

Review

Impact of COVID-19 pandemic on physical activity levels and mental health in university students

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Abstract: COVID-19 had a considerable impact on the physical activity and mental health of university students, with university students experiencing the most severe effects. Physical activity and mental health are critical for university students as they play a vital role in academic performance, overall well-being, and long-term health. Our study aimed to explore the effects of the COVID-19 pandemic on students' physical health and mental well-being, focusing on how the disruption impacted both their physical activity levels and psychological health. This literature review analyzed 47 studies to examine the impact of the COVID-19 pandemic on the physical activity and mental health of university students. Our findings indicate that COVID-19 lockdowns have led to several adverse effects, including concerns about inadequate nutritional intake, increased alcohol consumption, reduced physical activity, and prolonged sedentary behavior among university students. In conclusion, tailored interventions are necessary to support students' mental health and physical activity, with home-based exercises, including endurance and strength training, offering a potential solution. Future research should explore the long-term effectiveness and sustainability of virtual physical education and remote fitness interventions..

Keywords: COVID 19, pandemic, physical activity, university students

1. Introduction

The COVID-19 pandemic has had a profound global impact, leading to widespread lockdowns, social distancing measures, and various restrictions. These changes significantly affected university students, disrupting their daily routines and limiting opportunities for physical activity.

The shift to online learning, social isolation, and restricted access to recreational facilities uniquely affected university students by increasing sedentary behavior and screen time, leading to physical strain such as neck and back pain. Gym and sports facility closures contributed to a decline in physical activity, while social isolation increased feelings of loneliness, stress, and anxiety. Changes in daily routines, lack of motivation, and difficulty separating schoolwork from personal life made it harder to stay active and focus on well-being. Additionally, unpredictable schedules led to poor dietary habits and sleep disturbances, exacerbating both physical and mental health challenges [1]. A study conducted by Anders et al. (2022) [2] has shown an increase in physical inactivity as individuals transition from adolescence to adulthood, particularly during college/university years.

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Online classes during COVID-19 significantly impacted both the physical and mental health of students. As a result of increased screen time, in a study conducted by Sharma & Sharma (2021) [1], it was observed that 57.3% of students experienced moderate stress, while 32% reported mild depression.

Additionally, the shift to online learning led to physical health issues, with 48% of students suffering from mild neck pain and 41.3% experiencing moderate back pain. The longer durations of online classes on laptops and phones contributed to these physical and mental health challenges, highlighting the negative effects of extended screen time and sedentary behavior [1].

University students' physical activity levels, including walking, moderate, and vigorous exercise, significantly decreased during the COVID-19 pandemic, multiple studies reported substantial decreases in physical activity, with reductions in light/mild activities ranging from 32.5% to 365.5% and high/vigorous activities declining by 2.9% to 52.8% [2]. One study found a decrease of 636 steps per day and 58 minutes per week spent in various heart rate zones [3]. Even though students who met their physical activity recommendations before the lockdowns were generally still able to meet those recommendations during the lockdowns [2]. The impact of COVID-19 lockdowns on moderate and vigorous physical activity levels varied depending on the students' pre-lockdown sedentary behavior, with those who were more sedentary pre-lockdown increasing or maintaining their activity levels, and those who were less sedentary pre-lockdown decreasing their activity levels [4]. Results gathered from wearable fitness trackers such as Fitbit during the COVID-19 pandemic, showed significant decreases in physical activity [3].

In Poland, both primary and secondary school students were generally satisfied with distance education, particularly because it allowed them to fit their learning time to their needs, but they faced problems with concentration, lack of motivation, and apathy. In their case, the COVID-19 pandemic was a significant source of stress, leading to negative moods, but also increased interest in natural sciences among a notable proportion of students [5].

In a study conducted by Silisteanu et al., [6] greater negative impacts have been seen on students who are in their last year of study. Their results show that final-year students exhibited stronger negative correlations between affective signs, cognitive signs, and physical activity, whereas first-year students showed positive associations between physical condition, physical activity, emotional signs, and cognitive signs. Among second-year students, physical activity positively correlated with affective well-being but negatively with cognitive and affective signs. These findings suggest that physical activity plays a crucial role in mitigating stress and enhancing emotional and cognitive well-being among students. However, the impact varies based on academic standing, highlighting the need for tailored interventions to support students' mental health and physical activity levels.

Students' time spent on online classes and self-study, learning methods, sleeping habits, daily fitness routines, and the subsequent effects on their weight, social life, and mental health have been impacted during the COVID-19 pandemic [7]. A study conducted by Birmingham et al. (2023) [8] examining students' psychological well-being found that, although students did not have significant concerns about their academic progress, they faced challenges with motivation, concentration, and the effectiveness of remote instruction.

Several scientific findings highlight the need for interventions to address the physical and mental health challenges faced by students during the pandemic, with home-based activities being a helpful solution to staying fit and healthy [9].

This study *aimed* to explore the effects of the COVID-19 pandemic on students' physical health and mental well-being, focusing on how the disruption impacted both their physical activity levels and psychological health.

2. Materials and Methods

This study represents a literature review in which we used data from the scientific literature that approached similar interests as our aim. Selection criteria were based on the publication date; only studies published between 2020-2024 were selected according to the keywords used, such as "COVID-19", "pandemic", "physical activity", and "university students". The scientific material was selected through a manual search in electronic databases such as PubMed, Scopus, and Web of Science. The research group manually navigated databases to locate relevant journal articles and papers.

The primary focus of this study was on university students aged 18-22, as this demographic group was particularly vulnerable during the pandemic due to the significant life transitions they experienced, such as moving away from home, adjusting to higher education, and developing independent lifestyles. The physical and mental well-being aspects of this demographic group were critical during these times, as the university students faced disruptions in their routines, education, and social connections, all of which can have lasting effects on their health.

Exclusion criteria were based on items such as publication language other than English, publication year (before 2020/before the COVID-19 pandemic), systematic reviews, meta-analysis, and studies that observed high school students.

A total number of 97 articles were identified after a preliminary search in the electronic databases. During the screening process duplicate articles were removed. 75 articles were assessed for eligibility, out of which only 47 studies were included in our analysis.

After reviewing the full content of the included articles we determined the relevance of the findings. Details regarding the population to which the studies were addressed, methods used, and important findings were meticulously documented. After gathering all required information we refined the findings into categories of results.

3. Results

This study assessed forty-seven (47) research articles. Online surveys were the primary method of data collection for almost all of the research that were part of this review. Physical exercise is generally associated with fewer negative characteristics, including fear, anxiety, depression, and well-being, according to the studies. Social isolation and distance learning requirements increased symptoms of anxiety, depression, and insomnia [10, 11, 12]. Moreover, these challenges have been made worse by university closures. In general, every article showed a strong correlation between an increased level of physical exercise and better mental, emotional, and physical health.

3.1. COVID-19 and Physical Activity Changes

The COVID-19 pandemic era had a significant life-changing impact on all students from all over the world. Students who engaged in vigorous physical activity outperformed those who engaged in low or moderate-intensity physical activity [13]. According to a study that examined the connection between COVID-19 and cardiorespiratory fitness (CRF), students who engaged in more physical activity were more likely to believe that the occurrence of COVID-19 had a detrimental effect on their CRF. Although no direct link was found between COVID-19 and cardiorespiratory fitness (CRF), individuals who believed the pandemic had a negative impact on their

CRF were actually more physically active. This suggests that their perception of harm may have motivated them to exercise more [14].

It has been demonstrated that online learning is by no means the most effective way to educate and practice physical exercise, particularly for students enrolled in the Physical Education and Sport Faculty at West Timișoara University. Nonetheless, in such unusual circumstances, the digitised educational process has its advantages. It might be viewed as an essential alternative for students' health, education, and pleasure. The study clearly showed that, in vocational fields such as physical education and sports, the face-to-face approach remains the state-of-the-art for interpersonal communication. However, during pandemic times, the digitised form of physical education programs plays an essential part in sustaining a higher degree of enthusiasm [15].

Quarantine in Romania resulted in a significant increase in sedentarism among students from the Technical University of Cluj-Napoca and foreign students on mobility visits through the Erasmus program in Romania, as well as a decrease in energy for physical activity, which had an impact on their psychological well-being. The lack of social connections and onsite classes led to students adopting sedentary lifestyles, which intensified their worry and stress. The interruption of all sports and physical activity events resulted in fewer students being physically active [16].

Sedentary levels were higher during both lockdowns, and sedentary behaviors tended to persist over time. The level of mild physical activity decreased considerably following the first lockdown and remained low during the second lockdown. As a result, the rise was not sustained over time, showing a lack of long-term change in student habits. This can be linked to a loss of motivation or even resignation owing to the long duration of the pandemic. This study raises concerns about the long-term effects of the pandemic on students' health and lifestyle [12].

Due to gym closures, many students from the University of Salerno chose to engage in outdoor activities, such as aerobics, to avoid wearing masks while exercising. Outdoor exercise has more benefits than indoor exercise and may help prevent COVID-19. The second lockdown did not discourage motor science students from adapting to the new environment and engaging in physical activity both indoors and outdoors. Before the gyms closed, 87.1% engaged in physical and motor activity, with 42.0% decreasing their workouts and 36.6% maintaining or intensifying their activities. This could be because many students (54.5%) say they have more time to dedicate to physical activity now that they don't have to drive to the university or other facilities [10].

Spanish university students reported decreased PA, increased sedentary time, and worsened sleep, anxiety, mood, and perceived health during home confinement caused by the COVID-19 pandemic. Overall, these parameters had improved slightly one-year post-confinement but did not return to pre-pandemic levels [17]. The low level of students' physical fitness is also confirmed by Shilko et. al., [18] in their study. The pandemic has a negative impact on the physical activity levels, weight gain, and mental health of university students. Students reported gaining weight during the pandemic. Furthermore, the rise in depression symptoms is associated with higher levels of weight gain [19]. Removing restrictions on campus access increases physical activity levels and self-reported cognitive empathy scores in college students during the COVID-19 epidemic [20].

Total physical fitness test scores of college students decreased after the outbreak, but their mean body mass index (BMI) remained at normal levels. During the online learning period, the mean academic performance of college students unex-

pectedly improved. The positive correlation between physical test scores and academic performance was significantly higher during COVID-19 than before the outbreak [21]. Overall, university closures restricted possibilities for exercise and physical activity, resulting in major lifestyle changes among physical education students [22]. The absence of face-to-face physical education classes contributed to a decline in overall sport and fitness levels, as well as reduced academic performance in physical education among all participants [23].

In China, in 2021, the prevalence of overweight and obesity among boys increased from 22.53% to 29.25% and continued to rise each year since. Among all physical fitness indicators, boys in the overweight and obesity groups had the lowest strength scores, while endurance levels were the lowest across all individuals in these groups. So, when designing targeted interventions to improve students' physical health and mitigate the negative effects of COVID-19, it is essential to include endurance and strength training exercises.[24]

The home isolation environment during COVID-19 had a significant impact on the physical fitness of students, specifically in terms of endurance and flexibility qualities, as well as male BMI. To better prepare for future public health emergencies and mitigate the effects of isolation, teaching students endurance exercises that can be performed at home should be prioritized. Furthermore, physical education programs should be improved to enhance flexibility [25]. Total physical activity and walking durations decreased, whereas sitting time climbed dramatically [26].

To prevent the expansion of the disease, entire populations were instructed to live in home confinement. Adaptation to confinement, in terms of physical activity, was handled better by women than by men [27].

The COVID-19 lockdown led to a decline in physical performance among Chinese college men, particularly in endurance and upper-body strength. Specifically, their performance in the 1000-meter run, which measures cardiovascular endurance, and pull-ups, which assess upper-body strength, showed a noticeable decrease. The decline in physical performance varied by grade level, with third-year college men experiencing the most significant decrease, while first-year college men showed only a modest reduction [28]. Another research compared physical fitness test results for three consecutive years from 2019 to 2021, focusing on the impact of online physical education among medical school students in China. The pairwise comparisons of physical fitness test results from 2019 to 2021 show that online physical education is effective in improving all items except long-distance running. Future research needs to involve a larger and geographically more dispersed sample to further analyse the effectiveness of online physical education [29]. On the other hand, a different study indicates that students' physical health worsened while attending online classes from home [30].

3.2. COVID-19 and Lifestyle Factors

The COVID-19 epidemic had a lasting impact on communities around the world, forcing the deployment of strict national crisis measures that reverberated across all sectors, including education. It drove all students to adopt a sedentary lifestyle, which had a negative impact on health-related fitness indicators such as body composition, cardiorespiratory and musculoskeletal strength, and motor skills. Students who formerly participated in frequent physical activity, particularly school athletes, had severe fitness decreases [31].

A research conducted on 166 students from the University of Cadiz's faculties of Sports Science and Physical Therapy discovered that men had a better opinion of their overall health quality than women. Furthermore, men faced substantially fewer

difficulties in conducting daily tasks than women. Female university students, on the other hand, had stronger coping methods, which meant they were able to deal with daily challenges with greater coolness, focus, and concentration [32].

Around 52% to 59% of student-athletes reported that COVID-19 negatively affected their health and well-being, leading to a worse college experience [33]. There is a link between nutritional status, academic achievement, and pupils' physical fitness. Physical exercise improves student learning by 39% and nutritional status by 10.32%. To achieve ideal physical fitness, it's important to exercise regularly, get enough rest, and maintain a healthy lifestyle. It's also important to consume nutritious foods [34].

Sport and physical activity are practiced in Cuban universities with the primary goal of contributing to the integral and harmonious formation of future sports professionals, enhancing health, and practically correcting disorders. On the other hand, the COVID-19 pandemic forced a shift in behavior, leading to increased technology use and prolonged sedentary postures. Additionally, the long hours of mental work caused changes in daily habits and contributed to psychological discomfort [35].

The epidemic has resulted in altered lifestyles and habits and a rise in sadness and stress. These modifications have had an impact on the health of the students. Obesity and respiratory disorders were the most prevalent. High cholesterol, rheumatic diseases, circulatory system diseases, and hypertension being the least common [36]. COVID-19 has exerted significant impacts on human health, including aspects related to body weight. Body Mass Index (BMI) increased both during and post-lockdown periods among Chinese college students. However, during the lockdown, participants with higher BMI groups appeared to have a diminished BMI growth rate compared to those with lower BMI. After the lockdown, participants with higher BMI levels appeared to have an augmented BMI growth rate. In order to boost Chinese college students' physical activity levels and enhance their physical fitness performance following the lockdown, public policy action was required [37]. Not all dimensions of health outcomes were negatively impacted by the lockdown, as deterioration in BMI in males, muscle strength, and cardiorespiratory fitness following the COVID-19 lockdown were more than that in the absence of the lockdown, while deterioration in BMI in females and flexibility were less than that in the absence of the lockdown [38].

When examining the relationship between quality of life and physical and cognitive impairments, participants who had recovered from COVID-19 showed significant physical and cognitive impairments on average 4 months after their symptoms. These impairments were strongly correlated with a lower quality of life when compared to healthy, matched controls. These results emphasise that in order to create effective management strategies, a thorough examination is required [39].

The impact of lockdowns on students' quality of life, happiness, and stress levels was significant, with increases in alcohol consumption and appetite. On the other hand, students who maintained regular physical activity and healthy eating habits showed a more positive outcome [40]. Drug abuse and a post-COVID-19 condition resulted in poor performance in more demanding exercises, such as ascending several levels of stairs. After suffering from COVID-19 disease, the physical role was significantly impacted, with medicine consumption and decreased activity levels. Excessive drinking and drug use has been demonstrated to impair social functioning [13].

Other behaviours, such as sleep, eating, everyday activities (sports), and social activities, have all been affected or restricted as a result of changes in working conditions and the implementation of quarantine or curfews. Half of the students from the

study reported at least one unhealthy behaviour, such as alcohol drinking, tobacco usage, or insomnia [41].

3.3. COVID-19 and Mental Health Impacts

During the COVID-19 pandemic, university healthcare students' mental health deteriorated. Social isolation and house confinement have altered daily behaviour in Hungary. Students' perceived mental health status was poorer than their perceived physical health, and the percentage of people who did not participate in any sports fell from 37.61% to 29.26% [26]. Also, a study conducted by Şilişteanu et al. [41] revealed that many students (33.8%) were diagnosed with abnormal anxiety scores. Aside from affective changes, students reported cognitive changes such as difficulties with concentration (72.93%) and catastrophic thinking (25.22%).

Quarantine has affected college students' mental health with noticeable worry or stress. Decreased learning efficiency and duration can impact mental health. Students who engage in regular low-intensity exercise and get enough sleep are less likely to be affected. To alleviate mental pressure, improving the study environment, exercising regularly, and getting enough sleep would be an effective approach [42]. Polish students' physical and mental health suffered significantly due to several factors, including very limited access to recreational facilities, excessive time spent sitting or lying down each day, and insufficient physical activity [11].

University students particularly suffered from increased anxiety and depression, especially freshmen and sophomores compared to senior students, and this was mainly due to the sudden transition to distance learning. However, the contribution of physical activity to protecting youngsters' mental health was very small in this context [43].

The spread of COVID-19 has led students to take classes online, which had an impact on their physical activity performance, as well as some health problems they faced while taking online classes during the quarantine period, such as weight gain, depression, and anxiety. A study conducted by Rizwan et al., [44] proposed a method that addresses how to effectively manage an optimal future learning system for physical education students. During the isolation period of COVID-19, the required equipment for the participants was rarely available at home while attending the online classes, which inevitably reduced the number of physical education units that could be conveyed. This led to a shift in focus from competition to underperformance, weight gain, and the development of negative psychological conditions. They concluded that it is important to review and systematize the methods of online physical education learning, particularly highlighting the cultural and educational characteristics of different countries, and to investigate the effectiveness of online physical education as a whole.

Exercise can play a complex role in mental health. While some research shows that excessive reliance on exercise is negatively correlated with emotional states like stress, anger, exhaustion, and sadness, regular physical activity in balanced amounts remains crucial for improving college students' mental well-being. Exercise helps reduce stress, boosts mood, and enhances overall mental resilience, making it an essential practice for supporting students' mental health [45].

4. Discussion

The COVID-19 pandemic has affected all continents of the world on varying scales. The COVID-19 pandemic has had a profound impact on health and lifestyle patterns worldwide, influencing not only infection rates and mortality but also the behavioral and lifestyle patterns of populations worldwide. Studies have consistently shown a decline in physical activity levels during lockdowns, often accompanied by negative psychological effects, including increased anxiety, depression, and stress [32-36]. Our findings align with this trend, supporting the hypothesis of a bidirectional relationship between physical inactivity and mental wellbeing. Individuals who experienced declines in mental health, reinforcing the established literature on the strong interconnection between physical and psychological health outcomes.

The lockdowns imposed during the pandemic introduced several lifestyle disruptions, particularly among university students. Inadequate nutritional intake, excessive alcohol consumption, increased sedentary behavior, and reduced physical activity have all been reported as significant concerns. Prior studies indicate that university students, already at risk for unhealthy lifestyle behaviors, experienced exacerbations in poor dietary habits and increased screen time, further contributing to declines in physical fitness [12-13, 41]. These trends suggest that beyond immediate consequences, pandemic-related lifestyle shifts may have long-term implications for students' metabolic health, requiring targeted interventions to mitigate these effects.

An interesting aspect of our findings relates to the role of digital alternatives in sustaining engagement with physical activity. While traditional face-to-face physical education (PE) programs were disrupted, online social networks and digitized PE programs played a role maintaining students' interest in physical fitness [15]. However, their effectiveness appears to have been limited, as the overall reduction in sports participation and structured exercise persisted despite these efforts. The effectiveness of virtual physical education and remote fitness interventions remains an open question for future research, particularly regarding their long-term sustainability in promoting active lifestyles among students.

The university's closure and discontinuation of face-to-face PE programs in response to the COVID-19 epidemic reduced overall and sport/fitness PA levels in all participants (male and female students). This is consistent with prior research, which found that during the COVID-19 epidemic, the student population dropped their PA levels. Total physical activity and walking durations decreased, whereas sitting time increased dramatically [26]. Overall, university closures restricted possibilities for exercise and physical activity, resulting in major lifestyle changes among physical education students [22]. The interruption of all sports and PA events resulted in fewer pupils being physically active [16].

Contrary to expectations, our findings confirm that overall decrease in physical activity among students was not accompanied by a significant increase in BMI. This aligns with previous research suggesting that while physical inactivity negatively impacts body composition, its effects may be counterbalanced by changes in dietary behavior [38]. Interestingly, sex-specific differences were observed, with BMI deterioration in males and reductions in muscle strength and cardiorespiratory fitness being more pronounced than in females. These results highlight the complex interplay of lifestyle, metabolism, and physical fitness under conditions of restricted mobility.

The impact of remote learning on students' physical activity and well-being is also a significant concern. According to Radu et al. [46], while many Romanian university students expressed satisfaction with distance learning, several challenges were reported, including inadequate infrastructure, reduced teacher-student interaction, lack of socialization, and decreased motivation of learning. Additionally, the

increased reliance on screen-based education contributed to a more sedentary lifestyle, raising concerns about the potential long-term health consequences of prolonged digital engagement.

Pandemic-related closures of venues for sports and physical activity may disproportionately impact active students. The researchers found that students who were the most active prior to the institution closure had lower levels of physical activity. The less active PA students prior to cancellation, on the other hand, significantly raised their level of physical activity overall [47].

5. Conclusions

This review of the literature advances knowledge of the positive correlation between exercise and mental health during the COVID-19 pandemic, especially for university students. The COVID-19 pandemic has highlighted the crucial relationship between physical and mental health, emphasizing the need for universities and public health institutions to implement prompt and effective interventions that focus on fitness and physical activity. The pandemic's potential long-term impact on mental health underscores the importance of maintaining physical well-being to support psychological resilience. During the pandemic, universities had to rapidly adapt to reduce in-person interactions while continuing academic programs, with distance learning becoming a global solution. However, this shift also contributed to decreased physical activity, further exacerbating mental health challenges for students. Therefore, addressing both physical activity and mental health is essential in university settings to mitigate the long-term effects of the pandemic.

The large impact of pandemic-induced disruptions on scheduled physical activity and training methods is highlighted by our findings, which demonstrate a significant decline in physical fitness levels. This underlines the crucial need for concentrated initiatives to support active lifestyles among young adults in the post-pandemic phase, to avoid long-term negative health outcomes.

The data gathered in this study emphasizes the importance of physical activity promotion initiatives orientated towards the student population. The findings indicated that promoting regular physical activity during home quarantine and self-isolation, along with raising awareness among university students, would have been essential in reducing sedentary behaviors and inactivity during the COVID-19 pandemic.

The COVID-19 pandemic has reshaped students' health behaviors, underscoring the crucial role of physical activity in maintaining both physical and mental well-being. Both physical and mental health were greatly impacted by the COVID-19 pandemic; changes in lifestyle brought on by quarantine resulted in increased sedentarism, weight gain, sleep difficulties, anxiety, and despair. Although it has been demonstrated that vigorous physical activity is essential for good health, online physical education has emerged as a key tool for students to stay active and healthy. However, quarantine limitations affected health-related metrics, especially in education, and reduced fitness levels.

While pandemic-induced disruptions led to significant declines in structured exercise, emerging resilience mechanisms - such as increased cognitive empathy and adaptation to new fitness modalities - offered pathways for recovery. Moving forward, universities and teachers must adopt a holistic approach that integrates structured exercise programs, mental health support, and lifestyle education to ensure students maintain long-term physical and psychological well-being. Addressing these challenges proactively will be essential for strengthening resilience in future health crises.

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