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*Original Research*

# The Acute Effects of the COVID-19 Pandemic on Physical Activity and Sedentary Behavior in University Students and Employees

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ABSTRACT

***International Journal of Exercise Science 13(5): 1326-1339, 2020.*** The COVID-19 pandemic has closed non-essential businesses which may alter individuals' leisure behaviors. Consequently, physical activity and sedentary behavior may be negatively impacted as many fitness and recreational centers have been closed. This study aimed to examine the impact of the pandemic on physical activity and sedentary behavior in a sample of university students and employees before and after the university cancelled face-to-face classes and closed campus. Participants ($N$ = 398) completed the validated Godin physical activity questionnaire and the International Physical Activity Questionnaire which assessed physical activity and sedentary behavior pre- and post-cancellation of face-to-face classes. Participants were also separated in the groups (*low, moderate, high* physical activity) based upon a tertile split of pre-pandemic total physical activity. Physical activity group by time ANOVAs were used to assess potential changes in total physical activity and sedentary behavior. Post-cancellation sedentary behavior was greater ($F$ (1, 388) = 9.2, $p$ = 0.003, partial $\eta^2$ = 0.032) than pre-cancellation. Physical activity group moderated ($F$ (2, 395) = 22.0, $p$ < 0.001, partial $\eta^2 \geq$ 0.10) changes in total physical activity from pre- to post cancellation. The *high* activity group decreased physical activity whereas the *moderate* and *low* activity groups increased physical activity ($t \geq 2.4$, $p \leq 0.02$, Cohen's $d$ = 0.23). While the university closure increased sedentary behavior across the sample, it only decreased physical activity in participants who were the most active pre-cancellation. Pandemic-related closure of facilities designed for physical activity may disproportionately impact active individuals.

KEY WORDS: Novel Coronavirus 2019, bodyweight, sitting, inactivity, behavior change

## INTRODUCTION

The coronavirus disease 2019 (COVID-19) is an infectious disease caused by a novel form of a coronavirus first discovered in 2019. By 2020, COVID-19 had caused a global pandemic. Individuals infected with COVID-19 experience respiratory illness and those with underlying medical conditions are at greater risk of developing serious complications from the disease. Because the virus is thought to spread from person-to-person through respiratory droplets, physical distancing recommendations have been established to help slow the spread of the disease (37, 39). Physical distancing recommendations during the COVID-19 pandemic have altered social interactions, lead to the closure of non-essential businesses and public services (e.g., recreation and fitness centers, outdoor parks, theatres, restaurants), and limited leisure time activity options. Positive social interaction with peers is predictive of greater physical activity behavior as is having access to environments which promote physical activity (e.g., gyms, recreation centers, outdoor parks) (3, 5, 25, 35, 45). It is therefore possible that constraints placed upon social interaction and public spaces due to COVID-19 could decrease physical activity, increase sedentary behavior, and subsequently increase bodyweight.

Investigators have disseminated information outlining the potential negative impacts the pandemic may have upon health behaviors (12, 20, 23, 28, 31, 32). These preliminary studies indicate that stay-at-home orders (strict to lenient) have the potential to limit physical activity and promote sedentary behavior. While the benefits of physical activity and problems associated with excessive sedentary behavior are well documented, remaining active during the COVID-19 pandemic may be particularly important (44, 47). Obesity and a lack of fitness are emerging as risk factors for developing more severe symptoms and complications if one were to become infected with COVID-19 (12, 15, 27). For example, hospitalized obese COVID-19 patients under 60 years of age were two times more likely to be admitted to acute and critical care than similar patients who were not obese (27). Dietz and Santos-Burgoa also speculate that because obesity increased mortality risk with other respiratory illnesses (e.g., H1N1) it may similarly increase mortality risk during the COVID-19 pandemic (15). As such researchers are emphasizing the importance that individuals, despite the obstacles created by the pandemic, attempt to maintain recommended physical activity behavior put forth by the World Health Organization of 150 min/wk of moderate-intensity physical activity or 75 min/wk of vigorous-intensity physical activity (17). Recommendations to meet these thresholds include at home exercises such as: using a cycle ergometer, treadmill, or rowing machine, walking/jogging in the house or outside if the exerciser can maintain a distance of ≥1m from other individuals, playing physically-active video games, and using video- or app-guided equipment-free aerobics or strength training (12, 20, 23, 28, 31, 32). However, some individuals may have barriers (e.g., lack of equipment, space) to exercising at home. Furthermore, prior research has indicated that adherence to home-based exercise programs may be poor (22, 41).

In addition to articles that raised concerns about the potential negative effect of the pandemic on physical activity and sedentary behavior there are articles which attempt to quantify this impact (1, 29, 33, 42, 43). These articles used a variety of methods (e.g., various survey instruments assessing physical activity, a pedometer app) and examine different populations however, they agree that the pandemic may decrease physical activity. They all reported significant pandemic-related decreases in physical activity however, one article by Meyer at al. suggests that this change may be moderated by pre-pandemic physical activity (33). In this study, participants that were active pre-pandemic reported 32% reductions in physical activity during the pandemic while participants who were inactive pre-pandemic increased physical activity by 2.3%. This suggests that pandemic-related restrictions may differentially affect the physical activity behavior of active and inactive individuals.

There are also two survey-based studies indicating that the pandemic may increase sedentary behavior, and pre-pandemic physical activity behavior may moderate this effect as well (1, 33). These studies report 26-60% increases in daily sitting during the pandemic with the greatest increases seen in individuals who were physically active prior to the pandemic. Taken together, these decreases in physical activity and increases in sedentary behavior may result in decreased daily caloric expenditure which could promote pandemic-related weight gain (10). Compounding this problem Carter et al. suggest the pandemic may promote increased caloric consumption as well (12). Despite this potential for pandemic-related weight gain, to the best of our knowledge changes in bodyweight has not been assessed.

While there is an emerging body of literature examining the potential impact of the COVID-19 upon physical activity and sedentary behavior, Sallis et al stress the need for more research on this topic (40). They state that this type of research is needed not only to inform better activity recommendations during the COVID-19 pandemic but for improved responses to similar events in the future. Therefore, the purpose of this study was to assess physical activity, sedentary behavior, and bodyweight in a sample of university students and employees pre- and post-cancellation of face-to-face classes due to the COVID-19 pandemic. We assessed the ability of gender and university role (e.g., undergraduate student, faculty) to moderate this potential effect. Additionally, we separately assessed the ability of pre-pandemic physical activity to moderate changes in physical activity, sedentary behavior, and weight as was seen by Meyer, et al.(33). We hypothesized that participants would report reduced physical activity, increased sedentary behavior, and greater body weight post-cancellation and these effects may be greater in individuals from the sample which were the most physically active pre-pandemic. Furthermore, because pre-pandemic physical activity may predict changes in physical activity during the pandemic and because men tend to be more physically active than women, we hypothesized a greater reduction in physical activity from pre- to post-cancellation for men versus women (2, 33). Lastly, because age is inversely associated with physical activity and students tend to be younger than university employees, we hypothesized greater reductions in physical activity in students relative to university employees (6).

## METHODS

*Participants*

This study examined a sample of university students and employees. This population was selected for two primary reasons: 1) To date no study has examined the impact of the pandemic specifically on a university population. 2) There was a clearly defined date (3/11/2020) in which all face-to-face classes were cancelled, and normal university operations stopped. That stoppage likely significantly altered the daily lives of most of those working or taking classes at the university. Therefore, we believe this population may serve as a viable source for evaluating the effect of the pandemic upon the variables of interest. A link to the survey was sent to faculty and staff in a university-generated email newsletter. This link was also emailed to all university faculty directly from the principal investigator (PI, Barkley). The PI also emailed the link to the survey to a randomly selected subset of the total student population (both undergraduate and graduate students). SPSS was utilized to randomly select student emails for the survey invitation from a complete list of all student emails. The link to the survey was sent to potential respondents between 5/18/20 and 6/3/20. Survey data collection was halted on 6/18/20 and data was downloaded. The initial sample was $N$ = 714 (Figure 1). Any participant that was missing data for one or more of the items of interest (i.e., physical activity, sedentary behavior, bodyweight) at either time point (pre-, post-cancellation) in the survey was subsequently removed from the data set and the new sample size, with no missing data, was $N$ = 413. Participants were asked to report their university role (graduate, undergraduate student, faculty, staff, administration, other (please describe)) and any participant who indicated their role at the university was "other" was then eliminated ($n$ = 12). This was done as many of these individuals indicating their role as "other" listed roles that covered multiple categories (e.g., faculty and student, staff and student). Participants also reported their gender (male, female, non-binary, choose to self-describe, prefer not to say) and anyone reporting their gender as anything other than male or female was eliminated as there were only three such individuals ($n$ = two non-binary, one self-describe). The final sample was $N$ = 398 ($n$ = 298 female, 109 male) with $n$ = 100 undergraduate students (26.9 ± 8.9 years old), 84 graduate students (29.9 ± 9.7 years old), 176 faculty (52.1 ± 10.7 years old), 28 staff (48.1 ± 12.5 years old), and 10 administrators (48.2 ± 8.6 years old).

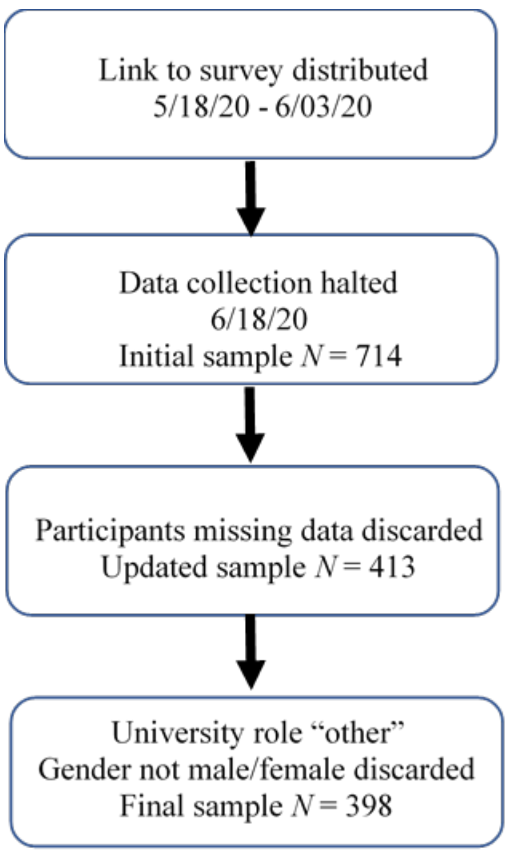


**Figure 1.** Flow diagram illustrating the timeline of participant recruitment and the removal of cases that had missing data, a university role of "other," or a gender that was not male/female.

Power analysis was conducted using the results from Ammar, et al (1). They used a survey-based instrument and examined physical activity and sedentary behavior pre-pandemic and after the initiation of stay at home orders. They reported total physical activity of 2192.6 ± 3300 MET minutes/week pre-pandemic to 1360 ± 2545 MET minutes/week after stay at home orders.

They also reported 5.3 ± 3.7 hours/day of sitting pre-pandemic and 8.4 ± 5.1 hours/day of sitting after. These difference yield effect sizes of Cohen's $d$ = 0.28 and 1.13 for physical activity and sitting, respectively. With these effect sizes and an $\alpha \leq 0.05$, 98 and 10 participants would be needed to achieve a power ≥ 0.80 for difference in physical activity and sedentary behavior, respectively. Based upon this analysis we believe our current sample of $N$ = 398 was adequate.

*Protocol*

On March 11th, 2020 a large, public university in the Midwestern United State cancelled face-to-face classes and altered all instruction to online only due to the COVID-19 pandemic. The campus, including all fitness facilities, was closed soon thereafter (3/20/20) and all students were sent home. Shortly after the university closure, the university's home state issued a "stay at home" order (3/22/20) (14). The university's cancellation of face-to-face classes and ultimate closure of the campus coupled with the governor's "stay at home" order likely changed the daily lives of those with roles at the university. There is evidence of pandemic-related disruption in daily life and corresponding potential negative psychological outcomes in both university faculty and students (8, 11). We attempted to assess the impact of these changes via an anonymous online survey designed to measure physical activity, sedentary behavior, and bodyweight pre- and post-cancellation of face-to-face classes. At the beginning of the survey there was text informing participants that the study was assessing health behaviors, such as physical activity and sedentary behavior, before and after the cancellation of classes. This approach of assessing past and present physical activity and sedentary behavior via survey methods is valid and has been utilized successfully in the past (4, 13, 30, 46). We also assessed age (years), and as mentioned previously, university role and gender. The first page of the survey contained an informed consent statement explaining the study. That consent statement indicated that by beginning the survey the participant had read the consent statement and voluntarily agreed to participate in this study. All procedures were approved by the university Institutional Review Board. Additionally, this research was carried out fully in accordance to the ethical standards of the International Journal of Exercise Science (36).

Physical activity was assessed using the Godin physical activity questionnaire which requires respondents to indicate the number of times, per week they participate in 15 minutes of strenuous (i.e., vigorous), moderate, and mild physical activity. The survey defines strenuous physical activity as activities in which the participant's "heart beats rapidly" and lists several examples of these types of activities (e.g., running, jogging, basketball). Moderate activity is defined as physical activities that are "not exhausting" and also provides examples (e.g., fast walking, tennis. easy bicycling). Finally, mild activities are defined as those that require "minimal effort" and, again, examples are provided (e.g., slow walking, bowling, golf). A score for each intensity is calculate using the following equations: times per week participating in strenuous x 9, moderate x 5, mild x 3. Each of these individual scores was then summed for a total physical activity score. This survey instrument has evidence of validity and reliability for the assessment of physical activity behavior and demonstrated good internal consistency (Cronbach's $\alpha$ = 0.78) in the present study (18, 19).

Participants were asked to report their typical activity prior to the university's cancellation of face-to-face classes (3/11/20) using the following language: "During a typical 7-day (one week) period before Kent State ended face-to-face classes (3/11/2020) how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time?" Participants then reported their current physical activity at the time they completed the survey using the following language: "During a typical 7-day (one week) period after Kent State ended face-to-face classes (3/11/2020) how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time? In other words, these questions are asking you to describe your current physical activity."

Sedentary behavior was assessed using the validated International Physical Activity Questionnaire and language that was similar to the physical activity assessments (13, 30, 46). Specifically, participants were asked "During a typical week before Kent State ended face-to-face classes (3/11/2020), how much time did you usually spend sitting on a weekday?" The same language was used for assessing weekend sedentary behavior pre-cancellation. Weekday and weekend sedentary behavior was similarly assessed for post-cancellation by slightly modifying the questions to "During a typical week after Kent State ended face-to-face classes…" Lastly, participants were asked to self-report their bodyweight (lbs.) before the cancellation of face-to-face classes and their weight currently. Using self-report is a valid method of assessing bodyweight in adults (24).

*Statistical Analysis*

University role (undergraduate, graduate student, faculty, staff, administrator) by gender (male, female) by time (pre, post-cancellation) analyses of variance (ANOVAs) with repeated measures on time were performed to examine changes in mild, moderate, vigorous, and total physical activity, sedentary behavior, and body weight. Only main effects and interactions related to changes in time (pre, post-cancellation) were reported for these ANOVAs as all research questions included this independent variable. For example, we did not report main effects of university role group and gender nor role group by gender interactions as these effects are not part of the research questions.

Tertile splits were then performed on pre-cancellation total physical activity score and the following groups were established: *low* ($n$ = 127, 12.9 ± 6.7 Godin score), *moderate* ($n$ = 132, 32.5 ± 5.4 Godin score), and *high* ($n$ = 139, 75.8 ± 59.5 Godin score) pre-cancellation physical activity. Separate, three pre-cancellation physical activity group (*low, moderate, high*) by time ANOVAs were then performed for mild, moderate, vigorous, and total physical activity, sedentary behavior, and bodyweight. For these ANOVAs we only report the results of the activity group by time interactions as all main effects of time are reported in the previous ANOVAs and main effects of activity groups were not part of the research questions. Post hoc analyses of any significant interaction effects for all ANOVAs were performed using t-tests with Benjamini and Hochberg False Discovery Rate correction for multiple comparisons (7). A priori significance was set at $\alpha \leq 0.05$ and all data were analyzed using SPSS Version 26.

**RESULTS**

University role group, gender, and time: For the university role group by gender by time analyses there were no significant ($F$ (4, 388) ≤ 2.0, $p$ ≥ 0.16, partial $\eta^2$ ≤ 0.005) main or interaction effects of time for moderate, vigorous, or total physical activity (Table 1). There was a significant ($F$ (4, 388) = 4.2, $p$ = 0.003, partial $\eta^2$ = 0.041) university role by time interaction for mild physical activity. This interaction was due to a significant ($t$ = 3.0, $p$ = 0.015, Cohen's $d$ = 0.33) decrease in mild physical activity from pre- to post-cancellation in undergraduate students with no significant ($t$ ≤ 1.0, $p$ ≥ 0.50, Cohen's $d$ ≤ 0.18) changes in mild physical activity for any of the other university role groups. There were no additional main or interaction effects for differences in mild physical activity ($F$ (4, 388) ≤ 1.9, $p$ ≥ 0.17, partial $\eta^2$ ≤ 0.015).

**Table 1.** Mean ± SD of Godin physical activity scores for mild, moderate, vigorous, and total physical activity pre- and post-cancellation for the five separate university role groups and an average score of all participants (Overall).

| University role | Mild pre | Mild post | Moderate pre | Moderate post | Vigorous pre | Vigorous post | Total pre | Total post |
|---|---|---|---|---|---|---|---|---|
| Undergrad | 16.3±22.6 | 10.8±12.9* | 15.0±15.7 | 12.9±12.4 | 16.0±22.1 | 14.0±17.9 | 47.2±40.2 | 37.7±30.7 |
| Grad | 12.0±22.4 | 11.2±11.7 | 17.1±36.9 | 16.6±19.7 | 19.1±32.9 | 21.0±33.7 | 48.2±75.2 | 48.7±58.8 |
| Faculty | 8.4±7.8 | 8.9±8.8 | 15.6±20.4 | 16.8±19.8 | 11.7±16.4 | 11.4±17.5 | 35.7±24.7 | 37.1±26.7 |
| Staff | 7.3±9.1 | 9.6±12.4 | 10.4±12.8 | 14.8±15.7 | 16.7±19.2 | 14.1±20.6 | 34.4±21.7 | 38.6±31.9 |
| Admin | 12.3±14.9 | 14.1±19.8 | 22.5±23.7 | 23.0±33.8 | 10.8±18.9 | 16.2±28.4 | 45.6±37.6 | 53.3±56.3 |
| Overall | 11.2±16.8 | 10.0±11.2 | 15.5±23.6 | 15.8±18.4 | 14.7±22.5 | 14.4±22.6 | 41.4±44.2 | 40.2±38.0 |

*Note:* *post value significantly ($p$ = 0.015) different from corresponding pre value.

There was a significant ($F$ (1, 388) = 9.2, $p$ = 0.003, partial $\eta^2$ = 0.032) main effect of time for sedentary behavior. Participants significantly increased average weekly sitting from pre to post-cancellation (Table 2). There were no additional main or interaction effects for differences in sedentary behavior ($F$ (4, 388) ≤ 1.8, $p$ ≥ 0.18, partial $\eta^2$ ≤ 0.011).

There were no significant ($F$ (4, 388) ≤ 2.0, $p$ ≥ 0.16, partial $\eta^2$ ≤ 0.009) main or interaction effects of time for bodyweight (Table 2).

**Table 2.** Mean ± SD of sedentary behavior (min·wk$^{-1}$) and bodyweight (lbs) pre- and post-cancellation for the five separate university role groups and an average value of all participants (Overall).

| University role | Sedentary pre (min·wk$^{-1}$) | Sedentary post (min·wk$^{-1}$) | Bodyweight Pre (lbs) | Bodyweight post (lbs) |
|---|---|---|---|---|
| Undergrad | 3089.2±1455.4 | 3681.0±1600.3 | 175.4±48.4 | 176.8±48.4 |
| Grad | 3129.1±1329.7 | 3696.4±1566.5 | 163.7±45.6 | 164.5±45.6 |
| Faculty | 2635.9±1039.6 | 3036.3±1258.0 | 176.9±50.8 | 177.8±51.5 |
| Staff | 3082.9±1166.4 | 3277.9±1225.1 | 198.8±61.4 | 193.6±66.2 |
| Admin | 3270.0±717.4 | 3594.0±1456.2 | 179.6±36.5 | 179.6±38.5 |
| Overall | 2901.3±1239.1 | 3368.6±1448.3* | 174.7±49.9 | 175.9±50.7 |

*Note:* *post value significantly ($p$ = 0.003) different from corresponding pre value.

Pre-cancellation physical activity group by time: For the pre-cancellation physical activity group by time analyses there were significant ($F$ (2, 395) ≥ 7.5, $p$ ≤ 0.001, partial $\eta^2$ ≥ 0.08) physical activity group by time interactions for mild, moderate, vigorous, and total physical activity (Table 3). These effects were due to significant reductions ($t$ ≥ 2.4, $p$ ≤ 0.029, Cohen's $d$ ≥ 0.22) in mild, moderate, vigorous, and total physical activity from pre- to post cancellation in the *high* activity group with significant ($t$ ≥ 2.2, $p$ ≤ 0.03, Cohen's $d$ ≥ 0.20) increases in moderate and total physical activity across time points in both the *moderate* and *low* activity groups. The *low* activity group also reported a significant ($t$ = 4.4, $p$ < 0.001, Cohen's $d$ = 0.43) increase in vigorous physical activity. There were no significant changes ($t$ = 0.71, $p$ = 0.48, Cohen's $d$ = 0.06) in light physical activity for the *low* activity group nor in light or vigorous physical activity for the *moderate* activity group ($t$ ≤ 2.0, $p$ ≥ 0.077, Cohen's $d$ ≤ 0.18).

There were not significant ($F$ (2, 395) ≤ 1.8, $p$ ≥ 0.16, partial $\eta^2$ ≤ 0.009) activity group by time interactions for sedentary behavior or bodyweight.

**Table 3.** Mean ± SD of Godin physical activity scores for mild, moderate, vigorous, and total physical activity pre- and post-cancellation for the three separate pre-cancellation physical activity groups.

| Activity group | Mild pre | Mild post | Moderate pre | Moderate post | Vigorous pre | Vigorous post | Total pre | Total post |
|---|---|---|---|---|---|---|---|---|
| Low | 6.7±6.2 | 7.2±7.7 | 4.8±6.2 | 10.0±12.5* | 1.4±4.0 | 6.5±13.7* | 12.9±6.7 | 23.6±25.0* |
| Moderate | 8.4±6.6 | 9.6±8.4 | 13.6±9.8 | 16.0±13.6* | 10.5±11.0 | 11.3±15.9 | 32.5±5.4 | 37.0±21.7* |
| High | 17.9±25.7 | 13.0±14.9* | 27.2±35.0 | 20.9±24.5* | 30.8±29.9 | 24.5±29.9* | 75.8±59.5 | 58.5±50.3* |

*Note:* *post value significantly ($p$ ≤ 0.03) different from corresponding pre value.

**DISCUSSION**

This is the first study we are aware of that attempted to assess potential changes in physical activity, sedentary behavior, and body weight in individuals across a university campus before and after face-to-face classes were cancelled and the university was shuttered due to the COVID-19 pandemic. Participants reported 7.8 hours or 13.9% more weekly sitting after the cancellation of face-to-face classes. Additionally, while there was not a main effect of time for changes in physical activity or bodyweight, there were changes in physical activity over time that were moderated by university role group and pre-cancellation physical activity group. Undergraduate students reported a significant reduction of 33.7% in mild physical activity from pre-to post-cancellation. This was not the case for any of the other university role groups. As we outlined in our hypotheses this reduction in mild activity may be due, in part, age-related differences in physical activity and the fact that the undergraduates were the youngest university role group. It is also possible that during a typical week, undergraduate students may be more likely to walk across campus to multiple buildings whereas the other university role groups may be sequestered in fewer buildings according to their specialty. For example, an undergraduate student may need to walk across campus from the math department to English whereas a math professor, staff member, graduate student, and administrator likely stays in their department. After the pandemic caused the cancellation of face-to-face classes the potentially greater need for walking for active transport across campus for undergraduate students was eliminated.

In addition to the reduction in mild physical activity for undergraduate students, there was a 22.4% reduction in total physical activity from pre- to post-cancellation in participants who were most physically active before the pandemic and this reduction was apparent for each exercise intensity (light, moderate, vigorous). Conversely, the *moderate* and *low* pre-cancellation physical activity groups significantly increased their total physical activity after the pandemic began by 13.9% and 83%, respectively. It is important to note that while the proportional increase in physical activity for the *low* pre-cancellation physical activity group was large, their unit increase (+10.7 Godin score) was actually less than the unit decrease (-17.3 Godin score) in the *high* pre-cancellation physical activity group. Despite differences in methodology and samples, this result was similar to that of Meyer et al who reported a reduction in physical activity in participants who were designated as active before the pandemic and an increase of physical activity for inactive participants (33). These results suggest that while the university closure may have created some barriers to participating in physical activity for some individuals it is possible that other aspects of the cancellation may have encouraged physical activity behavior in others. For example, with the closure of the campus and the state of Ohio's stay at home orders there was a closure of all fitness centers and gymnasiums. This may have disproportionately decreased activity among the most active participants as they may be more likely to utilize such facilities versus the less active participants (16). Conversely, with the change to entirely online instruction there would no longer be a need for commuting to campus for many respondents to this survey. This may create more free time within the day that could be allocated to in the home or outdoor physical activity (21). Perhaps scenarios like this promoted physical activity in our less-active participants. Future research is warranted to examine how different aspects of the cancellation (e.g., fitness center closures versus elimination of a daily commute) may differentially affect physical activity in individuals who were highly active before the pandemic versus those that were not.

While total daily physical activity was only decreased in the most active participants in this sample, the significant increase in daily sitting was across all physical activity groups and is worrisome. Physical activity and sedentary behavior are independent risk factors for a variety of cardio-metabolic disorders (9). Therefore, the increased sedentary behavior independent of maintained or even increased physical activity could increase the risk of disease development in our sample (9). Increasing sedentary behavior while maintaining physical activity may also increase the likelihood that individuals in our sample may be classified as "active couch potatoes" (38). An "active couch potato" is a person who regularly participates in physical activity yet also allocates excessive amounts of time to sitting (38). These individuals are at a greater risk for cardiometabolic disorders than peers who are similarly active yet allocate less time to sitting (9). We have previously reported that the "active couch potato" phenomenon may be prevalent among undergraduate students even prior to the pandemic (26). It is possible that the cancellation of face-to-face classes may exacerbate this problem.

Lastly, there was not a significant change in bodyweight from pre- to post-cancellation. This lack of a change may be because the majority of our sample (i.e., *low* and *moderate* activity groups) maintained or increased total physical activity over the survey period. It also suggests that caloric intake, which was not assessed, may not have increased (10). However, weight gain is a gradual process (10, 34). Therefore, the short window of the pre- to post-cancellation measurements in the present study may have limited the ability of participants to gain an appreciable amount of weight. If the pandemic-related environment persists it may be warranted to reexamine potential pandemic-related changes in body weight over a longer period of time.

While this study presents novel findings, it is not without limitations. We only examined a sample of individuals at a university and cannot extend these findings to others in differing fields. Additionally, data were all self-reported and the survey required participants to recall past behaviors. Furthermore, we did not assess whether patients had access to a scale to measure their bodyweight and/or activity monitors or software apps to measure physical activity. While these are limitations, the survey instruments in the present study are valid and there is evidence supporting the use of recall in the assessment of these variables (4, 13, 24, 30, 46). Furthermore, these methods were a viable option given the fact that because the university is closed, in-person data collection was not possible, nor could the university closure be predicted. However, future research could attempt to utilize objective measures (e.g., personal activity trackers, fitness apps, home scales) to assess these variables even if in-person data collection is not possible for the time being.

In conclusion, we have provided initial evidence of the impact of a university closure, due to the COVID-19 pandemic, upon physical activity, sedentary behavior, and bodyweight in a sample of university students and employees. Presently, undergraduate students significantly decreased mild physical activity, participants who were the most active before the pandemic decreased total physical activity, and there was a significant increase in sedentary behavior in the total sample. This is concerning as both decreasing physical activity and increasing sedentary behavior are positively associated with a variety of negative health outcomes (9, 38, 44, 47). While this data should be considered preliminary, we would encourage university students and employees to be mindful of their time spent sitting and take steps (e.g., taking activity breaks, using a standing desk) to limit this behavior. Furthermore, those who were most active before the pandemic should be aware that they may be most prone to reducing physical activity during the pandemic.

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