

# Gender Differences in the Association between Sedentary Time, Screen Time, and Depression

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## Abstract

Previous research has indicated a relationship between sedentary time and depression, but it is unclear how this relationship differs by gender or subtype of sedentary behavior. This commentary expands our previous study on screen time, gender, and depression by examining relationships between sedentary time, gender, and depression. This additional analysis utilized the 2017- March 2020 National Health and Nutrition Examination Survey (NHANES). Sedentary time was partitioned into two categories, utilizing a cut-off of 600 minutes per day for excessive sedentary time. Depression was defined as a Patient Health Questionnaire (PHQ-9) score  $\geq 10$ . Multivariable logistic regression was used to analyze the relationship between sedentary time and depression. Our results showed that there was not a significant difference between sedentary time and depression for women, but there was a relationship for men, OR = 2.22, 95% CI = 1.47, 3.35. Longitudinal research is needed to determine how sedentary time as a risk factor for depression compares to the partitioning of sedentary time into separate risk factors. In addition, this research should examine the relationship between sedentary subtypes and depression with respect to gender.

**Keywords:** Depression, Sedentary time, Screen time, Gender, National Health and Nutrition Examination Survey, Patient Health Questionnaire, Mental health

## Introduction

Our article, "Gender Differences in the Association Between Screen Time and Depression," found screen time to be a risk indicator for depression in women but not men [1]. This commentary will expand our research on the National Health and Nutrition Examination Survey (NHANES) dataset by exploring whether this gender-specific association persists between sedentary time and depression. Sedentary time is more general than screen time and refers to activities in a sitting or reclining position that do not increase the resting metabolic rate, such as sitting for classes, reading a book, or riding in a car [2]. A previous analysis by Guo *et al.* of the 2017-2018 NHANES found an association between sedentary time greater than 600 minutes per day and depression [3]. We employed the same exposure (sedentary time greater

than 600 minutes) with stratification by gender but included all individuals over 18 instead of Guo *et al.*'s exclusion of adults aged 18-19 and used the combined NHANES dataset from 2017- March 2020. We also utilized a mean imputation calculation instead of excluding participants with mostly complete exposure data.

The goal of this additional analysis was to determine if the association between sedentary time and depression differs by gender and to determine if sedentary time can be used interchangeably with screen time or whether different types of sedentary behaviors act independently on the risk for depression.

## Methods

Our methods are consistent with those of our previous study

on screen time and depression, with the following exceptions: sedentary time replaced screen time as the main exposure, and a more recent NHANES dataset (2017-March 2020) was analyzed [1]. The 2017- March 2020 dataset was used to employ the most recent dataset available, as data from 2021-2023 is not yet publicly available. The NHANES study was approved by the National Center for Health Statistics, and the employment of the dataset for secondary analysis was also approved [4,5].

In short, the NHANES dataset is a nationally representative cross-sectional survey of the United States with 15,560 individuals [6]. The primary outcome of this study, depression, was measured as a score of 10 or greater on the PHQ-9. The PHQ-9 has a sensitivity and specificity of 88% for major depressive disorder and is a self-report of depressive symptoms where questions are measured in the last two weeks from 0 (not at all) to 3 (nearly every day) [7]. The analysis was stratified by gender, and the primary exposure was sedentary time. Sedentary time was measured as a value in minutes, and participants were asked the amount of time they spent sitting during a typical day. The two categories of sedentary time were  $\leq 600$  minutes and  $>600$  minutes per day of sedentary time [3]. Covariates were consistent with our previous study and included age, education, race and ethnicity, and poverty level [1].

A multivariable logistic regression evaluated the strength of the association between sedentary time and depression, which was adjusted with the above covariates and stratified by gender. An analysis without gender stratification was performed to compare our results to a previous study. Participants with one missing value from the PHQ-9 were included with a mean imputation calculation. Participants with more than one missing item of the PHQ-9 and those with missing sedentary time values were excluded. Participants with missing demographic characteristics were partitioned into a missing category to retain the largest sample size, and outliers were assessed using box plots and histograms. Analysis was done in 2024 with Stata, Version 17, utilizing the command svyset for complex survey design and weighted sampling (Stata, version 17).

## Results

8,233 participants had complete exposure and outcome data and were included in the analysis. Significant differences in depression risk were observed between poverty level ( $p<0.01$ ), Hispanics ( $p=0.03$ ), non-Hispanic Whites ( $p=0.02$ ), and a level of education greater than college graduation ( $p<0.01$ ). Our results demonstrated a significant association between sedentary time  $>600$  minutes and depression for men (OR = 2.22, 95% CI = 1.47, 3.35) (Table 1). No significant association between sedentary time and depression was seen for women (OR = 1.47, 95% CI = 0.82, 2.63). When the analysis was not stratified by gender, the results between sedentary time and depression were significant (OR = 1.76, 95% CI = 1.21, 2.58).

## Commentary

Our analysis showed significant gender differences in the association between sedentary time, screen time, and depression. We found that while women showed a clear link between screen time and depression, this was not the case for sedentary time in general. Conversely, men did not exhibit a significant relationship between screen time and depression, but they did show a significant association with sedentary time. Notably, our odds ratio of the unstratified model was in line with an earlier analysis of the 2017-2018 NHANES, albeit with slight differences in magnitude due to differences in exclusion criteria and the use of a dataset from 2017-2020 [3].

Reducing sedentary time has become an important target for mental health interventions as the average American spends 60% of their day on sedentary tasks [8]. Despite this, research remains limited on the relationship between sedentary time and depression. Several studies have shown an association between adolescents, depression, and sedentary time [9,10]. A meta-analysis of 24 studies published in 2014 found an association between sedentary time and depression, and this finding was confirmed in a more recent meta-analysis performed in 2020 of twelve prospective studies [8,11]. However, available studies had limited diversity, including a limit in the range of ages included in several of the studies. In the 2014 meta-analysis, five studies were of older adults, and

**Table 1.** Association Between Sedentary Time and Depression, Comparing Women and Men.

Population Group	Odds Ratio	Upper 95% CI	Lower 95% CI
Total	1.76	2.58	1.21
Women	1.47	2.63	0.82
Men	2.22	3.35	1.47

- Cross-sectional associations of self-reported sedentary time with depression in women and men are shown.
- Models were adjusted for age, education, poverty level, and race.
- Data are from the 2017–March 2020 NHANES data set.
- Sedentary time is defined as the amount of time sitting each day; the reference group is  $\leq 600$  minutes per day of sedentary time.
- Depression is defined as a PHQ-9  $\geq 10$ .
- NHANES, National Health and Nutrition Examination Survey. PHQ-9, Patient Health Questionnaire

nine were of younger adults or pediatric populations, while the 2020 meta-analysis only included two studies from the United States, four studies were of older adults, and four were of younger adults or pediatric populations [8,11]. There is a lack of generalizable studies in adults on sedentary behavior and depression, and there is a need for studies that look at this relationship.

Our previous study (1) and this commentary support the idea that sedentary time may be more useful when broken down into different components than when analyzed as a whole. For example, sitting time has been shown to be a specifically strong risk factor for depression in women [12,13]. Moreover, as established in our paper, screen time may be a more potent risk marker for depression in women than in men [1]. Meanwhile, the results of this analysis and systematic reviews have suggested that for men, there is an association between general sedentary time and depression; however, their risk for depression from screen time may not be significant [1,11,14].

A leading hypothesis to explain the relationship between sedentary time and depression does not apply equally to all types of sedentary behavior. The social withdrawal hypothesis states that sedentary time increases social isolation. However, several sedentary behaviors, such as multiplayer gaming, texting, and video calls, increase social connections [14,15]. While this hypothesis may explain sedentary behaviors that do not include social interactions, not all sedentary behaviors support this explanation. Despite this, a second popular hypothesis, which posits that sedentary time decreases physical activity, a behavior that has been shown to decrease depression, applies to most categories of sedentary behavior [14,16]. As a result, more research is needed on subcategories of sedentary time to determine the validity of employing sedentary behavior as a generalizable risk factor for depression.

This analysis has several limitations. First, temporality cannot be determined in a cross-sectional survey. In addition, sedentary time may not have been reported accurately in a subjective questionnaire format. There also was potential selection bias from the modest response rate of 51% and the potential of residual confounding from unmeasured mental health disorders [6,17]. Although we were able to use a more recent dataset as the question for sedentary time is on the 2017-March 2020 NHANES dataset, screen time is most recently available on the 2015-2016 dataset due to limitations in gathering data during the COVID-19 pandemic [17]. Moreover, in the 2015-2016 survey, screen time was asked in an ambiguous way that did not specify recreational or occupational activities, but this specification was made to include both recreational and occupational activities for the sedentary time question [6].

In addition to the above, as our dataset was collected before the onset of the COVID-19 pandemic, we do not know if the association between sedentary time, screen time, and depression changed during the pandemic and if that

association persisted once pandemic restrictions were lifted. A meta-analysis reviewed how sedentary time changed during the COVID-19 pandemic and found that non-elderly adults during COVID-19 spent over 127 more minutes on sedentary time, and this increase did not vary by gender [18]. This meta-analysis, along with other studies, supports that sedentary time and screen time overall were associated with depression [18-21]. During the pandemic, the amount of sedentary time did not vary by gender, but it is unclear if the association between sedentary time and depression varied by gender [18,20]. Post-COVID-19 studies have shown that sedentary time increases the risk of depression, but specific research on gender remains limited [2]. Interestingly, the association between sedentary time, depression, and gender may vary by population, with some populations showing more sedentary time in males and others showing more sedentary time in females [22]. While no generalizable conclusions can be reached on adult populations for screen time, post-pandemic evidence did show an increase in depression from screen time for adolescent females but not males [23,24].

While this analysis has many of the same limitations as our previous study, it may help to characterize the differences between gender and depression risk and the value of partitioning screen time from the more general exposure of sedentary time [1]. Future research should focus on gender-stratified analysis and sub-analysis of different sedentary behaviors, which could provide a more comprehensive understanding of the complex relationship between sedentary time, screen time, and depression.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### Data Statement

The National Health and Examination Survey data is publicly available online.

### Credit Author Statement

Lauren Kleidermacher: Conceptualization, Methodology,

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