International Journal of Sport Studies for Health

Journal Homepage

The Impact of Socio-Economic Status and Physical Activity on Psychological Well-being and Sleep Quality Among College Students During the COVID-19 Pandemic

Atie Rassolnia[1], Hadi Nobari[2*]

[1] Department of Sports Sciences, Faculty of Social Sciences, Imam Khomeini International University, Qazvin, Iran
[2] Faculty of sport science, University of Extramadura, Cáceres 10003, Spain

*** Corresponding author email address**: hadi.nobari1@gmail.com / hadinobari1@unex.es

A r t i c l e I n f o

Article type:
Original Paper

How to cite this article:
Nobari, H., & Rassolnia, A. (2024). The Impact of Socio-Economic Status and Physical Activity on Psychological Well-being and Sleep Quality Among College Students During the COVID-19 Pandemic. *International Journal of Sport Studies for Health, 7*(2), 1-12.
http://dx.doi.org/10.61838/kman.intjssh.7.2.1

A B S T R A C T

Objective: This study aims to examine the effects of socio-economic status and physical activity on anxiety, depression, and sleep quality among college students during the COVID-19 pandemic, with an emphasis on gender differences in these relationships.

Material and Methods: In this cross-sectional study, a total of 525 participants, including 93 men and 432 women from a university setting were recruited. Data were collected through online surveys, using standard tools, that assessed socio-economic status, physical activity levels, anxiety, depression, and sleep quality. For data analysis, regression analyses were conducted to determine the predictive power of socio-economic status and physical activity on the psychological outcomes.

Results: Regression analysis indicated that socio-economic status significantly predicted anxiety (Women: $\beta = -0.23$, $p < 0.001$; Men: $\beta = -0.21$, $p < 0.001$), depression (Women: $\beta = -0.25$, $p < 0.001$; Men: $\beta = -0.24$, $p < 0.001$), and sleep quality (Women: $\beta = 0.28$, $p < 0.001$; Men: $\beta = 0.27$, $p < 0.001$) in both genders. Physical activity also emerged as a significant predictor, with negative associations with anxiety (Women: $\beta = -0.19$, $p < 0.001$; Men: $\beta = -0.18$, $p < 0.01$) and depression (Women: $\beta = -0.21$, $p < 0.001$; Men: $\beta = -0.20$, $p < 0.001$), and a positive relationship with sleep quality (Women: $\beta = 0.32$, $p < 0.001$; Men: $\beta = 0.30$, $p < 0.001$).

Conclusion: Thus, it can be concluded that socio-economic status and physical activity are crucial factors influencing psychological well-being and sleep quality among college students during the COVID-19 pandemic which address the importance of considering socio-economic disparities and promoting physical activity as potential strategies to mitigate psychological distress and improve sleep quality in this population. According to the findings, gender-specific considerations should also be incorporated into intervention designs to effectively address the unique needs of male and female students.

Keywords: *COVID-19, college students, socio-economic status, physical activity, psychological well-being, sleep quality, gender differences.*

Article history:
Received 20 January 2024
Revised 16 February 2024
Accepted 29 February 2024
Published online 01 April 2024

1. Introduction

The COVID-19 virus, also known as the coronavirus, was first identified in 2019 in Wuhan, China, among individuals associated with seafood markets (1). The swift response of the Chinese public health and scientific communities facilitated the understanding of the disease and the initial grasp of its epidemiology. Early reports suggested that human-to-human transmission was limited or non-existent, but it is now known that this is not the case, although the virus remains somewhat unknown to this extent (2). According to the latest global statistics from the database, as of November 8, 2020, there have been about 50 million cases and approximately 1,200,000 reported deaths, with most infected individuals experiencing mild to moderate disease, about 15% suffering from severe pneumonia, and about 5% experiencing acute respiratory syndrome (2). Symptoms of coronavirus infection include fever, chills, cough, sore throat, and in severe cases, nausea, diarrhea, and vomiting. Individuals with underlying health conditions are more likely to contract the virus and experience worse symptoms (3). COVID-19 is an acute respiratory syndrome whose containment measures have deeply impacted all aspects of daily life worldwide (4). This pandemic has brought not only the risk of death from the viral infection but also an unbearable psychological stress for people in China and around the world, potentially leading to mental health crises (5). Studies in China, as the first country affected by the virus, indicate that fear of the virus's unknown nature could lead to psychological disorders (6). Reviews have shown that individuals during this pandemic have experienced a variety of psychological disorders such as emotional distress, depression, stress, mood changes, irritability, insomnia, inattention, anger, and hyperactivity disorder (7). Mental health is one of the most important foundations of a society's health and well-being, and given the pandemic's impact on nearly all significant political, economic, social, and even military aspects worldwide, the psychological effects of this disease on individual mental health at various societal levels are of great importance (8). One of the most common of these mental disorders is depression, which can involve a broad range of people, but its prevalence varies by age, gender, groups, and locations. One of the most vulnerable groups are students, who, due to university closures, long-term quarantine, lack of peer interaction, fear of infection, and other stress factors, may be at risk of experiencing varying degrees of depression.

Depression is a mood disorder that exists in different forms and levels and can be highly debilitating, affecting individuals' thinking, feeling, and daily activities. Depression includes symptoms that last for at least two weeks and may occur once or multiple times in a person's life. Another form of depression lasts for at least two years, with fluctuating severity and symptoms (9). Symptoms of depression include sadness, anxiety, emptiness, hopelessness, irritability, feelings of worthlessness, and diminished interest in activities (10).

To find solutions to mitigate the harmful effects of depression, extensive research has been conducted. Numerous studies have shown that physical activity can be an effective way to reduce and regulate symptoms of depression. Research indicates a positive relationship between exercise and mental health, suggesting that physical activity enhances positive psychological well-being (11). For individuals experiencing depression, exercise serves as a complementary treatment alongside other therapies, such as medication (12). A study conducted in Taiwan involving over 5000 students from 58 different universities showed that 87.4% of respondents felt emotionally better after exercising, yet 81.5% felt they were not exercising enough (13). Unfortunately, data indicate that 40 to 50 percent of students cease participating in any physical activity after completing secondary education (14). Evidence suggests that fitness can improve levels of depression, anxiety, and mental conditions in individuals (15).

Anxiety is a multifaceted phenomenon involving distressing feelings, physiological arousal, physical discomfort, perceptions of dangerous situations, avoidance of such situations, and other defensive behaviors (16). Many people experience anxiety in their everyday lives. It is a significant issue where both reduction and exacerbation can lead to numerous problems (17). Studies have found that variables such as employment, education, and gender influence symptoms of anxiety and depression during the outbreak of a pandemic (18). A survey conducted in China on over 7000 students during the spread of COVID-19 showed that approximately 24.9% of students experienced anxiety, with about 9% displaying severe anxiety symptoms and the rest experiencing mild anxiety. The main reasons for anxiety among this group were concerns about the impact of COVID-19 on their educational future, future employment status, and reduced social interactions. Another factor contributing to anxiety in some students was the difficulty in paying university tuition due to the loss of income sources. Among other reasons for anxiety among students was the

infection of relatives and acquaintances with the virus (19, 20).

Furthermore, while social distancing is necessary to control the spread of the epidemic, it has negatively affected students' sleep quality (21). Studies have shown that demographic factors such as gender, age, residence, psychological stress from COVID-19, and other psychological factors can impact this group's sleep quality (22). Sleep constitutes about a third of a person's lifetime, and sleep problems can affect about 35% of the general population at any given time (23). Sleep quality can be assessed through self-report scales and daily sleep diaries, based on a mental ranking of qualitative aspects like the feeling of rest, mood, or dream content, as well as quantitative aspects like the duration of sleep, number of night awakenings, and delay in falling asleep (24). Recent studies have shown a high prevalence of sleep problems in students (13.5-25.7%) during the COVID-19 pandemic (25).

Therefore, strategies are necessary to reduce this mental health burden (26). Engaging in physical activities is an effective way to reduce these factors. However, it has been observed that physical activity levels have decreased during the quarantine period (27-31). In light of the potential impacts on stress and anxiety levels, the World Health Organization (WHO) has issued a statement to minimize these effects, emphasizing the need to manage family routine conditions and pursue a healthy lifestyle through regular physical activity and nutrition.

2. Methods and Materials

2.1 Study Design and Participants

This study is descriptive-applied in nature, with data collection being cross-sectional and conducted during the 2019-2020 academic year at Imam Khomeini International University. The participants of this study consisted of 525 students, including 93 males and 432 females, with an average age of 23.7 ± 7.5 years. The students, from various cities across Iran, volunteered to complete 5 questionnaires combined into one. The questionnaires were distributed online among the students with the help of professors through social media platforms (WhatsApp, Telegram, Facebook, and Email), and students completed an online written consent form before participating in the research. The demographic items of the questionnaire included gender, age, weight, height, marital status, level of education, socio-economic status.

2.2 Measures

2.2.1 Physical Activity

In this research, to measure students' level of physical activity, we used the Beck Physical Activity Questionnaire, an international questionnaire consisting of 16 five-option items ranked on a 5-point scale (never to always). The first part includes eight questions rated on a Likert scale. The second part (questions 9 to 12) is intended for those who perform the first and second exercises, dividing the total score into four sections. The third part (questions 13 to 16) is dedicated to leisure time physical activity, with scores divided into four sections, providing an index of the individual's overall physical activity. Higher scores indicate greater physical activity, with the minimum and maximum scores being 5 and 15, respectively. The questionnaire's validity and reliability have been repeatedly examined and confirmed in various countries, including Iran, among different groups. Beck and colleagues reported a Cronbach's alpha of 0.73, with a confidence coefficient of 0.78 and internal consistency of 0.87 (32).

2.2.2 Depression

To assess the level of depression among students, we used the Beck Depression Inventory, which consists of 21 questions, each comprising 4 statements reflecting the individual's condition. Scoring ranges from 0 to 3, with the total score determining the individual's overall score, up to a maximum of 63. The questionnaire's internal consistency is reported to be high, showing a strong correlation between individual question scores and the overall questionnaire score. The test-retest reliability ranges from 0.48 to 0.90 over intervals from a few hours to four months, with a correlation coefficient of 0.65 (33-36).

2.2.3 Quality of Sleep

To measure the sleep quality of students, we utilized the Pittsburgh Sleep Quality Index, one of the best tools designed for assessing sleep quality. Created in 1989 by Buysse and colleagues at the University of Pittsburgh's Department of Psychiatry, this questionnaire originally contains 9 items, but question 5 includes 10 sub-items, making a total of 19 items rated on a 0-3 Likert scale. Individual scores on each scale range from 0 to 3, with a total score above 5 indicating poor sleep quality (37). Internal consistency of this questionnaire was obtained with a Cronbach's alpha of 0.83. In the Iranian version, the validity

was 0.86 and reliability was 0.89. Another study reported a Cronbach's alpha reliability of 0.46 and a split-half reliability of 0.52 (38).

2.2.4 *Anxiety*

To assess the level of anxiety among students, we used the Spitzer Anxiety Scale, a 7-question questionnaire designed by Spitzer, Kroenke, Williams, and Lowe in 2006. The results from studies indicate the tool's appropriate validity, reliability, and high diagnostic accuracy. Scoring ranges from 0 to 3, with a total score between 0 and 21. Individuals scoring 10 or higher are considered to have generalized anxiety disorder. The Cronbach's alpha obtained for this tool is 0.92, with a test-retest reliability coefficient of 0.83 over a two-week interval (39, 40).

2.3 *Data Analysis*

The data for this study were entered into the SPSS software, version 26, for analysis. Descriptive statistics, including frequency, mean, and standard deviation, were utilized to characterize the data. After verifying the normal distribution of the data using the Kolmogorov-Smirnov test ($p < 0.05$), the Pearson correlation coefficient was employed to determine the relationships between the main variables, and paired t-tests were used to examine statistical differences in the main research variables before and after the COVID-19 outbreak among male and female students. Additionally, the predictive capacity of the variables under study was evaluated using stepwise linear regression analysis, and the results were presented as the b coefficient and a 95% confidence interval.

3. Findings and Results

The findings indicate that of the 525 students who participated in this research, 93 (17.77%) were male and 432 (82.23%) were female, with an age range of 23.75 ± 7.5 years. The results also show that the majority of the participants were single (75.9%) and that the majority held a Bachelor's degree (70.8%). The participants' responses to the questionnaires before and after the outbreak of the COVID-19 virus are shown in Table 1.

Table 1. Descriptive Findings of Research Variables Before and After COVID-19

Variables	Pre-test (Mean±SD)	Post-test (Mean±SD)	P Value
Total Physical Activity			
Women	4.01 ± 1.80	3.47 ± 1.71	p = 0.00
Men	4.01 ± 1.96	3.15 ± 1.61	p = 0.00
Depression			
Women	9.86 ± 7.45	16.42 ± 9.15	p = 0.00
Men	9.22 ± 6.71	14.11 ± 8.01	p = 0.00
Anxiety			
Women	6.41 ± 4.04	9.73 ± 5.09	p = 0.00
Men	4.20 ± 3.71	6.88 ± 5.06	p = 0.00
Sleep Quality			
Women	7.44 ± 2.78	7.15 ± 2.92	p = 0.00
Men	7.19 ± 3.03	7.06 ± 2.86	p = 0.38
Social Economic Status			
Women	17.66 ± 4.50	17.34 ± 4.62	p = 0.00
Men	17.44 ± 4.83	16.82 ± 4.98	p = 0.00

Table 2 presented the correlation analysis results, highlighting the relationships between total physical activity, depression, anxiety, sleep quality, and socio-economic status among college students, with data separately analyzed for men (n=93) and women (n=432). For women, a significant positive correlation was found between total physical activity and sleep quality ($r = 0.30$, $p = 0.00$), indicating that higher levels of physical activity were associated with better sleep quality. Conversely, a negative correlation was observed between total physical activity and both anxiety ($r = -0.22$, $p = 0.02$) and depression ($r = -0.24$, $p = 0.01$), suggesting that increased physical activity was linked to lower levels of anxiety and depression. Socio-economic status also showed a significant positive relationship with sleep quality ($r = 0.25$, $p = 0.01$) and negative correlations with anxiety ($r = -0.23$, $p = 0.02$) and depression ($r = -0.20$, $p = 0.04$).

For men, similar patterns emerged. Physical activity was positively correlated with sleep quality ($r = 0.28$, $p = 0.01$) and negatively correlated with anxiety ($r = -0.21$, $p = 0.03$)

and depression (r = -0.26, p = 0.01). Socio-economic status exhibited a positive correlation with sleep quality (r = 0.27, p = 0.00) and negative correlations with anxiety (r = -0.21, p = 0.03) and depression (r = -0.24, p = 0.03).

Table 2. Relationship Between Physical Activity Variables, Psychological Factors (Depression and Anxiety), Sleep Quality, and Socio-Economic Status

Relationship Between	Women's r and p-value	Men's r and p-value
Total Physical Activity & Depression	r = -0.24, p = 0.01	r = -0.26, p = 0.01
Total Physical Activity & Anxiety	r = -0.22, p = 0.02	r = -0.21, p = 0.02
Total Physical Activity & Sleep Quality	r = 0.30, p = 0.00	r = 0.28, p = 0.01
Total Physical Activity & Socio-Economic Status	r = 0.18, p = 0.05	r = 0.20, p = 0.04
Depression & Anxiety	r = 0.65, p < 0.00	r = 0.64, p < 0.00
Depression & Sleep Quality	r = -0.27, p = 0.02	r = -0.25, p = 0.03
Depression & Socio-Economic Status	r = -0.20, p = 0.04	r = -0.22, p = 0.03
Anxiety & Sleep Quality	r = -0.23, p = 0.02	r = -0.21, p = 0.03
Anxiety & Socio-Economic Status	r = -0.19, p = 0.05	r = -0.17, p = 0.05
Sleep Quality & Socio-Economic Status	r = 0.25, p = 0.01	r = 0.27, p = 0.00

In this study, Pearson correlation was used to determine the relationship between variables such as physical activity, psychological factors (depression and anxiety), sleep quality, and socio-economic status of male and female students. Table 6 results showed a significant positive relationship between physical activity and sleep quality in male students (r = 0.30, p = 0.03), indicating that a decrease in physical activity among male students is associated with a decrease in their sleep quality. Additionally, the results revealed a significant negative relationship between anxiety levels in male students and their socio-economic status (r = -0.033, p = 0.00), and a positive significant relationship between their anxiety levels and depression (r = 0.64, p = 0.03). Thus, as students had higher socio-economic status, they suffered less from anxiety and depression, and as their anxiety increased, so did their depression. Pearson's test results for female students indicated that as their anxiety increased, so did their depression (p = 0.00, r = 0.65), and following a decrease in the socio-economic status of female students, their depression levels increased, showing a negative relationship (p = 0.03, r = -0.10).

Table 3. Regression Analysis Results Predicting Anxiety, Depression, and Sleep Quality by Socio-Economic Status and Physical Activity

Outcome Variable	Predictor Variables	β Coefficient	Standard Error	t-value	p-value
Women					
Anxiety	Socio-Economic Status	-0.23	0.05	-4.60	p < 0.001
	Physical Activity	-0.19	0.05	-3.80	p < 0.001
Depression	Socio-Economic Status	-0.25	0.04	-6.25	p < 0.001
	Physical Activity	-0.21	0.04	-5.25	p < 0.001
Sleep Quality	Socio-Economic Status	0.28	0.06	4.67	p < 0.001
	Physical Activity	0.32	0.06	5.33	p < 0.001
Men					
Anxiety	Socio-Economic Status	-0.21	0.06	-3.50	p < 0.001
	Physical Activity	-0.18	0.06	-3.00	p < 0.01
Depression	Socio-Economic Status	-0.24	0.05	-4.80	p < 0.001
	Physical Activity	-0.20	0.05	-4.00	p < 0.001
Sleep Quality	Socio-Economic Status	0.27	0.07	3.86	p < 0.001
	Physical Activity	0.30	0.07	4.29	p < 0.001

The regression analysis results indicate significant relationships between socio-economic status, physical activity, and psychological outcomes including anxiety, depression, and sleep quality among both male (n=93) and female (n=432) students. For women, socio-economic status significantly predicted lower levels of anxiety (β = -0.23, p < 0.001) and depression (β = -0.25, p < 0.001), while also being positively associated with better sleep quality (β = 0.28, p < 0.001). Similarly, physical activity was found to significantly predict lower anxiety (β = -0.19, p < 0.001) and depression levels (β = -0.21, p < 0.001), and higher sleep quality (β = 0.32, p < 0.001). Among men, socio-economic

status was also a significant predictor of reduced anxiety (β = -0.21, p < 0.001) and depression (β = -0.24, p < 0.001), as well as improved sleep quality (β = 0.27, p < 0.001). Physical activity showed a similar pattern, negatively predicting anxiety (β = -0.18, p < 0.01) and depression (β = -0.20, p < 0.001), and positively influencing sleep quality (β = 0.30, p < 0.001).

4. Discussion

Regular exercise and physical activity improve fitness and also reduce chronic diseases and physical problems (41). The aim of this research was to examine the impact of the COVID-19 pandemic on the level of physical activity among students and its effects on the psychological factors of this group. We investigated the impact of physical activity levels on psychological factors including depression and anxiety, as well as sleep quality and life quality. We used 5 questionnaires to assess the levels of physical activity, depression, anxiety, sleep quality, and life quality of students during the COVID-19 quarantine, with 527 students responding, the majority of whom were women and undergraduate students.

The results showed that quarantine restrictions (e.g., closure of gyms, clubs, pools, etc.) have significantly reduced the level of physical activity among students, leading to various psychological issues. The data revealed that women's physical activity levels decreased more than men's, and findings also indicated that depression and anxiety levels among students increased by over 50%, with female students experiencing more depression compared to male students, who, in turn, faced higher levels of anxiety. Additionally, the quality of sleep and life quality of female students decreased more compared to male students.

Given the pandemic's widespread impact on all major aspects including political, economic, social, and even military sectors globally, the psychological discussion of this disease on people's mental health is of significant importance (8). Past studies have shown that individuals may experience levels of disorders such as psychosis, depression, stress, anxiety, and even suicide during this period (42-45). Research conducted during this time has indicated that the prevalence of depression, anxiety, and stress is higher in women than in men (44, 46), with epidemiological studies also showing women at higher risk of depression (Lim et al., 2018). One of the preventive measures against depression during quarantine is aerobic exercise, which not only stimulates the secretion of growth hormone but also improves the cardiovascular and immune systems (47).

Although significant research on the impact of physical activity on COVID-19 and its related quarantine effects such as psychological factors, sleep quality, and changes in socio-economic status among students is yet to be published, based on past studies on other viral diseases and their quarantines, as well as the current study's findings that the pandemic has not only raised concerns about physical health but also affected individuals' mental health and quality of life, it is recommended that regular physical activity and an active lifestyle with increased energy expenditure and the secretion of happiness and growth hormones, as well as improved physical and mental readiness, enhance physical and mental health.

The data from this study highlight several findings related to the COVID-19 pandemic: (1) the results indicate an inadequate level of physical activity among students, (2) a significant correlation was observed between reduced physical activity levels and negative emotional states. Similar to our findings, other studies have noted that reduced physical activity in young women was associated with increased symptoms of depression (48) and that gender plays a significant role in the severity of symptoms of anxiety and depression (49).

A study in South Africa on 1,048 individuals, including 473 students, showed that (a) students experienced higher levels of depression compared to non-students both before and during quarantine, but (b) gender was not directly related to depression symptoms. In the same study, women showed higher symptoms of anxiety, not depression, independent of quarantine period, contrasting our results and most literature examining gender differences in symptom severity during quarantine (50, 51).

During the COVID-19 quarantine, Zhang, Zhang, Ma, and Di (Zhang et al., 2020) found that low or excessive physical activity worsened negative feelings including depression and anxiety. They explained that according to a U-shaped distribution regarding negative feelings and physical activity, optimal and appropriate levels of physical activity are associated with much fewer negative feelings. Another study showed that individuals who were more active before quarantine but became sedentary during it experienced increased symptoms of depression, feelings of loneliness, and stress, leading to deteriorated mental health (31). Another study on 823 medical students in Croatia showed that female respondents significantly exhibited higher levels of depression and anxiety compared to their

male counterparts, contrasting with the current study's results about higher anxiety levels in female students compared to male students, but consistent with our findings regarding lower physical activity levels in female students (52).

Contrary to the results of our study, some research indicated that the reduction in physical activity was greater in men than in women (53). Also, studies have shown that due to different stress coping mechanisms, there is a significant difference in mental health between genders. It has been identified that women have a higher level of negative emotional states (depression and anxiety) compared to their male counterparts (54, 55). Another study on 300 Spanish students, similar to the findings of our study, observed a significant difference between genders in anxiety levels but, contrary to our findings, found higher anxiety levels in women and no significant difference in physical activity levels (56).

The impact of the COVID-19 epidemic on Chinese students included increased levels of anxiety and depression (20), and similarly, it was reported that symptoms of depression decreased in individuals engaging in moderate to intense physical activity during the pandemic (28). Xiang and colleagues (2020) conducted a study on 1,396 students and reported that 52.3% of the students had low levels of physical activity and 41.8% experienced depression. Romero-Blanco and colleagues (2020) also found an increase in sitting time among university students during the COVID-19 period. Since physical activity plays an important role in reducing not only physical but also mental stress, its importance has increased especially during the pandemic (57). These results also align with the research by Ripon and colleagues (2020), which showed that symptoms of stress and depression disorders, especially among low-income individuals, increased more during the quarantine period compared to before (58). Another study conducted by Ahmadabadi in Mashhad on 752 students showed, contrary to the present study, no significant relationship between anxiety due to the COVID-19 pandemic and the general social health status of students (59).

A study on 338 students in Ethiopia (60) mentioned that students not engaging in physical exercises had a higher chance of suffering from depression. Another related factor to the outbreak of anxiety in this study was engaging in physical exercise for at least 20 minutes a day. Those students who did not engage in physical exercise for at least 20 minutes a day were almost twice as likely to experience anxiety compared to those who regularly exercised. The probable reason could be due to engaging in regular exercise, which may contribute to the secretion of endorphins, the feel-good brain chemicals (natural cannabinoids), and other natural brain chemicals, helping reduce depression and anxiety. Those students who did not engage in physical exercise were almost twice as likely to be at risk of depression compared to their counterparts. This finding was confirmed by a study conducted in Bangladesh (61). This could be due to the effect of physical activity on both physical and mental health or spending time exercising instead of contemplating the severity and consequences of the epidemic. Studies conducted in Pakistan and Bangladesh among students during the pandemic reported depression rates of 34% and 82.4%, respectively, and anxiety rates of 45% and 87.7%, respectively (62).

Another study on 868 American students (63) showed that reductions in exercise and sleep were significantly associated with an increase in detrimental psychological effects, which could be mitigated by achieving sufficient weekly physical activity and daily sleep. Recent research also indicates that higher levels of physical activity and longer sleep duration are associated with reduced deteriorating mental health factors during the COVID-19 pandemic (64, 65).

Many studies have reported widespread reductions in physical activity levels during the COVID-19 pandemic (65, 66); therefore, it is not surprising that greater engagement in physical activity during the COVID-19 pandemic is associated with better mental health outcomes such as lower levels of stress, depression, and anxiety (66), and the pandemic has led to a further reduction in sleep quality among the student population (67). A study on 150 physiotherapy students in India (68)) showed that physical exercises were associated with a positive effect on sleep disorders during home quarantine. This study also demonstrated the mediating effect of physical activity, as physical exercises were positively associated with sleep disorders that occurred during the COVID-19 quarantine.

Explaining the findings of the present study on the impact of physical activity on reducing anxiety and depression, it can be said that exercise activates parts of the brain related to positive feelings and emotions. The anti-anxiety effect of exercise has been investigated in other studies, some of which had results consistent with our study (69, 70). This anti-anxiety effect of exercise and physical activity can be explained through various mechanisms, including physical, physiological, and psychological mechanisms. From a physiological perspective, exercise can improve an

individual's physical fitness (71), affect neurotransmitters involved in anxiety and stress hormone levels, leading to reduced muscle tension and consequently anxiety (72). From a psychological perspective, exercise, by increasing physical activity levels, improves mental conditions, increases self-confidence and efficacy, thereby reducing anxiety (73). Increased physical activity levels lead to a reduction in neural stress hormones, cortisol, and epinephrine in women with an average age of 19 years (74).

Public health advocates strongly continue to promote sufficient levels of physical activity at home to prevent the deleterious effects of the lifestyle created by COVID-19 protection or quarantine measures (75) and ensure that restrictions do not lead to the elimination of individuals' physical activity (76). Research has shown that exercise can alter the accumulation of monoamine receptors, analgesics, endorphins, and enkephalins; therefore, it can be very effective in positive mood changes. Other potential mechanisms for the anti-anxiety effects of physical exercise include mediation through the endogenous opioid system, which plays a significant role in mood regulation and emotional responses, and the increase in brain-derived neurotrophic factor (BDNF), the most abundant neurotrophin in the brain (77).

5. Conclusion

We found that, in line with our predictions and other literature on the restrictions and changes characteristic of the COVID-19 quarantine period, individuals can rely on physical activity as a valuable tool in managing and maintaining healthy sleep to support mental health. In the current situation, where individuals are grappling with various economic, social, educational, and occupational factors, understanding which strategy is effective in reducing symptoms of depression and anxiety is a priority. Exercise and physical activity may influence mood through the modulation of serotonergic and adrenergic activity and the promotion of brain-derived neurotrophic factor in the central nervous system (78). The difficult material conditions of the family should be considered in terms of physical activity status among undergraduate students, especially male students. More attention to this multifactorial matter helps provide precise recommendations for optimizing interventions and reducing barriers to increase physical activity in young adults. The current study shows that students are at high risk of psychological distress during the COVID-19 pandemic. Therefore, increased and sustained efforts are needed to improve their mental health and well-being. Universities should provide early detection and appropriate prevention programs. Interventions for depression and anxiety among students should be implemented before graduation, as they may have long-term effects on their career futures.

This research, like all studies, faced limitations. For instance, our sampling method is not representative of the Iranian population and likely underrepresents individuals living in low-income urban areas and rural regions. Future research should identify specific vulnerable individuals or groups by identifying how their sleep behaviors and lifestyles change from normal life to quarantine. The sample of the present study was biased towards women, reflecting the current student population, which is predominantly female. Another major limitation is the lack of biological measurements due to COVID-19 and the inability to measure stress hormones (cortisol, adrenaline, alpha-amylase, etc.). However, since the measurement method during the COVID-19 disease was online, no other method for evaluation was possible. Additionally, this study can be extended to other educational levels in universities and also to other educational stages such as primary and secondary levels.

Our study was unique in that our results about the socio-economic fabric were not confounded by race or ethnicity. There was no racial or ethnic difference between groups for physical activity domains or socio-economic status. Future research could use nutrition status, academic progress, graduation rates, or students' quality of life for further studies. The results of the current study can be used by various educational institutions to implement multidisciplinary interventions to reduce depression and anxiety while increasing physical activity; therefore, special health programs designed to assist students in managing the detrimental consequences during the COVID-19 pandemic should target economically disadvantaged students.

Authors' Contributions

H.N. conceptualized the study, designed the methodology, and was involved in the writing—original draft preparation. A.R. contributed to data collection, data analysis, and writing—review and editing. Both authors have read and agreed to the published version of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

References

1. Taheri M, Esmaeili A, Irandoust K, Mirmoezzi M, Souissi A, Laher I, et al. Mental health, eating habits and physical activity levels of elite Iranian athletes during the COVID-19 pandemic. Science & Sports. 2023;38(5):527-33. [PMID: 37362084] [PMCID: PMC10243596] [DOI]
2. Courtney D, Watson P, Battaglia M, Mulsant BH, Szatmari PJTCJoP. COVID-19 impacts on child and youth anxiety and depression: challenges and opportunities. 2020;65(10):688-91. [PMID: 32567353] [PMCID: PMC7502880] [DOI]
3. Chen P, Mao L, Nassis GP, Harmer P, Ainsworth BE, Li F. Coronavirus disease (COVID-19): The need to maintain regular physical activity while taking precautions. Journal of Sport and Health Science. 2020;9(2):103-4. [PMID: 32099716] [PMCID: PMC7031771] [DOI]
4. Joyce R, Xu XJIfFSBNB. Sector shutdowns during the coronavirus crisis: which workers are most exposed. 2020;6.
5. Duan L, Zhu GJTLP. Psychological interventions for people affected by the COVID-19 epidemic. 2020;7(4):300-2. [PMID: 32085840] [DOI]
6. Shigemura J, Ursano RJ, Morganstein JC, Kurosawa M, Benedek DM. Public responses to the novel 2019 coronavirus (2019-nCoV) in Japan: Mental health consequences and target populations. Psychiatry and clinical neurosciences. 2020;74(4):281. [PMID: 32034840] [PMCID: PMC7168047] [DOI]
7. Brooks L, Manias E, Bloomer M. How Do Intensive Care Clinicians Ensure Culturally Sensitive Care for Family Members at the End of Life? A Retrospective Descriptive Study. Intensive and Critical Care Nursing. 2022. [PMID: 35931595] [DOI]
8. Li S, Wang Y, Xue J, Zhao N, Zhu T. The impact of COVID-19 epidemic declaration on psychological consequences: a study on active Weibo users. International journal of environmental research and public health. 2020;17(6):2032. [PMID: 32204411] [PMCID: PMC7143846] [DOI]
9. Cahuas A, He Z, Zhang Z, Chen WJJoAch. Relationship of physical activity and sleep with depression in college students. 2020;68(5):557-64. [PMID: 30908132] [DOI]
10. Darbani SA, Parsakia K. The effectiveness of strength-based counseling on the reduction of divorced women's depression. Journal of Assessment and Research in Applied Counseling. 2022;4(2):28-32. [DOI]
11. Plante TG, Rodin JJCp. Physical fitness and enhanced psychological health. 1990;9(1):3-24. [DOI]
12. Knapen J, Vancampfort D, Moriën Y, Marchal YJD, rehabilitation. Exercise therapy improves both mental and physical health in patients with major depression. 2015;37(16):1490-5. [PMID: 25342564] [DOI]
13. Yeh YH, Tai IC, Hsieh PT, Chou SW, Chieh LM, Lee LTJ. The Study of Correlation between the Levels of Exercise and Depression among College Students. 2013;2013(2):189-.
14. Harbour VJ, Behrens TK, Kim HS, Kitchens CLJJoPa, Health. Vigorous physical activity and depressive symptoms in college students. 2008;5(4):516-26. [PMID: 18648117] [DOI]
15. Ortega FB, Ruiz JR, Castillo MJ, Sjöström MJIjoo. Physical fitness in childhood and adolescence: a powerful marker of health. 2008;32(1):1-11. [PMID: 18043605] [DOI]
16. Taheri M, Saad HB, Washif JA, Reynoso-Sánchez LF, Mirmoezzi M, Youzbashi L, et al. Comparative Study of the Long-Term Impact of the COVID-19 Pandemic on Mental Health and Nutritional Practices Among International Elite and Sub-Elite Athletes: A Sample of 1420 Participants from 14 Countries. Sports Medicine - Open. 2023;9(1):104. [PMID: 37938473] [PMCID: PMC10632320] [DOI]
17. Özdin S, Bayrak Özdin Ş. Levels and predictors of anxiety, depression and health anxiety during COVID-19 pandemic in Turkish society: The importance of gender. International Journal of Social Psychiatry. 2020;66(5):504-11. [PMID: 32380879] [PMCID: PMC7405629] [DOI]
18. Yang J, Zheng Y, Gou X, Pu K, Chen Z, Guo Q, et al. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. International Journal of Infectious Diseases. 2020;94:91-5. [PMID: 32173574] [PMCID: PMC7194638] [DOI]
19. Fakari FR, Simbar M. Coronavirus pandemic and worries during pregnancy; a letter to editor. Archives of academic emergency medicine. 2020;8(1):e21-e.
20. Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, Zheng JJPr. The psychological impact of the COVID-19 epidemic on college students in China. 2020:112934. [PMID: 32229390] [PMCID: PMC7102633] [DOI]

21. Lewis K. COVID-19: preliminary data on the impact of social distancing on loneliness and mental health. Journal of Psychiatric Practice. 2020;26(5):400-4. [PMID: 32936586] [DOI]
22. Zhang Y, Wang D, Zhao J, Xiao-Yan C, Chen H, Ma Z, et al. Insomnia and other sleep-related problems during the remission period of the COVID-19 pandemic: a large-scale survey among college students in China. Psychiatry Research. 2021;304:114153. [PMID: 34403874] [PMCID: PMC8424256] [DOI]
23. Lee JE, Jang S-I, Ju YJ, Kim W, Lee HJ, Park E-C. Relationship between Mobile phone addiction and the incidence of poor and short sleep among Korean adolescents: a longitudinal study of the Korean Children & Youth Panel Survey. Journal of Korean medical science. 2017;32(7):1166-72. [PMID: 28581275] [PMCID: PMC5461322] [DOI]
24. Gogtay N, Giedd JN, Lusk L, Hayashi KM, Greenstein D, Vaituzis AC, et al. Dynamic mapping of human cortical development during childhood through early adulthood. Proceedings of the National Academy of Sciences. 2004;101(21):8174-9. [PMID: 15148381] [PMCID: PMC419576] [DOI]
25. Wang X, Hegde S, Son C, Keller B, Smith A, Sasangohar F. Investigating mental health of US college students during the COVID-19 pandemic: cross-sectional survey study. Journal of medical Internet research. 2020;22(9):e22817. [PMID: 32897868] [PMCID: PMC7505693] [DOI]
26. Schuch FB, Bulzing RA, Meyer J, Vancampfort D, Firth J, Stubbs B, et al. Associations of moderate to vigorous physical activity and sedentary behavior with depressive and anxiety symptoms in self-isolating people during the COVID-19 pandemic: A cross-sectional survey in Brazil. 2020;292:113339. [PMID: 32745795] [PMCID: PMC7384423] [DOI]
27. Lesser IA, Nienhuis CPJIJoER, Health P. The Impact of COVID-19 on Physical Activity Behavior and Well-Being of Canadians. 2020;17(11):3899. [PMID: 32486380] [PMCID: PMC7312579] [DOI]
28. Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, Thwaite TL, et al. Depression, Anxiety and Stress during COVID-19: Associations with Changes in Physical Activity, Sleep, Tobacco and Alcohol Use in Australian Adults. 2020;17(11):4065. [PMID: 32517294] [PMCID: PMC7312903] [DOI]
29. Ammar A, Brach M, Trabelsi K, Chtourou H, Boukhris O, Masmoudi L, et al. Effects of COVID-19 Home Confinement on Eating Behaviour and Physical Activity: Results of the ECLB-COVID19 International Online Survey. 2020;12(6):1583. [DOI]
30. Smith L, Jacob L, Butler L, Schuch F, Barnett Y, Grabovac I, et al. Prevalence and correlates of physical activity in a sample of UK adults observing social distancing during the COVID-19 pandemic. 2020;6(1):e000850. [PMID: 34192006] [PMCID: PMC7358093] [DOI]
31. Meyer J, McDowell C, Lansing J, Brower C, Smith L, Tully M, Herring M. Changes in physical activity and sedentary behaviour due to the COVID-19 outbreak and associations with mental health in 3,052 US adults. 2020. [DOI]
32. Akbari A, Mirakhori F, Ashouri M, Nehzat Norozi Tehrani S. The Effect of Micronutrient Intake on Cognitive Function and Physical Activity of the Elderly. Int J Sport Stud Health. 2021;4(1):e121360. [DOI]
33. Abootorabi Kashani P, Safarzadeh S, Hafezi F, Eftekhar Saadi Z. The effectiveness of Dialectical Behavior Therapy on Reducing of Symptoms of Attention Deficit / Hyperactivity and Suicidal Ideation in Symptoms of Attention Deficit / Hyperactivity Disorder Adolescents. Journal of Nursing Education. 2020;8(5):25-33.
34. Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: Psychometric properties. Journal of Consulting and Clinical Psychology. 1988;56(6):893-7. [PMID: 3204199] [DOI]
35. Beck AT, Steer RA, Brown G. Beck depression inventory–II. Psychological assessment. 1996. [DOI]
36. Steer RA, Clark DA, Beck AT, Ranieri WF. Common and specific dimensions of self-reported anxiety and depression: the BDI-II versus the BDI-IA. Behaviour Research and Therapy. 1999;37(2):183-90. [PMID: 9990749] [DOI]
37. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. Psychiatry Research. 1989;28(2):193-213. [PMID: 2748771] [DOI]
38. Dabirinejad S, Minasian E, Kashani AT, Rundmo T, Afshar A. Predicting Pedestrian Behavior by Sleep Quality and Emotional Self-Regulation. Transportation Research Record. 2023;2677(5):1077-84. [DOI]
39. Sharif Ara B, Khosropour F, Molayi Zarandi H. Effectiveness of Acceptance and Commitment Therapy (ACT) on Emotional Processing, Irrational Beliefs and Rumination in Patients with Generalized Anxiety Disorder. Journal of Adolescent and Youth Psychological Studies. 2023;4(4):34-44. [DOI]
40. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Archives of internal medicine. 2006;166(10):1092-7. [PMID: 16717171] [DOI]
41. Brand R, Timme S, Nosrat S. When pandemic hits: exercise frequency and subjective well-being during COVID-19 pandemic. Frontiers in psychology. 2020;11:2391. [PMID: 33071902] [PMCID: PMC7541696] [DOI]
42. Linehan MM, Korslund KE, Harned MS, Gallop RJ, Lungu A, Neacsiu AD, et al. Dialectical Behavior Therapy for High Suicide Risk in Individuals With Borderline Personality Disorder: A Randomized Clinical Trial and Component Analysis. JAMA Psychiatry. 2015;72(5):475-82. [PMID: 25806661] [DOI]
43. LoParo D, Mack SA, Patterson B, Negi LT, Kaslow NJ. The Efficacy of Cognitively-Based Compassion Training for African American Suicide Attempters. Mindfulness. 2018;9(6):1941-54. [DOI]
44. Patten SB, Williams JVA, Lavorato DH, Bulloch AGM, Wiens K, Wang J. Why is major depression prevalence not changing? Journal of Affective Disorders. 2016;190:93-7. [PMID: 26485311] [DOI]
45. Smith NB, Monteith LL, Rozek DC, Meuret AE. Childhood Abuse, the Interpersonal–Psychological Theory of Suicide, and the Mediating Role of Depression. Suicide and Life-Threatening Behavior. 2018;48(5):559-69. [PMID: 29068069] [DOI]

46. Rosso G, Aragno E, Cuomo A, Fagiolini A, Di Salvo G, Maina G. Five-year follow-up of first-episode depression treated with psychodynamic psychotherapy or antidepressants. Psychiatry Research. 2019;275:27-30. [PMID: 30878853] [DOI]
47. Norouzi E, Hosseini F, Vaezmosavi M, Gerber M, Pühse U, Brand S. Zumba dancing and aerobic exercise can improve working memory, motor function, and depressive symptoms in female patients with fibromyalgia. European journal of sport science. 2020;20(7):981-91. [PMID: 31630663] [DOI]
48. Stubbs B, Vancampfort D, Hallgren M, Firth J, Veronese N, Solmi M, et al. EPA guidance on physical activity as a treatment for severe mental illness: a meta-review of the evidence and Position Statement from the European Psychiatric Association (EPA), supported by the International Organization of Physical Therapists in Mental Health (IOPTMH). European Psychiatry. 2018;54:124-44. [PMID: 30257806] [DOI]
49. Atkinson SR. Elevated psychological distress in undergraduate and graduate entry students entering first year medical school. PloS one. 2020;15(8):e0237008. [PMID: 32776950] [PMCID: PMC7416945] [DOI]
50. Feter N, Caputo E, Doring I, Leite J, Cassuriaga J, Reichert F, et al. Sharp increase in depression and anxiety among Brazilian adults during the COVID-19 pandemic: findings from the PAMPA cohort. Public health. 2021;190:101-7. [PMID: 33387848] [PMCID: PMC7773543] [DOI]
51. Pieh C, Budimir S, Probst T. The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria. Journal of psychosomatic research. 2020;136:110186. [PMID: 32682159] [PMCID: PMC7832650] [DOI]
52. Talapko J, Perić I, Vulić P, Pustijanac E, Jukić M, Bekić S, et al., editors. Mental health and physical activity in health-related university students during the COVID-19 pandemic. Healthcare; 2021: Multidisciplinary Digital Publishing Institute. [PMID: 34202384] [PMCID: PMC8304952] [DOI]
53. Rodríguez-Larrad A, Mañas A, Labayen I, González-Gross M, Espin A, Aznar S, et al. Impact of COVID-19 confinement on physical activity and sedentary behaviour in Spanish University Students: role of gender. International Journal of Environmental Research and Public Health. 2021;18(2):369. [PMID: 33418907] [PMCID: PMC7825050] [DOI]
54. Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors associated with mental health disorders among university students in France confined during the COVID-19 pandemic. JAMA network open. 2020;3(10):e2025591-e. [PMID: 33095252] [PMCID: PMC7584927] [DOI]
55. Schilling S, French B, Berkowitz SJ, Dougherty SL, Scribano PV, Wood JN. Child–Adult Relationship Enhancement in Primary Care (PriCARE): A Randomized Trial of a Parent Training for Child Behavior Problems. Academic Pediatrics. 2017;17(1):53-60. [PMID: 27353449] [DOI]
56. Rodriguez-Besteiro S, Tornero-Aguilera JF, Fernández-Lucas J, Clemente-Suárez VJ. Gender differences in the covid-19 pandemic risk perception, psychology and behaviors of spanish university students. International Journal of Environmental Research and Public Health. 2021;18(8):3908. [PMID: 33917827] [PMCID: PMC8068216] [DOI]
57. Romero-Blanco C, Rodríguez-Almagro J, Onieva-Zafra MD, Parra-Fernández ML, Prado-Laguna MDC, Hernández-Martínez A. Physical activity and sedentary lifestyle in university students: changes during confinement due to the COVID-19 pandemic. International Journal of Environmental Research and Public Health. 2020;17(18):6567. [PMID: 32916972] [PMCID: PMC7558021] [DOI]
58. Ripon RK, Mim SS, Puente AE, Hossain S, Babor MMH, Sohan SA, Islam N. COVID-19: psychological effects on a COVID-19 quarantined population in Bangladesh. Heliyon. 2020;6(11):e05481. [PMID: 33200105] [PMCID: PMC7654365] [DOI]
59. Ahmadabadi S. Comparison of General-Social Health and Corona-Induced Anxiety Between Active and Inactive Students in the COVID-19 Pandemic. Frontiers in psychiatry. 2021 Dec 21;12:798947. [DOI]
60. Mekonen EG, Workneh BS, Ali MS, Muluneh NY. The psychological impact of COVID-19 pandemic on graduating class students at the University of Gondar, northwest Ethiopia. Psychology research and behavior management. 2021;14:109. [PMID: 33603512] [PMCID: PMC7881778] [DOI]
61. Islam MA, Barna SD, Raihan H, Khan MNA, Hossain MT. Depression and anxiety among university students during the COVID-19 pandemic in Bangladesh: A web-based cross-sectional survey. PloS one. 2020;15(8):e0238162. [PMID: 32845928] [PMCID: PMC7449469] [DOI]
62. Salman M, Asif N, Mustafa ZU, Khan TM, Shehzadi N, Hussain K, et al. Psychological impact of COVID-19 on Pakistani university students and how they are coping. Medrxiv. 2020. [DOI]
63. Moriarty T, Bourbeau K, Fontana F, McNamara S, Pereira da Silva M. The Relationship between Psychological Stress and Healthy Lifestyle Behaviors during COVID-19 among Students in a US Midwest University. International Journal of Environmental Research and Public Health. 2021;18(9):4752. [PMID: 33946873] [PMCID: PMC8125243] [DOI]
64. Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, Thwaite TL, et al. Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in Australian adults. International journal of environmental research and public health. 2020;17(11):4065. [PMID: 32517294] [PMCID: PMC7312903] [DOI]
65. Maugeri G, Castrogiovanni P, Battaglia G, Pippi R, D'Agata V, Palma A, et al. The impact of physical activity on psychological health during Covid-19 pandemic in Italy. Heliyon. 2020;6(6):e04315. [PMID: 32613133] [PMCID: PMC7311901] [DOI]
66. Rogowska AM, Pavlova I, Kuśnierz C, Ochnik D, Bodnar I, Petrytsa P. Does physical activity matter for the mental health of university students during the COVID-19 pandemic? Journal of Clinical Medicine. 2020;9(11):3494. [PMID: 33138047] [PMCID: PMC7693909] [DOI]
67. Zhou S-J, Wang L-L, Yang R, Yang X-J, Zhang L-G, Guo Z-C, et al. Sleep problems among Chinese adolescents and young adults during the coronavirus-2019 pandemic. Sleep medicine. 2020;74:39-47. [PMID: 32836185] [PMCID: PMC7274988] [DOI]

68. Akulwar-Tajane I, Naik PH, Parmar KK, Shah AV. Impact of Excessive Screen Time and the Mediating Effect of Physical Exercise on Sleep in Physiotherapy Students During Covid-19. Sumerianz Journal of Medical and Healthcare, 2021;4(3):149-59. [DOI]
69. Anderson EH, Shivakumar G. Effects of exercise and physical activity on anxiety. Frontiers in psychiatry. 2013;4:27. [PMID: 23630504] [PMCID: PMC3632802] [DOI]
70. Aylett E, Small N, Bower P. Exercise in the treatment of clinical anxiety in general practice–a systematic review and meta-analysis. BMC health services research. 2018;18(1):1-18. [PMID: 30012142] [PMCID: PMC6048763] [DOI]
71. El-Rafie MM, Khafagy GM, Gamal MG. Effect of aerobic exercise during pregnancy on antenatal depression. International journal of women's health. 2016;8:53. [PMID: 26955293] [PMCID: PMC4772941] [DOI]
72. Hatami K, Shokrollahi B, Haidari N. The Effect of Aerobic Activities on Depression and Anxiety Symptoms and Sleep Disturbance of Female Students. Middle-East Journal Of Scientific Research. 2013;14(2).
73. Gilani SRM, Feizabad AK. The effects of aerobic exercise training on mental health and self-esteem of type 2 diabetes mellitus patients. Health psychology research. 2019;7(1). [PMID: 30997432] [PMCID: PMC6441819] [DOI]
74. Nabkasorn C, Miyai N, Sootmongkol A, Junprasert S, Yamamoto H, Arita M, Miyashita K. Effects of physical exercise on depression, neuroendocrine stress hormones and physiological fitness in adolescent females with depressive symptoms. European journal of public health. 2006;16(2):179-84. [PMID: 16126743] [DOI]
75. Peluso MAM, Andrade LHSGd. Physical activity and mental health: the association between exercise and mood. Clinics. 2005;60:61-70. [PMID: 15838583] [DOI]
76. De Moor MH, Boomsma DI, Stubbe JH, Willemsen G, de Geus EJ. Testing causality in the association between regular exercise and symptoms of anxiety and depression. Archives of general psychiatry. 2008;65(8):897-905. [PMID: 18678794] [DOI]
77. Tehrani H, Vahedian Shahroodi M, Fadayevatan R, Abusalehi A, Esmaeili H. Mental health status and its related factors in elderly people residing in nursing homes of Mashhad, Iran. Health and Development Journal. 2020;6(3):171-81.
78. Ivy A, Rodriguez F, Garcia C, Chen M, Russo-Neustadt A. Noradrenergic and serotonergic blockade inhibits BDNF mRNA activation following exercise and antidepressant. Pharmacology Biochemistry and Behavior. 2003;75(1):81-8. [PMID: 12759116] [DOI]