcomes in university students [36].

Furthermore, total METs showed an inverse relationship with depression, anxiety, and stress levels, indicating that higher overall physical activity levels were associated with fewer mental health symptoms. This relationship was particularly strong for vigorous activities, which reinforced evidence that higher-intensity activities might contribute more significantly to mental health improvements than moderate – or low-intensity exercises [12, 22].

The lack of correlation between sedentary behavior and mental health outcomes in our study contradicted findings from other studies, such as that by Savage et al., which showed a negative impact of sedentary lifestyles on mental health [30]. This discrepancy may be due to cultural, environmental, or study design differences, highlighting the need for further research exploring these associations in the Paraguayan context.

One of the key strengths of this study was the comprehensive assessment of physical activity across a large student population using a validated instrument such as the IPAQ and the DASS-21 for mental health assessment.

Furthermore, this study collected data from South America, a region that is often underrepresented in global mental health research. Focusing on Paraguayan university students, the findings offered insights into local public health strategies.

Several limitations in this study must be acknowledged. First, the cross-sectional nature of the study limited its ability to establish causality between physical activity and mental health outcomes. Longitudinal studies are needed to determine the directionality of these relationships and observe changes over time. Another limitation is the reliance on self-reported data, which may lead to social desirability or recall bias. Although the IPAQ and DASS-21 are validated tools, the accuracy of the responses may still be influenced by participants' perceptions and willingness to report their true behaviors and feelings. As previously mentioned, another significant limitation is the absence of pre-pandemic information on physical activity patterns among Paraguayan university students, which hinders direct comparisons. Another limitation of this study is the lack of distinction between participants from public and private universities. This would have been useful because students from public and private universities may experience different academic pressures, access to physical activity resources, and socioeconomic conditions, all of which could influence their physical activity levels and mental health outcomes. Finally, the overrepresentation of women may have biased our results.

Despite these limitations, the study findings are compelling, particularly regarding the inverse correlation between high levels of physical activity and low levels of depression, anxiety, and stress. The relevance of vigorous physical activity in reducing mental health symptoms suggests that interventions focusing on physical exercise could be particularly beneficial in universities [7].

Conclusion

This study demonstrated a significant inverse relationship between physical activity levels and mental health symptoms, with higher levels of physical activity being associated with lower rates of depression, anxiety, and stress among Paraguayan university students. Notably, vigorous physical activity showed the strongest correlation with improved mental health outcomes, particularly in reducing depressive symptoms and perceived stress, whereas walking, although popular, did not yield significant psychological benefits. These findings emphasize the critical role of physical activity intensity in mediating mental health improvements.

The high prevalence of mental health challenges observed in this study, with over 65% of students reporting symptoms of depression, anxiety, or stress, underscores

the urgent need for universities to prioritize student well-being. The results support the integration of structured, high-intensity physical activity programs into university health services, which could serve both preventive and therapeutic functions in mitigating mental health issues.

Moreover, this study provides an important baseline for future research on physical activity and mental health in Paraguayan university students, especially in the post-pandemic context, where physical activity patterns have shifted. Future research should focus on longitudinal studies to determine the long-term impact of physical activity on mental health and explore targeted interventions that can be tailored to the specific needs of university populations.

Conflict of interest: Authors state no conflict of interest.

References

1. Aboaja A., Wahab A., Cao Y.Y., O'Higgins M., Torales J. (2022) Mental health in the republic of Paraguay. *BJPsych. Int.*, 19(1): 10–12. DOI: 10.1192/bji.2021.24
2. Ainsworth B.E., Haskell W.L., Whitt M.C., Irwin M.L., Swartz A.M., Strath S.J., O'Brien W.L., Bassett D.R., et al. (2000) Compendium of Physical Activities: an update of activity codes and MET intensities. *Med. Sci. Sports Exerc.*, 32(Supplement): S498–S516. DOI: 10.1097/00005768-200009001-00009
3. Amarilla D., Cacace-Vely C., Fretes-Fariña R., Hiebl-Espinoza A., Huang-Liao M., Liñan-Leguizamón A., López-González M., Vera-Gómez P., et al. (2021) National University of Asunción medical students' perceptions on mental health and on the barriers to accessing mental healthcare services offered by the institution. *An. Fac. Cienc. Médicas Asunción*, 54(1): 109–124. DOI: 10.18004/anales/2021.054.01.109
4. Ammar A., Brach M., Trabelsi K., Chtourou H., Boukhris O., Masmoudi L., Bouaziz B., Bentlage E., et al. (2020) Effects of COVID-19 Home Confinement on Eating Behaviour and Physical Activity: Results of the ECLB-COVID19 International Online Survey. *Nutrients*, 12(6): 1583. DOI: 10.3390/nu12061583
5. Antony M.M., Bieling P.J., Cox B.J., Enns M.W., Swinson R.P. (1998) Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychol. Assess.*, 10(2): 176–181. DOI: 10.1037/1040-3590.10.2.176
6. Camerini A.-L., Albanese E., Marciano L. (2022) The impact of screen time and green time on mental health in children and adolescents during the COVID-19 pandemic. *Comput. Hum. Behav. Rep.*, 7: 100204. DOI: 10.1016/j.chbr.2022.100204

7. Carballo-Fazanes A., Rico-Díaz J., Barcala-Furelos R., Rey E., Rodríguez-Fernández J.E., Varela-Casal C., Abelaíras-Gómez C. (2020) Physical Activity Habits and Determinants, Sedentary Behaviour and Lifestyle in University Students. *Int. J. Environ. Res. Public. Health*, 17(9): 3272. DOI: 10.3390/ijerph17093272
8. Craig C.L., Marshall A.L., Sjöström M., Bauman A.E., Booth M.L., Ainsworth B.E., Pratt M., Ekelund U., et al. (2003) International Physical Activity Questionnaire: 12-Country Reliability and Validity: *Med. Sci. Sports Exerc.*, 35(8): 1381–1395. DOI: 10.1249/01.MSS.0000078924.61453.FB
9. Gallè F., Sabella E.A., Ferracuti S., De Giglio O., Caggiano G., Protano C., Valeriani F., Parisi E.A., et al. (2020) Sedentary Behaviors and Physical Activity of Italian Undergraduate Students during Lockdown at the Time of CoViD-19 Pandemic. *Int. J. Environ. Res. Public. Health*, 17(17): 6171. DOI: 10.3390/ijerph17176171
10. Gosling S.D., Vazire S., Srivastava S., John O.P. (2004) Should We Trust Web-Based Studies? A Comparative Analysis of Six Preconceptions About Internet Questionnaires. *Am. Psychol.*, 59(2): 93–104. DOI: 10.1037/0003-066X.59.2.93
11. Grasdalsmoen M., Eriksen H.R., Lønning K.J., Sivertsen B. (2020) Physical exercise, mental health problems, and suicide attempts in university students. *BMC Psychiatry*, 20(1):, 175. DOI: 10.1186/s12888-020-02583-3
12. Guo S., Liu F., Shen J., Wei M., Yang Y. (2020) Comparative efficacy of seven exercise interventions for symptoms of depression in college students: A network of meta-analysis. *Medicine (Baltimore)*, 99(47): e23058. DOI: 10.1097/MD.00000000000023058
13. Herbert C. (2022) Enhancing Mental Health, Well-Being and Active Lifestyles of University Students by Means of Physical Activity and Exercise Research Programs. *Front. Public Health*, 10: 849093. DOI: 10.3389/fpubh.2022.849093
14. Herbert C., Meixner F., Wiebking C., Gilg V. (2020) Regular Physical Activity, Short-Term Exercise, Mental Health, and Well-Being Among University Students: The Results of an Online and a Laboratory Study. *Front. Psychol.*, 11: 509. DOI: 10.3389/fpsyg.2020.00509
15. Ji C., Yang J., Lin L., Chen S. (2022) Physical Exercise Ameliorates Anxiety, Depression and Sleep Quality in College Students: Experimental Evidence from Exercise Intensity and Frequency. *Behav. Sci.*, 12(3): 61. DOI: 10.3390/bs12030061
16. Kljajević V., Stanković M., Đorđević D., Trkulja-Petković D., Jovanović R., Plazibat K., Oršolić M., Čurić M., et al. (2021) Physical Activity and Physical Fitness among University Students – A Systematic Review. *Int. J. Environ. Res. Public. Health*, 19(1): 158. DOI: 10.3390/ijerph19010158
17. Kwan M.Y., Cairney J., Faulkner G.E., Pullenayegum E.E. (2012) Physical Activity and Other Health-Risk Behaviors During the Transition Into Early Adulthood. *Am. J. Prev. Med.*, 42(1): 14–20. DOI: 10.1016/j.amepre.2011.08.026
18. Lesser I.A., Nienhuis C.P. (2020) The Impact of COVID-19 on Physical Activity Behavior and Well-Being of Canadians. *Int. J. Environ. Res. Public. Health*, 17(11): 3899. DOI: 10.3390/ijerph17113899
19. Morrison R.M., Pidgeon A. (2017) Cultivating Resilience and Self-control among University Students: An Experimental Study. *Univers. J. Psychol.*, 5(1): 1–7. DOI: 10.13189/ujp.2017.050101
20. Muñoz Navarro S.R. (2014) How many subjects do I need to power my study? *Medwave*, 14(06): e5995–e5995. DOI: 10.5867/medwave.2014.06.5995
21. Murphy M.H., Carlin A., Woods C., Nevill A., MacDonncha C., Ferguson K., Murphy N. (2018) Active Students Are Healthier and Happier Than Their Inactive Peers: The Results of a Large Representative Cross-Sectional Study of University Students in Ireland. *J. Phys. Act. Health*, 15(10): 737–746. DOI: 10.1123/jpah.2017-0432
22. Murray A., Marenus M., Cahuas A., Friedman K., Ottensoser H., Kumaravel V., Sanowski J., Chen W. (2022) The Impact of Web-Based Physical Activity Interventions on Depression and Anxiety Among College Students: Randomized Experimental Trial. *JMIR Form. Res.*, 6(4): e31839. DOI: 10.2196/31839
23. National University of Asuncion, Multidisciplinary Center of Technological Research, San Lorenzo, Paraguay, Meza-Miranda E.R., Giménez J., Police Hospital Rigoberto Caballero, Asunción, Paraguay. (2021) Level of physical activity and quality of life associated with health in Paraguay adults. *Exerc. Qual. Life*, 13(2): 5–11. DOI: 10.31382/eqol.211201
24. Ovelar Coronel E., Pereira L. (2023) Aplicación de la Escala de Depresión, Ansiedad y Estrés – 21 a estudiantes universitarios de ingeniería y matemáticas. *Rev. Ing. Cienc. Soc.*, 5(1): 91–104. DOI: 10.47133/facet-unc-2023-1-6g
25. Ramón-Arbués E., Martínez Abadía B., Granada López J.M., Echániz Serrano E., Pellicer García B., Juárez Vela R., Guerrero Portillo S., Saéz Guinoa M. (2019) Eating behavior and relationships with stress, anxiety, depression and insomnia in university students. *Nutr. Hosp.*, 36: 1339–1345. DOI: 10.20960/nh.02641
26. Reyes-Molina D., Alonso-Cabrera J., Nazar G., Parra-Rizo M.A., Zapata-Lamana R., Sanhueza-Campos C., Cigarroa I. (2022) Association between the Physical Activity Behavioral Profile and Sedentary Time with Subjective Well-Being and Mental Health in Chilean University Students during the COVID-19 Pandemic. *Int. J. Environ. Res. Public. Health*, 19(4): 2107. DOI: 10.3390/ijerph19042107

27. Ricci P., Pallocci M., Treglia M., Ricci S., Ferrara R., Zanollo C., Passalacqua P., Damato F.M. (2023) The Effect of Physical Exercise during COVID-19 Lockdown. *Healthcare*, 11(11): 1618. DOI: 10.3390/healthcare11111618
28. Ruiz F.J., García Martín M.B., Suárez Falcón J.C., Odrizola González P. (2017) The hierarchical factor structure of the Spanish version of Depression Anxiety and Stress Scale – 21. *Int. J. Psychol. Psychol. Ther.*, 17(1): 97–105.
29. Santos G.C.J., Rino M.J., Da Silva Lima V.L., Santos J.A., Da Silva Fidelis D.E., Ramos T.L., De Andrade A.J., De Lira C.T.C., et al. (2023) Physical activity and mental health in Brazilian university students: An analysis in different sexes during the COVID-19 pandemic. *Biomed. Hum. Kinet.*, 15(1): 113–120. DOI: 10.2478/bhk-2023-0014
30. Savage M.J., Hennis P.J., Magistro D., Donaldson J., Healy L.C., James R.M. (2021) Nine Months into the COVID-19 Pandemic: A Longitudinal Study Showing Mental Health and Movement Behaviours Are Impaired in UK Students. *Int. J. Environ. Res. Public. Health*, 18(6): 2930. DOI: 10.3390/ijerph18062930
31. (2022) *Scoring protocol for the International Physical Activity Questionnaire (IPAQ)* <https://sites.google.com/view/ipaq/score>
32. Snedden T.R., Scerpella J., Kliethermes S.A., Norman R.S., Blyholder L., Sanfilippo J., McGuine T.A., Heiderscheit B. (2019) Sport and Physical Activity Level Impacts Health-Related Quality of Life Among Collegiate Students. *Am. J. Health Promot.*, 33(5): 675–682. DOI: 10.1177/0890117118817715
33. Torales J., Barrios I. (2023) Diseño de investigaciones: algoritmo de clasificación y características esenciales. *Med. Clínica Soc.*, 7(3): 210–235. DOI: 10.52379/mcs.v7i3.349
34. Torales J.C., Castaldelli-Maia J.M., O'Higgins M.G., Florio L., Almirón Santacruz J., Barrios J.I., Navarro R., García O.E., et al. (2021) Índice de vulnerabilidad CAPE: Compasión, Acción Asertiva, Pragmatismo y Evidencia – Versión para América Latina y el Caribe (CAPE VI – LAC) “Globalización, conflicto, cambio climático, desastres naturales: poner la salud mental en la política exterior.” *An. Fac. Cienc. Médicas Asunción*, 54(1): 21–50. DOI: 10.18004/anales/2021.054.01.21
35. Torales J., Torres-Romero A.D., Di Giuseppe M.F., Rolón-Méndez E.R., Martínez-López P.L., Heinichen-Mansfeld K.V., Barrios I., O'Higgins M., et al. (2022) Technostress, anxiety, and depression among university students: A report from Paraguay. *Int. J. Soc. Psychiatry*, 68(5): 1063–1070. DOI: 10.1177/00207640221099416
36. Wei M.X., Liu Z. (2023) A Questionnaire-Based Study to Compare the Psychological Effects of 6 Weeks of Exercise in 123 Chinese College Students. *Med. Sci. Monit. Basic Res.*, 29: e939096. DOI: 10.12659/MSM-BR.939096
37. Zhang J., Zheng S., Hu Z. (2022) The Effect of Physical Exercise on Depression in College Students: The Chain Mediating Role of Self-Concept and Social Support. *Front. Psychol.*, 13: 841160. DOI: 10.3389/fpsyg.2022.841160
38. Zhang S.X., Batra K., Xu W., Liu T., Dong R.K., Yin A., Delios A.Y., Chen B.Z., et al. (2022) Mental disorder symptoms during the COVID-19 pandemic in Latin America – a systematic review and meta-analysis. *Epidemiol. Psychiatr. Sci.*, 31: e23. DOI: 10.1017/S2045796021000767

Received 27.06.2024

Accepted 04.10.2024

© University of Physical Education, Warsaw, Poland