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RESEARCH ARTICLE

COVID-19 pandemic: Restrictions and functionality in the knees of physiotherapy students, preliminary study

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Abstract

Background: The COVID-19 pandemic declared by the WHO in 2020 led to restrictive measures that exerted an impact on physical activity, which can affect musculoskeletal health. **Objective:** The aim of the present study was to analyze the impact of the pandemic on knee pain and functioning among university students influenced by social isolation measures. **Methods**: An observational, cross-sectional study was conducted at the Evangelical University of Goiás (UniEVANGELICA) with 52 physiotherapy students. Data were collected with the aid of an online questionnaire addressing lifestyle habits, physical activity, knee pain, and functioning using the Lysholm knee score. Data analysis was performed with SPSS 21, using appropriate statistical tests. **Results**: The chi-square test revealed no significant association between COVID-19 and knee pain, but an apparent relationship was found between physical activity and pain. No significant association was found between COVID-19 and worse walking function, although a tendency was suggested. **Discussion**: Despite the apparent association between physical activity and pain, the lack of statistical significance indicates the need for more detailed analyses. The present results diverge from those of global studies, underscoring the complexity of the relationship between the pandemic and musculoskeletal health. Limitations of the study include the sample size and self-reporting. **Conclusion**: This study provides insights into the relationships between COVID-19, knee pain, physical activity, and walking function in university students. Although no significant association was found in some analyzes performed in this study, caution should be exercised when interpreting the results. Further research considering additional variables is recommended to gain a robust understanding of these relationships.

Keywords: Patellofemoral pain; pandemic; COVID-19; physical activity.

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BACKGROUND

The definition of a pandemic and specific care for COVID-19 (disease caused by SARS-CoV-2) was established by the World Health Organization (WHO) in early 2020 and restrictive measures were subsequently proposed with regards to mobility on public streets and outdoor activities[1]. These measures may have contributed to a reduction in physical activity, with an impact on comorbidities and a decline in quality of life[2]. The restrictions imposed by government agencies were unexpected and had repercussions for public health, including adverse effects on mental health. During the initial restrictions, adults reported a significant increase in psychological distress[3,4], manifesting higher levels of depression and anxiety[5]. Throughout the pandemic, approximately one in four children experienced high levels of depression and one in five faced high levels of anxiety. These prevalence rates were twice as high compared as pre-pandemic rates[6].

Although this analysis is related to children, a reduction in physical activity occurred among adolescents during the pandemic[7]. Despite causing psychological and physical harm, restrictive measures were important to containing the spread of COVID-19 infection and reducing pressure on health care services. However, such measures may have altered patterns of general orthopedic injuries[8], negatively affecting the biopsychosocial, socioeconomic, and familial aspects of individuals of all ages due to the reductions in physical activity and access to health services[9].

Aerobic exercise is widely recommended by orthopedists and physiotherapists to minimize the occurrence of osteoarthritis in the population[10]. However, little has been discussed on about how university students felt the effects of the pandemic, especially the occurrence of knee pain due to the lack of physical activity. The scientific literature points out that the social isolation proposed by government agencies had multiple impacts on the muscular system, such as joint pain, the loss of muscle mass, reduced functional mobility, as well as impacts on physical and mental wellbeing in general[11]. The knee is one of the main joints for performing activities such as walking, standing, and other daily movements, including physical activity[12]. The knee is a complex joint with considerable range of motion in terms of flexion and extension as well as certain degrees of rotation in varus and valgus, maintaining stability and control during changes in load[13]. This joint is indispensable for locomotion, standing, and another everyday movements. A study of participants in lockdown showed a significant impact on pain, knee function, and physical functioning in 63 patients with end-stage knee or hip osteoarthritis[14]. However, no observational or cross-sectional studies have assessed university students with altered knee functioning due to the influence of social isolation. The general objective of the present study was to assess the impact of the COVID-19 pandemic and reduced physical activity on knee functioning and pain. The specific objectives were to assess changes in lifestyle habits and physical activity due to measures restricting social mobility during the COVID-19 epidemic and assess changes in knee functioning after this period.

METHODS

An observational cross-sectional study was conducted at the Evangelical University of Goiás (Unievangelica) following approval from the Human Research Ethics Committee (certificate number: 61201122.9.0000.5076). This study complied with the guidelines and regulatory standards for research involving human beings formulated by the National Board of Health, Ministry of Health, established in October 1996 and updated in Resolution 466 in 2012. All volunteers received clarifications regarding the objectives and procedures of the study and were asked to provide informed consent electronically. The participants were university students at a higher education institution who were invited to participate through an invitation letter and informal interpersonal communication. A convenience sample of 52 physiotherapy students participated by answering the questionnaires.

The inclusion criteria were age 18 years or older and enrolment the Physiotherapy Course at the Unievangelica. The following exclusion criteria were 1) comorbidities that prevented mobility and physical activity since the pre-pandemic period of COVID-19 or during the pandemic for any other reason; 2) a history of previous surgeries or known

serious knee conditions (previous fractures, tumors, ligament injury whether or not submitted to surgical treatment, meniscus injury whether or not submitted to surgical treatment); and 3) neurological or vestibular disorders that caused any balance problems. Data were collected through an online questionnaire available via Google *Forms* and completed by the participants themselves. Participation did not involve any legal procedures or risk to the participant's dignity. The form addressed the following variables: age, sex, weight, height, body mass index (BMI), period of the physiotherapy course, physical activity, type of activity, and frequency in number of days per week, whether pain was felt in the knee, and whether worsening of knee function was felt, along with the application of the symptom scale. The Lysholm Knee Scoring Scale was used to assess knee functioning. This scale has been translated and validated for the Portuguese language and consists of eight closed-ended questions. The result is expressed in nominal and ordinal form as "excellent" (95 to 100 points), "good" (84 to 94 points), "fair" (83 to 65 points), and "poor" (≤ 64 points). The nominal form was adopted in the present study.

Data were entered into Microsoft Excel spreadsheets and statistical analysis was performed using mean ± standard deviation (SD) values. The qualitative variables were the number of cases (absolute values - unweighted data) and rates (percentages - weighted data). The variation in absolute values was expressed as percentage and rates were expressed as percentage points. Comparisons were performed using the chi-square test with a 95% confidence interval (CI). A two-tailed p-value ≤ 0.05 was considered significant. Microsoft Excel (2007) and the SPSS 21 statistical package (IBM, Chicago, USA) were used to analyze the data.

RESULTS

Table 1 displays the anthropometric data, age, height, and frequency of physical activity per week.

Table 1. Anthropometric data and frequency of physical activity

	Age	Weight (in kilograms)	Height (in meters)	Frequency of physical activity (days per week)
Median	20	65.3	1.65	2.5
Standard deviation	8	13.45	22.37	2.28
Minimum	18	49	1,5	0
Maximum	44	108	1,63	6

Table 2 displays the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests, demonstrating that the population studied did not correspond to normal distribution, i.e. Gaussian distribution. Table 3 shows the results of the two-variable contingency analysis of participants who had COVID-19 and reported pain, with observed and expected frequencies for the analysis of a possible association between infection and the occurrence of knee pain in participants of the present study.

Table 2. Results of Kolmogorov-Smirnov and Shapiro-Wilk tests

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Significance (P- value)	Statistic	df	Sig. (P-value)
Age	0,319	52	0	0,682	52	0
Weight	0,116	52	0,077	0,924	52	0,003

Notes*: df = Degrees of freedom

Table 3 - Occurrence of COVID-19 and pain

			Pain		Total
			Yes	No	
COVID -19	**Yes**	Count	13	14	27
		Expected Count	10,9	16,1	27
		% within COVID	48,10%	51,90%	100,00%
		% within Pain	61,90%	45,20%	51,90%
		% of Total	25,00%	26,90%	51,90%
	No	Count	8	17	25
		Expected Count	10,1	14,9	25
		% within COVID	32,00%	68,00%	100,00%
		% within Pain	38,10%	54,80%	48,10%
		% of Total	15,40%	32,70%	48,10%
Total		Count	21	31	52
		Expected Count	21	31	52
		% within COVID	40,40%	59,60%	100,00%
		% within Pain	100,00%	100,00%	100,00%
		% of Total	40,40%	59,60%	100,00%

In the statistical analysis shown in Table 4, the chi-square test revealed no significant differences ($p > 0.05$). Table 3 shows that 48.1% of the individuals who had COVID-19 also had knee pain, whereas 51.9% did not have pain. Among those who did not have COVID-19, 32% had knee pain and 68% did not.

Thus, the chi-square test addressing the occurrence of COVID-19 and pain indicated no possibility of an association between the two variables (1, n = 52) = .81; p= .27; phi = .23).

Table 4. Results of chi-square test

	Value	df	Asymp.Sig (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,406[a]	1	0,236	-	-
Continuity Correction	0,815	1	0,367	-	-
Likelihood Ratio	1,416	1	0,234	-	-
Fisher's Exact Test	-	-	-	0,27	0,183
Linear-by-Linear Association	1,379	1	0,24	-	-
N of Valid Cases	52	-	-	-	-

Notes*: df = Degrees of freedom; Sig. = Significance.

To ensure the significance and relevance of this study, the practice of physical exercise and the occurrence of pain were assessed in the same sample of 52 participants. The statistical data were presented in a contingency table relating the variables "Pain" and "Physical Activity", with observed and expected frequencies. The distribution within the "Physical Activity" category revealed that 46.7% of the respondents practiced physical activity and 53.3% did not. Within the group that practiced physical activity, 66.7% reported having pain. Within the group that did not practice physical activity, 51.6% reported the presence of pain. This suggests an apparent association between the practice of physical activity and the occurrence of pain. When considering the distribution within the "Pain" category, 57.7% of the respondents reported pain. Within this group, 26.9% practiced physical activity and 30.8% did not. Analyzing the total percentages, 40.4% of the respondents practiced physical activity and 59.6% did not. These data were analyzed using the chi-square statistical method.

Lastly, another statistical analysis pertinent to this study was based on the occurrence of COVID-19 and worsening of the participants' ambulation with observed and expected frequencies presented in a contingency table. In the "Worsening Function" category, 51.9% of the respondents reported worsening, while 48.1% indicated no worsening. When analyzing the "COVID" category, 14.8% of respondents with COVID-19 reported worse functioning compared to 36.0% of those without COVID-19. This suggests a possible association between the presence of COVID-19 and worsening function, indicating that those with COVID-19 may be less likely to experience worse functioning.

The expected frequencies were calculated under the assumption of independence between the variables; the comparison of observed and expected frequencies can be used to assess possible deviations from this independence. The overall analysis shows that 25.0% of the respondents had COVID-19 and 75.0% did not. Moreover, 25.0% reported worsening in terms of function, whereas 75.0% did not.

The results of the chi-square tests applied to the contingency table between the variables "Worsening Function" and "COVID-19" indicate no statistically significant association between the two variables. Pearson's chi-square test, the Continuity Correction test, and the Likelihood Ratio test produced chi-square statistics of 3.107, 2.080, and 3.160, respectively, all with one degree of freedom. Despite the relatively low p-values (0.078, 0.149, and 0.075, respectively), these values were not low enough to reject the null hypothesis of independence between the variables. The chi-squared test also showed no statistically significant difference ($p = 0.112$).

Therefore, based on the results of these tests, there is no convincing statistical evidence to state that the presence of COVID-19 was significantly associated with worse function in the present sample. However, it is crucial to consider the limitations of statistical tests and the complexity of the specific context before drawing definitive conclusions. Marginal results such as these often require further analysis and, if possible, the use of other statistical approaches to confirm the findings.

DISCUSSION

The aim of the present study was to assess the impact of the COVID-19 epidemic and reduced physical activity on knee functioning. To achieve this aim, specific objectives were established addressing the functional capacity of the participants, including the investigation of the occurrence of this infection and the presence of pain. However, the statistical analysis of the 52 participants revealed no significant association between the two variables. Furthermore, an apparent association was found between physical activity and pain, with higher frequencies of pain among individuals who practiced physical activity, but with insufficient statistical results to reject the established null hypothesis.

Lastly, in the analysis between the occurrence of COVID-19 and worsening ambulation, although a tendency was found for those who had the infection to have less worsening in terms of ambulation, the statistical data did not support the rejection of the null hypothesis of a lack of an association. The increase in knee pain reported in the world literature correlates with the increase in complaints to movement and rehabilitation therapists, with an impact on the quality of life of those suffering from this physical condition, which can be limiting in some groups of individuals[15].

Although this study did not address the general population, focusing only on physiotherapy students at a private university in Brazil, a study involving 5804 participants found that 37% of the population complained of physical impacts, with an increase in pain according to the Japan Knee Society score for the general population, especially women 65 years of age, with a notable increase in the score indicating pain and reduced functioning[16]. In contrast, this survey of Brazilian students with an average age of 20 found no significant association between isolation measures due to the COVID-19 pandemic and worse knee functioning (Table 3). Thus, there is a distinction between populations and scales for analyzing knee function in individuals who have been subjected to social isolation measures.

The results of this study conducted with university students can be attributed to various factors. It is crucial to consider the methodological limitations and specific context of the study, which was conducted in a university setting. The non-normal distribution of

the age and weight variables may have influenced the subsequent analyses, requiring statistical tests to eliminate discrepancies. The lack of a statistically significant association between the practice of physical activity and the occurrence of pain suggests the need for more detailed investigations, including factors such as the intensity and type of exercise as well as the consideration of confounding factors. The absence of a significant association between the occurrence of COVID-19 and worse walking function underscores the complexity of the relationship between the disease and musculoskeletal function related to the decrease in physical activity due to restrictive measures and the widespread scientific implications[17]. Future research may benefit from longitudinal approaches, considering temporal variables for which this study can be a valuable starting point in future investigations aimed at clarifying the underlying mechanisms and contributing to the development of practical, effective guidelines for the management of musculoskeletal health in challenging periods such as the COVID-19 pandemic. Moreover, studies should be conducted with individuals between 40 and 65 years of age to enable comparisons to findings described using scores in other cultures, such as Japan. Knee assessments are essential for the investigation of locomotion, the maintenance of the standing position, and other daily movements in individuals, especially those who had been under restrictive measures during the pandemic period[18].

A possible limitation of the present study was the sample size. With 52 participants, there is a possibility that individual variations could have a significant impact on the results. Studies with a larger sample could provide more appropriate, generalizable results. Within this sample size, the normality test indicated non-normal age and weight distributions, suggesting the need for studies involving participants whose data have normal distribution for the use of less robust, more common statistical methods. Another limitation was the fact that data collection was based on self-reports, which could introduce memory bias that could have been corrected by in-person physical examinations, such as the collateral ligament stress test and the drawer test to assess the posterior and anterior cruciate ligaments. Lastly, an association analysis is required, because, although the statistical tests showed no significant association between specific variables, the absence of statistical evidence does not necessarily imply a lack of a causal relationship. Other variables not taken into account may have influenced the results, which implies that further research is needed.

CONCLUSION

The results presented here offer valuable insights into the relationships between the presence of COVID-19, the occurrence of knee pain, the practice of physical activity, and worsening walking function in a sample of university students. Although the analyses indicated no association between the occurrence of COVID-19 and worsening knee function, these results should be interpreted with caution, considering the inherent limitations of statistical tests and the nature of the research itself. The absence of significant statistical evidence in some associations does not completely rule out the possibility of subtle relationships that may require further investigation. Future research with larger samples, more objective data collection methods, and the consideration of additional variables is suggested for a more comprehensive, robust understanding of these relationships.

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