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# Towards understanding the role of physical activity on mental health among university students during COVID-19: Review

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## ABSTRACT

Several studies in previously published literature have approved the positive role of performing physical activity (PA) on mental health among university students before COVID-19. These studies have investigated the relationship between PA and mental health extensively under normal circumstances and have concluded similar results. *Objective:* This review examines the association between PA and mental health among university students during COVID-19. *Methods:* Published literature was searched in PubMed and ScienceDirect using specific keywords, including physical activity, university students, college students, mental health, and COVID-19. This review data synthesis included observational and interventional studies published in English between 2020 and 2024. *Results:* Seven studies investigated the relationship between PA and mental health among university students during COVID-19, all cross-sectional and published between 2020 and 2022. During COVID-19, decreased PA and increased sedentary times were associated with poorer mental health and higher levels of depressive symptoms, anxiety, and stress, in addition to higher negative emotions. However, studies have not examined the impact of increasing PA on mental health among university students during COVID-19. *Conclusion:* Reducing PA levels among university students during COVID-19 significantly impacted their mental health. However, the effects of performing different levels of PA (low, moderate, vigorous) on students' mental health during COVID-19 have not been explored yet. Therefore, researchers in future studies are recommended to cover this knowledge gap by exploring this effect among university students.

**Keywords:** Physical activity, mental health, depression, anxiety, stress, university students, COVID-19.

## 1. INTRODUCTION

Caspersen et al., (1985) define physical activity (PA) as physical movements performed by the skeletal muscles that cause energy expenditure. It includes all movements during leisure, transport, work times, or domestic activities. In 2007, the American College of Sports Medicine and the American Heart Association recommended adults from 18 to 65 years of age to be engaged in moderate-intensity aerobic activity with a minimum of 30 minutes for five days a week or vigorous-intensity aerobic activity with a maximum of 20 minutes for three days a week or combine both to meet the recommendations and gain health promotion (Haskell et al., 2007). Following the recommendations of PA for adults has several health benefits. Evidence shows that PA has a positive impact on the prevention of chronic diseases, including cardiovascular disease, cancer, diabetes mellitus, obesity, hypertension, osteoporosis, and depression, as well as premature death.

On the other hand, physical inactivity is linked to developing these chronic diseases (Warburton et al., 2006). PA has been used as an intervention to improve mental health by decreasing the symptoms of depression and anxiety (Heissel et al., 2023; Gordon et al., 2017). Mental health has been defined by the World Health Organization (WHO) as the state of mental well-being that allows individuals to recognize their abilities, learn well, cope with everyday stressors in daily life situations, be productive at work, and contribute to their surrounding community (WHO, 2024). Moreover, positive mental health relates to pursuing habits and behaviors that can contribute to developing healthy and good mental health (Tamminen et al., 2020). WHO identified coronavirus (COVID-19) as a global pandemic on March 11th, 2020.

Accordingly, many countries followed mandatory confinements to control the spread of the COVID-19 pandemic outbreak, and most countries worldwide applied public restrictions. As a result, teaching organizations shifted the mode of studies to online platforms; therefore, approximately all students across the globe, including university students, moved to online education. Consequently, applying physical restrictions and lockdowns and moving from on-campus to online education negatively impacted university students' PA levels (Rivera et al., 2021; Chu and Li, 2022; Almeheyawi et al., 2024). In terms of the prevalence of adverse mental symptoms among university students during COVID-19, 37% of students suffered from depression, 29% suffered from anxiety, and 23% suffered from stress (Wang et al., 2021).

PA was found to have a positive association with mental health among university students before COVID-19, as increasing PA was associated with better mental health and lower depression, anxiety, and stress symptoms. It has been used previously as a mediator that has the potential to alleviate mental symptoms, including depression, anxiety, and stress, and improve mental health. Therefore, the primary purpose of this review was to explore the association between PA and mental health among university students during COVID-19.

## 2. METHODS

Literature in PubMed and ScienceDirect databases were searched on 01 July 2024, using specific keywords to identify observational and interventional studies investigating PA and mental health among university students during COVID-19 published in the last five years between 2020 and 2024. Keywords included physical activity, university students, college students, mental health, and COVID-19. Studies that examined and reported relationships between PA and mental health were identified and included. Data have been extracted from the included studies and summarised in a table as authors, years of publication, country, study design, sample size (number of males/females), mean age in years  $\pm$  standard deviation (SD), relationship investigated, and study results.

## 3. RESULTS

Seven studies were identified, all published in English, conducted on university students, examined the relationship, and reported results were included and reviewed. All studies were cross-sectional studies published between 2020 and 2022, with sample sizes between 194 and 11,787 students and mean age ranges between 19.99 and 25.11 years. All studies reported statistically significant associations between PA and mental health among university students. These significant associations supported the role of PA on mental health, as stated in the studies in (Table 1).

**Physical activity and mental health during COVID-19 among university students**

As stated in Table 1, an early cross-sectional study investigated PA and mental health during the COVID-19 lockdown among university studies and recruited 1512 students from 11 different Ukrainian universities (31% male, 69% female) with a mean age of 20.06 ± 3.05 years. Data was collected between May 14th and June 4th, 2020, during the COVID-19 lockdown. Students reported that they were more physically active before COVID-19, and students with anxiety and depression had double the likelihood of being not engaged in PA. Moreover, inactive students scored higher levels of anxiety and depression when compared to active students (Rogowska et al., 2020). Interestingly, a prospective study from the United Kingdom started collecting data before COVID-19 and continued to collect data during the COVID-19 lockdown and compared levels of mental health and sedentary time spent by students before and during the COVID-19 lockdown.

The study enrolled 214 university students (28% males, 72% females) with a mean age of 20 years. The results showed reduced PA and mental health levels, measured and compared among university students, as noted in the increase in sedentary times and perceived stress levels during the first five weeks of lockdown. In terms of the association between PA and mental health, the results of this study reported that increased symptoms of perceived stress were significantly associated with increased sedentary time spent by students who participated in this study (Savage et al., 2020). Two cross-sectional studies conducted on Chinese university students collected data from a relatively large number of participants, with 11,787 students in Zhang and colleagues study (42.9% males, 57.1% females, mean age=20.51 ± 1.88 years) and 1,214 students in Li and colleagues study (41.68% males, 58.32% females, mean age=19.99 ± 1.73 years).

According to Zhang et al., (2021), performing PA less than three days per week was associated positively with depression among university students when compared to performing PA three days or more per week. Additionally, according to Li et al., (2021), higher levels of physical exercise were significantly associated with lower negative emotions, which indicates better mental health (Zhang et al., 2021). Two additional cross-sectional studies conducted in the United States supported these findings and reported similar results during COVID-19 (Coakley et al., 2021; Coughenour et al., 2021). The first study recruited 697 university students (34% males, 62% females, and 4% others) with a mean age of 21.29 ± 1.62 years and reported that long sitting times were significantly associated with higher levels of depression and anxiety (Coakley et al., 2021).

The second study recruited 194 university students (72.2% males, 27.3% females, 0.5% others) with a mean age of 25.11 ± 7.84 years. The results reported a small significant negative association between PA and depression, as lower levels of PA were significantly associated with higher scores of depression (Coughenour et al., 2021). Furthermore, a cross-sectional study conducted in Chilean universities recruited 469 university students (34% males, 66% females) with a mean age of 22.4 ± 0.19 years. Results showed that physically inactive students who presented with a sedentary profile during COVID-19 reported worse mental health and well-being (Reyes-Molina et al., 2022).

**Table 1** Studies included investigating the relationship between PA and mental health among university students during COVID-19.

Authors, year of publication (Country)	Study design	Sample size (N) (male/female)	Age M ± SD (Years)	Relationship investigated	Results
Coakley et al., 2021 (USA)	Cross-sectional	697 (238/431) Others=28	21.29 ± 1.62	Association between vigorous-intensity exercise (min per week) and depressive symptoms.	Performing vigorous intensity exercise was positively associated with less depressive symptoms (p= 0.054).
				Association between sitting hours per day and depression, anxiety symptoms.	Longer sitting hours per day was associated positively with greater symptoms of depression and anxiety (p< 0.05*).

Coughenour et al., 2021 (USA)	Cross-sectional	194 (53/140) Other=1	25.11 ± 7.84	Association between PA and depression.	Significant small negative association between PA and depression (p= 0.04*)
Li et al., 2021 (China)	Cross-sectional	1,214 (506/708)	19.99 ± 1.73	Association between physical exercise and negative emotions	A significant negative association between physical exercise and negative emotions (p< 0.001*)
Reyes-Molina et al., 2022 (Chile)	Cross-sectional	469 (159/310)	22.4 ± 0.19	Association of PA and sedentary time with mental health.	Higher levels of PA and lower sedentary profiles were associated significantly with greater mental health (p< 0.01*).
Rogowska et al., 2020 (Ukraine)	Cross-sectional	1,512 (474/1038)	20.06 ± 3.05	Association between PA and anxiety, depression.	Physically inactive students scored higher levels of anxiety and depression compared to active students (p< 0.001*).
Savage et al., 2020 (UK)	Cross-sectional	214 (60/154)	20 ± NR	Association between perceived stress and increased sedentary time	A significant weak positive association between perceived stress and increased sedentary time (p< 0.010*).
Zhang et al., 2021 (China)	Cross-sectional	11,787 (5056/6731)	20.51 ± 1.88	Association between PA and depression symptoms.	In comparison to performing PA ≥ 3 days per week, performing PA < 3 days per week was associated positively with depression (p< 0.01*)

Abbreviations: N=number; M=Mean; SD=Standard deviation; USA= United States of America; UK= United Kingdom; PA= physical activity; NR=Not reported.

\* Significant p-value.

#### 4. DISCUSSION

This review explored the association between PA and mental health among university students during COVID-19. Seven relevant studies were identified, reviewed, and used for the data synthesis of this review to develop a better understanding of the role of PA on mental health among university students during this exceptional period of COVID-19. All studies reported significant relationships and supported the negative association between PA and mental health, as lower levels of PA were associated significantly with worse mental health among university students. Before COVID-19, the published literature on this topic supported the significant positive impact of PA on mental health among university students in several cross-sectional studies with relatively large sample sizes that recruited both male and female students.

Pengpid and Peltzer, (2018) published a study that recruited 15,122 university students (42.1% males, 57.9% females) from 23 countries and found that students who met vigorous-intensity PA recommendations reported less perceived stress, good health, and less depression (Pengpid and Peltzer, 2018). Another cross-sectional study published in 2013 investigated the association between vigorous-intensity PA, mental health, and perceived stress of 14,804 university students. The findings of this study showed that students who met vigorous PA recommendations were less likely to present poor mental health and perceived stress (Vankim and Nelson, 2013). Moreover, higher levels of PA were associated with better mental health in a dose-response relationship, as reported by a cross-sectional study conducted in the United Kingdom that investigated the relationship between different levels of PA and mental health, including anxiety and depression, and recruited 100 university students (20% males and 80% female).

The results compared students with low, moderate, and vigorous levels and reported that increasing levels of PA were associated with better mental health (Tyson et al., 2010). Additionally, two studies only investigated and included female students and reported further positive results (Adams et al., 2007; Herbert et al., 2020). Applying public restrictions during COVID-19, lockdown, and shifting to online learning were significant factors that significantly affected the norms of daily life and impacted PA and mental health. Moreover, the potential decrease in PA and the increase in sedentary behavior were linked to poor mental health among university students during COVID-19, as reported in the published literature. As mentioned earlier, a systematic review and meta-analysis published in 2021 revealed that 37% (95% CI, 32–42%) of college students experienced depression, 29% (95% CI, 19–25%) experienced anxiety, and 23% (95% CI, 8–39%) experienced stress symptoms during COVID-19 (Wang et al., 2021).

Moreover, higher numbers of students suffered from moderate to severe symptoms of depression (53.9%), anxiety (66.2%), and stress (44.6%), as reported by (Wong et al., 2023). In general, longer screen times were associated significantly with higher depression, anxiety, and stress among university students (Deyo et al., 2023). During COVID-19, one of the significant modifications that affected students was shifting to online platforms, which made students worldwide spend longer hours facing screens, which might contribute to worsening their psychological status in this context. In addition to poor mental health, longer screen time was significantly associated with lower PA and poor sleep quality (Wu et al., 2015).

Studies found in previously published literature showed that PA plays a substantial positive role in improving anxiety, depression, and perceived stress symptoms among undergraduate students in a dose-response manner. The identification of this relationship started before COVID-19, as it was extensively investigated and approved by several studies (Adams et al., 2007; Tyson et al., 2010; Vankim and Nelson, 2013; Pengpid and Peltzer, 2018; Herbert et al., 2020). Moreover, studies conducted during COVID-19 that examined this relationship showed further positive results, supporting the findings of studies conducted under normal circumstances. The findings of these studies showed that during COVID-19, the reduction in PA negatively impacted the mental health of university students Rogowska et al., (2020), Zhang et al., (2021), Coughenour et al., (2021), Li et al., (2021) and spending longer hours sedentary was associated with poorer mental health in this period (Coakley et al., 2021; Reyes-Molina et al., 2022; Savage et al., 2020).

Only one study investigated the impact of moderate-vigorous exercise on mental health and found that more vigorous exercise was positively associated with less depressive symptoms. However, this association was with a trend toward significance ( $p=0.054$ ) (Coakley et al., 2021). No further studies have linked PA to better mental health among university students during COVID-19. As discussed earlier in this review, although plenty of studies examined the relationship between PA and mental health and reported the negative impact of decreasing PA on mental health, the role of PA as an intervention has not been investigated under exceptional circumstances such as COVID-19 yet, as up to the author's knowledge, no studies were found that examined the association between increasing PA and mental health among university students during COVID-19.

Thus, researchers in future studies are commended for conducting interventional studies to investigate the dose-response relationship between different levels of PA and mental health among undergraduate students under unusual circumstances, such as pre-exam periods. Researchers are also advised to take further steps in searching this field by investigating the relationship between PA and mental health and recruiting both male and female students to compare the potential variations between them at different levels of PA. Moreover, researchers are advised in future studies to investigate the impact of performing moderate-vigorous activity on mental health, as PA is a promising intervention that could be implemented to improve mental health, control depression symptoms, and improve anxiety and stress among university students, particularly during unusual periods of experiencing high symptoms of depression, anxiety, or stress.

## 5. CONCLUSION

This review explored the association between PA and mental health. It concluded that decreased PA during COVID-19 has a significant negative role on mental health among university students during COVID-19. The results of studies found that lower levels of PA were associated with significantly higher scores of depression, anxiety, stress, and negative emotions among university students during COVID-19. However, cross-sectional studies investigated this relationship, with no studies examining the impact of increasing PA on mental health. Therefore, researchers in future studies are advised to explore the effect of performing different levels of PA (low, moderate, vigorous) on mental health among university students under unusual circumstances, such as pre-exam periods, and to explore the potential variation in this relationship by recruiting male and female university students.

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**Author Contributions**

Rania N Almeheyawi conceived the study design, conducted the research, wrote the introduction, methods, results, discussion, and conclusion, drafted the manuscript, reviewed, and approved the final draft.

**Ethics approval**

Not applicable.

**Informed consent**

Not applicable.

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**Conflict of interest**

The authors declare that there is no conflict of interests.

**Data and materials availability**

All data sets collected during this study are available upon reasonable request from the corresponding author.

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