

Cell Phone Use, Physical Activity, Sedentary Behavior, and Bodyweight During the COVID-19 Pandemic: A Cross-Sectional Study

Original Research

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Abstract

Introduction: Cell phone use is associated with physical activity and sedentary behavior. These relationships have not been assessed in the context of the COVID-19 pandemic. This study assessed the potential effects of pandemic-related restrictions on cell phone use and the possible relationship of altered cell phone use to physical activity, sedentary behavior, and bodyweight.

Methods: Participants (N = 307) completed a survey assessing cell phone use, physical activity, sedentary behavior, and bodyweight before and after pandemic restrictions were implemented.

Results: Most participants reported increased cell phone use ($\chi^2 = 61.50, p < 0.001$). Participants increased sitting by 10 hours/week ($F = 25.63, p < 0.001$). Those that increased cell phone use reported greater increases in daily sitting (11.65 hours/week, $F = 4.14, p = 0.04$) than those that did not increase cell use (5.0 hours/week). There was also an increase ($F = 10.08, p = 0.002, \eta^2 = 0.04$) in reported bodyweight regardless of cell phone use. Physical activity did not change ($F \leq 1.58, p \geq 0.21$).

Conclusions: During the pandemic individuals reported increased cell use, sedentary behavior, and bodyweight. Those that reported increased cell use reported greater increases in sitting than those not increasing cell use.

Key Words: COVID-19, physical activity, sedentary behavior, smartphone.

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Introduction

COVID-19 became a global pandemic in 2020. The main avenue of transmission is through respiratory droplets which in return led to the implementation of widespread recommendations for social distancing and mask wearing in public areas as an effort to slow the spread of the virus ¹. As a part of these recommendations, some protocols led to closures of parks, fitness centers, theaters, and restaurants leading to a diminished ability to gather and use these types of facilities. Research has shown that positive social interactions and access to physical activity environments (e.g., gyms, parks etc.) may promote physical activity ²⁻⁴. However,

these early pandemic-related restrictions limited social interactions and access to these physically active environments which may have impacted our health and behavior patterns. Literature has begun to outline how the pandemic-related restrictions may have had a negative effect on physical activity behavior. Multiple studies have reported decreases in physical activity as well as increases in sedentary behavior as a consequence of the pandemic ⁵⁻⁸. Given these potential negative changes in physical activity and sedentary behavior it is not surprising that there is also emerging evidence of weight gain during the pandemic ⁹⁻¹².



While literature supports the notion that the pandemic-related restrictions may have decreased physical activity, increased sedentary behavior and bodyweight, little contemporary research has been done assessing potential moderators of these effects.^{5,6,8,9} One potential moderator could be cell phone use.^{13,14} Due to the pandemic there has been an increased reliance on virtual workspaces and decreased face-to-face social interactions¹⁵. Regulations such as cancellations of face-to-face education or work from home orders forced individuals to shift these traditionally in-person activities to largely virtual environments; this in turn may promote greater cell phone use. Unsurprisingly, emerging evidence has shown that cell phone use has increased during the pandemic¹⁶. This is of potential importance as prior research has repeatedly indicated that cell phone use may interfere with physical activity and is positively associated with sedentary behavior^{13,14,17,18}. In other words, high cell phone use has been associated with elevated sitting, lower cardiorespiratory fitness, and reduced exercise intensity. Given these relationships between cell phone use, physical activity, and sedentary behavior it is possible that greater cell phone use during the pandemic may have contributed to the previously reported pandemic-related decreases in physical activity and increases in sedentary behavior.

Therefore, the purpose of the present study was twofold: first, to assess the proportion of individuals from a university sample indicating they increased cell phone use during the pandemic. Second, to assess whether or not altered cell phone use moderates pandemic-related changes in physical activity, sedentary behavior, and bodyweight. Based on previous research indicating that greater cell phone use may interfere with physical activity and is associated with greater sedentary behavior, we hypothesized that individuals who increased cell phone use during the pandemic would report greater decreases in physical activity and increases in sedentary behavior and bodyweight as compared to individuals who did not change their cell phone use.

Scientific Methods

Participants

A sample of 307 students and employees from a large public university in the midwestern United States completed an online survey assessing cell phone use, physical activity, sedentary behavior, and bodyweight before and after university wide cancellations of face-to-face classes and campus closures due to the COVID-19 pandemic which occurred on March 11th, 2020.

Protocol

Proceeding the cancellations and closures an online survey was emailed to a random sample of 6000 college students and all faculty. Additionally, a link to the online survey was posted on a university generated email newsletter targeted to all university staff. Data was collected from 5/18/2020 to 6/18/2020. There is existing evidence supporting the validity of measuring physical activity, sedentary behavior, and bodyweight using recall survey methods and this approach has been implemented previously^{6,19-21}. A power analysis was used based on previous literature using survey-based data examining physical activity and sedentary behavior pre-pandemic and after the onset of stay-at-home orders²². The researchers reported a decrease in total physical activity (Pre: 2192.6 ± 3300 MET minutes/week; Post: 1360 ± 2545 MET minutes/week) and an increase in sedentary behavior (Pre: 5.3 ± 3.7 hours/day; Post: 8.4 ± 5.1 hours/day) after the stay-at-home orders. These results yielded effect sizes of Cohen's *d* 0.28 and 1.13 respectively. In order to achieve significance with power ≥ 0.80 and $\alpha \leq 0.05$ for differences in physical activity and sedentary behavior, sample sizes would need to be at least 98 and 10 participants respectively²². Participants were given an informed consent statement explaining the study as well as information indicating that participation was voluntary and by initiating the survey, they were providing consent to participate in the study. All procedures were approved by the university Institutional Review Board.

Cell Phone Use

To assess changes in cell phone use participants were given the following statement:

"I have been using my smartphone more since (university name) ended face-to-face classes on 3/11/2020."

They were asked to respond using a Likert like scale (1 strongly disagree; 7 strongly agree). A quasi-independent variable of cell phone use was then created by separating the participants into two groups (no change in cell phone use; increase in cell phones use). Individuals that reported ≤ 3 on the Likert like scale were placed in the no change in cell phone use group ($n = 73$) whereas individuals who responded ≥ 5 were placed in the increased cell phone use group ($n = 204$). Any participants reporting a neutral score of 4 ($n = 30$) were excluded from final analyses.

Physical Activity

Physical activity was assessed using the validated Godin Leisure-Time Exercise Questionnaire ²³. Participants were asked to report their pre-pandemic and current mild, moderate, and vigorous activity levels using the following language:

“During a typical 7-day (one week) period before (university) 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?”

This same question was asked but was changed to “after” the face-to-face cancellations to assess physical activity after the pandemic-related cancellations. A physical activity score was then generated using the following equations: vigorous activity = times per week participating in vigorous activity x 9, moderate activity = time per week participating in moderate exercise x 5, and mild activity = times per week participating in mild activity x 3. The scores for each intensity were then summed to create a total physical activity score for the week before and after face-to-face cancellations. Participants reporting scores greater than 3SD were excluded from all final analyses ($n = 4$).

Sedentary Behavior

Sedentary behavior was assessed via the validated International Physical Activity Questionnaire ²⁰. Participants were asked to report their sedentary behavior during weekdays and weekend days using the following language:

“During a typical week before (university name) ended face-to-face classes (3/11/2020), how much time did you usually spend sitting on a weekday (weekend)?”

Similar to physical activity, this same question was asked but was changed to “after” the face-to-face cancellations to assess sedentary behavior after the pandemic-related cancellations. Average weekly sitting was calculated using the following equation: weekly sitting = (minutes sitting per weekday x 5) + (minutes of sitting per weekend day x 2) for both pre- and post-cancellations.

Bodyweight

Bodyweight was assessed through self-reported estimates. This form of assessment is validated in adults ²⁴. Participants were asked to report their bodyweight for both pre- and post-cancellations. Participants who did not report both pre- and post-cancellation bodyweights were excluded from all final analyses ($n = 23$).

Statistical Analysis

A chi square analysis was performed to assess the difference in proportions of participants in the no increase in cell phone use (NCPU) and increased cell phone use (ICPU) groups. A cell phone group (NCPU; ICPU) by time (pre-, post-pandemic-related cancellations) analysis of variance (ANOVA) with repeated measures on time was used to analyze changes in total physical activity, total weekly sitting, and bodyweight. Significant main or interaction effects were further investigated using t-tests. A priori significance was set at $\alpha \leq 0.05$. All data was analyzed using SPSS Version 27 (IBM, New York).

Results

Cell Phone Use

A chi square analysis revealed a significantly greater ($\chi^2 = 61.50, p < 0.001$) proportion of participants indicated that they increased cell phone use (75%) versus those that did not increase cell phone use (25%).

Total Physical Activity

There was a significant main effect of group ($F = 16.74, p < 0.001, \eta^2 = 0.06$) for total reported physical activity. This was due to NCPU having a significantly lower total reported physical activity (28.48 ± 19.69) than ICPU (43.82 ± 33.86). There were no additional ($F \leq 1.58, p \geq 0.21, \eta^2 \leq 0.01$) main or interaction effects (Table 1).

Sedentary Behavior

There was a significant ($F = 4.14, p = 0.04, \eta^2 = 0.02$) group by time interaction for changes in total reported sitting. This was due to a significant ($t = -7.13, p < 0.001$, Cohen's $d = -0.52$) increase in total reported sitting for ICPU as compared to no significant ($t = -1.71, p = 0.09$, Cohen's $d = -0.22$) change in NCPU total reported sitting. There was a significant ($F = 25.63, p < 0.001, \eta^2 = 0.09$) main effect of time on total reported sitting. This was due to a significant



(Pre = 3227.28 ± 1779.49 ; Post = 3825.04 ± 1919.67) increase in overall reported sitting pre- to post-cancellation. There was no significant ($F = 1.10, p = 0.30, \eta^2 = 0.004$) main effect of group (Table 2).

Table 1. Godin physical activity scores for total reported physical activity pre-and post-cancellation for the two groups (NCPU = No Change in Cell Phone Use; ICPU = Increase in Cell Phone Use), an overall score for all participants (Overall) as well as an average total reported physical activity of each group (Average).

Group	N	Total Reported PA Pre	Total Reported PA Post	Average
NCPU	63	27.29 $\pm$ 16.68	29.67 $\pm$ 22.70	28.48 $\pm$ 19.69 *
ICPU	187	45.72 $\pm$ 35.52	41.92 $\pm$ 32.19	43.82 $\pm$ 33.86
Overall	250	41.07 $\pm$ 32.80	38.83 $\pm$ 30.51	39.95 $\pm$ 31.66

Data are Means $\pm$ SD

*Significant ($p < 0.001$) difference between groups.

Table 2. Total reported sitting for pre-and post-cancellation for the two groups (NCPU = No Change in Cell Phone Use; ICPU = Increase in Cell Phone Use) and an overall score of all participants (Overall).

Group	N	Total Reported Sitting Pre (min*week ⁻¹)	Total Reported Sitting Post (min*week ⁻¹)
NCPU	63	3573.81 $\pm$ 2512.53	3872.06 $\pm$ 2092.35
ICPU	187	3110.53 $\pm$ 1437.43	3809.20 $\pm$ 1863.60 *
Overall	250	3227.28 $\pm$ 1776.49	3825.04 $\pm$ 1919.67 *

Data are Means $\pm$ SD

*Post-value was significantly ($p < 0.001$) different from corresponding pre-value.

Bodyweight

There was a significant ($F = 10.08, p = 0.002, \eta^2 = 0.04$) main effect of time on bodyweight. This was due to a significant increase (Pre = 173.46 ± 49.01 lbs.; Post = 175.48 ± 50.40 lbs.) in bodyweight pre- to post-cancellations. There were no additional ($F < 0.75, p > 0.11, \eta^2 < 0.01$) main or interaction effects (Table 3).

Table 3. Reported bodyweight for pre-and post-cancellation for the groups (NCPU = No Change in Cell Phone Use; ICPU = Increase in Cell Phone Use) and an overall score of all participants (Overall).

Group	N	Reported Bodyweight Pre (lbs.)	Reported Bodyweight Post (lbs.)
NCPU	63	182.40 $\pm$ 49.09	183.69 $\pm$ 49.92
ICPU	187	170.45 $\pm$ 48.75	172.71 $\pm$ 50.39
Overall	250	173.46 $\pm$ 49.01	175.48 $\pm$ 50.40 *

Data are Means $\pm$ SD

*Post-value was significantly ($p = 0.002$) different from corresponding pre-value.



Discussion

This is the first study we are aware of to assess the potential impact of changing cell phone use habits on physical activity, sedentary behavior, and bodyweight during the COVID-19 pandemic. There was a significant difference in overall reported physical activity between NCPU and ICPU regardless of the pandemic, a significant change in sedentary behavior, and a significant change in reported bodyweight during the pandemic. Presently, individuals who reported an increase in cell phone use reported higher total reported physical activity than individuals who did not increase cell phone use. In other words, individuals who reported an increase in cell phone use had 53.9% greater amounts of overall reported physical activity than those who did not report an increase in cell phone use. Although contrary to our original hypothesis, it is not entirely surprising being that literature suggests that the relationship between physical activity and cell phone use is ambiguous. Reports have shown cell phone use may promote physical activity, may interfere with physical activity, as well as have no relationship at all with physical activity^{14,18,19}. To explain this difference in physical activity between groups can be challenging, however, a phenomenon identified as the “active couch potato” phenomenon may be one potential explanation. Reports have shown that individuals with high levels of physical activity coupled with high levels of sedentary behavior experience decreased health benefits of physical activity as compared to individuals with similar physical activity with lower amounts of sedentary behavior¹⁸. Being that the ICPU group had higher levels of reported physical activity as well as significant increases in sedentary behavior, there is a possibility of the “active couch potato” phenomenon being present in this study. Furthermore, we have reported that during the pandemic 75% of our participants indicated they increased cell phone use. Of the individuals who reported an increase in cell phone use, they experienced a 22.5% increase in weekly reported sitting; this equates to an additional 11 hours of reported sitting per week. This result aligns with previous literature supporting a positive relationship between cell phone use and sedentary behavior^{13,17}. This highlights a point of concern being that sedentary behavior is an independent risk factor of negative health outcomes such as increased risk of a cardiovascular event, increased blood glucose levels, increased blood pressure, and premature mortality²⁵.

Literature has shown changes associated with pandemic-related restrictions may have resulted in decreased physical activity, increased sedentary behavior, and increased bodyweight^{6,26,27}. Our results support previous literature suggesting the pandemic-related restrictions may have had a negative impact on sedentary behavior and bodyweight^{6,26,27}. Presently, we report that regardless of cell phone use individuals experienced an overall increase in weekly reported sitting as well as an increase in reported bodyweight during the pandemic. This equates to an additional 9 hours in weekly reported sitting as well as an increase of 2 pounds of reported bodyweight. These results emphasize another point of concern not only because these changes may lead to an increased risk of cardiometabolic diseases but there is evidence that increased weight leads to greater complications should an individual contract COVID-19^{28,29}. While studies have shown a change in physical activity during the pandemic, we do not report such a change^{6,22,27}. Similar to the relationship between cell phone use and physical activity, the changes in physical activity during the pandemic remain somewhat equivocal.

While this study is ultimately non-experimental it does use a quasi-experimental design in attempt to assess the potential impact of cell phone use on physical activity, sedentary behavior, and bodyweight. Being that most of the prior work in this area only observes the associations of cell phone use with physical activity, sedentary behavior, and bodyweight this study allows for more direct explanations of the role cell phones play in our overall physical activity behavior patterns. This study suggests that increasing cell phone use may promote greater amounts of reported sitting and pandemic-related restrictions may have negatively impacted health outcomes.

Conclusions

Taken together, this study supports a growing body of literature reporting that the pandemic-related restrictions may have promoted greater amounts of sitting and increased bodyweight^{6,8,27}. Participants indicating an increase in cell phone use during the pandemic reported greater increases in reported sitting as compared to those that did not increase their cell phone use. Furthermore, participants reported an increase in reported bodyweight regardless of cell phone use. This study presents the first evidence we are aware of indicating that greater cell phone use, as a result of a pandemic, lead to negative physical activity behavior outcomes.

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References

1. CDC. COVID-19 and Your Health. Centers for Disease Control and Prevention. Published August 11, 2022. Accessed September 28, 2022. <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html>
2. Barkley JE, Salvy SJ, Sanders GJ, Dey S, Von Carlowitz KP, Williamson ML. Peer Influence and Physical Activity Behavior in Young Children: An Experimental Study. *Journal of Physical Activity and Health*. 2014;11(2):404-409. doi:10.1123/jpah.2011-0376
3. Eriksson U, Arvidsson D, Sundquist K. Availability of exercise facilities and physical activity in 2,037 adults: cross-sectional results from the Swedish neighborhood and physical activity (SNAP) study. *BMC Public Health*. 2012;12(1):607. doi:10.1186/1471-2458-12-607
4. Stearns JA, Godley J, Veugelers PJ, et al. Associations of friendship and children's physical activity during and outside of school: A social network study. *SSM Popul Health*. 2018;7:100308. doi:10.1016/j.ssmph.2018.10.008
5. Alomari MA, Khabour OF, Alzoubi KH. Changes in Physical Activity and Sedentary Behavior Amid Confinement: The BKSQ-COVID-19 Project. *RMHP*. 2020;Volume 13:1757-1764. doi:10.2147/RMHP.S268320
6. Barkley JE, Lepp A, Glickman E, et al. The Acute Effects of the COVID-19 Pandemic on Physical Activity and Sedentary Behavior in University Students and Employees. *Int J Exerc Sci*. 2020;13(5):1326-1339.
7. Bates L, Zieff G, Stanford K, et al. COVID-19 Impact on Behaviors across the 24-Hour Day in Children and Adolescents: Physical Activity, Sedentary Behavior, and Sleep. *Children*. 2020;7(9):138. doi:10.3390/children7090138
8. Dunton GF, Do B, Wang SD. Early effects of the COVID-19 pandemic on physical activity and sedentary behavior in children living in the U.S. *BMC Public Health*. 2020;20(1):1351. doi:10.1186/s12889-020-09429-3
9. Almandoz JP, Xie L, Schellinger JN, et al. Impact of COVID-19 stay-at-home orders on weight-related behaviours among patients with obesity. *Clinical Obesity*. 2020;10(5):e12386. doi:10.1111/cob.12386
10. Lin AL, Vittinghoff E, Olgin JE, Pletcher MJ, Marcus GM. Body Weight Changes During Pandemic-Related Shelter-in-Place in a Longitudinal Cohort Study. *JAMA Netw Open*. 2021;4(3):e212536. doi:10.1001/jamanetworkopen.2021.2536
11. Pellegrini M, Ponzio V, Rosato R, et al. Changes in Weight and Nutritional Habits in Adults with Obesity during the "Lockdown" Period Caused by the COVID-19 Virus Emergency. *Nutrients*. 2020;12(7):2016. doi:10.3390/nu12072016
12. Zachary Z, Brianna F, Brianna L, et al. Self-quarantine and weight gain related risk factors during the COVID-19 pandemic. *Obesity Research & Clinical Practice*. 2020;14(3):210-216. doi:10.1016/j.orcp.2020.05.004
13. Lepp A, Barkley JE, Sanders GJ, Rebold M, Gates P. The relationship between cell phone use, physical and sedentary activity, and cardiorespiratory fitness in a sample of U.S. college students. *Int J Behav Nutr Phys Act*. 2013;10(1):79. doi:10.1186/1479-5868-10-79
14. Rebold MJ, Lepp A, Sanders GJ, Barkley JE. The Impact of Cell Phone Use on the Intensity and Liking of a Bout of Treadmill Exercise. *PLOS ONE*. 2015;10(5):e0125029. doi:10.1371/journal.pone.0125029
15. Gao G, Sai L. Towards a "virtual" world: Social isolation and struggles during the COVID-19 pandemic as single women living alone. *Gender Work Organ*. 2020;27(5):754-762. doi:10.1111/gwao.12468
16. Sañudo B, Fennell C, Sánchez-Oliver AJ. Objectively-Assessed Physical Activity, Sedentary Behavior, Smartphone Use, and Sleep Patterns Pre- and during-COVID-19 Quarantine in Young Adults from Spain. *Sustainability*. 2020;12(15):5890. doi:10.3390/su12155890
17. Fennell C, Barkley JE, Lepp A. The relationship between cell phone use, physical activity, and sedentary behavior in adults aged 18–80. *Computers in Human Behavior*. 2019;90:53-59. doi:10.1016/j.chb.2018.08.044
18. Lepp A, Barkley JE. Cell phone use predicts being an "active couch potato": results from a cross-sectional survey of sufficiently active college students. *DIGITAL HEALTH*. 2019;5:205520761984487. doi:10.1177/2055207619844870
19. Barkley JE, Lepp A, Glickman EL. "Pokémon Go!" May Promote Walking, Discourage Sedentary Behavior in College Students. *Games for Health Journal*. 2017;6(3):165-170. doi:10.1089/g4h.2017.0009
20. Craig CL, Marshall AL, Sj?Str??M M, et al. International Physical Activity Questionnaire: 12-Country Reliability and Validity. *Medicine & Science in Sports & Exercise*. 2003;35(8):1381-1395. doi:10.1249/01.MSS.0000078924.61453.FB
21. van der Ploeg HP, Tudor-Locke C, Marshall AL, et al. Reliability and validity of the international physical activity questionnaire for assessing walking. *Res Q Exerc Sport*. 2010;81(1):97-101. doi:10.1080/02701367.2010.10599632
22. Ammar A, Mueller P, Trabelsi K, et al. Psychological consequences of COVID-19 home confinement: The ECLB-COVID19 multicenter study. *PLoS One*. 2020;15(11):e0240204. doi:10.1371/journal.pone.0240204



23. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci.* 1985;10(3):141-146.
24. Hodge JM, Shah R, McCullough ML, Gapstur SM, Patel AV. Validation of self-reported height and weight in a large, nationwide cohort of U.S. adults. *PLOS ONE.* 2020;15(4):e0231229. doi:10.1371/journal.pone.0231229
25. Healy GN, Dunstan DW, Salmon J, Shaw JE, Zimmet PZ, Owen N. Television Time and Continuous Metabolic Risk in Physically Active Adults. *Medicine & Science in Sports & Exercise.* 2008;40(4):639-645. doi:10.1249/MSS.0b013e3181607421
26. Barkley JE, Farnell G, Boyko B, Turner B, Wiet R. Impact of Activity Monitoring on Physical Activity, Sedentary Behavior, and Body Weight during the COVID-19 Pandemic. *Int J Environ Res Public Health.* 2021;18(14):7518. doi:10.3390/ijerph18147518
27. Meyer J, McDowell C, Lansing J, et al. Changes in Physical Activity and Sedentary Behavior in Response to COVID-19 and Their Associations with Mental Health in 3052 US Adults. *International Journal of Environmental Research and Public Health.* 2020;17(18):6469. doi:10.3390/ijerph17186469
28. Carter SJ, Baranaukas MN, Fly AD. Considerations for Obesity, Vitamin D, and Physical Activity Amid the COVID-19 Pandemic. *Obesity (Silver Spring).* 2020;28(7):1176-1177. doi:10.1002/oby.22838
29. Owen N, Healy GN, Matthews CE, Dunstan DW. Too Much Sitting: The Population Health Science of Sedentary Behavior. *Exercise and Sport Sciences Reviews.* 2010;38(3):105-113. doi:10.1097/JES.0b013e3181e373a2