

The Effect of Exercise and Physical Activity on the Mental Health of High School Students
in Virtual School during the COVID-19 Pandemic

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Abstract

During the COVID-19 pandemic, many high school students were forced to go to school online due to quarantine. Students had to do their school work over the computer screen and stay in the house most of the time. From that, this study wanted to investigate the effect of how much physical activity an individual is able to do while at home and how it affects the mental health state of students. We hypothesized that higher levels of daily activity will be associated with lower poor mental health symptoms. Twenty-nine students participated in up to 3 rounds of surveys, including questions about the amount of physical activity, measured in hours, and mental health questions using the DASS21. From our study, we found a positive relationship between anxiety symptoms and physical activity, which was opposite what we thought would happen. However, because most students were very healthy and did not exercise much, we cannot conclude if exercise helps or hurts mental health.

Introduction

Adolescents often exercise when competing in school sports or gym class. However, now with the pandemic, many students are virtual and spend their days being sedentary. This could be bad for their physical and mental health. In a study of over one million people in the USA, researchers found those who exercise reported having 1.5 fewer days of poor mental health a month, compared to people who do not exercise (1). In the current study, we will be investigating the impact of exercise on the mental health of teenagers, specifically during the COVID-19 pandemic. Data shows that 47% of people who were sheltered/quarantined reported negative mental health impacts, caused from worry or stress of COVID-19 (2). The current study is important because a lot of people, especially teens, have some type of mental health issue, so it is important to find different ways to potentially help them.

There is evidence that aerobic exercise might be healthy for the brain. When exercising, one's heart rate increases, which sends more oxygen to the brain (3). This causes different hormones to be released and new brain cells grow. Exercise also helps the brain grow connections between the cells, called brain plasticity. Also, exercise is related to the "runner's high" which helps relieve stress. Exercise can also help new cells grow in the hippocampus. Researchers believe that a slowing of cell growth in it could be a cause of depression (3).

Experimental Studies

For young people diagnosed with depression, research suggests that intensive exercise might be helpful. Carter et al. performed their study on 174 young people from ages 14-17, and had half participate in a 12 week aerobic exercise program (4). Participants chose their amount of effort during exercise. Both the experimental and control groups had talk therapy. They found that right after the program there was no difference in their mental health, but six months after there was a small significant improvement in depression, but not quality of life. This suggests that exercise may be helpful for teens, but the effect may be small and may occur over time (4).

Aerobic exercise, like in gym class, may be associated with children's well-being. Crews *et al.*'s study included 66 Hispanic students in the fourth grade that lived in low income neighborhoods (5). There were two groups: a control group and an aerobic exercise group. In their exercise group, they did activities like cycling, track running and jumping on a trampoline for 20 minutes. They did some of those activities 3 times a week for 12 weeks. The experimental

group had better heart health and were less depressed after 12 weeks. They found no information on well-being and anxiety. This study proposes that frequent exercise can help with the health of the heart and depression (5).

A meta analysis of eight studies was performed by Lees *et al.* on the effect of aerobic exercise on different things like being able to obtain knowledge, academic achievement, and psychosocial function. (6). They found that exercise has a small improvement in cognitive functioning, lower depression and improvements in self esteem. (6).

Cross Sectional Studies

Five different sources were reviewed by Biddle *et al.* about the effect of physical activity on the mental health in children and adolescents (7). Although their evidence was limited, they concluded that exercise can help reduce anxiety. Their review made them come to the conclusion that physical activity and mental health conditions are inversely proportional. This study proposes that exercise tailored to a person's ability will help reduce anxiety (7).

The different types of exercise domains and their effect on different parts of the mental health of individuals was studied by Asztalos *et al.*. Researchers looked at different types of physical activity like work and exercise, such as housework, leisure, active transportation, biking, walking, and sports participation (8). Researchers found that activities people choose to do tend to make them less stressed than activities that need to be done, and that the stress level depends on whether the person is employed or unemployed and age difference. From this study it suggests that preferred physical activities by individuals help relieve stress an individual has (8).

The effect of physical activity on anxiety, depression, and well-being was studied in European adolescents across 168 schools by McMahon *et al.* (9). They found a positive correlation between the frequency of activity and well-being and a negative correlation for anxiety and depression for both genders. Results from the study allowed them to conclude that regular physical activity comes with better mental health and well-being in adolescents (9).

The mental health of individuals being affected by exercise was studied by Checkroud *et al* (10). They looked at studies of over 1,237,194 people from many different surveys. To find their results, they had people complete a self reported survey of their exercise activity. They found that mindful exercises like yoga cause a significant reduction in poor mental health symptoms, as well as activities like team sports, cycling, and going to the gym. These results

from their study suggests that exercising has a significant impact on mental health (10). In another survey of 7,674 adults, researchers determined the relationship between physical activity and mental health. Those who engaged in more physical activity had better mental health, with the largest mental health differences occurring when people had two to four hours of physical activity a week (11).

Study Hypotheses

Overall, research suggests exercise is beneficial for people's depression, anxiety and general well being. Due to COVID, many people may be less active. So, we wanted to see if the pandemic has helped or hurt people, especially high school students. We gave a questionnaire multiple times throughout the experiment to measure their mental state. We hypothesized that higher levels of daily physical activity will be associated with better mental health. This is because research suggests more activity leads to a better mental state and well being (9-11). We also hypothesized that participation in team aerobic sports improved mental health compared to those who do not participate. Research says that participating in sports, or activities one prefers, will help with mental health (8-10).

Methods

The participants in our study were the 11th & 12th graders at The Neighborhood Academy, a college preparatory, private school. They were 35 students invited to participate in the study, 27 females and 8 males. Twenty-nine students actually participated, six completed three rounds, 13 completed two rounds, and 10 completed one round of surveys. The materials we used were the Depression, Anxiety, and Stress Scale (DASS21). Participants also answered unique personal questions made up by us to customize our survey about how much time they spent doing different activities. The DASS21 was combined with personal questions to compare how certain activities will impact individuals' depression and anxiety.

We amended the DASS21 to include only the depression and anxiety questions. The personal questions we made up involved questions about the amount of physical activity and lounging time in the past 24 hours, liquid nutrition intake, and how often individuals listen to music. Some of these questions were for other projects. Students answered the DASS21 questions on a scale of 0-4 with options ranging from always applies to never applies to me.

They answered 7 questions each for depression and anxiety, then the results from their scores were added up. The personal questions were answered in time increments of how much time was spent on homework, chores, exercising, sports, playing with siblings, on cellular devices, and physical activity. Those questions were asked, so we can compare how those activities affect their mental state.

The survey for the students to complete was sent via link in email, with a week time span to accomplish it. If some people didn't respond we made follow-ups to those individuals via email, text, or call. Participants were found by picking grades at The Neighborhood Academy, and asking them to fill out the survey 3 times over three weeks. My peers and I, Jada Adams and Jamar Robinson, combined our survey since we all used the DASS21. We just inputted our own personal questions for our personal projects.

Results

In this study, we looked at the effect of different amounts of exercising and physical activity on mental health. We used the DASS21 amended with no stress questions, and personal questions to make our study unique. The personal questions were questions involving the amount of physical activity and lounging an individual did in the past 24 hours, measured in hours. The questions were given in a survey via email that was filled out, once each week for three weeks. From our study we expected to find results that exercise or some type of physical activity would have a good impact on decreasing the poor mental health symptoms of individuals.

	Homework	Exercise	Phone Use	Chores	Babysitting
Anxiety	$r_s = -0.01$ $p = 0.48$	$r_s = 0.32$ $p = 0.04$	$r_s = 0.02$ $p = 0.45$	$r_s = -0.14$ $p = 0.2$	$r_s = 0.17$ $p = 0.18$
Depression	$r_s = 0.33$ $p = 0.04$	$r_s = 0.21$ $p = 0.14$	$r_s = -0.10$ $p = 0.30$	$r_s = 0.11$ $p = 0.28$	$r_s = 0.13$ $p = 0.25$

Table 1. Correlations between Activities and Mental Health. *The table shows the significance levels for different activities and mental health for 29 surveyed high school students. Time spent exercising was positively related to anxiety, and time spent doing homework was positively related to depression symptoms.*

From all 35 students at The Neighborhood Academy invited to participate in our study, 29 students actually participated in answering the questions in our survey. The average amount of exercise was 50 minutes per day, ignoring the students who did not exercise at all. During our review of our results we realized only one individual played on a team sport, so we eliminated sports (hypothesis 2) out of the study. Most students during the COVID-19 pandemic are at home, so individuals did not exercise much. The results from our study show that most people were not anxious or depressed or very anxious and depressed. The average anxiety score was 5.6 and the average depression score was 6.1. Three people out of 29 scored higher than a 10 on one of either depression or anxiety, which signifies a possible mental health problem (12).

During our study we thought that more exercise done by an individual would reduce their anxiety. To measure the amount of exercise each individual did we converted them to hours, and then found their average from each response they gave. When analyzing our results we chose to interpret the data in a rank order correlation. A rank order correlation was chosen in order to control our outliers, since some individuals had very extreme scores. Most of the p-values for the relationships in Table 1 were greater than 0.05. A p-value shows whether or not a correlation is significant enough to show a relationship; less than 0.05 shows a correlation and greater than shows no correlation. The only significant correlation shown by the data was with exercise and anxiety, showing that the more exercise, the higher the anxiety level ($r_s(27) = 0.32$ $p = 0.04$). Although the test showed a significant correlation; it is hard to interpret since so many individuals are in a healthy mental state and also don't exercise.

Anxiety Score vs. In the past 24 hours, how much time did you spend exercising?

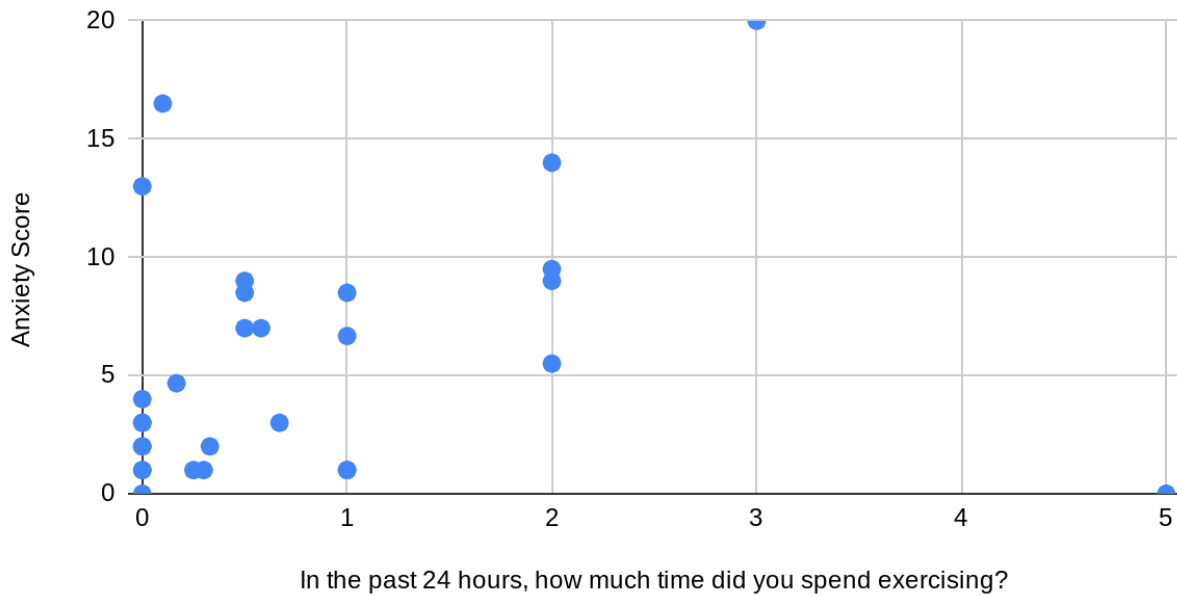


Figure 1. Correlation between amount of time spent exercising and anxiety levels. This graph shows the positive relationship between exercising anxiety levels. The more time spent doing homework correlates with higher anxiety levels.

In our study we hypothesized that the more exercise an individual does, it will be related to reducing their depression levels by a significant level. Our data only showed one significant correlation between depression and homework. Showing that the more time spent on doing homework increased depression levels, which we think results from students being stressed or frustrated with not understanding their homework. According to our data only three people had high depression scores over 10. Without the three people with high scores our results don't show a significant correlation. Therefore we can conclude that homework and depression may not be related for most individuals at The Neighborhood Academy. No correlation was found between time spent exercising and depression.

Depression Score vs. In the past 24 hours, how much time did you spend sitting doing homework?

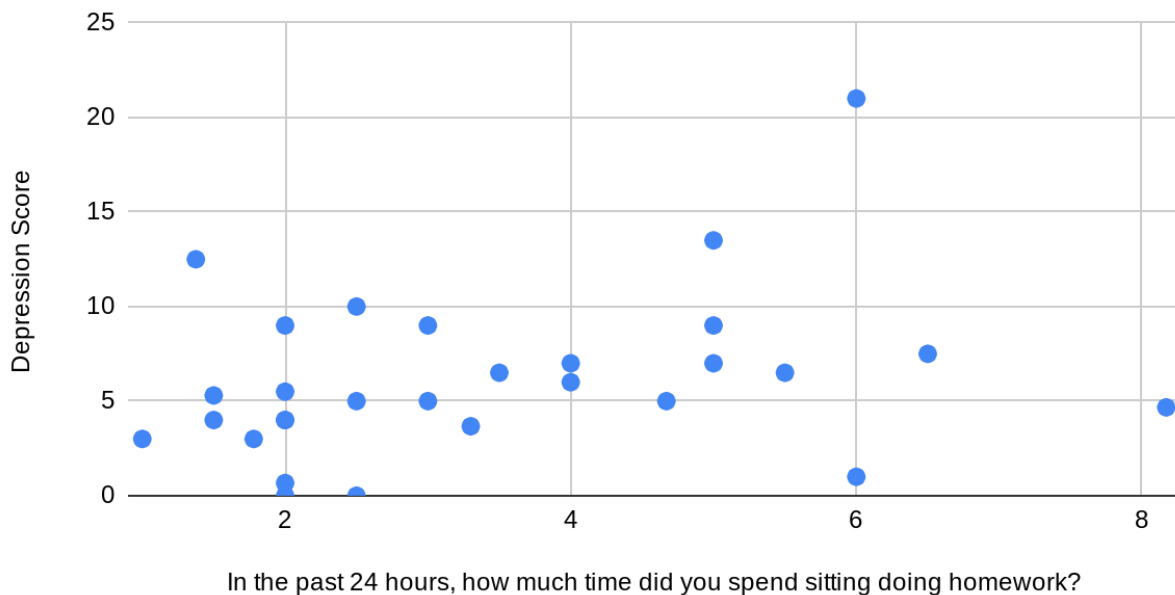


Figure 2. *The correlation between amount of time doing homework and depression levels. The relationship between homework and depression was positive. The more time spent doing homework by students the higher the depression level.*

Discussion

From the results in our study we found a positive relationship between exercise and anxiety (Figure 1). Although data showed the positive conclusion, we suspect it is not meaningful because many of our participants did not exercise and most have a healthy mental state. Our data showed no relationship between depression and any physical activity. Therefore, results suggest our hypotheses cannot be supported since there was no negative correlation between exercise and mental states.

One source we looked at did their study on exercise affecting European adolescents' anxiety, depression and general well being (9). Their results showed a negative correlation between the frequency of activity, anxiety, and depression. Our results were the opposite, since we found a positive correlation for anxiety, and nothing at all for depression. The differences between our studies is that they had about 11,000+ more people, had more active people that exercised 6.6 days out of 14 with 60+ minutes of exercise. The participants in our study were naturally healthy with barely any exercise. This source was inconsistent with our results, but we

can conclude that exercise might improve someone's mental health, depending on their activity level or their attitude towards it. Although we can not necessarily agree that exercise is a good thing for individuals from our data, there is a possibility that it can be a helpful solution to people's mental health challenges.

Another source we looked at studied adults conducting daily activities and how it affected their stress levels (8). They found that preferred activities like sports, reduced stress, but unwanted activities like housework increased stress levels. In our study only one participant played sports, so we have no results and we had to eliminate it out of the study. We found that homework, which most would consider a chore, was related to depression. The more time individuals spend doing homework is related to higher depression levels. In conclusion this source was partially consistent when discussing activities that don't require physical activity. In general, preferred activities are associated with better mental health.

We also looked at another source that studied the effect of exercise on the mental health of young Hispanic students (4). For their study they had two groups: an experiment group and an exercise group. They found that their experimental group had better heart health, and the exercise group was less depressed after the 12 week program. They did not find any differences in anxiety or self esteem. Our study did not find any negative correlations between exercise and mental health, so their study is also inconsistent with our results. This makes sense, as students were forced to exercise in gym class in the previous study, but our students did not have gym class, so many people did not exercise.

One limitation to the current study is only one participant played a team sport, which caused us to abandon a hypothesis about sports. Another limitation we had is that out of the 29 students that participated barely any of them actually exercised, which limited our ability to see a pattern in our data. We chose to do our study during the COVID-19 pandemic, which caused us to do everything virtually, reaching out to people virtually to give them the surveys. Doing everything virtually is harder to get people to fill out the surveys because they have nobody constantly asking them to do so, which caused us to have a smaller sample size.

During this COVID-19 pandemic, we expected students would be stressed or depressed, but this was not the case, most people reported being mentally healthy. The Neighborhood Academy gave students freedom to somewhat make their own schedule during virtual learning. Because they were not forced to be on a screen all day, preferring optional meetings and tutoring,

students basically made their own schedule. Students may have been more independent and accountable, which could have helped reduce stress by letting them be more flexible with their day and their workload. Because of this, we may not have been able to find a negative relationship between exercise and mental health.

For future research, we suggest that researchers make a connection with their participants so it is easier to get responses from those individuals. We would also suggest that they should choose their participants wisely, seeking participants that actually exercise. It would also be helpful to study for a longer time in order to look at the changes over time, and make a group for people to exercise, therefore researchers will know exactly what they are doing and the time for real data. Future researches should also take into account how people feel about exercise because one's opinion of an activity can affect its benefits (8).

From many different previous research studies, we conclude that exercise can be beneficial to mental health. Although we had a small sample size and saw little effect of exercise, our results should not be interpreted as totally discouraging exercise. The Neighborhood Academy's 11th and 12th grade students were mentally healthy individuals that were not generally very anxious or depressed. The Neighborhood Academy should after the pandemic, consider ways to allow students to have freedom in their schedule, as it may help them mentally.

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