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## ANALYSIS OF THE IMPACT OF THE CORONAVIRUS PANDEMIC ON THE LEVEL OF PHYSICAL ACTIVITY OF UNIVERSITY STUDENTS IN GOIÁS USING THE IPAQ QUESTIONNAIRE: RETROSPECTIVE COHORT STUDY

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### ABSTRACT

During the COVID-19 pandemic, classes in graduate courses at Higher Education Institutions in Goiás, Brazil, were suspended in 2020 and part of 2021. This research aimed to evaluate the impact of the COVID-19 pandemic on the physical activity (PA) practice of university students in the state of Goiás. A cross-sectional descriptive prevalence study was carried out. The data were obtained using a form created using the Google Forms platform and sent to 373 university students in Goiás in August 2021. The questionnaire included personal and anthropometric data, and the "International Physical Activity Questionnaire" (IPAQ) was answered for the period before and after the pandemic; a significance level of  $p < 0.05$  was adopted. Our research demonstrated a high percentage of inactive academics before (35.6%) and after (37.5%) the pandemic. It was evident that when essential changes were imposed on everyone's routines in times of adversity, university students intensified their basic (pre-pandemic) behavior: those previously active tended to remain active and improve their diet. In contrast, the inactive ones became even more inactive and ate worse. A higher percentage of women remained or became inactive during the pandemic.

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## INTRODUCTION

Covid-19 is a new disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV 2) first identified in Wuhan, China, on December 1, 2019. On March 11, 2020, the Organization World Health Organization (WHO) declared a COVID-19 pandemic, a fact responsible for changing the frequency of physical exercise for many individuals<sup>1</sup>. In this scenario, since there was no vaccine or specific treatment available, much was discussed about habits that could positively or negatively interfere with the effectiveness of the immune system, including the practice of physical activity (PA). Regular exercise is one of the pillars of a healthy life for all age groups. Practicing PA improves cardiovascular health, lowers blood pressure, helps control body weight, and protects against various diseases<sup>2</sup>. Exercise contributes to the proper functioning of immunity, as promoting circulation allows immune system cells and substances to move freely throughout the body and act efficiently<sup>3</sup>. In recent years, the world has observed two pandemics, that of COVID-19 and the considerable decrease in the practice of physical activities and an

increase sedentary behaviors among people of all ethnicities, socioeconomic conditions, and age groups<sup>4</sup>. In Brazil, AF was linked to disputes over narratives and practices about whether to maintain social distancing. Some positions advocated that only groups at risk for COVID-19 worsening should adopt social distancing; others advocated more restrictive measures. Such clashes reached the highest level of the Brazilian judiciary<sup>5</sup>, culminating in the closure of gyms and restricting access to public places. In a publication in a newspaper with a large national circulation in June 2020, the author emphasizes, "It is time to talk about another pandemic, that of physical inactivity." It states that one in every ten deaths on the planet can be attributed to insufficient PA; in addition, there is a projection of an increase in deaths if physical inactivity is intensified due to social isolation<sup>6</sup>. On the same topic, Peçanha et al. (2020) state that physical inactivity of 3 to 6 hours already harms cardiovascular health. Such harm would be worsened if the periods without PA were extended. In addition, the authors state that, although fundamental, achieving a particular duration and intensity of PA has become a challenge in times of social isolation<sup>7</sup>. The suspension of so-called non-essential activities included graduate courses at the Federal University of Goiás (UFG) and other Higher Education Institutions

(HEIs) in the state in 2020 and part of 2021. The suspension of in-person activities aimed to interrupt the coronavirus contamination cycle and preserve the health of the university's students, teachers, and employees and represented an impact factor in the academic sphere for students. The new EAD (Distance Study) teaching style associated with the closure of sports practice scenarios negatively impacted the practice of PA and, consequently, the quality of life and physical and emotional health of students<sup>8</sup>. The main objective of this research was to evaluate the impact of the COVID-19 pandemic on the PA practice of university students in the state of Goiás. The secondary objectives were to describe the students' physical activity habits, compare the degree of physical activity BEFORE and AFTER the COVID-19 pandemic, evaluate clinical and sociodemographic variables of Active and inactive academics and those who changed their PA level during the pandemic, and describe the academic's perception of the impact that the Covid-19 Pandemic had on their lifestyle habits.

## METHODOLOGY

A descriptive cross-sectional prevalence study was carried out. Data were obtained using a form created via the Google Forms platform and sent to 373 university students in Goiás in August 2021. The project was submitted and approved by the UFG Research Ethics Committee (CAAE: 45027921.5.0000.5083). Students under 18 were excluded and did not respond to the entire questionnaire. The questionnaire included personal and anthropometric data, subjective qualification of physical activity (PA), and the "International Physical Activity Questionnaire" (IPAQ) in its short version answered for the period before and after the pandemic<sup>9</sup>.

According to the answers obtained by the questionnaire, participants were divided into groups: very active, active, irregularly active A, irregularly active B, and sedentary according to the classification according to IPAQ9. Based on the traditional IPAQ classification described above, we divided academics into "Active" and "Inactive." The "Active" group comprised individuals classified as active and very active by the IPAQ. In contrast, the "Inactive" group included individuals classified as sedentary, irregularly active A, and irregularly active B by the IPAQ. Statistical analyses were done using SPSS (Statistical Package for Social Science) version 26.0. The parametricity of the data was verified using the Kolmogorov-Smirnov test. The demographic, anthropometric profile, physical activity habits, and the pandemic's impact on practices were characterized using mean, standard deviation, absolute frequency, and relative frequency. IPAQ was associated with the sample profile using Pearson's Chi-square, Posthoc Chi-square, Student's t-test, and Analysis of Variance (ANOVA). A significance level of 5% ( $p < 0.05$ ) was adopted in all analyses.

## RESULTS

The study included responses from 373 undergraduate students, 192 (51.5%) female and 181 (48.5%) males. The average age of participants was 21.88 years. The results of anthropometric measurements demonstrated that the participants' average height was 170.47 cm, their average weight was 67.23 kg, and their average BMI was 22.99. Most of the students (84.2%) were studying medicine, with the Federal University of Goiás (UFG) being the predominant institution with 217 (58.2%) students. Regarding the period studied, 105 (28.2%) were in the first period, 101 (27.1%) in the second to

**Table 1. Characterization of the level of physical activity according to the groups originating from the IPAQ classification**

Groups	n (%)	IPAQ Classification	n (%)
Before Pandemic		Before Pandemic	
Inactive	133 (35.6)	Sedentary	42 (11.3)
		Irregularlyactive A	41 (11.0)
		Irregularlyactive B	50 (13.4)
Active	240 (64.4)	Active	130 (34.9)
		Very Active	110 (29.5)
Groups AfterPandemic		IPAQ Classification AfterPandemic	
Inactive	140 (37.5)	Sedentary	34 (9.1)
		Irregularlyactive A	50 (13.4)
		Irregularlyactive B	56 (15.0)
Active	233 (62.5)	Active	147 (39.4)
		Very Active	86 (23.1)

n = absolute frequency; % = relative frequency

**Table 2. Perception of the impact of the pandemic on weight, routine activities, level of physical activity, nutrition, and professional training according to the level of physical activity.**

	Groups AFTER Pandemic		Total	p*
	Active n (%)	Inactive n (%)		
Weight BEFORE x AFTER the pandemic	233 (62.5)	140 (37.5)		
I increased my weight	107 (45.9)	62 (44.3)	169 (45.3)	0.96
I maintained my weight	73 (31.3)	45 (32.1)	118 (31.6)	
I lost weight	53 (22.7)	33 (23.6)	86 (23.1)	
Routine BEFORE x AFTER the pandemic				
Less active	106 (45.5)	99 (70.7)‡	205 (55.0)	<0.01
Same active	25 (10.7)	16 (11.4)	41 (11.0)	0.11
More Active	102 (43.8)‡	25 (17.9)	127 (34.0)	0.01
PA BEFORE x AFTER the pandemic				
I stopped practicing PA	17 (7.3)	53 (37.9)‡	70 (18.8)	<0.01
I reduced PA	52 (22.3)	44 (31.4)‡	96 (25.7)	0.03
I maintained PA	42 (18.0)‡	16 (11.4)	58 (15.5)	0.02
I started practicing PA	50 (21.5)‡	12 (8.6)	62 (16.6)	0.01
I increased my PA	72 (30.9)‡	15 (10.7)	87 (23.3)	0.01
Nutrition BEFORE x AFTER the pandemic				
I am eating worse	54 (23.2)	48 (34.3)‡	102 (27.3)	0.02
I am eating the same way	69 (29.6)	69 (49.3)‡	138 (37.0)	0.02
I am eating better	110 (47.2)‡	23 (16.4)	133 (35.7)	0.01
Did the pandemic impact professional training?				
No	9 (3.9)	15 (10.7)	24 (6.4)	<0.01
Yes	224 (96.1)	125 (89.3)	349 (93.6)	

\*Pearson chi-square; ‡Posthoc; n = absolute frequency; % = relative frequency

fourth period, 138 (37%) in the fifth to seventh period, and 29 (7.8%) in the eighth to twelfth period. Regarding the education system, 196 (52.5%) participants were fully distance learning, 157 (42.1%) via a hybrid approach, and only 20 (5.4%) were entirely in-person. Most academics were active before the pandemic (64.4%), and this predominance continued after the pandemic (62.5%). Table 1 shows the characterization of the level of physical activity according to the IPAQ and the proposed subgroups, both before and after the pandemic's start. Table 2 compares the groups of active and inactive academics after the start of the pandemic with the perception of weight change, routine activities, degree of physical exercise, diet, and professional training of the participants. Regarding weight change before and after the pandemic, we did not observe a significant difference between the groups ( $p=0.96$ ).

remained active after it. Of the 233 students active after the pandemic, 170 (73.0%) were already active before it, while 63 (27.0%) were inactive before and became active after the pandemic. Of the 140 academics who were inactive after the pandemic, 70 (50%) were already inactive before, and the other 70 (50%) were active before and became inactive after the pandemic. Among the 133 who were inactive before the pandemic, 63 (47.4%) became active after the pandemic. We proposed the name "A→I" for participants who were active before the pandemic and who became inactive after the pandemic. At the same time, we call "I↔I" participants who were inactive before and who remained inactive. Likewise, participants who were active before the pandemic and remained active after it was designated as "A↔A" and those inactive before and who became active as "I→A."

**Table 3. Comparison of pre-pandemic IPAQ with IPAQ during the pandemic**

	Groups BEFORE pandemic		Total	p*
	Active n (%)	Inactive n (%)		
Groups AFTER pandemic				
Activen (%)	170 (70.8)	63 (47.4)	233 (62.5)	<0.01
Inactiven (%)	70 (29.2)	70 (52.6)	140 (37.5)	
Total n (%)	240 (64.3)	133 (35.7)	373 (100)	

\*Pearson chi-square; ‡Posthoc; n = absolute frequency; % = relative frequency

**Table 4. Demographic and anthropometric profile according to groups according to the IPAQ classification before and after the pandemic**

	Groups according to FAbefore and after pandemic				p*
	A → I n (%)	I ↔ I n (%)	A ↔ A n (%)	I → A n (%)	
	70 (18.8)	70 (18.8)	170 (45.6)	63 (16.9)	
Mean ± DP					
Age (years)	22.20 ± 5.01	21.79 ± 3.85	21.89 ± 3.66	21.62 ± 3.05	0.85*
Stature (cm)	169.49 ± 9.67	168.23 ± 8.72	171.99 ± 9.76	169.94 ± 8.82	0.09*
Weight (kg)	65.29 ± 14.08	63.83 ± 17.28	69.34 ± 13.59	67.45 ± 16.22	0.05*
BMI (kg/m <sup>2</sup> )	22.63 ± 4.04	22.40 ± 5.02	23.30 ± 3.23	23.20 ± 4.78	0.36*
n (%)					
Sex					
Female	37 (52.9)	45 (64.3)	76 (44.7)	34 (54.0)	0.05**
Male	33 (47.1)	25 (35.7)	94 (55.3)	29 (46.0)	
Course					
Medicine	60 (85.7)	59 (84.3)	144 (84.7)	51 (81.0)	0.88**
Other courses	10 (14.3)	11 (15.7)	26 (15.3)	12 (19.0)	
Institution					
Other Institutions	27 (38.6)	36 (51.4)	63 (37.1)	30 (47.6)	0.14**
UFG	43 (61.4)	34 (48.6)	107 (62.9)	33 (52.4)	
Period					
1	23 (32.9)	21 (30.0)	40 (23.5)	21 (33.3)	0.25**
2 a 4	25 (35.7)	18 (25.7)	42 (24.7)	16 (25.4)	
5 a 7	16 (22.9)	26 (37.1)	75 (44.1)	21 (33.3)	
8 a 12	6 (8.6)	5 (7.1)	13 (7.6)	5 (7.9)	
Education system					
Hybrid (DL + In-person)	21 (30.0)	37 (52.9)	78 (45.9)	21 (33.3)	0.06**
DL	43 (61.4)	29 (41.4)	85 (50.0)	39 (61.9)	
Fully in person	6 (8.6)	4 (5.7)	7 (4.1)	3 (4.8)	

Caption: \*ANOVA; \*\*Pearson chi-square; n = absolute frequency; % = relative frequency; A → I: Active that became Inactive; I ↔ I: Inactive who remained inactive; A ↔ A: Assets that remained Active; I → A: Inactive who became Active. DL: distance learning

However, the routine of currently inactive participants is even less active than before the pandemic ( $p < 0.01$ ). In contrast, the performance of presently active participants is even more active than before the pandemic ( $p = 0.01$ ). Likewise, inactive people stopped ( $p < 0.01$ ) and reduced ( $p = 0.03$ ) physical activity after the pandemic, while active people maintained ( $p = 0.02$ ) and started ( $p = 0.01$ ) or increased ( $p = 0.01$ ) the practice of physical activity. Inactive participants reported eating worse ( $p = 0.02$ ) or in the same way ( $p = 0.02$ ) after the pandemic, while active participants reported eating better ( $p = 0.01$ ). Regarding the impact of the pandemic on the professional training of students, there was a greater perception of impact among active compared to inactive students ( $p < 0.01$ ). Table 3 presents the groups' level of physical activity before and during the pandemic. An association was observed between the habit of practicing PA before the pandemic and maintaining this routine after it ( $p < 0.01$ ). Among academics active before the pandemic, 70.8%

Table 4 compares the demographic and anthropometric profile of the participants according to whether students changed or remained in the active and inactive groups before and after the pandemic. There was no association between group change and age ( $p = 0.85$ ), height ( $p = 0.09$ ), or BMI ( $p = 0.36$ ). Likewise, no association was observed between group change and the course ( $p = 0.88$ ), institution ( $p = 0.14$ ), period studied ( $p = 0.25$ ), or the education system ( $p = 0.06$ ) of the participants. A higher percentage of females was observed in the inactive group after the pandemic, covering both I↔I and A→I participants ( $p = 0.05$ ). Table 5 details the PA practice of academics according to whether they changed or remained in active and inactive groups before and after the pandemic. There was a significant association between regular PA practice and a frequency of 5 times a week with groups A↔A and I→A ( $p < 0.01$ ). No association was found with other weekly frequencies, duration of PA, and changing or remaining in a group ( $p = 0.07$ ).

**Table 4. Demographic and anthropometric profile according to groups according to the IPAQ classification before and after the pandemic**

	Groups according to PA before and after pandemic				p*
	A → I n (%) 70 (18.8)	I ↔ I n (%) 70 (18.8)	A ↔ A n (%) 170 (45.6)	I → A n (%) 63 (16.9)	
Mean ± DP					
Age (years)	22.20 ± 5.01	21.79 ± 3.85	21.89 ± 3.66	21.62 ± 3.05	0.85*
Stature (cm)	169.49 ± 9.67	168.23 ± 8.72	171.99 ± 9.76	169.94 ± 8.82	0.09*
Weight (kg)	65.29 ± 14.08	63.83 ± 17.28	69.34 ± 13.59	67.45 ± 16.22	0.05*
BMI (kg/m <sup>2</sup> )	22.63 ± 4.04	22.40 ± 5.02	23.30 ± 3.23	23.20 ± 4.78	0.36*
n (%)					
Sex					
Female	37 (52.9)	45 (64.3)	76 (44.7)	34 (54.0)	0.05**
Male	33 (47.1)	25 (35.7)	94 (55.3)	29 (46.0)	
Course					
Medicine	60 (85.7)	59 (84.3)	144 (84.7)	51 (81.0)	0.88**
Other courses	10 (14.3)	11 (15.7)	26 (15.3)	12 (19.0)	
Institution					
Other Institutions	27 (38.6)	36 (51.4)	63 (37.1)	30 (47.6)	0.14**
UFG	43 (61.4)	34 (48.6)	107 (62.9)	33 (52.4)	
Period					
1	23 (32.9)	21 (30.0)	40 (23.5)	21 (33.3)	0.25**
2 a 4	25 (35.7)	18 (25.7)	42 (24.7)	16 (25.4)	
5 a 7	16 (22.9)	26 (37.1)	75 (44.1)	21 (33.3)	
8 a 12	6 (8.6)	5 (7.1)	13 (7.6)	5 (7.9)	
Education system					
Hybrid (DL + In-person)	21 (30.0)	37 (52.9)	78 (45.9)	21 (33.3)	0.06**
DL	43 (61.4)	29 (41.4)	85 (50.0)	39 (61.9)	
Fully in person	6 (8.6)	4 (5.7)	7 (4.1)	3 (4.8)	

Caption: \*ANOVA; \*\*Pearson chi-square; n = absolute frequency; % = relative frequency; A → I: Active that became Inactive; I ↔ I: Inactive who remained inactive; A ↔ A: Assets that remained Active; I → A: Inactive who became Active. DL: distance learning

**Table 5. Details of physical activity practice according to groups according to the IPAQ classification pre and post-pandemic**

	Groups according to PA before and after pandemic				p*
	A → I n (%) 70 (18.8)	I ↔ I n (%) 70 (18.8)	A ↔ A n (%) 170 (45.6)	I → A n (%) 63 (16.9)	
Practice PA Regularly					
No	55 (78.6)	53 (75.7)	31 (18.2)	5 (7.9)	<0.01
Yes	15 (21.4)	17 (24.3)	139 (81.8)	58 (92.1)	
Weekly frequency					
1 to 3 times	10 (66.7)	12 (70.6)	30 (21.6)	17 (29.3)	0.06
4 times	2 (13.3)	4 (23.5)	32 (23.0)	12 (20.7)	0.05
5 times	2 (13.3)	1 (5.9)	43 (30.9)‡	22 (37.9)‡	<0.01
6 to 7 times	1 (6.7)	0 (0.0)	34 (24.5)	7 (12.1)	0.10
Duration of Activity					
Between 30 minutes and 1 hour	13 (86.7)	13 (76.5)	79 (56.8)	36 (62.1)	0.07
More than 1 hour	2 (13.3)	4 (23.5)	60 (43.2)	22 (37.9)	
How long					
< 3 months	5 (33.3)	5 (29.4)‡	27 (19.4)	15 (25.9)	0.01
≥ 3 months and one year	3 (20.0)	6 (35.3)‡	25 (18.0)	26 (44.8)‡	0.02
Between 1 and 2 years	3 (20.0)	2 (11.8)	28 (20.1)	13 (22.4)	0.12
Between 2 and 5 years	1 (6.7)	3 (17.6)	26 (18.7)	0 (0.0)	0.11
More than 5 years	3 (20.0)	1 (5.9)	33 (23.7)‡	4 (6.9)	0.02
Intention to practice PA in the future					
No	0 (0.0)	2 (3.8)	0 (0.0)	0 (0.0)	0.34
Yes	53 (96.4)	47 (88.7)	31 (100.0)	5 (100.0)	
Maybe	2 (3.6)	4 (7.5)	0 (0.0)	0 (0.0)	
The primary motivation for practicing PA					
Chronic disease control	0 (0.0)	2 (11.8)	9 (6.5)	3 (5.2)	0.56
Aesthetics	11 (73.3)	9 (52.9)	97 (69.8)	43 (74.1)	0.40
Healthy lifestyle	12 (80.0)	15 (88.2)	121 (87.1)	50 (86.2)	0.99
Medical prescription	3 (20.0)	1 (5.9)	13 (9.4)	7 (12.1)	0.53
Social interaction	2 (13.3)	3 (17.6)	27 (19.4)	12 (20.7)	0.93
Weight loss	4 (26.7)	7 (41.2)	40 (28.8)	22 (37.9)	0.49
Reason for not practicing PA					
Cost	11 (20.0)	11 (20.8)	5 (16.1)	0 (0.0)	0.68
Lack of time	44 (80.0)	44 (83.0)	31 (100.0)	4 (80.0)	0.07
Physical limitation	9 (16.4)	2 (3.8)	2 (6.5)	0 (0.0)	0.10
Do not like	7 (12.7)	16 (30.2)	1 (3.2)	2 (40.0)	<0.01

Legend: \*Pearson chi-square; ‡Posthoc; n = absolute frequency; % = relative frequency; A → I: Active that became Inactive; I ↔ I: Inactive who remained inactive; A ↔ A: Assets that remained Active; I → A: Inactive who became Active.

Regarding the length of time that students had already been practicing PA, there was a significant association between students who had been performing PA regularly for less than three months with I→A participants ( $p= 0.01$ ), as well as an association between those who had this habit between 3 months and one year with participants I↔I ( $p= 0.02$ ), and the practice of PA for more than five years with group A↔A ( $p= 0.02$ ). On the other hand, there was no correlation between whether participants changed or remained in groups to practice PA in the future ( $p= 0.34$ ) nor with the participants' primary motivation for practicing PA. Furthermore, an association was observed between participants who dislike practicing PA, which is the main reason for not exercising, and the I↔I group ( $p< 0.01$ ). Still, no correlation between the groups and the other reasons not to practice PA was observed.

## DISCUSSION

Our research demonstrated a high percentage of inactive academics before (35.6%) and after (37.5%) the pandemic. It was evident that in times of adversity when essential changes were imposed on everyone's routines, university students in the state of Goiás intensified their basic (pre-pandemic) behavior: those previously active tended to remain active and improve their diet. In contrast, the inactive ones became even more passive and ate worse. The evaluation of the groups according to change or permanence in the degree of activity before and after the pandemic showed that a higher percentage of women remained or became inactive during the pandemic.

**Table 6. Perception of the impact of the pandemic on weight, routine activities, level of physical activity, nutrition, and professional training, according to the groups originating from the IPAQ classification**

	Groups according to PA practice BEFORE and AFTER the pandemic				$p^*$
	A → I n (%) 70 (18.8)	I ↔ I n (%) 70 (18.8)	A ↔ A n (%) 170 (45.6)	I → A n (%) 63 (16.9)	
Weight BEFORE x AFTER the pandemic					
I increased my weight	34 (48.6)	28 (40.0)	82 (48.2)	25 (39.7)	0.49
I kept my weight	22 (31.4)	23 (32.9)	55 (32.4)	18 (28.6)	
I lost weight	14 (20.0)	19 (27.1)	33 (19.4)	20 (31.7)	
Routine BEFORE and AFTER the pandemic					
Less active	57 (81.4)‡	42 (60.0)	89 (52.4)	17 (27.0)	<0.01
The same	2 (2.9)	14 (20.0)	21 (12.4)	4 (6.3)	0.21
More active	11 (15.7)	14 (20.0)	60 (35.3)	42 (66.7)	0.10
FA practice BEFORE and AFTER the pandemic					
I have stopped PA	36 (51.4)‡	17 (24.3)	15 (8.8)	2 (3.2)	<0.01
I have reduced the PA	23 (32.9)	21 (30.0)	50 (29.4)	2 (3.2)	0.12
I kept the former PA	5 (7.1)	11 (15.7)	39 (22.9)	3 (4.8)	0.15
I have initiated the PA	2 (2.9)	10 (14.3)	16 (9.4)	34 (54.0)‡	<0.01
I have increased the PA	4 (5.7)	11 (15.7)	50 (29.4)‡	22 (34.9)‡	0.01
Nutrition BEFORE x AFTER the pandemic					
I am eating worse	27 (38.6)‡	21 (30.0)	47 (27.6)	7 (11.1)	0.02
I am eating the same way	31 (44.3)‡	38 (54.3)‡	45 (26.5)	24 (38.1)	0.03
I am eating better	12 (17.1)	11 (15.7)	78 (45.9)‡	32 (50.8)‡	0.01
Did the pandemic impact professional training?					
No	8 (11.4)	7 (10.0)	9 (5.3)	0 (0.0)	0.02
Yes	62 (88.6)‡	63 (90.0)	161 (94.7)	63 (100.0)	

Legend: \*Pearson chi-square; ‡Posthoc; n = absolute frequency; % = relative frequency; A → I: Active that became Inactive; I ↔ I: Inactive who remained inactive; A ↔ A: Assets that remained Active; I → A: Inactive who became Active.

Table 6 shows academics' perceptions regarding the pandemic's impact on different aspects of their lives, according to active and inactive groups, before and after the pandemic. Among participants A → I, 48.6% reported gaining weight, representing the highest percentage, compared to 31.4% who maintained and 20.0% who lost weight. However, there was no statistically significant difference between the maintenance or change group with weight change. The general perception of the routine reported by academics corroborated the IPAC classification before and after the pandemic in several items asked, as we will explain below. A statistically significant association existed between participants who stopped practicing PA after the pandemic and A → I students ( $p< 0.01$ ).

At the same time, participants who started practicing PA after the pandemic are associated with I → A students ( $p< 0.01$ ), while among academics who increased their PA practice after the pandemic, a correlation was observed with groups A ↔ A and I → A ( $p= 0.01$ ). Experiencing a less active routine after the pandemic was the most frequent finding among A → I participants, representing 81.4% of them ( $p< 0.01$ ). Regarding food, we observed that reporting that they were eating worse after the pandemic occurred mainly among students who were in group A → I ( $p= 0.02$ ). On the other hand, participants who reported eating better belonged primarily to student groups A ↔ A and I → A ( $p= 0.01$ ). Concerning a college, the report that the pandemic directly impacted professional training received the most responses in all groups. However, it showed a significant relationship with participants A → I ( $p= 0.02$ ).

Concerning the results that obtained a significant difference, there was a perception of increased adiposity, worsening dietary quality, and a more substantial impact on academic training in group A → I, highlighting the importance of regular physical activity in maintaining several other aspects of life that involve healthy habits. In this context, it was observed that group I → A showed an improvement in eating habits, just as group A ↔ A, whose participants had already been active for more than five years, also showed an improvement in their eating habits, corroborating findings from the literature<sup>10</sup>. On the other hand, in group I ↔ I, the main reason for participants not to perform PA was "not liking it," highlighting the importance of fun in the activity to strengthen the habit of exercising in the long term, in agreement with the literature<sup>11</sup>. When analyzing the subgroups, there was an increase in physical activity and a decrease in sedentary lifestyle. This can be explained by the fact that with the lockdown at the beginning of the pandemic, many people had more idle time, especially students because classes were suspended. Later, they returned in the form of distance learning. Thus, several students who were previously sedentary began to perform some physical activity, even if indoors or outdoors, individually. Likewise, the decrease in sedentary people shows an increase in the number of irregularly active individuals but not in the number of active individuals, given that these irregularly active individuals do not practice PA regularly but may carry out sporadic or non-continuous activities. The number of very active people decreased, which can also be explained by the lockdown and subsequent restrictions. Gyms closed, gyms and team sports were also suspended. Very active individuals often carry out activities that depend on these spaces and collective actions. With the suspension of group spaces and activities, staying active becomes

more complex, which explains the decrease in these individuals during the pandemic. Even so, the number of active people increased, which could be a consequence of the very active only becoming active and the inactive only becoming active. Thus, our results contrast with what was reported in a study carried out with university students in Bangladesh<sup>11</sup>, which compared the practice of physical activity before and during the pandemic, showing a decrease in the pattern of physical activity in general, in addition to the increase in a sedentary lifestyle. Also, another study was carried out with university students in Poland, and there was a consequent decrease in the amount of PA performed during the pandemic<sup>12</sup>. Regarding the habits of the students analyzed compared to the period before and after the pandemic, weight, routine, physical activity, diet, and professional training were evaluated concerning the group of active and inactive individuals. Firstly, about weight, it is noted that the increase, maintenance, or loss of weight did not have a significant correlation when compared to whether the individual was active or inactive. Despite this, the increase in weight was a result that converged with most of the other studies analyzed, with an increase in weight occurring after the start of the pandemic among students, supposedly one of the consequences of confinement at the beginning of the pandemic with the limitation of routine daily routine and decreased physical activity<sup>13</sup>. In addition to these factors, it has also been described that food intake may increase, which can be considered a response to the stress generated by the pandemic, and that confinement can lead to unhealthy eating patterns<sup>14</sup>, that is, changes in diet combined with restrictions imposed by the pandemic are essential factors that can drive weight gain among individuals.

Routine was another factor that showed a change concerning the previous period and during the pandemic. More than half of the individuals (55%) started to have a less active routine. This shows that the fact that the individual is active or inactive concerning physical activity influenced whether they had a more or less busy routine during the pandemic. Our opinion is that individuals in the active group made more effort to maintain this lifestyle during the pandemic, even if the obstacles of social distancing were imposed. The results regarding the practice of physical activity also show that among the group of active people during the pandemic, only 7.3% stopped practicing physical exercise, compared to 37.9% of those inactive. Regarding the fact that inactive people had a more significant reduction in physical activity, our results were similar to those of a study carried out in Canada, which concluded that mainly inactive individuals began to have a decrease in physical activity during the pandemic<sup>15</sup>. A possible reason for this improvement in the active diet is that this group is more concerned about health and well-being, and the restrictions of the pandemic may have led to a decrease in daily caloric expenditure, making it necessary to control the caloric intake in the diet, with better nutrition. In the inactive group, changing eating habits would not be a concern. Professional training impacted most individuals in both groups, but the impact was slightly more remarkable in the group of active individuals. The implications for professional training are expected, considering that face-to-face activities at universities were suspended, with the subsequent return remotely with distance learning. Remote teaching has several obstacles to student learning, possibly the main factor that harms student's professional training. A study carried out in 2022 demonstrated that, especially among individuals aged 18 to 41, the change from in-person activities to remote or hybrid activities was one of the most significant changes in the lives of these individuals<sup>16</sup>.

Analyzing the regularity and duration of physical activity, the present study demonstrated a greater predisposition for participants considered active to practice physical activity more frequently, even during the pandemic, compared to those deemed not active, remaining regular during periods. Therefore, the results align with the study on students in Bangladesh, which demonstrated a decrease in the frequency of physical activities, especially in those who did not have the pre-pandemic habit. About the length of time that the habit of practicing PA has been present, an increase in the precocity of practicing physical activities can be noted, that is, those people who had already started the habit less than three months ago, ranging from 27.3 % before the pandemic and to 31.8% during the pandemic.

These demonstrated data were also observed in a study conducted in a Canadian city, which showed a more significant number of participants who reported having started practicing PA recently, which would also be explained by the interruption of the practice of those who had the habit of exercising for a long time. Longer and returned after a sedentary lifestyle, generally associated with the first months of the pandemic<sup>17</sup>. When it comes to the reason for the lack of PA practice, the primary justification was the lack of time. It is known that higher education is highly demanding both in terms of workload and in psychological terms for the student. In this context, learning how to seek balance so that PA practice is incorporated as a habit within the routine seems to be an efficient way to stay active. Furthermore, incorporating more activities that can make the routine dynamic can be an alternative so that individuals who report not liking practicing PA can escape inactivity.

## CONCLUSION

Our study demonstrated that the COVID-19 pandemic promoted significant changes in the routine activities of university students, as well as in the practice of physical activity and the professional training of participants. In this context, individuals who have been practicing PA for a more extended period and more regularly every week demonstrated a better ability to maintain this habit during the pandemic, demonstrating more excellent resistance to adversity. Furthermore, the association between healthy eating and physical activity was evident, indicating that regular exercise can encourage students to eat healthier. Therefore, higher education institutions must promote measures to encourage standard PA practice among their students, promoting health and quality of life for all.

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