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The impact of physical activity on mental health of students in the context of remote learning

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Abstract

The COVID-19 pandemic led to an unexpected transition to remote learning, profoundly altering students' daily routines. Studies report significant declines in physical activity levels during periods of online education. At the same time, elevated levels of anxiety, depression, and stress have been documented among students learning remotely. Evidence indicates that engagement in regular exercise provides mental health benefits: for example, students who engage in physical activity experience significantly reduced anxiety and depression compared to those who do not. In this review, we summarize findings from recent studies, specifically emphasizing how remote learning has led to decreased physical activity and deteriorated psychosocial outcomes. We highlight how physical activity interventions can mitigate stress,

anxiety, and depression in student populations. This paper underscores the importance of promoting exercise during periods of online education to support students' mental well-being.

Keywords: physical activity; mental health; students; remote learning; COVID-19; online education; anxiety; depression

Introduction

The coronavirus disease 2019 (COVID-19) pandemic drastically transformed the learning environment, forcing millions of students worldwide into online education almost overnight. Educational institutions either closed or shifted to virtual classes to control the spread of COVID-19, leading to prolonged periods of home schooling. This disruption has significantly impacted young people's lifestyles.. Lockdowns and school closures limited participation in organized sports and travel to campus, fostering a more sedentary lifestyle (Coughenour et al. 2021; Chu and Li 2022). For instance, Taiwanese university students experienced significant reductions in vigorous, moderate, and light physical activity during the online learning period (Chu and Li 2022). Similarly, a systematic review of university students reported that nine out of ten studies observed significant reduction in total physical activity under pandemic restrictions (López-Valenciano et al. 2021). In children and adolescents, similar trends emerged: across 84 studies an average decrease of 10.8–91 minutes per day of total activity was documented during the pandemic (Rossi et al. 2021). These findings suggest that the transition to remote education has significantly limited students' regular physical activity.

Recent studies indicate that remote learning has a negative impact on mental health. Surveys of e-learning students report alarmingly high levels of psychological distress, attributed to social isolation, disruption of routines, and diminished support networks in remote education (Chu and Li 2022). For example, a meta-analysis indicated that nearly 58% of remote-learning students present anxiety and 50% depression during the pandemic (Xu and Wang 2023). In a Polish study of university students taking online courses, 56% reported depressive symptoms, while 58% reported increased stress compared to traditional in-person classes (Rutkowska et al. 2022). One large cohort study linked the pandemic lockdown with deteriorating mood in students, observing an almost linear association between reduced physical activity and worsened mental health (Brand et al. 2020). The consensus is that many students have faced increased anxiety and depression in the remote-learning context.

Importantly, engaging in physical activity is recognized to influence mental well-being. Numerous studies have documented that active students tend to have better psychological outcomes. In a cross-sectional study, students experiencing anxiety or depression were nearly twice as likely to be physically inactive compared to those without such diagnoses. Moreover, the inactive group scored significantly higher on anxiety and depression scales (Rogowska et al. 2020). Additionally, a study of children and adolescents indicated that physical activity has significantly reduced depression and anxiety symptoms, thereby improving quality of life (Mahfouz et al. 2023). In contrast, sedentary behaviors (prolonged time spent sitting) are associated with poor mental health outcomes (Barbosa et al. 2024). In this context, it is reasonable to suggest that decrease in activity related to COVID-19 pandemic could have exacerbated students' mental health problems. This paper explores the interplay between remote learning, physical activity, and mental health. It outlines how changes in exercise levels during online learning have impacted depression, anxiety, stress and well-being, as well as how interventions that encourage physical activity can mitigate these effects.

Effect of Remote Learning on Physical Activity

The transition to online-schooling has notably decreased opportunities and motivation for exercise. Amongs college students, remote learning was associated with significant reduction in routine physical activity. For example, a study conducted on Taiwanese university students reported that vigorous physical activity dropped drastically during online learning period, especially in male students (Chu and Li 2022). Likeawise, a systematic review involving university students revealed that lockdown measures led to significant declines in mild physical activity (32.5–365.5%) and in vigorous physical activity (2.9-52.8%) compared to pre-lockdown levels (López-Valenciano et al. 2021) . These large percentage decreases indicate that remote learning replaced many incidental activities (e.g. moving between classes) with prolonged screen time. High school and younger students have also become less active. Throughout the pandemic, children's average daily activity times decreased by 10.8–91 minutes (Rossi et al. 2021). One study involving high schoolers used wearable monitors to confirm that students spent substantially more time in sedentary behaviours and much less time in moderate to vigorous physical activity during online-schooling (Starbek et al. 2022). In Greece, researchers observed that distance learning and lockdown notably increased sedentary behavior and, as a result, musculoskeletal pain among students (Papageorgiou et al. 2023).

These findings collectively indicate that remote learning has greatly impacted students' physical activity, leading to negative consequences for mental health outlined below.

Effect of Remote Learning on Students' Mental Health

During the COVID-19 pandemic, online education has been linked to increased emotional distress in students. Research consistently reports a rise in anxiety, depression, and stress caused by factors related to e-learning. For instance, in a Polish survey more than half of university students experienced clinically significant stress (58%) or depressive symptoms (56%) while learning from home. Additionally, 18% of the participants had suicidal thoughts (Rutkowska et al. 2022). Similarly, a meta-analysis reported that about 58% of remote-learning students suffered from anxiety and 50% had depression, rates far above pre-pandemic norms (Pacheco et al. 2017; Xu and Wang 2023). Even young students have demonstrated declines in well-being during lockdown: research notes that in Italy and Spain children and adolescents experienced difficulty concetrating, boredom, increased irritability, nervousness and restlesness during the quarantine (Orgilés et al. 2020). These studies together indicate that numerous students in online education suffer from worsened mental health.

It seems that multiple factors lead to this decline. Loss of social interaction is frequently mentioned: students in e-learning environment miss direct peer relationships and support networks, which leads to loneliness and isolation. (Elmer et al. 2020; Liu and Lin 2024) . Increased academic uncertainty and technological challenges also contribute to anxiety (Cahyadi 2021). Moreover, the lifestyle changes, such as altered sleep patterns and unhealthy eating habits, add to the burden (Ingram et al. 2020). Therefore, remote learning itself, by changing daily routines and limiting access to support, has dramatically increased psychological distress among students. It becomes crucial to examine factors – notably physical activity – that might alleviate such outcomes.

Relationship Between Physical Activity and Mental Health

Extensive research has documented a positive relationship between excercise and mental well-being in general, and student populations are no exception. Physically active students consistently show better psychological profiles compared to their sedentary peers. (Hong et al. 2024; Çakir et al. 2025). A study investigating college students before and after lockdown revealed that those who became less active reported more mental health concerns, with a

significant correlation between reduced exercise minutes and worse depression scores (Coughenour et al. 2021). A sedentary lifestyle has been identified as a risk factor for mental disorders: a recent cross-sectional study found that sedentary behaviour during the pandemic was significantly associated with symptoms of anxiety and depression in university students, and importantly, lack of moderate to vigorous physical activity amplified these negative effects (Barbosa et al. 2024). Conversely, frequent physical activity protects psychological well-being. One randomized trial demonstrated that college students who participated in web-based exercise classes during the pandemic experienced a significant reduction in depressive symptoms over several weeks (Murray et al. 2022). Likewise, a meta-analysis showed that exercise programs for undergraduates decreased symptoms of anxiety, depression, and perceived stress. However, the authors caution that these results should be interpreted carefully due to the high risk of bias in the included studies (Huang et al. 2024).

The type, intensity and duration of exercise may also matter. Vigorous physical activity had a greater impact on reducing anxiety and depression than moderate activity. Interventions lasting eight weeks or less, performed fewer than four times per week, and consisting of sessions lasting 30 minutes or less, were more effective in alleviating symptoms of anxiety and depression (Luo et al. 2022). These results highlight the importance of tailoring physical activity programs to optimize mental health benefits for university students.

Overall, the research states that physical activity benefits psychological well-being of students, By contrast, prolonged inactivity and sedentary behavior are detrimental, particularly in stressful contexts like a global pandemic (Coakley et al. 2021). Thus, students should be encouraged to participate in daily physical activity and to minimize prolonged periods of sitting.

Physical Activity Interventions for Supporting Mental Well-Being

Given the evidence linking exercise with improved mental health, several studies have considered how to promote physical activity among young people. One practical recommendation is to incorporate active breaks within classroom sessions. This approach aims to counteract the sedentary nature of remote education and maintain student engagement (Peiris et al. 2021; Rutkowska et al. 2022). Teachers could encourage students to sit less not only by scheduling short movement breaks even during virtual lectures, but also assigning tasks that require movement (Starbek et al. 2022) . Such short bursts of exercise have been

shown in non-pandemic settings to boost mood, concentration and memory (Fenesi et al. 2017), and they can be implemented easily in a virtual setting.

Multiple studies on remote interventions offer empirical evidence. For instance, an 8-week randomized trial compared web-based aerobic resistance exercise intervention (WeActive) and a web-based yoga mindfulness exercise intervention (WeMindful) in college students. Both programs led to significant improvements in depression scores, with the WeActive group showing better results. Importantly, it proves that implementing online exercise programs is a viable and effective strategy to promote physical activity and well-being during periods of social distancing (Murray et al. 2022). In another trial, participants were delivered individualized exercise recommendations via video consultation . During lockdown, students receiving the exercise intervention did not show the increase in depressive symptoms seen in control students – suggesting a stress-buffering effect of the exercise (Philippi et al. 2024). In light of the mental health challenges exacerbated by the pandemic, research emphasizes the benefits of physical activity interventions for students. In a systematic review of 58 controlled trials of physical activity programs for higher-education students, over half of them resulted in significant improvements in mental well-being or quality of life . Effective programs often included moderate to vigorous activities such as dance or pilates (Donnely et al. 2024). In the specific context of returning to in-person school, one cross-sectional study conducted in Saudi Arabia noted that after two years of remote learning, students' physical activity levels remained moderate and their mental health declined. As physical activity is linked to improved quality of life and better mental health, the authors highlighted that reinforcing exercise could help rebuild well-being (Mahfouz et al. 2023). In summary, interventions that encourage movement—whether through institutional programs, online classes, or at-home routines—consistently show benefit for mood and stress management.

At both the policy and school levels, experts recommend taking proactive measures. The Slovenian cohort study concluded that policy support is needed for safe (indoor and outdoor) spaces where students can be active during lockdowns (Starbek et al. 2022) . Physical education departments are encouraged to maintain at least minimal activity requirements even when schooling remotely (Pavlovic et al. 2021). On an individual level, researchers advise parents and teachers to set limits on passive screen use and integrate walking or exercise tasks into assignments (Starbek et al. 2022). Because sedentary lifestyle itself worsens mental health (Barbosa et al. 2024), even small efforts to minimize long periods of sitting are beneficial. Overall, the research points to a comprehensive approach—promoting daily

movement, reducing inactivity, and offering emotional support—as the most effective way to support students' mental well-being during and after extended periods of remote learning.

Discussion

According to the research discussed above, remote learning during the COVID-19 pandemic has generally reduced students' physical activity and has been associated with increased mental health concerns, while physical activity itself acts as a protective factor against stress, anxiety and depression. During lockdown, as school closed, physically active children and adolescents faced fewer emotional problems, therefore physical activity should be recommended as a feasible long-term support for youth well-being (Zhong et al. 2024). Likewise, sedentary university students were at greater risk for anxiety and depression, but even moderate activity could mitigate these effects (Barbosa et al. 2024). These findings are consistent with pre-pandemic research on exercise psychology (Fenesi et al. 2017) and extend it into the context of e-learning.

It should be noted that most of the available research is either observational or short-term. There are still a few longitudinal studies and it is difficult to distinguish the impact of remote learning itself from other simultaneous stressors such as family income loss, illness, social unrest. Nevertheless, the consistency across diverse countries and age groups supports the notion that physical activity serves as a flexible tool for enhancing resilience. The successful enhancement of mood through randomized experimental trial of physical activity interventions (Murray et al. 2022) implies that the relationship between exercise and better mental health are probably at least somewhat causal. The systematic reviews and meta-analyses reinforce this: students who were randomized to physical activity programs had better outcomes than control groups, indicating real intervention effects (Huang et al. 2024).

One practical implication is that remote education policies should explicitly incorporate physical activity components. For instance, mandatory physical education classes could be adapted to virtual settings, or teachers could award credit for participation in exercise. Breakout "exercise room" sessions during long online lectures could enhance both attention and well-being (Rutkowska et al. 2022; Starbek et al. 2022).

On a public health level, excessive screen use led to impaired mental health during COVID-19 among youth, thus healthy alternatives, like play and sports, must be promoted during and after the pandemic (Resende et al. 2023). In practice, programs that simultaneously tackle

screen time and physical activity are optimal: for example, curricula that combine learning tasks with physical activities can aid in breaking the sedentary behaviour. Even though these concepts were proposed prior to the pandemic, the existing evidence indicates that they are more relevant than ever.

Our review emphasizes a subtle point: intensity matters, yet even a light-intensity exercise routine is beneficial. While vigorous exercise yielded more significant mental health improvements in some studies, any increase from baseline appears beneficial (Luo et al. 2022). Group activities, including online exercise classes, also provide social support, which is another mediator of the exercise benefits (Elmer et al. 2020). Importantly, maintaining physical fitness appears to mitigate immunological stress from illness, adding another reason to stay active during health crises (Nieman et al. 2019).

Finally, it is worth mentioning that educational institutions like schools and universities are crucial. Prior to the pandemic, nearly all schools required a minimum of 1–2 hours of physical education each week, with only 2.8 % of fully closed and 7.7 % of open schools reporting no requirements. During COVID-19, the percentage of schools eliminating physical education increased dramatically—to 21 % among closed schools and 60.5 % among open ones. Overall, there was a marked decrease in both physical education requirements and the time students engaged in exercise (Pavlovic et al. 2021). Active support from educators can make a difference: teachers who promote activity and implement short movement breaks can substantially reduce students' sedentary time (Starbek et al. 2022).

Conclusions

The COVID-19 pandemic's shift to remote learning has unintentionally reduced students' physical activity while coinciding with a decline in their mental health. The research shows that this is a dangerous combination: reduced exercise and increased sedentary time are linked with heightened anxiety, depression and stress among students. However, physical activity appears to be a powerful mitigating factor. Students who remained active during lockdown – whether through home workouts, outdoor play (where safe), or attending virtual physical education classes – consistently report improved psychological well-being. Interventions and strategies that promote movement during online education can therefore play a crucial role in protecting students' mental health. Universities and schools should actively incorporate exercise into their programs, encourage active breaks, and support students in maintaining

their fitness even when campuses are closed. Such efforts will not only address the immediate stress of remote learning, but may also encourage long-lasting habits that enhance resilience for future difficulties. By emphasizing the connection between body and mind, educators and policymakers can help ensure that the transition to digital classrooms does not come at the expense of student health. As the world emerges from the pandemic, future research is needed to define the best types and doses of physical activity, but the message remains clear: keeping students active is vital for their mental well-being in the era of remote and hybrid education.

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