

The Role of Physical Activity in COVID-19 Mortality Rate: A Cross-Sectional Study

Abstract

Background: Recent evidence suggests a negative correlation between physical activity and the incidence and severity of noncommunicable chronic diseases like cardiovascular disease, diabetes, and respiratory infections. This study explores the potential influence of physical activity levels on the mortality rate and coronavirus disease (COVID-19) recovery. **Materials and Methods:** This descriptive analytical cross-sectional study evaluated 175 Polymerase Chain Reaction (PCR)-confirmed COVID-19 patients admitted to Baqiyatallah Hospital. The participants' hospitalization data and physical activity levels were assessed. The Mann–Whitney *U* test explored the association between physical activity and COVID-19 outcomes. **Results:** Findings revealed that COVID-19 patients had a mean (SD) physical activity score of 6.55 (1.76) out of a possible 15. The mean scores for physical activity in work, sport, and leisure environments were 2.69 (0.49), 1.37 (1.45), and 2.49 (0.59) out of 5, respectively. Surviving patients exhibited significantly higher sports-specific and overall physical activity levels than those who succumbed to the disease. A Mann–Whitney *U* test results noted statistically significant relationship between total and sports-specific physical activity, hospitalization (interquartile range (IQR) 2.3–3.06, $p = 0.020$ and IQR 2.5–3, $p = 0.010$, respectively), and mortality (IQR 0.44–2.75, $p = 0.020$ and IQR 1.47–2.97, $p = 0.020$). **Conclusions:** In summary, increased total physical activity, particularly in a sports environment, appears to be linked with reduced COVID-19 hospitalization and mortality rates.

Keywords: COVID-19, exercise, hospitalization, mortality, sports

Introduction

COVID-19 was first detected in December 2019 in Wuhan City, Hubei Province, China. On March 11, 2020, the World Health Organization (WHO) declared it a pandemic. By February 11, 2022, 3 years into the pandemic, approximately 399 million COVID-19 cases and 5.76 million.^[1] Deaths were reported globally, according to WHO data. In Iran, 6.7 million cases and 130,000 deaths were recorded during this period. Since no definitive treatment protocol exists, identifying risk factors influencing mortality is crucial. Age, obesity, smoking, lung and kidney diseases, hypertension, heart disease, cancer, and sedentary lifestyles have been identified as risk factors affecting COVID-19 mortality.^[2,3] Research by Lee *et al.* (2022)^[3] found that individuals who met the WHO recommended physical activity level had a reduced risk of contracting COVID-19, developing severe forms of the disease, and dying from it.

Physical activity (PA) is any bodily movement generated by skeletal muscles that expends energy.^[4] The World Health Organization (WHO) recommends that adults aged 18–64 engage in at least 150–300 minutes of moderate-intensity aerobic activity or 75–150 minutes of vigorous intensity aerobic activity weekly.^[4] In 2022, WHO statistics revealed that more than one-fourth of the global adult population (1.40 billion adults) is inactive.^[4] WHO's 2016 data for Iran showed insufficient PA levels varied from 23.50% to 70%,^[5] with an additional statistic of 54%.^[6] Research focusing on different PA domains concerning chronic disease burden remains limited. A study by Laddu *et al.* (2021)^[7] demonstrated a dose–response relationship between PA and the incidence, duration, and severity of upper respiratory tract infections (URTI). Similarly, Cho, D. H. *et al.* (2021)^[8] reported in a South Korean study that moderate to severe PA levels correlate with

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a 10% reduction in the risk of COVID-19 infection and a 53% decrease in mortality risk.

Campbel *et al.* (2023)^[9] suggested that nonpharmaceutical interventions such as healthy nutrition and physically active lifestyles may offer risk reductions comparable to or better than mandatory vaccination in combating COVID-19. The mechanism through which PA impacts COVID-19 remains unclear, but Nieman and Wentz (2019) noted that improvements in the immune system from exercise appear to be volume-dependent. Individuals engaging in over 300 minutes per week may achieve a personalized level of reduced chronic inflammation.^[10] In addition, Sallis *et al.* (2021)^[11] demonstrated that being “somewhat active” (11–149 minutes per week) or “consistently active” (≥ 150 minutes per week) significantly lowered the risks of COVID-19–related hospitalization and death compared to inactive individuals.

No studies have explored the potential relationship between physical activity levels and Iran’s COVID-19 mortality and survival rates. This study aims to investigate the impact of physical activity levels on COVID-19 mortality and recovery rates for the first time in this region.

Materials and Methods

In this descriptive–analytical cross-sectional study, 250 questionnaires were initially distributed randomly among COVID-19 patients treated at Baqiyatallah Hospital. However, 25 patients refused to participate, and 50 others provided incomplete responses. As a result, the final sample included 175 COVID-19 patients who were seen at Baqiyatallah Hospital between March 2020 and June 2021. A power analysis conducted using STATA 11 indicated that, with a Type I error of 0.05 and results from Tables 2 and 3 (total scores), the sample size was deemed sufficient to achieve the study objectives with over 95% power.

The inclusion criteria required a physician’s diagnosis of the disease and a positive PCR test for COVID-19. Upon their initial referral to the hospital patients completed a physical activity questionnaire. Physical activity levels were assessed using the standard questionnaire developed upon their initial referral to the hospital in 2003, which has been validated and proven reliable in previous studies involving the Iranian population.^[12,13] Sanai *et al.* (2013)^[14] further confirmed the validity of the Beck physical activity questionnaire tools with Cronbach’s alpha of 0.781, and its reliability through factorial validity with KMO of 0.882 in the Iranian population. The questionnaire assessed physical activity in three domains: workplace, sports, and leisure time, providing a total score. Exclusion criteria included questionnaires with 30% or more incomplete response. The maximum score on the questionnaire was 15, categorizing patient physical activity levels as poor (≤ 5), average (5.10–10), and good (10.10–15). Patients were recruited to evaluate

disease outcomes one to 2 months after the initial hospital referral. If patients were unreachable, disease outcomes were obtained through phone calls.

Descriptive statistics were used to analyze the data, which included mean, standard deviation, and frequency percentages. As the data for physical activity levels did not adhere to a normal distribution, the nonparametric Mann–Whitney test was used to compare physical activity levels between groups based on hospitalization and mortality due to COVID-19. Data were reported as mean \pm standard error of the mean or median and IQR. All statistical analyses were carried out using SPSS 24 (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.), with a significance level set at $p < 0.05$.

Ethical considerations

All research stages adhered to the ethical principles of the Declaration of Helsinki. Participants provided written informed consent, and the study was approved by the Local Ethics Committee of Baqiyatallah University of Medical Sciences (ID: IR.BMSU.REC.94.56).

Results

Table 1 presents the anthropometric and physiological characteristics of patients who tested positive for SARS-CoV-2. The participants ages ranged from 21 to 90 years. Forty-six percent of the participants were overweight, and 24% were obese. Reviewing the cases showed that three patients died in the hospital, and follow-up phone calls revealed that three more had died postdischarge. The participants’ total physical activity levels and subdomains, as shown in Table 1, were moderate overall. Hospitalization days categorized by physical activity levels are illustrated in Figure 1. The average hospital stay was 10 days for patients with poor physical activity compared to 7 days for those with good levels. However, the differences in hospitalization rates based on physical activity levels were not statistically significant [Figure 1].

Table 1: Anthropometric, physiological, and physical activity profiles of COVID-19 patients

Demographics	Mean (SD [§])
Age	46.75 (14.21)
Height	171.54 (9.96)
Weight	80.64 (15.87)
BMI*	27.47 (5.50)
Beck physical activity levels score	
WPA **	2.69 (0.51)
SPA ***	1.37 (1.45)
LTPA ****	2.51 (0.59)
TPA *****	6.55 (1.76)

*: Body mass index. **: Work-related physical activity, ***: Sport-related physical activity, ****: Leisure time–related physical activity, *****: Total Beck questionnaire physical activity levels, §: Standard Deviation

We found that 59.43% of the patients were hospitalized, while 40.57% were not. The Mann–Whitney U test indicated a significant difference in hospitalization periods based on physical activity levels ([IQR 3.06- 2.3] U = 2879, Z = -2.38, $p = 0.02$, see Figure 1). In addition, the Mann–Whitney U test results showed significant differences in sports-specific and total physical activity levels between hospitalized and nonhospitalized patients (4.7 [IQR 2.5] vs. 6.31 [IQR 3], $p = 0.014$ and 4.7 [IQR 2.3] vs. 6.31 [IQR 3.06], $p = 0.017$, respectively; refer to Table 2).

The results of the Mann–Whitney U test also indicated that total and sports-specific physical activity levels were significantly lower in patients who died from COVID-19 (6.17 [IQR 0.44]) compared to survived (6.81 [IQR 2.75]) patients ($p = 0.02$, Table 3). Figure 2 illustrates the comparison of COVID-19 outcomes (survival/death) based on physical activity levels.

Discussion

The primary findings of this study indicated a

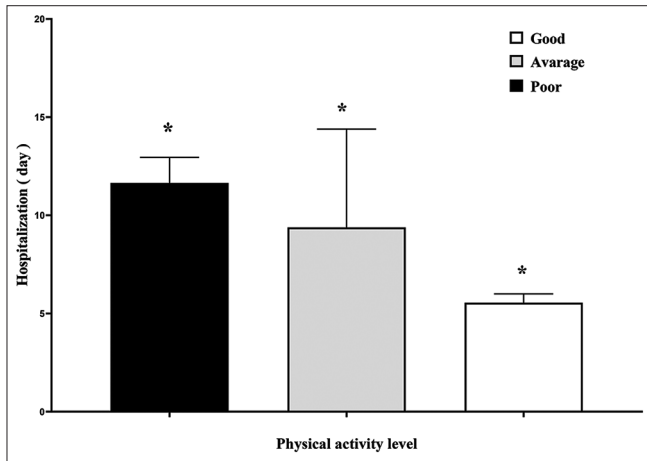


Figure 1: Comparison of hospitalization due to COVID-19 based on physical activity levels. *Significant difference in physical activity levels between groups ($p \leq 0.05$); values are mean (SD)

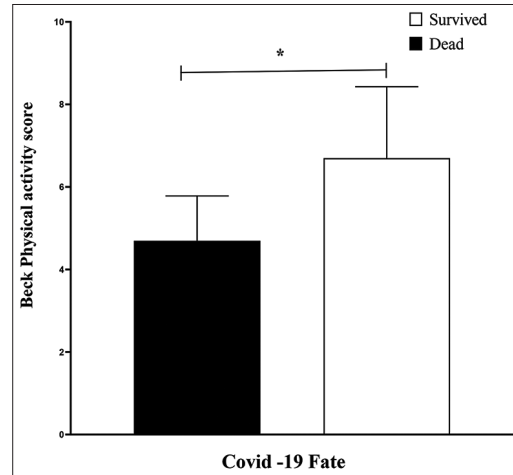


Figure 2: Comparison of physical activity levels based on COVID-19 outcomes. *Significant difference between groups ($p \leq 0.05$); values are mean (SD)

Table 2: Mann–Whitney U test results comparing physical activity levels based on COVID-19–induced hospitalization

	Hospitalization (No)	Mean (SD)*	Median (IQR)	SEM**	p	
WPA***	No	104	2.67 (0.05)	2.69 (0.75)	0.05	0.470
	Yes	71	2.72 (0.06)	2.66 (0.54)	0.06	
SPA****	No	104	1.59 (0.14)	0 (2.50)	0.14	0.014#
	Yes	71	1.05 (0.17)	2 (3)	0.17	
LTPA*****	No	104	2.56 (0.06)	2.49 (0.25)	0.06	0.206
	Yes	71	2.41 (0.07)	2.49 (0.75)	0.07	
TPAS	No	104	6.81 (0.17)	5.75 (2.30)	0.17	0.017#
	Yes	71	6.17 (0.21)	6.87 (3.06)	0.21	

*: Standard deviation, **Standard Error of the Mean, ***: Work-related physical activity, ****: Sport-related physical activity, *****: Leisure time–related physical activity, \$: Total Beck questionnaire physical activity levels. #: Significant at $p \leq 0.05$

Table 3: Mann–Whitney U test results comparing physical activity levels based on COVID-19 mortality

	Death (No)	Mean (SD)*	Median (IQR)	SEM**	p	
WPA***	No	169	2.71 (0.03)	2.69 (0.63)	0.03	0.062
	Yes	6	2.32 (0.17)	2.43 (0.86)	0.17	
SPA****	No	169	1.41 (0.11)	1.37 (2.75)	0.11	0.020#
	Yes	6	0.29 (0.29)	0 (0.44)	0.29	
LTPA*****	No	169	2.51 (0.04)	2.49 (0.50)	0.04	0.571
	Yes	6	2.11 (0.19)	2.25 (0.99)	0.19	
TPAS	No	169	6.62 (0.13)	6.68 (2.97)	0.13	0.020#
	Yes	6	4.71 (0.44)	4.65 (1.47)	0.44	

*: Standard deviation, **: Standard Error of the Mean, ***: Work related physical activity, ****: Sport related physical activity, *****: Leisure time related physical activity, \$: Total Beck questionnaire physical activity levels. #: Significant at $p \leq 0.05$

significant reduction in both COVID-19 mortality rates and hospitalization days based on levels of physical activity. These findings are consistent with those of Lee *et al.* (2022), Hamer *et al.* (2021), Brawner *et al.* (2021), and Salgado-Aranda *et al.* (2021), while they contradict the findings of Rowlands *et al.* (2021).^[2,3,15-17] Rowlands and colleagues found no correlation between total physical activity and moderate to vigorous activity with severe COVID-19. However, they did find that a balance between physical activity and sleep was linked to COVID-19. Daytime physical activity reduced the risk of disease, while more activity during sleep and rest cycles increased the risk of severe COVID-19.^[17]

This study used the number of hospitalization days to measure COVID-19 disease severity and treatment progress. Patients with low physical activity levels spent an average of 10 days in the hospital, while physically active patients spent 7 days on average [Figure 1]. Lee *et al.* (2022)^[3] also discovered that hospitalization days decreased by 2.8 in COVID-19 patients with appropriate physical activity levels. Salgado-Aranda *et al.* (2021)^[2] reported that in Brazil, patients with low or sedentary physical activity levels were hospitalized for about 8 days, whereas those with adequate activity levels stayed around 7 days. Brawner *et al.* (2021)^[16] observed that COVID-19 patients with higher aerobic exercise capacity had significantly shorter hospital stays compared to those with lower capacity (6.7 days versus 8 days). Boukelia and Alataibi (2020) examined the relationship between physical activity, body mass index, and COVID-19 symptom duration in Saudi Arabia. They found that recovery in active individuals was 2.7 times faster than in inactive individuals (4.5 days versus 10.5 days).^[18]

In addition to its direct effects on COVID-19, physical activity also indirectly impacts body mass index (BMI), cardiovascular disease, hypertension, blood lipids, diabetes, and immune system enhancement, all of which can influence the infection and severity of COVID-19.^[3] In a cohort study, Lee *et al.* (2022) used national South Korean data to observe the levels of physical activity levels in 76,000 patients. Among these, 2,295 were infected with COVID-19, and 45 (0.06%) died. This led to the conclusion that physical activity is directly and indirectly correlated with COVID-19 incidence and mortality.^[3]

The incidence of COVID-19 deaths in the present study was 3.4%. However, owing to variations in virus variants, treatment protocols, and vaccinations, global mortality rates have dropped to around 3% and lower.^[19] Physical activity levels were significantly lower in deceased patients than in survivors. A sedentary lifestyle, independent of other risk factors, increased the COVID-19 mortality rate (Risk Ratio 5.91), as reported by Salgado-Aranda *et al.* (2021). In their study, 13.8% of 522 patients with sedentary or low physical activity levels died from COVID-19, compared to 1.8%

of those with adequate activity levels.^[2] Another study by Pitanga *et al.* (2021)^[20] observed a negative relationship between leisure time physical activity and COVID-19 severity and mortality in Brazil.

In this study, only the scores related to physical activity in sports environments significantly differed based on COVID-19 hospitalization days and mortality rates compared to other subdomains of physical activity, such as work and leisure time. Supporting this, Cho *et al.* (2021)^[8] stated that light physical activity levels do not impact COVID-19 mortality, while moderate to vigorous levels can reduce incidence by 10% and mortality by 53%. One major limitation of this study was its small sample size, highlighting the need for a national-level cohort study with a larger population to confirm these findings.

Conclusion

Based on the findings of this study, increasing physical activity levels through lifestyle modifications can have positive impact on COVID-19 treatment and help lessen its effects. Physical activity in sports settings reduces hospitalization duration and COVID-19-related mortality. However, further research is necessary to validate these findings.

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Conflicts of interest

Nothing to declare.

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