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How the COVID-19 pandemic has affected physical activity, sleep and mental health in university students, faculty and staff and to examine the relationship between these variables

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How the COVID-19 pandemic has affected physical activity, sleep and mental health in university students, faculty and staff and to examine the relationship between these variables.

Abstract

Background: Increased physical activity has been shown to be beneficial in decreasing stress. This project will expand on this knowledge while also studying college students, a demographic that has been less studied. This study will also examine the impact of COVID-19 on these variables. COVID-19 changed many peoples' activities of daily life, and possibly physically activity levels, due to public health measures such as lockdowns and remote learning. **Purpose:** The purpose of this study is to examine how the COVID-19 pandemic has affected physical activity, sleep, and mental health in university students, faculty and staff and to examine the relationship between theses variables. **Methods:** Participants were recruited through their previous participation in the Exercise is Medicine study as we compared their previous year's data to this year's data. Participants completed an online questionnaire on the Qualtrics platform consisting of the IPAQ, Pittsburgh Sleep Quality Instrument, and DASS-21. To provide an objective, device-based measurement, self-reported physical activity and sleep were compared with Actigraph GT9x accelerometers worn 24 hours a day for 7 days. Paired T-tests were used to compare normally distributed variables (sleep) and Wilcoxon signed-rank tests were used to compare non-normal outcome variables (physical activity and mental health). **Results:** 38 participants completed the post survey (23 faculty/staff, 8 graduate students, 7 undergraduate students). Pre-COVID, total physical activity was 2,978.9 (SD 3,334.3) METmin/week and post-COVID was 4,281.2 (SD 4,758.3) METmin/week which was statistically different ($p=0.01$). When examined by type of physical activity, only domestic and leisure and not active transport or work physical activity were different with domestic ($p=.008$) and leisure ($p=.02$) physical activity increasing post-COVID. Pre-COVID, PSQI score was 5.3 (SD 3.1) and post-COVID was 5.6 (SD 3.0) METmin/week which was not statistically different ($p=0.42$). Due to changes in

the questionnaire over years, only 9 participants had pre- and post-mental health measures. There were no statistical differences in mental health pre- and post-COVID. **Conclusion:** There was a statistically significant difference in the amount of physical activity, with participants completing more physical activity after the start of the pandemic compared to before the start. Physical activity increased the most in leisure and domestic activities. There was not a statistical difference in the amount of active transport or work physical activity. These results are similar to previous findings in the literature as people spent more time at home due to reduced schedules and commitments. We did not find a statistically different change in mental health measures pre and post COVID-19, however this could be due to a small sample size. At this time, we cannot draw any conclusions about the relationship between physical activity and stress. We can however show that the onset of the COVID-19 pandemic has led to an increase in physical activity in certain types of activities.

Introduction

The benefits of physical activity for college students

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen, C J et al. 1974). It has been theorized that being physically active results in benefits for college students in areas such as academic performance, health outcomes, and mental health. Physical activity has been shown in both college aged and broader aged sample sizes as providing health benefits in different areas from mental functioning to increasing VO2 max. Specifically it was found that physical activity persistently increases executive functions, attention, memory, and speed of processing weeks and months after physical activity interventions have been put into place (Hotting, K. and B. Roder 2013). Also, a study found that VO2 max scores, a common physiological variable used to measure cardiovascular fitness, showed a highly significant difference in pre and post

scores after completing a six week exercise program (Demers 2013) In regards to general health, it was found that evidence suggests a dose response relationship such that being active, even to a modest level, is preferable to being inactive or sedentary, increases in physical activity and fitness result in additional improvements in health status, and that participation in regular physical activity and exercise provides numerous benefits for health (Hills AP, Street SJ, Byrne NM 2015).

Physical activity has also been shown to be beneficial in relieving symptoms of anxiety and depression in college aged students. In examining the relationship and between exercise and mental health in college students, researchers saw that participation in physical activity had positive impacts on mental health. In one study it was found that results of the Burns' Anxiety Inventory and Burns' Depression Inventory revealed that self-reported ratings of anxiety and depression in participants significantly changed over the course of the study for those participating in weeks of exercise (Demers 2013). This same study found that the treatment group for their study showed a statistically significant decrease in depression scores from before and after participation in an exercise intervention.

Another area of study of possible benefits of physical activity has to do with its relationship to academic performance. As will be examined shortly, there is evidence that points to there being a positive correlation between physical activity and academic performance. As previously noted, physical activity did affect mental functioning, and this may go on to have a positive impact on academic performance. Another possibility is that physical activity positively affects academic performance, but not directly. A review of literature found physical activity lead to certain positive effects such as integrating with social aspects of the university while involved in campus recreation programs and reporting higher levels of vigor and lower levels of fatigue compared to insufficiently active students (Cressy 2011). The positive effects of these variables provide a student with a possibility to increase academic performance. There have also been studies conducted that do not show there being a significant relationship between the two variables. One study found that reported study hours were

negatively associated with VO2 max and vigorous physical activity (Calestine, Jesse et al 2017). This could be due to the workload increasing in demand with more hours and having less time for physical activity. This same study found that despite the findings for study time and physical activity, there was no relationship between GPA and fitness (Calestine, Jesse et al 2017).

Physical activity rates in college students

As students transition from high school into college, they are given the opportunity to make more choices for themselves, especially in regard to physical activity. Multiple research studies have shown that 60% of college students do not on average accumulate the recommended amount of physical activity for an adult and are unaware that adults should exercise five days a week for 30 minutes (Judge et al., 2012). In contrast, another research study found that only 64.3% of participants met the minimum physical activity guidelines of 150 minutes of moderately vigorous physical activity per week and only 27.5% of participants were classified as “moderately active,” while 8.1% of participants were classified as inactive (Murphy et al., 2018). An interesting finding from this study also showed that around 40.3% of the students they studied stated that they actively commuted to college and that students reported spending an average of 12.1 hours per weekday engaged in sedentary behaviors (Murphy et al., 2018). Both of these variables have the possibility to be impacted by COVID-19 and therefore have a large impact on physical activity rates. We will be monitoring student physical activity using accelerometers and one study that employed the use of pedometers found that participants in their study took anywhere from 7,982.6-2,209.6 steps per day which is short of the goal of 10,000 steps that the American Heart Association recommends (Miller, Joshua & Street, Brian. 2019).

A caveat to measuring physical activity in college students is the difference in self-reported amounts of physical activity and objectively measured amounts of physical activity. One study found that students using IPAQ (International Physical Activity questionnaire) self-reported engaging in an average of 66.14 minutes of moderately vigorous physical activity per day during the 14-day study. They

then found that accelerometer data showed that the participants actually only engaged in an average of 19.90 minutes of moderately vigorous physical per day. This same study found that 66.7% of the students would qualify to be sufficiently physically active based of their self-reports and when compared to their accelerometer data only 33.8% would be considered physically active compared to CDC guidelines. (Downs PhD et al., 2014).

Certain trends have begun to emerge as studies of physical activity rates of college students have increased. One is that there appears to be an overall increasing trend in physical activity among college students. Among college students there is also a difference in gender and rates and types of physical activity. It has been found that females tend to engage in more aerobic activity and males engage in more weightlifting and anaerobic activities. Another interesting find from this study that has implications with the discussion of physical activity and academic performance is that they found that participants with higher GPAs were more likely to choose to participate in aerobic exercise (Judge et al., 2012).

Mental Health and Stress in college students

Mental health in college students is a continuing topic of research and discussion as there seems to be an increase in reports of students reporting mental health issues and seeking help from campus mental health professionals. One aspect of mental health that is commonly studied as a burden to college students is stress. Stress is so prevalent in college that a study with over 2,000 first year undergraduate students reported that 85% of them experienced stress daily (Simpson, Stacy 2018). College students are constantly facing stress from school related work, relationships, and friends just to name a few. The most common stressors faced by a large sample of college students included academic performance, pressure to succeed, post-graduation plans, financial concerns, quality of sleep, relationship with friends, relationship with family, overall health, body image, and self-esteem (Beiter, Rebecca et al., 2014). With academic performance being one of the most common stressors, the

National Survey of Student engagement found that in 2012 the average college student spent around seventeen hours per week preparing and studying for class (Simpson, Stacy 2018). Also, as many of these top stressors relate to having success after completing college it has been found that upperclassmen have scored the highest on depression, anxiety, and stress scales when compared to students in lower grades (Beiter, Rebecca et al., 2014).

Physical activity has been shown to have a positive impact on the stress that many college students face. It has been studied that students who meet the recommendations for vigorous physical activity were less likely to report poor mental health and perceived stress when compared to other students who did not meet those recommendations (Vankim, Nicole A, and Toben F Nelson 2013). Similarly, students who self-reported being recently physically active showed lower subjective stress levels, even after accounting for the autocorrelation in stress (Schultchen, Dana et al 2019). This same study found that even if it wasn't vigorous physical activity, low and moderate physical activity was also associated with significantly lower stress levels (Schultchen, Dana et al 2019). An interesting finding from this study showed that physical activity levels were lower shortly after stressful times with possible explanations for this being physical activity is an effortful activity and stress may lead to lower motivation to complete such effortful tasks (Schultchen, Dana et al 2019). This high level of stress and subsequent drop in physical activity may be another indicator that physical activity and stress are strongly correlated.

Associations between mental health and academic performance

Current literature and research show that there is a strong link between mental health and academic performance. In fact, the 2015 National College Health Assessment found that stress and anxiety were the two prominent factors that affected individual academic performance with stress accounting for 30% and anxiety for 22% (American College Health Association 2015). Research has shown that there is an impact on academic success that is associated with mental and emotional health

and that students who experience stress are more likely to face challenges with academics (Goodman, Leah 2017). Also, students who have psychiatric disabilities or mental health related challenges have been shown to earn lower GPAs and have higher a rate of dropping out than their peers (Goodman, Leah 2017).

Along with anxiety and stress, depression has been shown to have an impact on academic performance. One study found that depression is significantly associated with a lower GPA and higher chance of dropping out and that co-occurring depression and anxiety are also associated with a lower GPA. This study also found that anhedonia, which is the inability to feel pleasure, is significantly associated with GPA and that this association was independent of other depressive symptoms. The explanation to this finding in this study is that students can still function even if they are depressed. The depression only begins to have an impact once someone loses interest or enjoyment in usual activities (Daniel Eisenberg, Ezra Golberstein, and Justin B. Hunt 2009).

The prevalence of associations of mental health and academic performance increase as students progress through college. A study examining mental health and academic performance of first year college students found that only 25% of students reported that stress did not impact them in the previous 12 months and that about 38.5% of the students reported a negative academic impact from experiencing stress. They also found that upperclassmen were affected more by the impacts of mental health on their academic performance and the freshman reported higher rates of self-injury and seriously considering suicide (Wyatt, Tammy & Oswalt, Sara & Ochoa, Yesenia 2017). As students get older, classes become harder and the thought of making a living as an adult loom large which may lead to the reason that older students are more negatively impacted by the mental health issues that can arise from dealing with such problems.

Association between physical activity and academic performance

Research into the association between physical activity and academic performance has produced a variety of results, with some research pointing towards them being statistically significant and others showing no relationship exists. Research that supports them being statistically significant showed in one study that meeting the national guidelines of for moderately vigorous physical activity was a significant positive predictor of GPA and that by meeting those recommendations, GPA was higher by an average of 0.03 points (Wald, Adrienne et al., 2013). A study that examined the effects of incentivized physical activity found that the incentives increased gym attendance and also increased academic performance by an average of 0.15 standard deviations. This study found that at the end of their treatment GPA increased on average by about 0.30 and that students in the treatment group completed more courses (Cappelen, Alexander W et al., 2017). A similar study examining incentivized physical activity found that incentivizing physical activity increased participations by 47% and also increased grades by 0.14 standard deviations (Fricke, H., Lechner, M., & Steinmayr, A. 2017). This study theorized that students became more physically active on campus due to the incentives which may have led to them combining studying and exercising. They also pointed out that even though much is known about the effects of exercise on brain functioning, little is known whether or not physical activity enhances productivity (Fricke, H., Lechner, M., & Steinmayr, A. 2017).

Contradictory to the correlations mentioned above, one research study, that included over 10,000 undergraduate students from across the United States, found that there was no statistically significant correlation between physical activity and academic achievement (Meacham, Jared T. 2015). This study instead found that increasing physical activity was associated with increasing academic achievement, but only up to a certain point. It found that students who had medium physical activity levels as indicated by a FIT score between 16 to 64 performed better academically than those with very low FIT Scores (16 or less) and very high FIT scores (64 and above) (Meacham, Jared T. 2015). A possible

explanation is that students are still benefiting from the physical activity, but at the very high range they may be spending more time exercising than focusing and studying for school.

HOW COVID-19 is affecting physical activity

COVID-19 or the technical name SARS-CoV-2 is a respiratory disease that took the world by storm in early 2020. The World Health Organization describes COVID-19 as “an infectious disease caused by a newly discovered coronavirus (World Health Organization).” They also describe it as being a disease that is spread through droplets and has the potential to develop into a possibly life-threatening disease for the elderly and people with underlying health conditions (World Health Organization). The severity of this disease and its ease of transmission from human droplets has led to the lockdowns, mandates, and masks wearing that many people around the globe are still experiencing today. These lockdowns have altered how and when we move around in our lives and subsequently have had a major effect on the amount of physical activity that most people do.

At the height of lockdowns in the spring of 2020, some countries forced residents to stay in their homes and were only allowed to leave for essential trips such as going to the grocery or pharmacy. A study that examined world-wide shifts in physical activity during the lockdowns found that within 10 days of being declared a pandemic, there was a 5.5% decrease in mean steps, and within 30 days there was a 27.3% decrease in mean steps (Tison et al., 2020). Countries across the world employed different lockdown measures and the study found that Italy, who had one of the strictest lockdowns, saw a 48.7% maximal decrease in steps. In comparison, Sweden who did not have a nationwide lockdown and instead advocated for social distancing and limitations on gatherings, only saw a 6.9% maximal decrease in steps (Tison et al., 2020).

Some expected and also not expected trends have begun to emerge as research continues to expand on the effects of continued lockdowns and mitigation efforts. One study examining the effects of physical activity in France and Switzerland during the pandemic found that as expected, more leisure

time was spent in sedentary behavior and less time was spent doing vigorous physical activity. However unexpectedly, they noted an increase in walking and in moderate physical activity during leisure time (Boris et al., 2020). Another study found that participants who would have been classified as highly or moderately active before COVID-19, had drastically decreasing levels of physical activity during the pandemic. They also found that participants who would have been classified as low active before COVID-19 had significantly increasing levels of physical activity during the COVID-19 pandemic and this increase could possibly be due to completing more housework activities since they were being forced to stay home (Maugeri, Grazia et al., 2020). A study conducted in the UK, a country that did not have extremely strict lockdowns, found that during social distancing, 75% of the participants had sufficient physical activity. This study also noted that the mean number of minutes of moderate-to-vigorous physical activity increased for all adult age groups and that previously in the UK approximately 58-68% of the adult population met the physical activity guidelines compared to the 75% that they found (Smith L, Jacob L, Butler L, et al., 2020).

Purpose

The purpose of this study is to examine how the COVID-19 pandemic has affected physical activity, sleep, and mental health in university students, faculty and staff and to examine the relationship between these variables.

Methods

Participants

A representative sample of current undergraduate students, graduate students, and faculty/staff 18 or above, who have completed the Exercise is Medicine protocol in the past at the University of Arkansas. Participants must have sufficient data from previous involvement in Exercise is Medicine. They must be able to complete the questionnaire in English.

Recruitment

Participants were recruited through their previous involvement in Exercise is Medicine. We employed emails as the primary way of contacting participants.

Measures

We followed a modified method of the Exercise is Medicine protocol while employing the same questionnaire on the Qualtrics platform that is employed in that study. The questionnaire was completed before any objectively measured variables were collected.

Physical activity and sleep. Physical activity and sleep were objectively measured 24 hours a day for a period of 7 days. For monitoring we used the Actigraph GT9x accelerometers. As part of the questionnaire, participants also completed the IPAQ and Pittsburgh Sleep Quality Instrument.

Mental health/stress. Participants completed an online questionnaire using the Qualtrics platform where the DASS-21 (Depression, Anxiety, and Stress Scale) will be used to assess stress and mental health

Academic Performance. Undergraduate student academic performance was measured using students' GPAs. Participating students will self-report their GPA using the Qualtrics platform. Academic records from the office of student success were obtained to verify that the self-reported GPA matches students' actual GPAs.

Comparison Data. Data from previous participation in Exercise is medicine was accessed electronically in order to compile it and to compare it to the newly recorded data from the same participant.

Procedures

The participants completed the questionnaire at home before they received the accelerometer. Due to COVID-19, participants had a number of options to receive the accelerometer and to return it at the end of 7 days. They had the options of contactless delivery and return, coming to the HPER and picking up and returning, or receiving it in the mail and returning in a postage paid envelope.

Main analyses

To study the effects of the COVID pandemic we accessed participant data from previous participation in Exercise is Medicine. We will compare the newly collected data for each variable to previously collected data for each variable before the onset of the COVID-19 pandemic. Paired T-tests were used to compare sleep the normally distributed variable. Wilcoxon Signed Rank tests were used to compare the normal outcome variables of physical activity and mental health. Individual variables will be compared with each other to determine if there are any correlated changes before and after the onset of the COVID-19 pandemic.

Results

This study consisted of 38 participants. 23 faculty/staff, 8 graduate students, and 7 undergraduate students. Total physical activity increased from a mean Pre COVID level of 2,978.9 METmin/week to 4,281.2 METmin/week which was statistically significant ($p=0.01$). Work physical activity increased from 779.9 METmin/week to 1,200.4 METmin/week which was not statistically significant ($p=0.32$). Active transport physical activity decreased slightly from 584.1 METmin/week to 545.5 METmin/week which was not statistically significant ($p=.27$). Domestic physical activity increased

from 701.5 METmin/week to 1,399.2 METmin/week which was statistically significant ($p=0.01$). Leisure physical activity increased from 972.7 METmin/week to 1,753.8 METmin/week which is statistically significant ($p=0.03$). From the survey we found 55% of participants believed their physical activity decreased, 24% believed their physical activity increased, and 13% believed that there was no change. Sleep quality scores increased slightly from an average of 5.3 to 5.6 which was not statistically significant ($p=0.33$). From the survey we found 39% of participants did not think COVID affected their sleep, 34% thought it was a little worse, 18% thought it was little better, 3% thought it was a lot worse, and 3% thought it was a lot better. We only had 9 participants with pre and post COVID-19 scores for the DASS-21 and due to the low number, there was no statistical difference in scores for mental health measures.

Table 1: Average physical activity levels pre and post COVID-19, mean (SD)

Measure	Pre-COVID (METmin/week)	Post-COVID (METmin/week)
Total physical activity	2,978.9 (3,334.3)	4,281.2 (4,758.3)
Work PA	779.9 (1,509.1)	1,200.4 (2,520.6)
Active transport PA	584.1 (824.3)	545.5 (509.7)
Domestic PA	701.5 (1,049.5)	1,399.2 (2,061.4)
Leisure PA	972.7 (1,673)	1,753.8(1,504.6)

Chart 1: Average physical activity

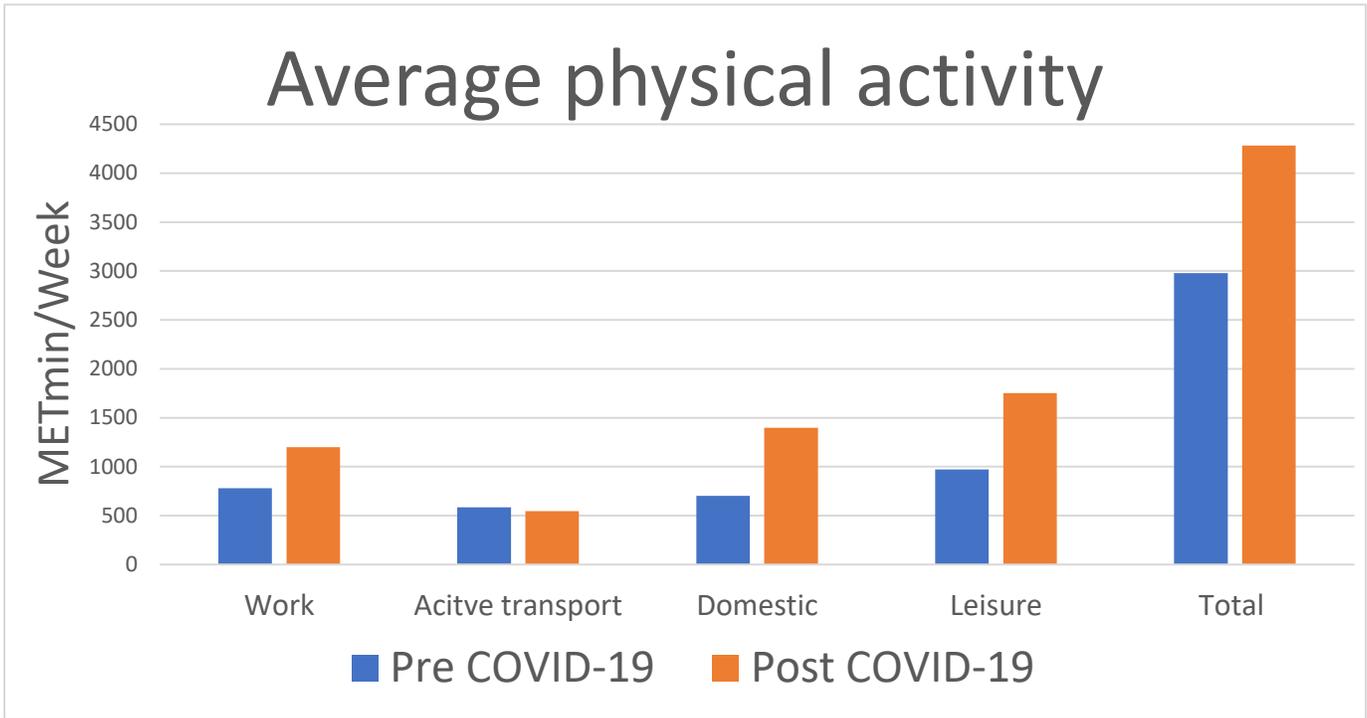


Chart 2: Perceived change in physical activity

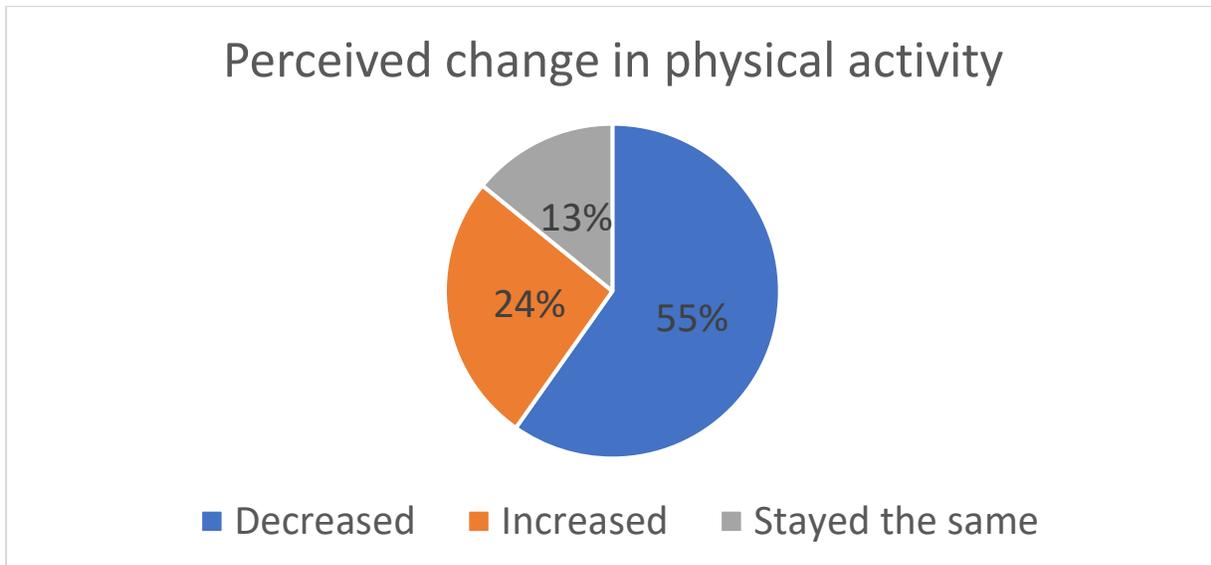
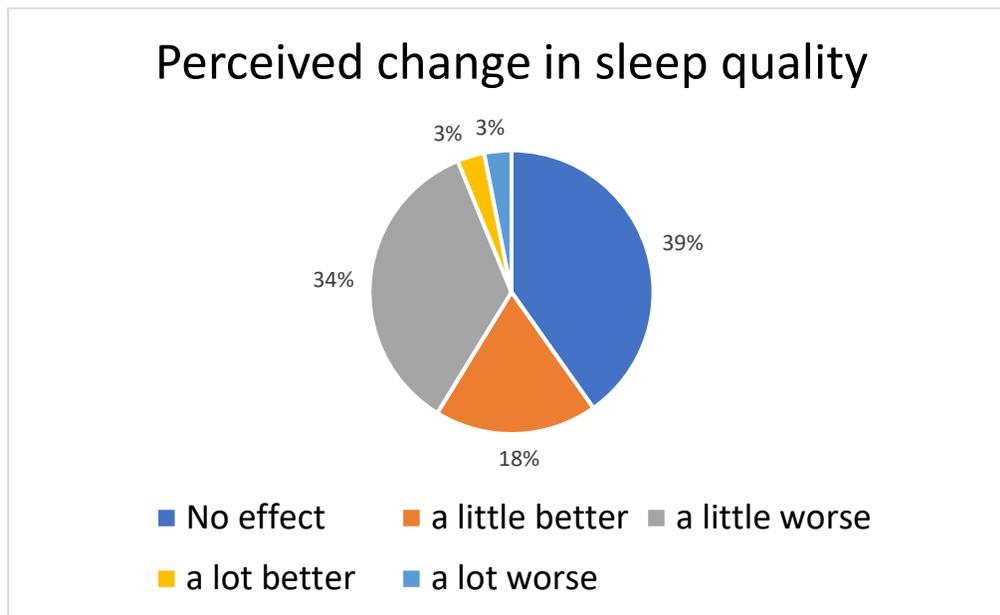


Chart 3: Perceived change in sleep quality



Discussion

This project found that overall physical activity, domestic physical activity, and leisure physical activity have all statistically increased since the onset of the COVID-19 pandemic. This is surprising considering we found that a majority of the participants actually believed that their physical activity levels had decreased since the start of COVID-19. It also found that there was a slight increase in work physical activity and a slight decrease in active transport physical activity. However, both of these results were not statistically significant. Due to a low number of participants with comparable data, no conclusions could be made about changes in mental health, and no conclusions can be made about the effect of physical activity on mental health. We also found that the onset of COVID-19 did not have a statistically significant effect on sleep quality outcomes.

Due to the literature on the effects of COVID-19 on physical activity being relatively new, this result of an overall increase is both supported in some literature and refuted in other literature. A study

conducted in the UK found that 75% of the participants had sufficient physical activity after the start of COVID-19 and that the mean number of minutes of moderate-to-vigorous physical activity increased for all adult age groups (Smith L, Jacob L, Butler L, et al., 2020). We discussed that a possibility of the increase seen in our data and in the UK is that these are both countries that did not enforce extremely strict widespread lockdowns. This lack of strict lockdowns subsequently did not have as many restrictions on opportunities for individuals to engage in physical activity. Also, as people had more time at home and less commitments, they had more time to possibly engage in physical activity in the areas of domestic and leisure. In comparison, a multinational study that focused on physical activity in countries that were significantly affected by COVID-19, found that self-reported moderate to vigorous physical activity decreased by 41% and compliance with World Health Organization guidelines for physical activity decreased to 62.5% since the onset of the pandemic (Wilke, J.; Mohr, L.; Tenforde, A.S.; Edouard, P.; Fossati, C.; González-Gross, M.; Sánchez Ramírez, C.; Laiño, F.; Tan, B.; Pillay, J.D.; et al. 2021) This decrease could possibly be attributed to stricter lockdowns and less access to opportunities to engage in physical activity. However, this was not examined as governments around the world imposed a patchwork of different styles of lockdowns and restrictions. This is an area that warrants future study on what the effects of different lockdown styles were on physical activity, but it is behind the scope of our study.

This project has undergone many changes since its infancy and has faced some challenges. An ever-changing world, especially in the world of COVID-19 restrictions, has caused us to change the focus and question of this project multiple times. We had initially hoped to compare physical activity levels with academic performance, sleep, and mental health. We shifted our main focus towards how COVID-19 affected the variables and would secondly address if there was any relationship between the variables themselves. We did not include the effects on academic performance due to delays in the data collection, but we still included it in the literature review and procedures to show how we had originally

planned to include it. We still included mental health as a variable however, the assessment that we used for mental health in the past did not provide easily comprehensible data and this year the assessment was switched to the DASS-21. This meant that we did not have enough comparable data from before and after the start of COVID-19 to draw any accurate conclusions from. This project was part of a larger inter-institutional study and we faced delays in getting the inter-institutional IRB approved. This delay caused us to only be able to compare physical activity data from the IPAQ section of the questionnaire which could have led to some participant bias. However, at this time this project is still on going and data is now being collected objectively with the accelerometers. We are continuing to collect data with the accelerometers because they will provide us with device based, objective data. We will be using the device based data to confirm the IPAQ questionnaire responses and control for any potential participant answer bias on the questionnaire.

In conclusion we found that physical activity as a whole, domestic physical activity, and leisure physical activity all showed statistically significant increases after the start of the COVID-19 pandemic. No statistically different changes were seen in sleep or mental health after the start of COVID-19. This study is important because it showed that even during a global pandemic physical activity increased. As a country that struggles to meet physical activity recommendations, finding the reason for these increases could provide ways to continue this trend in physical activity even after the COVID-19 pandemic has ended.

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