

The Negative Relationship Between Objectively Assessed Physical Activity and Total Smartphone Usage

Direct Original Research

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Abstract

Introduction: Existing evidence supports a positive relationship between smartphone use and sedentary behavior (i.e., high smartphone use is associated with high sitting). While evidence supports that smartphone use during physical activity reduces intensity, the relationship between daily smartphone use and daily physical activity is equivocal. Prior research assessing these relationships has relied on self-report survey instruments. The purpose of this research was to assess the relationship between minutes of smartphone use and physical activity (steps) using objective measures.

Methods: College-aged individuals ($N = 50$) completed a brief survey assessing daily screen time (min) and daily steps for the previous 10-days. This data was obtained from participants' smartphone applications (e.g., "Health" and "Screen Time" apps) and the relationship was assessed.

Results: There was a near moderate effect size for a negative correlation between average smartphone use and steps ($r = -0.25$). Mixed model regression indicated that this relationship was significant ($F = 3.65$, $p = 0.00019$).

Conclusions: The results differ from prior research which has not reported a significant relationship between smartphone use and physical activity when using self-reported survey instruments. This difference highlights the need for additional research employing objective measures when assessing relationships between smartphone use and health behaviors.

Key Words: cellphone, walking, steps

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Introduction

Smartphone use is a ubiquitous behavior among college students with these individuals reporting approximately four hours/day of use^{1,2}. Prior research from our group and others has indicated that increased smartphone usage is correlated with increased sedentary behavior³⁻⁶. In other words, as individuals use smartphones more, they engage in more sedentary behaviors and vice versa³. Conversely, while research has suggested smartphone use during physical activity leads to decreased

intensity⁶ and decreased overall walking speed⁷, there is not clear evidence that a relationship between total smartphone use and total physical activity is significant^{3,5}. However, this prior evidence relied primarily on subjective, self-reported measures of sedentary behavior, physical activity, and smartphone use. While this approach is valid, reliance upon self-report measures may be problematic especially for the assessment of physical activity which is often reported inaccurately⁸. Therefore, there is a need for additional research examining these potential relationships utilizing

objective measures. The purpose of the present research study was to assess the relationship between minutes of daily smartphone use and physical activity (daily steps) utilizing objective measures.

Scientific Methods

Participants

Participants ($N = 50$, $n = 23$ females) consisted of students recruited via flyers and in classrooms from a public university in the midwestern United States. To be eligible, potential participants were required to indicate owning and using a smartphone (Apple or Android devices only) and were free from any contraindications to physical activity (e.g., orthopedic injury). The first page of the survey document asked individuals only to complete the survey if they consented to the study protocol. All procedures were approved by the university institutional review board.

Protocol

Each participant came to the laboratory once and completed a brief survey in which they self-reported their sex (male, female), age (years) and their daily steps and smartphone screen use (daily hours and minutes) from each of the previous 10 days. Participants were not informed of the 10-day data collection procedure prior to completing the survey in order to control potential changed behaviors. Smartphone use and step data was obtained from software applications (i.e., apps) on the participants' smartphones. Apple iPhone users ($n = 42$ or 84% of the sample) utilized the "Screen Time" and "Health" apps to report their smartphone use and steps, respectively. Participants with Android devices ($n = 8$ or 16% of the sample) used the "Digital Wellbeing" and "Auto Step Tracking" functions under their device settings to report use and steps. Evidence supporting the validity of both Apple and Android devices for measuring daily steps has demonstrated low mean absolute percentage errors on both devices and comparable step measurements to standard accelerometers^{9,10}. Average daily steps (steps per day) and smartphone use (minutes per day) variables were calculated from the 10-day data.

Statistical Analysis

Independent samples t-tests were performed to assess potential differences in age, average daily smartphone use, and daily steps in females versus males. A correlation coefficient was calculated for the relationship between the 10-day averages of smartphone use and steps. Finally, a mixed model regression was utilized to determine the significance of the relationship between cell use and steps over the entire 10-day period. Mixed model analysis was used to assess the significance of the relationship as it allows for the assessment of data that are interdependent as was the case with the 10-days data^{11,12}. All data were analyzed via SPSS version 26.

Results

Participants allocated an average of 212.0 ± 76.7 min•day⁻¹ to smartphone use and accumulated 7091.4 ± 3270.8 steps•day⁻¹. There were no significant differences ($t \leq 1.1$, $p \geq 0.28$) between males and females for age, average cell use, or average steps (Table 1). There was a near moderate effect size for a negative correlation between average smartphone use and steps ($r = -0.25$) (Figure 1). In other words, as smartphone use increased, steps decreased. Finally, a mixed model regression indicated that there was a significant relationship ($F = 3.65$, $p = 0.00019$) between smartphone use and steps over the entire 10-day period.

Table 1. Descriptive statistics for male ($n = 27$) and female ($n = 23$) participants.

	Sex	Mean	Standard Deviation	Standard Error of Mean
Average Cell Use	Female	200.7	76.8	16.0
	Male	221.5	76.8	14.8
Average Steps	Female	7164.5	4429.3	923.6
	Male	7029.1	1884.9	362.7
Age	Female	21.9	4.7	1.0
	Male	20.9	1.1	0.2

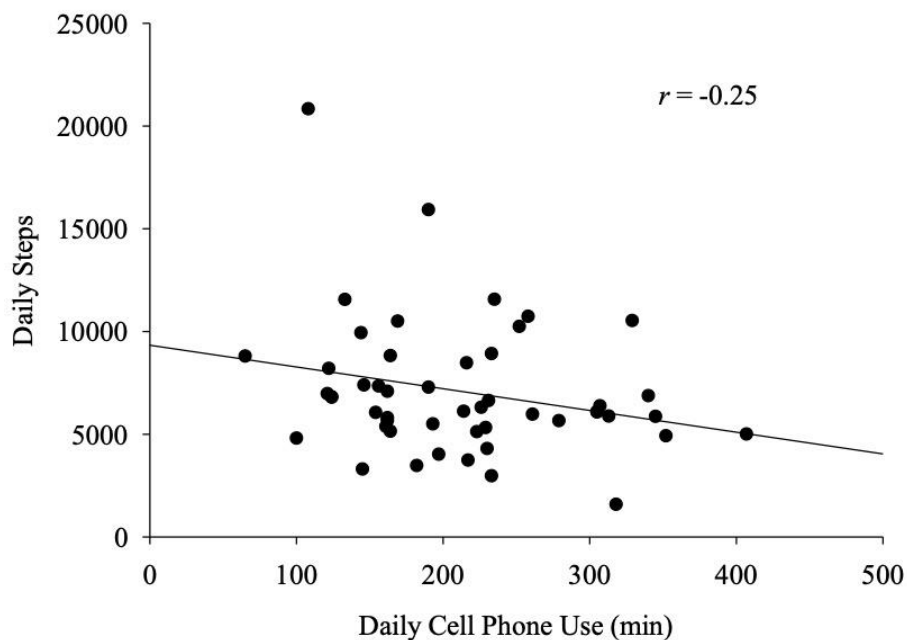


Figure 1. The significant negative relationship ($p = 0.00019$) between average daily smartphone use (minutes) and average daily steps.

Discussion

The current study sought to expand on previous work from our group examining the relationship between smartphone use and physical activity (i.e., total steps per day) using objective measures^{3-5,13}. Results demonstrated a significant, inverse relationship between cell phone usage and steps per day over the 10-day period.

This finding differs from our previous research which failed to demonstrate a significant association between smartphone use and total physical activity^{3-5,13}. This prior lack of a relationship has been somewhat unexpected as researchers have previously theorized that a negative relationship likely exists between smartphone use and physical activity^{5,6,13} similar to the established negative relationship between television watching and physical activity¹⁶⁻¹⁸. However, this prior research that failed to demonstrate a relationship between smartphone use and physical activity relied on subjective, self-report measures of both smartphone use and total physical activity. An expansive systematic review from Prince et al reported that self-report methods of physical activity assessment often over or underreport (depending on the scale used) objectively measured physical activity⁸. It is also possible that individuals may underestimate total smartphone use as research has demonstrated that this activity is often a mindless and habitual behavior¹⁵. Therefore, use of objective assessments for both physical activity and smartphone use may yield information that may differ from self-report measures. This appears to be the case in the current study and may explain why we presently have a significant relationship between objective measures of smartphone use and physical activity whereas we did not identify such a relationship in previous research which relied upon subjective, self-report measures.

Limitations

This study was conducted using college-aged students from a midwestern public university between the months of October and November; therefore, results cannot be generalized to individuals not within this age range and cannot be generalized to potential steps in different seasons. Further, as participants' smartphones were used to find total steps per day, it is possible that participants who complete physical activity without their smartphone on their person or those that participate in physical activity that may not be measured in steps (e.g., resistance training) may have their daily physical activity underestimated by the software application. Finally, this study utilized a non-experimental research approach, thus, causation cannot be inferred.



Conclusions

Results indicated a negative correlation between objectively measured smartphone use and steps per day over a 10-day period. Future research should further examine this relationship in larger, more diverse samples of participants (e.g., wider age ranges, different geographic locations). Understanding the potential relationship between smartphone use and physical activity is important. If such a relationship exists smartphone use may represent a behavior that interventions designed to promote physical activity could target.

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