Psychosocial and Friend Influences on Objective Sedentary Behavior and Screen Time: A Mixed Methods Analysis

Jeanette M. Garcia, Alen Agaronov, John R. Sirard, Diane Whaley, David J. Rice, and Arthur Weltman

Background: Sedentary behavior (SB) increases throughout adolescence, and is associated with adverse health outcomes. Purpose: Examine psychosocial and friend influences on SB and screen time in adolescents using a mixed-methods design. Methods: 108 middle and high school students wore accelerometers to measure objective SB, completed screen time and psychosocial questionnaires, and nominated friends to complete activity questionnaires. Focus groups centered around influences on SB behavior. Regression analyses and NVivo software analyzed quantitative and qualitative data. Results: Screen time was associated with greater screen time enjoyment, lower self-efficacy, and friends’ screen time ($r^2 = .21, P < .0001$). Friends influenced whether adolescents engaged in screen time behaviors, with active friends encouraging less screen time. Conclusion: Active friends influenced adolescents to engage in less SB. Interventions should place an emphasis on encouraging less screen time, and providing opportunities for adolescents and their friends to engage in activities that promote physical activity rather than SB.

Keywords: adolescents, qualitative research, accelerometry, physical activity

It has been well established from previous studies that physical inactivity is linked to poorer physical and mental health outcomes in adolescents, such as increased risk of obesity, type 2 diabetes, depression, and anxiety. Until recently, however, the majority of research has examined physical inactivity in the context of low levels of moderate-to-vigorous physical activity (MVPA). There is emerging evidence suggesting that physical inactivity, or more accurately, sedentary behavior (SB), is a distinct behavior that is independent of MVPA. SB refers to activities that require minimal body movement, which include sitting for a wide range of purposes (work, driving) and screen-based activities (screen time) such as television watching, computer usage, and playing video games. In addition to being behaviorally distinct from the absence of MVPA, evidence suggests that high levels of MVPA may not protect adolescents from chronic disease risk factors if they also have high levels of SB, in particular screen time, which has been found to carry greater health risks beyond other types of SB. Although correlates of MVPA have been extensively studied, few studies have examined correlates of SB and screen time in adolescents, and results have been mixed. A few studies have identified that older adolescents and males have higher levels of screen time, however, other studies have found no difference in screen time between males and females. In addition, research examining psychosocial variables and social influences on SB and screen time is scarce and limited to self-report measures.

Further examination of friends on SB and screen time in adolescents is warranted, given the importance of friends on adolescent behaviors. Only 3 studies to our knowledge have examined friends’ screen time behaviors with participants’ screen time, with 2 of the studies finding significant correlations between friends’ screen time and participants’ screen time, while Ali et al found no associations in screen time behavior. None of these studies, however, examined objective SB or psychosocial variables. The current study draws on the Theory of Planned Behavior. Based on this theory, participants’ levels of screen time and SB in the current study will be influenced by a combination of attitudes and beliefs toward screen time and SB, perceived support and behavior of friends and family, and adolescents’ intentions to increase MVPA/decrease screen time. Thus, the current study aims to examine friend and psychosocial influences on SB and screen time, in addition to exploring these associations by utilizing focus groups to provide insight into the mechanisms by which friends and psychosocial factors may influence both SB and screen time. Finally, since evidence suggests that influences may differ according to age and gender (Kirby et al.), this study will examine the data for gender and school-level themes related to SB and screen time.

Methods

Participants

Adolescents (N = 152) in middle (grades 6 to 8) and high schools (grades 9 to 12), living in the Albemarle County, VA area, were recruited to participate in this study. Students were randomly selected from a school or class roster, and asked to participate in this study. Participants were matched by school level and sex to ensure an equal number of males and females from middle and high schools. This study obtained approval from both the University of Virginia Institutional Review Board, and the Albemarle County Public Schools Review Board. Written consent/assent was obtained from all participants and a parent/guardian.

Focus Groups

Students from each school level (middle school grades 6 to 8; high school grades 9 to 12) were selected to participate in focus groups,
consisting of 4 to 12 participants of the same gender. Each focus group lasted approximately 45 to 60 minutes and was conducted by a trained moderator. All focus groups were audio recorded using an Olympus VN-7200 digital recorder and an assistant moderator took notes on participants and any salient events. The focus groups had a semi-structured design with follow-up process on key topics of interest. Questions were based on adolescents’ PA, SB, and screen time, with an emphasis on psychological and social influences on these activity behaviors. The conversations from these sessions were audio recorded, transcribed by 2 researchers, discrepancies resolved, and coded based on content response.

Demographic Characteristics
Following the focus group, participants completed a short questionnaire containing questions about the following demographic characteristics: age, grade level, race/ethnicity, parent education, and self-reported height and weight so that body mass index (BMI; kg/m²) could be calculated. BMI was then converted into a BMI z-score and BMI percentile based on age and gender.

Objective Sedentary Behavior Measures
The ActiGraph GT3X+ device was used to assess PA and SB (ActiGraph, LLC, Pensacola, FL). The ActiGraph has the ability to detect normal human motion while filtering out high-frequency vibrations that would artificially increase movement data, and has been validated for use in children and adolescents in laboratory and field studies. Movement was captured in 3 axes at 30 Hz and raw acceleration data collapsed and expressed at a rate of counts per minute (CPM). Participants were instructed to wear the accelerometers for 7 days except while sleeping, swimming, or bathing. Times of > 60 minutes of accelerometer CPM values = 0 were considered times when the device was not worn, and were excluded from the analysis. Participants were included in this analysis if they provided at least 3 days of 600 minutes of data per day. Values less than 100 CPM were classified as SB, 101 to 2996 CPM was classified as light activity, and values ≥ 2296 CPM was classified as moderate-to-vigorous physical activity (MVPA).

Screen Time
Participants responded to a previously validated questionnaire that asks “In your free time on an average weekday (Monday-Friday), how many hours do you spend doing the following activities?” These activities included watching television/DVDs/videos, using a computer, and videogames (Xbox/Play-Station/other electronic games). Participants were asked to rate the amount of time engaged in these activities on an average weekend day. The 7 response options ranged from “0 hours” to “5+ hours.” Test-retest reliabilities for both weekday and weekend items were \( r = .63 \) and 0.64 for television viewing, \( r = .76 \) and 0.77 for computer use, and \( r = .72 \) and 0.84 for electronic games. The weighted mean was calculated based on responses to these 6 questions to obtain the weekly hours spent on screen time.

Psychological Measures
Self-efficacy for screen time behavior was measured using a 7-item screen time self-efficacy scale that assesses adolescents’ confidence to reduce their amount of screen time (eg, plan ahead of time what TV shows you will watch during the week). The 5-point Likert scale contains responses that range from 1 (“I’m sure I can’t”) to 5 (“I’m sure I can”). A higher score indicated that participants were more confident that they could refrain from sedentary behaviors. Test-retest reliability for this scale was .81 and internal consistency was \( \alpha = .81 \).

Enjoyment of screen time was measured using a validated scale that consisted of 10 items that started “I enjoy doing the following activities . . .” followed by SB items such as “computer use” and “television viewing.” The 5-point scale contains responses that range from 1 (“Strongly disagree”) to 5 (“Strongly agree”).

To compare adolescents’ PA and screen time with their friends’ PA and screen time, participants were asked to select up to 5 friends to participate in this study. Friends did not have to be in the same grade or attend the same school. Participants were given an envelope containing a consent/assent form for the nominated friend and parent/guardian, a PA recall questionnaire, and the screen time questionnaire described above.

Procedures
For the initial visit, 2 researchers traveled to the selected schools and randomly selected students from the designated grade levels to participate in the study. If the students agreed to participate, they were presented with the consent/assent forms that they took home to their parent/guardian to sign. If a student refused, another student would be randomly selected to participate. For the second visit, the investigators returned to the schools for collection of the consent forms and to conduct the focus groups. The focus groups lasted approximately 45 to 60 minutes and consisted of semi-structured questions pertaining to participants’ after school and weekend activities, friendship groups, and activities with friends. At the end of the focus groups, participants completed demographic and previously described psychosocial questions, and received an accelerometer that they were to wear for the next 7 days. In addition, participants nominated up to 5 of their closest friends. A week later, we returned to the schools to collect the accelerometers, distribute a questionnaire inquiring about screen time, and collected any consent/assent forms and questionnaires from the nominated friends.

Statistical Analysis
Quantitative Analysis. Independent \( t \) tests and a 2 × 2 between subjects ANOVA were conducted to examine differences in gender, school level, and the interaction effect of gender and school level on objectively measured SB and screen time. Tukey HSD post hoc tests were conducted to determine the differences in the gender and school level interaction effect.

A multiple regression model was used to examine the association between demographic variables (including a gender × school level interaction effect), psychosocial factors, and nominated friends self-reported screen time and MVPA with objectively measured adolescent SB and reported screen time. If either gender or school level were significant in the models, or if a gender × school level interaction effect existed, further analyses stratified by gender and school level were conducted. For gender and school level stratified analyses, Spearman correlations were conducted to examine the associations of SB and screen time with psychosocial and nominated friends’ variables. Participants were included in the analysis if there was data on at least one of their nominated friends’ MVPA and screen time. Analyses were stratified by gender and school level interaction. All quantitative analyses were performed using SAS statistical software, version 9.3, with a significance level set a priori at \( \alpha < .05 \).
Qualitative Analysis. All focus groups were audio recorded and transcribed verbatim. Consistent with content analysis, transcripts were read line by line and marked with independent codes that described the content response. Two trained researchers coded the transcriptions from the focus groups independently, met to refine code definitions, and any inconsistencies were addressed. Cohen’s κ statistic was calculated to assess interrater reliability. Cohen’s κ statistic was 0.85 suggesting that there was good interrater reliability. The data and coding structure was then entered into a database in NVivo qualitative analysis software, version 10.0. After the coding was applied in NVivo, the software was used to search the data for patterns of codes, yielding matrices of codes that allowed for the identification of hierarchical codes (categories that describe a broader group of themes). Text retrievals were then performed on the hierarchical codes and content was analyzed for patterns, interpreted for meaning and summarized into tables.

Results

Participants

Approximately 200 participants were recruited to take part in the current study. Out of the 200 who were recruited, data were collected on 179 adolescents. However, 21 of the 179 participants were missing nominated friends’ data, 4 had insufficient accelerometer data, and 3 of the participants had multiple missing variables. Therefore, the final sample consisted of 152 participants (53% female, 80% Caucasian, 50% middle school, mean age 14.5 years). An average of 4.08 (1.4) friends were nominated by participants, and there was an average response rate of 2.32 (.88) nominated friends per participant. Independent samples t tests indicated that there were no significant differences in demographic variables (gender, age, BMI %, parent education) among the excluded and included participants. Table 1 displays descriptive results for middle and high school males and females.

Focus Group Participants

Three schools (2 high schools, 1 middle school) chose not to participate in the focus group discussions, therefore, the focus group sample was comprised of 108 participants from the original 152 participants. There were no significant differences in demographic data. SB, or screen time among the adolescents who participated in the focus groups (n = 108) compared with adolescents who did not take part in the focus group discussions (n = 44).

Quantitative Results

Objective SB. High school participants had significantly greater minutes per day of objective SB than middle school participants (P = .05). No significant differences existed between males and females or when the sample was broken down by school level and gender. Descriptive results are displayed in Table 2.

The regression model predicting sedentary behavior was not significant (P = .4, r² = .06). The only predictor significantly associated with sedentary behavior was school level, suggesting that high school students had greater levels of SB (P = .05). There was no significant gender by school level interaction. Further exploration of the differences in SB between middle and high school students indicated that there was a significant inverse correlation between SB and MVPA in middle school students (r = –0.26, P = .02), however there were no significant correlations between SB and any psychosocial or friend variables in high school students.

Reported Screen Time. Independent t tests revealed that males engaged in greater overall screen time than females. No differences existed between middle and high school participants. When broken down by gender and school level, middle school (mean = 12.04 ± 7.28) and high school males (11.47 ± 5.67) had significantly greater hours per week of overall screen time than middle school females (mean = 7.14 ±4.56, P < .05) (Table 2). When broken down by activity, males engaged in more video games. There were no significant differences between high school and middle school participants, although there was a trend toward higher computer use in high school students (P = .06).

The overall regression model significantly predicted screen time (P < .0001, r² = .21). Being male, lower screen time self-efficacy, greater enjoyment of screen time, and greater hours per week of friends’ screen time was significantly associated with increased screen time in participants. In addition, there was a significant gender by school level interaction effect (P = .05). Further exploration of gender differences indicated that for males, significant correlations existed between total hours of screen time and the following variables: screen time enjoyment (r = .34, P = .04), screen time self-efficacy (r = –.0.5, P < .0001), friends’ screen time (r = .31, P = .008). For females, significant correlations existed between total hours of screen time and the following variables: screen time enjoyment (r = .26, P = .02), friends’ MVPA (r = –.0.27, P = .01), friends’ screen time (r = .25, P = .03). There was also an inverse correlation between female participants’ MVPA and friends’ screen time (r = –.0.28, P = .01). Due to the differences in specific screen time activities, correlations were examined separately for television, video games, and computer use between genders. For males, significant correlations existed between the following: hours of video games and screen time enjoyment (r = .29, P = .01), hours of video games and screen time self-efficacy (r = –.0.36, P = .002), hours of video games and friends’ hours of video games (r = .34, P = .007), total hours of computer use and screen time self-efficacy (r = –.0.52, P < .0001), total hours of computer use and friends’ hours of computer use (r = .26, P = .04). For females, significant correlations existed between the following: hours of television and screen time enjoyment (r = .28, P = .01), hours of television and friends’

Table 1 Participant Demographics According to Gender and School Level (n = 152)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Middle school males (n = 37)</th>
<th>Middle school females (n = 39)</th>
<th>High school males (n = 35)</th>
<th>High school females (n = 41)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, Mean (SD)</td>
<td>13.31 (.81)</td>
<td>12.86 (.87)</td>
<td>16.11 (.8)</td>
<td>16.07 (.79)</td>
</tr>
<tr>
<td>Overweight or “at risk” (&gt;85%), N (%)</td>
<td>7 (19)</td>
<td>3 (8)</td>
<td>7 (20)</td>
<td>4 (10)</td>
</tr>
<tr>
<td>White Non-Hispanic, N (%)</td>
<td>30 (81)</td>
<td>29 (74)</td>
<td>30 (86)</td>
<td>33 (80)</td>
</tr>
<tr>
<td>Parent 4-year degree+, N (%)</td>
<td>21 (81)</td>
<td>25 (81)</td>
<td>27 (77)</td>
<td>31 (76)</td>
</tr>
</tbody>
</table>
Individual Psychosocial Factors. During focus group discussions, 3 main themes that were discussed among participants regarding psychosocial factors were: psychological health and well-being, enjoyment of SB and screen time, and SB and screen time self-efficacy.

Psychological health and well-being was discussed in greater detail by females than males. This was particularly seen in high school females regarding reasons for engaging or not engaging in SB and screen time. Females reported poorer psychological feelings of health when engaging in prolonged periods of SB or screen time. As one high school female reported, “If I just watch TV all day, I feel kind of lazy and like blah . . . you know. Like I’ll feel like I have no energy even though I just sat around all day.” However, these feelings did not extend toward phone use, even though phone use for purposes of social media and TV viewing could be counted as screen time. One middle school female reported feeling “fat” when she spent a significant amount of time in front of a television. For instance, she reported, “It’s really bad when I watch TV, I feel like I’m getting fatter, and then I feel bad about myself . . . like I should be outside running or doing something good for myself.” Another high school female reported feeling depressed after prolonged stretches of SB. She remarked, “I’ll feel lazy and depressed if I spend a whole day watching shows. Like I got nothing accomplished. It’s the opposite of how you feel after exercising when you feel strong.” None of the males in this study reported psychological health and well-being as an influence on their behavior.

Enjoyment of SB and screen time was the most common psychosocial reason given for participation in SB and screen time. Although participants across all groups reported some form of enjoyment, their reasons for enjoying the behaviors differed from one another. Middle school males reported enjoying video games because they were “fun” and a source of entertainment, while high school males reported that they enjoyed watching television and playing video games because they served as sources of relaxation during evenings and on the weekends, after a long week of school and sports. Middle school females reported enjoyment from using their mobile phones for texting, social media (Facebook, twitter), playing games, and watching television and movies. None of the males in the study reported phone use as a form of SB. In addition, middle and high school females reported nonscreen forms of SB, such as sitting and talking with friends, listening to music, and reading books for fun. Only 2 middle school males mentioned reading for recreation.

Qualitative Results

Types of SB and Screen Time. Overall, there were gender differences in types of SB that participants preferred. Overall, males reported primarily watching television or playing video games. Video game playing was the most common form of SB in middle school males, with 79% of middle school males reporting that they currently engage in video game playing on a regular basis. High school males did not report as frequent video game playing, however, they reported computer use for playing games, doing homework, or using the internet, and watching television as a way to relax after school and sports. While several females also reported television watching, phone usage was their primary form of SB, however, only 2 female participants reported using the phone for talking purposes. The majority of females used their mobile phones for texting, social media (Facebook, twitter), playing games, and watching television and movies. None of the males in the study reported phone use as a form of SB. In addition, middle and high school females reported nonscreen forms of SB, such as sitting and talking with friends, listening to music, and reading books for fun. Only 2 middle school males mentioned reading for recreation.

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Table 2 Activity Variables by Entire Sample, Gender, and School Level (n = 152)

<table>
<thead>
<tr>
<th>Total sample</th>
<th>Mean (SD)</th>
<th>Gender</th>
<th>Males (n = 72)</th>
<th>Females (n = 80)</th>
<th>School level</th>
<th>Middle school</th>
<th>High school</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVPA (min/day)</td>
<td>46.87 (21.03)</td>
<td>53.29 (21.39)*</td>
<td>41.08 (19.04)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SB (min/day)</td>
<td>536.3 (86.83)</td>
<td>527.77 (86.23)</td>
<td>543.97 (87.14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST (hr/wk)</td>
<td>10.09 (6.3)</td>
<td>11.76 (6.5)*</td>
<td>8.58 (5.72)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Males (n = 72)</td>
<td>48.29 (20.83)</td>
<td>522.78 (89.68)</td>
<td>549.81 (82.25)*</td>
<td></td>
<td></td>
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<tr>
<td>SB (min/day)</td>
<td>45.43 (21.27)</td>
<td>41.08 (19.04)</td>
<td>53.29 (21.39)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST (hr/wk)</td>
<td>9.53 (6.49)</td>
<td>10.65 (6.09)</td>
<td>11.76 (6.5)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>School level</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total sample</td>
<td>52.1 (21.93)</td>
<td>44.69 (19.32)</td>
<td>41.08 (19.04)</td>
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<td></td>
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<tr>
<td>Middle school</td>
<td>505.36 (90.9)</td>
<td>539.32 (86.42)</td>
<td>551.46 (75.3)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>12.04 (7.28)</td>
<td>7.14 (4.56)**</td>
<td>11.40 (5.69)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*P < .05; **P < .01; ***P < .001.

Abbreviations: ST, screen time; SB, sedentary behavior; MVPA, moderate-to-vigorous physical activity.
television in the evening when I’m super tired. Like I don’t have to think of anything important or stressful. I can just zone out.”

Low screen time self-efficacy was mentioned by both males and females as a reason for engaging in higher levels of screen time. For males, video game playing was the behavior they felt that they had difficulty walking away from, however, for females, television series and talk shows were more likely to engage them for longer durations. One high school male reported, “Yeah I’ll tell myself that I’m going to play video games for an hour, and then I get sucked into the game, and next thing I know, it’s been like 3 hours and I’m still playing.” Similarly, another high school female lamented, “I think it’s lack of motivation or something. I’ll start watching a good series like Game of Thrones, and then I get sucked in and I have to see what happens, and then I keep watching, and it’s like I can’t turn it off now.” A summary of individual psychosocial influences on SB and screen time among middle and high school males and females are displayed in Tables 5 and 6.

**Table 3  Correlation Matrix (r-value) for Screen Time (ST) in Males (n = 72)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>ST</th>
<th>MVPA</th>
<th>ST self-efficacy</th>
<th>ST enjoyment</th>
<th>Friends’ ST</th>
<th>Friends’ MVPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST</td>
<td>—</td>
<td>—</td>
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<td>MVPA</td>
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<tr>
<td>ST self-efficacy</td>
<td>—.5***</td>
<td>—.11</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>ST enjoyment</td>
<td>.34**</td>
<td>.12</td>
<td>—.11</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Friends’ ST</td>
<td>.31**</td>
<td>—.07</td>
<td>—</td>
<td>.26*</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Friends’ MVPA</td>
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<td>.25*</td>
<td>.26*</td>
<td>—.1</td>
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</tr>
</tbody>
</table>

*P < .05; **P < .01; ***P < .001.
Abbreviations: ST, screen time; MVPA, moderate-to-vigorous physical activity.

**Table 4  Correlation Matrix (r-value) for Screen Time (ST) in Females (n = 80)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>ST</th>
<th>MVPA</th>
<th>ST self-efficacy</th>
<th>ST enjoyment</th>
<th>Friends’ ST</th>
<th>Friends’ MVPA</th>
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</thead>
<tbody>
<tr>
<td>ST</td>
<td>—</td>
<td>—</td>
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<td>MVPA</td>
<td>—.17</td>
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<td>—</td>
</tr>
<tr>
<td>ST self-efficacy</td>
<td>—.04</td>
<td>—.02</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>ST enjoyment</td>
<td>.26*</td>
<td>—.21</td>
<td>—.03</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Friends’ ST</td>
<td>.25*</td>
<td>—.28**</td>
<td>—.23*</td>
<td>.17</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Friends’ MVPA</td>
<td>—.28*</td>
<td>.53***</td>
<td>.16</td>
<td>.01</td>
<td>—.42***</td>
<td>—</td>
</tr>
</tbody>
</table>

*P < .05; **P < .01; ***P < .001.
Abbreviations: ST, screen time; MVPA, moderate-to-vigorous physical activity.

Social Influences on SB and Screen Time. All participants reported that their friends influenced their SB and screen time either directly (ie, coparticipation in screen time) or indirectly (ie, decreasing screen time by coparticipation in MVPA). Participants reported that the type of friendship group made a difference on their activity choices. Two main friendship groups that were mentioned in every focus group discussion were “school friends” and “sports team friends.” The majority of participants reported that individuals they identified as their school friends were more likely to influence them to participate in more SB and screen time behaviors, while sports team friends were more likely to discourage SB and encourage MVPA, mainly through coparticipation. For example, as one high school female reported, “Like I have school friends and friends from my team. My team friends never want to just sit around, so we’re always active, playing soccer or going to the gym. My school friends though, we’ll maybe do homework together or go to a coffee shop and sit around talking. I definitely do different things depending on who I hang out with.”

For females, friends appeared to influence alternative forms of SB, other than screen time. For example, a common theme mentioned within female discussion groups was sitting and socializing with friends. As one high school female said, “It’s just kind of boring for me to sit with friends being all quiet and watching a show. We’d rather hang out at like the downtown mall area and talk about stuff . . . I guess you could say gossip (laughs). I guess you can call that a sedentary activity.” One middle school female reported only resorting to screen time behaviors with friends if they run out of items to talk about, “I would say we only watch TV together if there’s nothing else to do. Like if a friend is around all day and we’ve talked about everything already.” However, there was an indirect influence of friends on females’ screen time through phone use. Females reported engaging in a large amount of texting and social media use through their phones. One high school female reported, “I’d say I spend about 3 hours per day using my phone. Not really talking or anything but like . . . uh texting friends . . . and social media stuff like Facebook and twitter.”

The influence of friends on males’ screen time appeared to be more direct, with middle school males in particular, reporting that friends would encourage them to participate in video game playing. Several males reported that they were not as likely to play video
games if their friends did not encourage them to play. As one middle school male reported, “My friends will want to play for hours. If I’m by myself I may play for like a half hour or not really at all, but with my friends, it’s like hours will fly by and we’re still playing each other. Yeah it’s bad sometimes.” High school males, however, reported that friends were more likely to encourage them to decrease SB and screen time by encouraging MVPA through coparticipation in sports as the majority of high school males preferred spending time with their sports friends rather than their school friends. One high school male reported, “I usually mainly hang out with my sports friends, and they never want to just sit around. I don’t think I’d be nearly as active if I didn’t hang with them.”

During the focus group discussions, the influence of family was repeatedly mentioned by all participant focus groups. None of the participants reported that parents actively encouraged screen time, although certain SB’s were supported if it was felt that the activity contributed to academic enrichment. For example, parents encouraged reading if books were educational, and the practice of musical instruments.

Parents’ actions toward SB and screen time were to verbally discourage these behaviors. High school males, in particular, did not feel this was effective in reducing their levels of SB or screen time, especially if parents themselves engaged in significant amounts of screen time. As one high school male reported, “Yeah, my dad says how watching TV is bad, but then he sits and watches for hours. He can’t tell me one thing and then do the exact opposite. Why would I listen?” Mothers appeared to be more effective in altering SB and screen time in females through modeling. One high school female reported, “My mom always discourages sitting around all day. She’s a big runner, and will take me to the gym and get me outside. I don’t think I’ve ever seen her just sit and watch TV.”

For middle school males, older brothers were almost viewed as friends in that they influenced SB and screen time similarly. Coparticipation in video game playing and television watching with older brothers was reported by several middle school male participants. As one middle school male reported, “My older brother doesn’t like being active or really playing sports. He just sits around and watches TV. It’s kind of boring, but, you know, I want to hang out with him, so then I just sit around watching TV with him.” For females, older brothers served as “models” for engagement in screen time behaviors. Middle school females also mentioned older brothers as having influence on their SB and screen time through coparticipation. As one middle school female reported, “I only watch TV when my older brother does because that’s the only way I get to spend time with him.” Older sisters were also mentioned by middle school and high school females, though they were described as discouraging SB and screen time through modeling, verbal encouragement, and coparticipation. For example, one high school female reported, “My older sister is in her first year of college and put on weight. So when she comes home to visit, she always will ask me to stop sitting around and come to the gym with her. It’s actually kind of fun because we get to bond, and I feel like I’m being healthy by working out and helping her get healthier.” Overall summary of social influences that increase sedentary behavior and screen time:

<table>
<thead>
<tr>
<th>Middle school males</th>
<th>Psychological Influences</th>
<th>Mechanism</th>
<th>Social Influences</th>
<th>Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle school females</td>
<td>- Enjoyment</td>
<td>- Fun to play video games</td>
<td>- Enjoyment</td>
<td>- Social interaction</td>
</tr>
<tr>
<td></td>
<td>- Low self-efficacy</td>
<td>- Can’t walk away from video games</td>
<td>- Low self-efficacy</td>
<td>- Can’t walk away from TV</td>
</tr>
<tr>
<td>High school males</td>
<td>- Enjoyment</td>
<td>- Relaxation</td>
<td>- Enjoyment</td>
<td>- Social interaction</td>
</tr>
<tr>
<td></td>
<td>- Low self-efficacy</td>
<td>- Can’t walk away from TV/video games</td>
<td>- Low self-efficacy</td>
<td>- Relaxation</td>
</tr>
<tr>
<td>High school females</td>
<td>- Enjoyment</td>
<td>- Social interaction</td>
<td>- Enjoyment</td>
<td>- Social interaction</td>
</tr>
<tr>
<td></td>
<td>- Low self-efficacy</td>
<td>- Relaxation</td>
<td>- Low self-efficacy</td>
<td>- Coparticipation</td>
</tr>
<tr>
<td>- Participants’ guilt</td>
<td>- Participants’ guilt</td>
<td>- Coparticipation</td>
<td>- Verbal encouragement of reading</td>
<td>- Verbal encouragement of reading</td>
</tr>
</tbody>
</table>
on SB and screen time among middle and high school males and females are displayed in Table 5.

Interaction Between Psychosocial and Social Influences. Focus group data suggests that individual psychosocial variables and social influences were related to one another, and that this relationship was bidirectional. Females reported that while they preferred to be active, if a close friend wanted to watch television or a movie, they would feel “guilty,” and would then choose to engage in screen time with their friend. As one middle school female reported, “I have one school friend who hates being active and always wants to watch TV shows. I get bored but if she’s at my house, I feel kind of guilty like I’m being a bad friend, so I’ll watch with her.” This interaction was also seen in middle school females, but only 4 middle school females reported this compared with 18 high school females. Middle school females who reported not enjoying SB, but having friends who did not enjoy PA, would choose to spend time with their more active sports team friends rather than engage in SB and screen time with their inactive friends. As one middle school female reported, “I have one friend from school who hates doing any active stuff. She’ll complain that she’s tired. It’s really annoying! I just try to avoid hanging with her now. I’d rather spend time with my friends who like doing active stuff.”

The interaction between psychosocial and friend influences tended to result in a different direction for high school males. High school males reported that they would not “feel like” engaging in physical activity and would prefer to play video games, but when they would get together with a group of their friends, they were more inclined to engage in physical activity because of friends’ encouragement to be active. As one high school male reported, “Yeah I wouldn’t be nearly as active if it weren’t for my friends. Like I’ll come home from school and not feel like doing anything, and just watch TV. But then my friends will come over and talk me into coming out to shoot hoops or something. They definitely make me feel less lazy.”

Middle school males stood out from the sample in that they both enjoyed screen time in the form of video game playing, and had friends who would influence them to spend even more time playing video games. Friends appeared to promote a competitive aspect to participants’ video game playing which would encourage them to continue playing video games, even when they knew they should stop. As one middle school male stated, “We’ll play for hours, and like I know I should go do something else, but there’s this competitive side of me that has to keep playing. Especially my one friend who plays all the time. I hate when he beats me.”

Discussion

Although, we hypothesized that there would be both gender and school level differences in SB and screen time in the sample, we found only partial support for this from both the quantitative and qualitative data. While gender differences were apparent throughout the discussions, school level differences were not as prominent, and appeared to be gender-specific. For example, video game playing with friends was emphasized in middle school males, however, older males did not report this activity as much. Only one female reported playing video games, and this was only when in the presence of male friends. Similarly, high school females appeared to use their mobile phones for more social media purposes than middle school females, while none of the male participants mentioned phone use as a SB. The primary differences between high school and middle school participants appeared to be overall objective SB and computer use, with high school participants accumulating greater minutes of SB per day, and reporting more hours of computer use compared with middle school participants. This difference may be due to increased school and homework demands on high school participants, since during the focus group discussions, high school participants were more likely to mention school demands as a reason for SB. Our findings of no gender differences in SB minutes per day is supported by Broderson et al,8 however, other studies have found that males tend to spend more time in SB,8 while others argue that females are more likely to be sedentary.9 Recently, there has been evidence to suggest that cutpoints of 150 or lower CPMs may be more indicative of SB, rather than the current recommendation of 100 CPM and lower (Peterson).31 However, we reran these analyses using the new cutpoints, and the findings did not significant change. In general, studies appear to be mixed on SB differences between genders, however, it appears in the current study, the type of SB (screen time) is where differences are observed rather than overall SB.

Friends’ screen time was associated with participants’ screen time for both males and females. For males, there were significant correlations between their video game playing and their friends’ game playing, while for females and their friends, associations were significant for television watching only. Data from focus group discussions provided more insight into these findings, indicating that males tended to prefer playing video games together, while for females, television watching was one of the only screen time behavior that they would do with friends. Interestingly, friends appeared to have a positive influence on adolescent behavior in this sample, and encouraged more PA rather than SB or screen time. Many participants reported that they were more active around their friends, however, this appeared to be dependent on the “type” of friendship group participants were associating with. Participants reported that they tended to be most active around their “sports team” friends, while they were more sedentary around their “school” friends. The findings that adolescents engage in different activities according to friendship groups are supported by a qualitative study by Jago et al,32 who reported adolescents would choose different activities according to their friendship group; however, Jago et al did not differentiate between school friends and friends who played on school sports teams. Studies from adolescent sports literature33 suggest that friends on sports teams may be particularly important in supporting healthier habits in adolescents as opposed to friends who are active, but not on sports teams.

It is worth noting that although it was not a primary aim of the current study, family influence was consistently mentioned in all focus group discussions. Interestingly, there did appear to be differences in the mechanisms by which family influenced SB and screen time according to gender and school level (modeling, coparticipation, verbal discouragement), although interactions between participants and specific family members appeared to be dependent on the gender and age of participants. For example, middle school males reported that the only influence mothers had on their behavior was that they indirectly encouraged more SB because they discouraged certain MVPA due to fear of injury risk, while high school females reported mothers discouraging screen time behavior indirectly by coparticipating in PA and acting as “models” of healthy behaviors. These findings suggest that future studies should consider influences by both friend and family environment, and that age and gender of adolescents should be considered. A study by Davison and Jago34 support these findings, suggesting that modeling and coparticipation of PA and screen time in parents may be one of the most important influences on adolescents’ behavior. In addition, these findings are in line with the Theory of Planned Behavior in that social support
and influence from friends and family have a large influence on adolescents’ behavior and intentions to engage in SB and screen time. Finally, in addition to parental influences, siblings in the current study appeared to play a diverse role that was often between that of a parent and a friend. Focus groups revealed that siblings, mainly older brothers, were proven to heavily promote SB and screen time, but also PA, mainly by way of modeling and coparticipation. These findings complement a qualitative study by Edwards and colleagues which found that siblings can have a significant influence over children’s screen time, more so than parents.

Several limitations should be noted. These data were cross-sectional, and therefore, causality cannot be determined. Further, although objective measures were used to assess SB and PA in participants, screen time and nominated friends’ data were assessed by self-report which may be prone to recall bias. Future studies that assess social influences, such as friends, should use objective measures to assess PA and SB, as well as self-report to determine screen time behavior. The present sample was of high socioeconomic status (SES), mainly white, and reported a relatively high level of PA, and thus, results may have limited generalizability. However, several trends found in the current study, such as high levels of mobile phone use in female adolescents, have also been found in females from low income and minorities households. Thus, the findings from this study, although collected from a high SES sample, may have major implications for minority and high-risk populations.

Future studies should examine a diverse population of adolescents to determine whether the influence of social and psychological factors on SB and screen time behavior may differ according to demographic characteristics. Finally, although the focus groups did investigate the influence of family members on SB and screen time, family dynamics were not an original purpose of the current study, and quantitative measures did not inquire about family influences. Further investigation into family relationships in addition to friends’ influence is warranted.

There were also several strengths of the current study. To the best of the authors’ knowledge, this was the first study to examine both individual and social influences on SB and screen time using a mixed methods approach. In addition, SB and PA were measured in main participants using objective measures. Further, previous studies have primarily limited nominated friends to those who currently matriculated to the same school as participants, however, participants in this study were free to nominate friends from anywhere in their social network. Finally, the sample of 108 participants is considered large for a mixed-methods study.

Implications

The results from this study have several implications for research and practice related to adolescent SB and screen time. Family promotion of PA may be most effective for middle school youth, especially in the form of modeling and coparticipation, while interventions for high school students may require friend interaction. Provided that “sports team friends” relative to “school friends” were proven to be promoters of PA, interventions should make efforts to induce healthy friendships, such as by encouraging participation and creating opportunities for after-school sports. Interventions with families may wish to focus on family members modeling and coparticipating in activities that promote PA, and guide these activities as a form of family bonding, as one high school female in the study described “family basketball night” as a great family bonding experience. Finally, more research on sibling influences is warranted, considering their coparticipation in activities and diverse role between that of a friend and family member.

The mixed-methods approach by this study revealed implications for future research in SB and screen time in youth. Although it can be determined that the majority of participants were influenced by family and friends, the mechanisms by which their SB and screen time was influenced varied greatly, which could not be captured by quantitative analysis. Future studies should take these mechanisms into account when developing interventions to reduce SB and screen time. For example, coparticipation in video game playing was a large theme in middle school males. Therefore, an intervention that focuses on engaging participants and their friends in more activity-based video games (Wii fit), may be beneficial for middle school males, but be ineffective for females. Finally, the development of more comprehensive questionnaires to assess screen time and SB is necessary to accurately track emerging types of SB and screen time and their duration, especially for females. From focus group discussions, it was apparent that females may have not considered the use of mobile phones to play games, use social media and watch movies as a form of screen time behavior. In addition, screen time and SB often occurred concurrently with other activities; female adolescents reported using mobile phones while walking, doing homework and socializing with friends. Thus, more contextual information must be collected in future questionnaire assessing screen time and SB, and a mixed approach should be taken whenever possible to better understand multitasking and multiple screen viewing.

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References