Does Preschool Physical Activity and Electronic Media Use Predict Later Social and Emotional Skills at 6 to 8 Years? A Cohort Study

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Background: Little is known about the associations of preschoolers’ health behaviors with their later psychosocial well-being. This study investigates the association of 3- to 5-year-old children’s physical activity and electronic media use with their later social-emotional skills (6-8 years). Methods: Data were collected in 2008–2009 and 2011–2012 for the Healthy Active Preschool and Primary Years (HAPPY) Study in metropolitan Melbourne. Participants were a random subsample (n = 108) of the 567 children at follow-up. Physical activity was objectively measured using ActiGraph GT1M accelerometers; electronic media use (television viewing, sedentary electronic games and active electronic games) was parent proxy-reported. Social and emotional skills were child-reported using the Bar-On Emotional Quotient Inventory—Youth Version. Regression analyses controlled for sex, clustering by center of recruitment, and accelerometer wear time (for physical activity analyses). Results: Sedentary electronic games were positively associated with intrapersonal and stress management skills and total emotional quotient. Computer/internet use was inversely associated with interpersonal, and positively associated with stress management, skills. Conclusions: Findings suggest that physical activity is not associated with children’s psychosocial health while some types of electronic media use are. Future research should investigate the contexts in which preschoolers participate in these behaviors and potential causal mechanisms of associations.

Keywords: accelerometry, active video gaming, e-gaming, mental health, sedentary behavior

In adolescents and adults both higher levels of physical activity and lower levels of electronic media use, such as television viewing, have been shown to be favorably associated with aspects of mental health, including self-esteem, anxiety, and depression. Emerging evidence suggests that physical activity and electronic media use may also be associated with psychosocial health during the early childhood period (5 years and younger). However, the majority of studies during the early childhood period have focused solely on television viewing and the association of other types of electronic media use with psychosocial health during early childhood remains largely unexplored. Psychosocial health incorporates the presence of higher levels of positive, and lower levels of adverse psychological and social attributes and behaviors (eg, prosocial behavior, attentional problems). Research has shown that indicators of psychosocial health during early childhood are associated with later academic achievement and mental health. Therefore, promoting healthy levels of physical activity and electronic media use during the early childhood period may result in improved psychosocial health, academic achievement and mental health throughout life. However, game-playing is a normal and healthy component of childhood development and participating in moderate amounts of electronic games may not be detrimental to healthy development. Further, some studies in older children, adolescents and young adults have shown that participating in prosocial electronic games (ie, games in which characters support each other) may be supportive of improved prosocial behaviors. Therefore, investigating associations of different types of electronic media use with indicators of psychosocial health is necessary.

There are few studies investigating longitudinal associations of physical activity and electronic media use early in life (birth to 5 years) with psychosocial health in middle childhood (primary school years). Further, the indicators of psychosocial health investigated are often adverse outcomes, such as attentional problems, or internalizing and externalizing behaviors rather than more positive aspects of psychosocial health such as skills in stress management, interpersonal relationships, or adaptability. Only 1 cohort study has previously investigated physical activity in early childhood and psychosocial health indicators. That study used a total of only 8 hours of direct observation across 2 data collection time points to assess physical activity and reported null associations for physical activity with externalizing problems, internalizing problems, and total problem behavior. However, that study may have failed to capture habitual physical activity due to the short period of direct observation and assessment of only large motor activity (defined as climbing, running, or jumping and where the child was actively changing their position in space). This definition is likely to have excluded light-intensity physical activity, which has more recently been recognized as potentially important for health outcomes and consequently incorporated in several recent physical activity recommendations for young children.

The few cohort studies which have investigated associations between electronic media use and psychosocial health have generally reported on television viewing only, overlooking other electronic media such as computer or electronic games usage (for instance), and have typically investigated adverse aspects of psychosocial health such as bullying, attention deficit/hyperactivity disorder (ADHD), and attention problems, while few have investigated positive aspects of psychosocial health such as prosocial behavior. Overall, the findings are inconclusive: increased television viewing has been associated with increased victimization and bullying, not associated with ADHD or attention, positively
associated with hyperactivity-inattention and inversely associated with prosocial behavior, and null and inverse associations with social skills have also been reported. The 1 cohort study to investigate media use other than television found null associations between total electronic media use (television, computer, electronic games, etc. combined) and outcomes such as aggressive behavior and attention problems among Latino toddlers.

No cohort studies have investigated potential associations between individual electronic media behaviors in early childhood and subsequent aspects of psychosocial health. The evolution of available electronic media other than television has been rapid and recent and this explains, at least in part, the lack of studies investigating use of such devices. For instance, Nintendo PlayStation was released in the mid 1990s, Xbox in the early 2000s, smart phones gained popularity in the mid 2000s, and iPads were released in 2010. Access to such devices by children is ubiquitous: an average Australian household will have 2 televisions, 2 laptops, 2 smart phones, and 2 digital tablets. Approximately 16% of children aged 2 to 4 years, and 51% of 5- to 17-year-olds, are estimated to have at least 1 electronic media device in their bedroom. Studies reporting time spent in each of the individual types of electronic media use are scare; however, some evidence suggests that among young children the majority of time using electronic media is still spent in television viewing, and that parents are reticent to reduce children’s television viewing. There is much variation in the time young children spend in different forms of electronic media use, and there are also important differences in the ways in which they interact with these media (television viewing tends to be more passive mentally and socially than using the Internet, for example) that could have differential impacts on psychosocial outcomes. When individual electronic media behaviors are combined, associations of individual behaviors with psychosocial health could be masked. Examining associations between individual electronic media behaviors and psychosocial outcomes may help to identify which specific forms of electronic media may be harmful and where to intervene accordingly; some forms may be more detrimental to psychosocial health than others. The aim of this study was to investigate prospective associations of objectively measured physical activity and multiple types of electronic media use during early childhood with positive aspects of psychosocial health during middle childhood.

**Methods**

**Participants and Recruitment**

Data were drawn from the Healthy Activity Preschool and Primary Years (HAPPY) study. In total, 1002 children aged 3 to 5 years at baseline (2008–2009) were recruited through preschool and childcare centers in high-, mid-, and low-socioeconomic areas in metropolitan Melbourne, Australia. Eligibility criteria were only that the child attend 1 of the preschools or childcare centers in the study and be aged 3 to 5 years at baseline. Follow-up of the 766 families who had provided contact details occurred 3 years later (2011–2012) when the children were aged 6 to 8 years (n = 567; 74% response). Details of the study methods have been published previously. Briefly, children wore ActiGraph GT1M accelerometers and parents completed a survey including demographics and proxy-report of children’s electronic media use. Part way through follow-up data collection in 2012, once additional ethical approval had been obtained, a subset of families were invited to participate in a child survey component of the study. In total, 184 families were invited to have their child participate in this aspect of the study; 176 consented and 109 were randomly allocated the Bar-On Emotional Quotient Inventory—Youth Version (EQi-YV), with the remaining children completing a survey on an unrelated concept for a different substudy. Figure 1 shows the flow of children through baseline and follow-up of this study. Children in the subsample for this study did not differ from the larger sample at follow-up on demographic characteristics such as socioeconomic position (using maternal education as the indicator), child sex or Body Mass Index (BMI), meeting either physical activity or electronic media recommendations, nor on any measures of electronic media use at baseline or follow-up. However, children in this subsample spent a significantly lower percent of their day in total physical activity at baseline (49.4%; SD 6.9) than children in the larger follow-up sample (50.8%; SD 5.9; P = .04, t = 2.08).

HAPPY was approved by the Deakin University Human Research Ethics Committee and the Victorian Department of Education and Early Childhood Development. The STROBE statement checklist for cohort studies was followed in the reporting of this study.

**Measures and Data Management—Baseline (Independent Variables)**

Numerous measures were used in HAPPY; only those used in this sub study are reported here.

**Electronic Media Use.** All data were collected during school terms. Parents reported their child’s usual time spent in electronic media use including television (television/DVD/video) viewing, sedentary electronic games (Xbox, PlayStation, etc.), active electronic games (Xbox Kinect, etc.) and computer/internet use (not including games) over the past month. Computer/internet use, other than games, for preschool children is likely to include activities considered educational. For each type of electronic media use, parents reported the total time in hours and minutes that children participated across week (Monday–Friday) and weekend (Saturday–Sunday) days. The 2 durations were summed (total weekly participation) for each behavior and divided by 7 to determine average daily duration (in minutes/day). These items were shown to have generally acceptable test-retest reliability in a separate sample (ICC = 0.51 to 0.69) with the exception of active electronic game items which showed poor reliability (ICC = 0.23). Reliability for these items in a study in older children was good. It is likely that the poorer reliability of this 1 item in this sample is due to factors other than instability of the item itself such as the time between administrations (14–50 days, mean 24 days) which may have led to real changes in the behavior itself.

**Physical Activity.** Children wore ActiGraph GT1M accelerometers for 8 days during waking hours as per standard protocols. Data were collected in 15-second epochs. Nonwear time was identified by 20 or more consecutive minutes of 0 counts. Given the sporadic and constant nature of young children’s physical activity, it would be difficult for a child this age to be motionless for this long. Children were included in the analyses if they had at least 4 days of accelerometry data with a minimum of 6 hours of data on each day, including at least 1 weekend day. This volume of data has previously been shown to provide a reliability of 0.7. The cut-point of 100 counts per minute was applied to the data to identify when children were participating in light-, moderate-, or vigorous-intensity physical activity (total physical activity). Mean time (minutes per day) in light- to vigorous-intensity physical activity was chosen as the independent variable to align with current
Figure 1 — Flowchart of participants through the HAPPY study from baseline to participation in the Bar-On Emotional Quotient Inventory.
international recommendations for physical activity for preschool children and recent studies. Associations with moderate-to-vigorous-intensity physical activity were also assessed; however, all associations aligned with those reported for total physical activity and therefore only the latter results are reported.

**Parent and Child Demographic Variables.** Parents reported on a range of demographic characteristics including child sex and date of birth. Parent-reported maternal education was used as a proxy for family socioeconomic position. Previous studies have reported that maternal education is strongly associated with broader indicators of area-level socioeconomic position and some evidence suggests that maternal characteristics may have a more important influence on children’s health behaviors than paternal characteristics. Maternal education was reported on a 7-item scale from no formal qualifications to postgraduate qualifications and was subsequently classified as low (Year 10 or lower), medium (school completion/trade/diploma), or high (university/postgraduate).

**Measures and Data Management—Follow-up (Dependent Variables)**

**Child Social and Emotional Skills.** The EQi-YV (short version) was administered to participating children during school or home visits. A trained researcher read each of the questions to each child individually. This validated and reliable instrument captures young people’s social and emotional skills (construct validity with adult scales, correlations = 0.56 to 0.88; factorial validity, item loadings on primary factor = 0.40 to 0.77; internal reliability: α = 0.65 to 0.81; test-retest reliability correlations = 0.77 to 0.81). It has been validated for children aged 7 to 18 years; 24% of this sample were aged 6 years at the time of administration. Children responded to 30 items, such as “I get angry easily,” “I am good at solving problems,” and “I like everyone I meet.” Response options were on a 4-point Likert scale ranging from “not true of me” to “very much true of me.” The self-report inventory provides an overall score for emotional intelligence and scores for each of 4 composite subscales which assess: intrapersonal (ability to understand own emotions); interpersonal (ability to listen to, understand, and appreciate feelings of others); stress management (ability to remain calm and work well under pressure); and adaptability (ability to be flexible, realistic, and effective in managing change) skills. Subscales have previously been reported to have good psychometric properties for internal reliability, test-retest reliability and validity. Similar to IQ instruments, each subscale of the EQi-YV, and the overall EQ, is age- and sex-standardized to a mean score of 100 with a standard deviation of 15 points. Although standardized scores can be categorized into 7 levels from markedly low to markedly high, continuous scores for each subscale and the overall EQ scale were used for these analyses with a higher score representing more favorable psychosocial health. None of the subscales nor the overall EQ have previously been investigated for potential associations with electronic media use or physical activity during childhood.

**Statistical Analyses**

Descriptive statistics (mean, percent) were used to describe the sample. As data were normally distributed, independent t tests were used to assess differences in EQi-YV outcome variables between boys and girls. A series of multiple linear regression models were used to assess associations between the baseline variables (physical activity, electronic media) and each of the EQi-YV subscales at follow-up. As previous studies have shown that associations of independent variables, such as television viewing, with subscales of instruments capturing psychosocial health may vary (for instance, television viewing has been shown to be associated with emotional well-being but not self-esteem in the same sample), each of the independent variables (physical activity, each of the electronic media variables) were assessed for their association with the overall score for emotional intelligence and with each of the subscale scores (eg, intrapersonal, interpersonal) from the EQi-YV. All of the electronic media variables were then entered simultaneously into models with the overall score for emotional intelligence and with each of the subscale scores to assess their relative contributions; collinearity was assessed and found to be within acceptable limits. All analyses controlled for child sex and clustering by center of recruitment; no differences by child age, socioeconomic position, maternal age, or parental marital status were observed in the outcome variables in preliminary analyses and therefore these were not included as confounders in the analyses. Residuals were essentially normal. Analyses using physical activity as the independent variable additionally controlled for accelerometer wear time. Standardized beta (β) coefficients were also calculated as an indicator of effect size and to allow meaningful comparison between studies. Stata 12 (Stata Corp, College Station, Texas) was used for all analyses. Statistically significant associations (P < .05) are identified in the results.

**Results**

Children (n = 108) were a mean age of 4.4 (SD 0.7) years at baseline and 7.6 (SD 0.7) years at follow-up. Slightly more than half (53%) of the children were boys and most (76%) were from a high-socioeconomic position (university educated mother) family. Descriptive statistics for physical activity, electronic media use, and EQi-YV subscales are presented in Table 1. Television viewing time accounted for the majority of children’s electronic media use (84.1, SD 51.8 mins/day out of 101.1 mins/day in total electronic media). Children scored slightly above the mean of 100 on each of the EQi-YV subscales and total EQ scale. Boys scored significantly higher than girls on the adaptability scale. No other between-sex differences were evident.

Table 2 presents the results for associations of baseline physical activity and electronic media use with child social and emotional skills at follow-up. Each additional minute spent in sedentary electronic games was associated with a 0.13 point increase in intrapersonal skills (β = .039; 7.7 points for each additional hour; β = 0.16) and a 0.13 point increase in stress management skills (P = .003; 7.8 points for each additional hour; β = 0.15) at follow-up. Each additional minute spent in computer/internet use was associated with a 0.10 point decrease in interpersonal skills (P = .039; 6.2 points per hour; β = –0.11) and a 0.11 point increase in stress management skills (P = .032; 6.9 points per hour; β = 0.11) at follow-up. No associations between physical activity and any of the indicators of psychosocial health were evident.

Table 3 presents the results of the multivariable analysis of all baseline electronic media use variables with each of the outcome variables. In multivariable analyses of all baseline electronic media use variables, sedentary electronic games showed a consistent, positive association with intrapersonal skills, stress management skills and total emotional quotient. Each additional minute of sedentary electronic game use was associated with a 0.15 (P = .032; 8.8/hour; β = 0.18), 0.17 (P < .001; 10.2/hour; β = 0.20) and 0.12 (P = .030; 7.4/hour; β = 0.15) point improvement in intrapersonal skills, stress management skills and total emotional quotient, respectively.
additional minute of computer use at baseline was associated with a 0.10 point improvement in children’s stress management skills \((P = .049; 6.0/\text{hour; } \beta = 0.09)\) at follow-up.

**Discussion**

This study sought to identify prospective associations of physical activity and electronic media use during early childhood with social and emotional skills 2 years later. Despite being slightly above standardized mean scores, children scored within the standardized average range for each of the EQi-YV subscales and total emotional quotient scale^{44} and the observed difference between boys and girls on the adaptability subscale was consistent with previously reported findings.{44,48} Associations with each of the social and emotional skills varied between different forms of electronic media use, illustrating the importance of investigating each of these behaviors separately.

In this study, physical activity was not associated with any of the indicators of psychosocial health. Previous research suggests that physical activity may be associated with better stress management techniques in adolescents^{49} and fewer emotional symptoms in preschool children.\(^{50}\) Overall, the majority of research investigating physical activity during early childhood and psychosocial health indicators has reported null associations,\(^{6}\) including the only cohort study to investigate such an association.\(^{12}\) However, a number of studies have found associations between physical activity and indicators of psychosocial health.\(^{50–52}\) Therefore, the findings between studies differ and are difficult to explain. The context in which behavior occurs, both the social context (eg, who the child is with and the types of interactions which occur) and the physical environment, may help to shed some light on the associations. Social context has previously been shown to be an important factor in the association between physical activity and women’s mental health.\(^{53}\)

For children, it may be that sharing active play with other children or adults is important to consider when attempting to unravel such discrepancies in associations. Aspects of children’s home environments, such as parental interaction, or the types of activities in which children engage, such as active outdoor play, active transport, or shopping with a parent, may help explain differences in associations. The current study did not capture data on the context in which children’s physical activity occurs, nor the types of behaviors themselves, and is therefore unable to explore such hypotheses. Therefore, further research is required to confirm reported findings and unpack potential mechanisms of such associations.

Previous research has suggested that lower levels of electronic media use may be beneficial to aspects of psychosocial health during early childhood.\(^{5}\) The finding in this study that increased computer use, despite the minimal time these children spent in this behavior, is associated with lower levels of interpersonal skills concurs with such findings. This finding also concurs with a previous cross-sectional study in young Korean children which found that those with higher computer use had lower socioemotional developmental scores, including those for peer-interaction which may be similar to interpersonal skills as captured in this study.\(^{54}\) The mechanisms for such an association remain to be explored. However, children’s participation in computer/internet use is often a solitary endeavor, and this may reduce opportunities to engage in interpersonal interaction which is necessary for the development of these important skills.

Other findings in this study did not concur with the notion that electronic media use is detrimental to children’s psychosocial health. Baseline time in sedentary electronic games (eg, PlayStation, Nintendo) was positively associated with interpersonal and stress management skills and total emotional quotient, and baseline computer/internet use positively associated with stress management skills, at follow-up. In considering the social context of behaviors, young children may participate in electronic games with others, such as their parents,\(^{55}\) siblings, or peers,\(^{56}\) whereby opportunities for interaction and subsequent development of social and emotional skills may be fostered. More generally, game-playing (including board games, imaginary games, etc.) is a normal and necessary part of childhood which supports healthful development through provision of opportunities for challenge and stimulation,\(^{10}\) and moderate levels

### Table 1: Descriptive Data on Physical Activity and Electronic Media Variables at 3–5 Years and Social and Emotional Skills at 6–8 Years

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity (minutes per day)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total physical activity</td>
<td>80</td>
<td>323.0 (55.3)</td>
<td>181.7–468.4</td>
</tr>
<tr>
<td>Electronic media (minutes per day)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television/DVD/Video viewing</td>
<td>109</td>
<td>84.1 (51.8)</td>
<td>0–231.4</td>
</tr>
<tr>
<td>Sedentary electronic games (PlayStation, etc.)</td>
<td>109</td>
<td>7.0 (17.1)</td>
<td>0–120.0</td>
</tr>
<tr>
<td>Active electronic games (Wii etc.)</td>
<td>109</td>
<td>2.2 (5.4)</td>
<td>0–25.7</td>
</tr>
<tr>
<td>Computer/internet (excluding games)</td>
<td>109</td>
<td>5.9 (13.7)</td>
<td>0–85.7</td>
</tr>
<tr>
<td>Social and emotional skills(^{a})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>109</td>
<td>102.4 (13.7)</td>
<td>65.0–130.0</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>109</td>
<td>103.0 (13.4)</td>
<td>65.0–123.0</td>
</tr>
<tr>
<td>Stress management</td>
<td>108</td>
<td>105.9 (14.5)</td>
<td>65.0–125.0</td>
</tr>
<tr>
<td>Adaptability(^{b})</td>
<td>109</td>
<td>102.1 (15.5)</td>
<td>65.0–128.0</td>
</tr>
<tr>
<td>Total EQ</td>
<td>108</td>
<td>107.1 (13.8)</td>
<td>75.0–130.0</td>
</tr>
</tbody>
</table>

\(^{a}\) Scale scores are standardized around a mean of 100 with an SD of 15.

\(^{b}\) Significant between-sex difference: boys > girls (105.5 vs. 98.2, respectively; \(P = .01\)).
Table 2  Associations\(^a\) Between Baseline Electronic Media Use/Physical Activity and Social and Emotional Skills at Follow-up

<table>
<thead>
<tr>
<th>Baseline physical activity/electronic media use (min/d)</th>
<th>Intrapersonal</th>
<th>Interpersonal</th>
<th>Stress management</th>
<th>Adaptability</th>
<th>Total Emotional Quotient</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (95% CI) β</td>
<td>B (95% CI) β</td>
<td>B (95% CI) β</td>
<td>B (95% CI) β</td>
<td>B (95% CI) β</td>
<td>B (95% CI) β</td>
</tr>
<tr>
<td>Physical activity(^b)</td>
<td>-0.01 (-0.08, 0.07)</td>
<td>-0.03</td>
<td>-0.03 (-0.10, 0.04)</td>
<td>-0.12</td>
<td>-0.07 (-0.14, 0.01)</td>
</tr>
<tr>
<td>Television/DVD/video viewing</td>
<td>-0.02 (-0.07, 0.04)</td>
<td>-0.06</td>
<td>-0.02 (-0.07, 0.02)</td>
<td>-0.10</td>
<td>-0.01 (-0.10, 0.04)</td>
</tr>
<tr>
<td>Sedentary electronic games (PlayStation, etc.)</td>
<td>0.13 (0.01, 0.25)(^c)</td>
<td>0.16</td>
<td>0.04 (-0.13, 0.20)</td>
<td>0.05</td>
<td>0.13 (0.05, 0.21)(^c)</td>
</tr>
<tr>
<td>Active electronic games (Wii, etc.)</td>
<td>0.01 (-0.63, 0.66)</td>
<td>0.01</td>
<td>0.16 (-0.30, 0.63)</td>
<td>0.07</td>
<td>-0.43 (-1.12, 0.26)</td>
</tr>
<tr>
<td>Computer/internet (excluding games)</td>
<td>0.05 (-0.11, 0.21)</td>
<td>0.05</td>
<td>-0.10 (-0.20, -0.01)(^c)</td>
<td>-0.11</td>
<td>0.11 (0.01, 0.22)(^c)</td>
</tr>
</tbody>
</table>

\(^a\) Linear regression models adjusted for child sex and clustering by center of recruitment.

\(^b\) Model additionally adjusted for accelerometer wear time.

\(^c\) P < .05.

Table 3  Multivariable Associations\(^a\) Between All Baseline Electronic Media Use and Each of the Social and Emotional Skills at Follow-up

<table>
<thead>
<tr>
<th>Baseline electronic media use (min/d)</th>
<th>Intrapersonal</th>
<th>Interpersonal</th>
<th>Stress management</th>
<th>Adaptability</th>
<th>Total Emotional Quotient</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (95% CI) β</td>
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<td>B (95% CI) β</td>
<td>B (95% CI) β</td>
</tr>
<tr>
<td>Television/DVD/video viewing</td>
<td>-0.03 (-0.08, 0.03)</td>
<td>-0.10</td>
<td>-0.03 (-0.07, 0.01)</td>
<td>-0.10</td>
<td>-0.03 (-0.09, 0.03)</td>
</tr>
<tr>
<td>Sedentary electronic games (PlayStation, etc.)</td>
<td>0.15 (0.01, 0.28)(^b)</td>
<td>0.18</td>
<td>0.05 (-0.12, 0.22)</td>
<td>0.06</td>
<td>0.17 (0.09, 0.25)(^b)</td>
</tr>
<tr>
<td>Active electronic games (Wii, etc.)</td>
<td>-0.05 (-0.66, 0.56)</td>
<td>-0.02</td>
<td>0.12 (-0.36, 0.61)</td>
<td>0.05</td>
<td>-0.50 (-1.19, 0.18)</td>
</tr>
<tr>
<td>Computer/internet (excluding games)</td>
<td>0.05 (-0.12, 0.23)</td>
<td>0.05</td>
<td>-0.10 (-0.21, 0.01)</td>
<td>-0.10</td>
<td>0.10 (0.00, 0.20)(^b)</td>
</tr>
</tbody>
</table>

\(^a\) Multivariable linear regression model included all baseline electronic media use variables and adjusted for child sex and clustering by center of recruitment.

\(^b\) P < .05.
of electronic games may be 1 more avenue through which children engage in game playing. Adolescents who participate in computer games have previously been shown to have more positive outcomes in several areas, including mental health, compared with nongame players, and it is possible that moderate use of such electronic games may provide similar opportunities for younger children. The levels of electronic game use in this study were relatively low, and as such children may avoid adverse outcomes previously shown to be associated with higher levels. Nonetheless, the broader context in which young children participate in such electronic games requires further exploration to identify potential mechanisms which may explain the findings. With respect to stress management skills, the nature of the activities in which children participate may foster such skills when children are faced with failure in those media. For instance, loss of rewards or incorrect answers may give children opportunities to manage stressful emotions such as becoming upset or angry, which they can then apply in other contexts. However, this is conjecture only and future research is required to identify the causal pathways in such associations.

This study also found a number of null associations between behavior and psychosocial health outcomes, consistent with previous research in this area. Potential explanatory factors are worth investigating given associations between health behaviors and psychosocial health in older populations and reported associations from previous reviews in the early childhood period. The null associations may be valid, that is, there may be no meaningful association between either physical activity or electronic media use and psychosocial outcomes during early childhood. A lack of sufficient heterogeneity in outcomes across different domains may explain the lack of association. Homogeneity of outcome scores may result from insufficient opportunity for differences to develop across children’s lives. Such differences may not be evident until later childhood or adolescence. Nonetheless, children in this study did report a range of scores on each of the EQi-YV scales. It is possible that behaviors such as physical activity and electronic media use show associations with some indicators of psychosocial health but not others, as is evident in this study, or that other factors, not accounted for in the sparse volume of available literature, mediate or moderate potential associations. In addition, physical activity and electronic media behaviors are fluid and may change over time, showing differential associations with outcomes. Differences in associations between children’s behaviors and the EQi-YV subscales underscore the importance of investigating associations of behaviors with individual psychosocial health outcomes rather than composite scores to uncover more subtle associations which may not be evident in composite scores.

Strengths and limitations of this study must be acknowledged. The study used a small sample and may therefore have suffered from a lack of sufficient power to identify potential associations. Nonetheless, several associations were identified adding novel findings to the limited evidence base on physical activity, electronic media use and positive indicators of psychosocial health. Generalizability of the study findings may be limited due to the small sample size and high-SEP level of participant families. The study did not include measures of social and emotional skills at baseline and was therefore unable to control for those in analyses. It is therefore not possible to rule out reverse causality. Maternal mental health has previously been identified as a predictor of childhood psychosocial wellbeing; however, data on maternal mental health were not collected in this study and therefore could not be controlled for in analyses. Data for this study were collected just before the widespread use of smart phones and digital tablets; future studies should include time children spend using such devices to assess potential differential associations with psychosocial health outcomes. Although a number of significant, and consistent, associations are identified, coefficients are small and the practical meaningfulness of such changes in children’s lives remains to be identified. Strengths of the study include use of objectively measured physical activity, providing a valid measure of children’s total physical activity, and several types of electronic media use. The study used a reliable and valid instrument to capture children’s social and emotional skills, characteristics of psychosocial health not previously reported in the physical activity or electronic media literature in this age group, thereby adding novel findings to the extant literature.

In conclusion, this study has identified associations of electronic media use at 3 to 5 years with interpersonal, intrapersonal and stress management skills and total emotional quotient at 6 to 8 years. Future research should examine the context in which behaviors occur to identify potential causal mechanisms which were not able to be examined in this study. Where possible, large samples should be used to improve generalizability and ensure sufficient analytical power to confirm or refute the findings of the current study and extant literature. Objective measures of physical activity should be used to ensure the sporadic nature of young children’s physical activity, which is difficult to accurately assess from proxy-report, is captured. Multiple types of electronic media use should also be included as associations may vary between media types. Despite findings in this study being somewhat inconclusive, there is some suggestion that the electronic media behaviors young children engage in during early childhood may impact their later social and emotional skills.

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