

Screen-Time Policies and Practices in Early Care and Education Centers in Relationship to Child Physical Activity

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Abstract

Background: Few preschool children meet physical activity recommendations, whereas the majority exceeds screen-time recommendations. The purpose of this study was to examine the relationship of screen-time policies and practices with children's physical activity and sedentary time in early care and education (ECE) centers.

Methods: We conducted a cross-sectional study of 104 children (3.3 ± 0.5 years; 50% girls) attending 10 ECE centers in the United States. Physical activity was measured by accelerometry. Screen-time practices were measured by classroom observation and director report. Mixed linear models were used to examine the relationship of screen-time practices with children's total physical activity (TPA) and moderate-to-vigorous physical activity (MVPA) and sedentary time, adjusting for child's age, sex, and BMI z-score and taking into account the clustering of children within each center. Models were repeated to include director-reported active play time as a covariate.

Results: More limited/supervised screen-time (by observation) was related to higher TPA ($p=0.0003$) and lower sedentary time ($p=0.0003$). More limited/supervised screen-time (by director report) was related to higher TPA ($p<0.0001$) and MVPA ($p=0.021$) and lower sedentary time ($p<0.0001$). Associations remained significant when active play time was included as a covariate. TPA was inversely related to computer access ($p=0.0015$) and positively related to the use of educational screen-time compared with noneducational screen-time ($p=0.04$).

Conclusions: Limiting computer usage and ensuring screen-time is educational, and integrated within the curriculum may benefit children's physical activity levels and reduce time spent sedentary.

Keywords: computer; locomotion; movement; preschool child; television

Introduction

Obesity affects 13.7% of children aged 2–5 years in the United States (US).¹ Insufficient physical activity coupled with high amounts of sedentary time contribute to excess weight gain in children.^{2–5} Screen-time, which is time spent with TV, computers, or other hand-held screens, is a common sedentary activity of young children promoted by extensive marketing and device availability.⁶ Preschoolers spend 4.1 hours/day with a screen,⁷ exceeding guidelines of 1 hour/day,^{8–10} while less than half meet physical activity guidelines of ≥ 15 minutes/h engaged in

physical activity.¹¹ Excessive screen-time has been associated with elevated BMI, shorter sleep, and emotional and cognitive delays in young children,^{8,12–15} although evidence of a direct link between preschoolers' screen-time and physical activity remains inconclusive.^{12,16–18}

Children spend a large portion of their weekdays in nonparental care: 82% of US children aged 3–5 years attended an early care and education (ECE) center in 2016.¹⁹ Physical activity is highly variable between centers,^{20,21} but is generally low: only 2%–3% of children's time was spent in moderate-to-vigorous physical activity (MVPA) based on accelerometry data collected from 281 children

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attending nine preschools.²¹ Many centers provide children with access to digital screens; children engaged in between 0.1 and 1.3 hours/day of screen-time across seven studies.²² Furthermore, direct observations in 24 preschools revealed that 98% of screen-time (“video/screen”) was sedentary.²³

Best practice guidelines for physical activity promotion in ECE centers include the reduction of sedentary activities.^{24,25} The present study was designed to address a gap in the literature specifically to examine screen-time practices and their potential relationship to children’s physical activity, which was identified as a research priority for obesity prevention by expert consensus.²⁶ Furthermore, previous examinations were limited to only examining minutes of screen-time and the presence of screens in the room^{18,25,27,28} without examining other screen-time policies and practices such as the educational content of the screen-time, children eating during screen-time, providers using screens as rewards, provider supervision during screen-time, or parent or provider training on screen-time. Therefore, the purpose of the present study was to conduct a comprehensive examination of screen-time policies and practices and to examine relationships with children’s physical activity and sedentary time. The Louisiana Department of Education enacted licensing regulations in 2015 that required ECE centers to have an electronic device policy limiting screen-time to 2 hours/day at child care,²⁹ providing an opportune time to examine practices and potential impacts on children’s behavior.

Methods

This study is a cross-sectional analysis of the baseline data collected in 2016–2017 for “Pause & Play,” a prospective cohort study that aims to examine the implementation of screen-time policies and practices in ECE centers in relationship to children’s physical activity.²⁹ As previously reported,²⁹ the study was designed to occur in 10 ECE centers for sufficient power to compare children’s MVPA between low vs. high supportive child care environments.³⁰

ECE Centers

The state Department of Education provided a list of licensed ECE centers in one parish (county), which was then randomized. ECE centers were contacted in order of randomization (146 centers were contacted; see Supplementary Fig. S1 for the CONSORT diagram; Supplementary Data are available online at www.liebertpub.com/chi) to ultimately enroll 10 centers. Study staff contacted each center’s director by telephone in order of randomization and confirmed eligibility criteria, which included being a licensed ECE Center located in East Baton Rouge Parish, enrollment of at least 18 children ages 3–4 years, and willing to participate. Directors provided informed consent during a scope visit. The study protocol was ap-

proved by the Pennington Biomedical Institutional Review Board. Each ECE center received \$200 of school supplies for time and effort.

Centers were church-affiliated ($n=3$), Head Start ($n=2$), a corporate-sponsored center serving employees ($n=1$), a privately owned and operated independent center ($n=1$), a nonprofit/faith-based preschool ($n=1$), affiliated with an elementary school ($n=1$), or affiliated with a university ($n=1$). All centers had been in operation for at least 10 years. All centers participated in the state’s Quality Start rating system ($n=6$) and/or the National Association for the Education of Young Children accreditation ($n=5$). Four centers received child care assistance funding or state food program funding. Student enrollment included 70 children/center aged 3–4 years (range: 19–194).

Child Participants

Parents were notified about the study via informational handout, email/letter from director, and/or in-person informational session. No parent refused participation for the classroom observation. The full purpose of the study was not disclosed to children, parents, teachers, or directors until after data collection. Parents were invited to allow their child to participate in the accelerometry and height/weight assessments. A child was eligible if aged 3–4 years; spent at least 6 hours/day, 5 days/week at the center; and planned to attend the same center the next year for follow-up (data forthcoming). A parent/guardian provided written informed consent. Children were not asked to provide assent due to their young age, but procedures were explained in child-friendly terms and a child could refuse to participate. One ECE center required documented verbal assent. Children received a toy for each day they wore their accelerometer (~\$1/child total).

Procedures

Physical activity and sedentary time. Physical activity and sedentary time were measured by accelerometry at the right hip, secured by a neoprene belt (ActiGraph GT3X+, Ft. Walton Beach, FL). Parents and teachers were encouraged to have each child wear the accelerometer 24-hours/day for at least 7-days (plus an initial familiarization day and the morning of the final day).

Anthropometry. Height to the nearest 1.0 cm and weight to the nearest 0.1 kg were measured with children dressed in light clothing using a portable stadiometer and high-precision electronic scale, respectively.

Sociodemographic characteristics. Parents reported child’s date of birth, sex, and race/ethnicity in a survey.

Center policies and practices. Ten screen-time policies/practices were ascertained using director report and direct observation (Table 1). Director surveys were based on the

Table 1. Screen-Time Policies and Practices Based on Director Report and Classroom Observation Across 10 Early Care and Education Centers

Component	Item	Dichotomized response	Director report	Observed
1. Screen-time policy	At our child care facility, a written policy on electronic devices in preschool classrooms:	Does not exist	0	0
		Is written	10	10
2. Screen-time allowed	For preschool children, the amount of screen time allowed at child care center is:	Any allowed	6	6
		None allowed	4	4
3. Television access	In preschool classrooms, televisions are:	Accessible to children	4	5
		Not accessible to children	6	5
4. Computer access	Among preschool children, computers are:	Each child allowed	3	4
		≥30 minutes/day		
		Each child allowed ≤15 minutes/day	7	6
5. Educational	For preschool children, their television/DVD viewing at school includes:	Some/mostly educational contents	3	3
		All educational contents	7	7
6. Eating occasions	For preschool children, television/DVD viewing during meals or snack time occurs:	Some of the time	1	3
		Rarely or never	9	7
7. Screens as reward	Television/video viewing is used as a reward in preschool children's classrooms:	Some of the time	0	0
		Rarely or never	10	10
8. Provider supervision	During screen time activities with preschool children, providers supervise and watch with the children:	Rarely/some of the time	2	0
		All of the time	8	10
9. Provider training	Providers are offered training opportunities on screen time reduction and/or media literacy for preschool children:	Rarely or never	6	6
		One or more times per year	4	4
10. Parent training	Parents of preschool children are offered screen time reduction and/or media literacy education (e.g., special programs, newsletters, or information sheets):	Rarely or never	6	6
		One or more times per year	4	4

Nutrition and Physical Activity Self-assessment for Child Care (NAPSACC)³¹ and also included information on physical activity practices. The item used for the present analysis was “Active play time [indoor and outdoor] is provided to all preschool children, including children with special needs” with five response choices: 45 minutes/day or less, 46–60 minutes/day, 60–90 minutes/day, 90–120 minutes/day, more than 120 minutes/day.

A day-long observation of one classroom at each ECE center was conducted by one of two trained research specialists following the physical activity components of the Environment and Policy Assessment and Observation (EPAO) tool.^{25,28} Each observation began at the start of the teacher's class to the end (average observation of 7.5 hours). Recordings included any screen-time, including type, duration, and content; screens present in the room; screen-time used during an eating occasion or as a reward; and provider's presence during screen-time. Before data collection, the research specialists completed over 20

hours of training with ≥95% agreement during two practice observation periods.

Statistical Analysis

BMI z-score and percentile were calculated.³² Accelerometry data were stored as 15-second intervals³³ and spliced to include time spent at preschool based on start/stop time of each classroom observation. For the present analysis, a valid day was considered complete accelerometry data from the start to stop time of the classroom observation day. Only accelerometry data during the classroom observation day for students in the observed classrooms were used. Cut-points were based on Pate et al.³⁴ Total physical activity (TPA) included light, moderate, and vigorous intensity, whereas MVPA included moderate and vigorous intensity. Fifty-seven children were excluded from the present analysis because they were not students in the observed classrooms. These children did not differ from the analytic sample by age, sex, race/ethnicity, or BMI z-score.

A summary score characterizing each center's screen-time policies and practices was created using 10 components from the director's survey (ScreenLimit_{director}) or direct observation (ScreenLimit_{observed}). Each item consisted of 4–5 response choices; these were dichotomized and a composite score was created by summing scores for all components (range: 0–10), with 0 representing the most access to screens and 10 representing the most limits/supervision of screen-time.

The analytic sample included 104 children. Mixed models were used to examine the relationship of summary screen score with children's activity levels. Covariates included child's age, sex, and BMI z-score,³⁵ taking into account the clustering of children within center. Models were repeated for each dependent variable: TPA, MVPA, or sedentary time. Models were repeated with director-reported active play time as a covariate based on associations with physical activity in ECE centers.²⁵ Each model was repeated to examine each policy/practice component as the independent variable. Statistical analysis was performed using SAS 9.4.

Results

Children who enrolled in the study were aged 3.3 ± 0.5 years, including 50% girls. The race distribution included 54% White, 34% African American, 8% Asian, and 4% Mixed/Other race; also, the ethnicity distribution included 5% Hispanic. Fifteen percent of children were overweight, and 7% had obesity.

Children had complete accelerometry data for 4.0 ± 1.0 days (range: 1–5 preschool days). During the observed classroom period, children spent 50% of the time engaged in sedentary time and 50% engaged in TPA, including 15% of the total period engaged in MVPA. Specifically, children engaged in 3.7 ± 0.6 hours of TPA (including 1.1 ± 0.4 hours/day of MVPA) and 3.8 ± 0.6 hours of sedentary time at preschool; only two children did not attain at least 15 minutes/h of TPA, while 39% engaged in less than 1 hour/day MVPA at preschool (Table 2).

Screen-Time Policies and Practices

Based on director report, ScreenLimit_{director} score was 7.3 ± 1.0 . Centers met eight ($n=5$), seven ($n=1$), six ($n=3$), or five ($n=1$) components. Higher ScreenLimit_{director} (indicating more limits/supervision) was associated with higher levels of children's TPA ($p<0.0001$) and MVPA ($p=0.021$) and less sedentary time ($p<0.0001$). When active play time was included as a covariate, ScreenLimit_{director} remained significantly associated with higher levels of TPA ($p=0.015$) and less sedentary time ($p=0.015$) but not MVPA.

Based on direct observation, ScreenLimit_{observed} was 6.4 ± 1.2 . Centers met eight ($n=1$), seven ($n=3$), six ($n=4$), five ($n=1$), or three ($n=1$) components. Higher ScreenLimit_{observed} was associated with higher levels of TPA ($p=0.0003$) and less sedentary time ($p=0.0003$) but

Table 2. Descriptive Characteristics of the Children

	Boys, (n = 52)	Girls, (n = 52)	All, (n = 104)
Age, years	3.4 ± 0.5	3.3 ± 0.5	3.3 ± 0.5
BMI z-score	0.1 ± 1.1	0.3 ± 1.2	0.2 ± 1.1
BMI percentile	53.7 ± 30.0	59.9 ± 30.9	56.8 ± 30.3
Activity at school, hours/day			
Sedentary	3.7 ± 0.8	3.9 ± 0.5	3.8 ± 0.6
Total physical activity	3.8 ± 0.8	3.6 ± 0.5	3.7 ± 0.6
MVPA	1.2 ± 0.4*	1.0 ± 0.3	1.1 ± 0.4

Values are mean ± standard deviation. Physical activity includes light, moderate, and vigorous physical activity; MVPA includes moderate-to-vigorous physical activity.

Significant sex difference notated by * $p<0.05$.

not significantly associated with MVPA ($p=0.096$). With active play time as a covariate, ScreenLimit_{observed} remained significantly associated with higher levels of children's TPA ($p=0.033$) and less sedentary time ($p=0.033$) but not MVPA.

Screen-time policy. Directors at all 10 centers reported having a written screen-time policy; upon observation, the state policy²⁹ was posted for display in all centers. Without variance, further analysis was not possible.

Screen-time allowed. Four directors reported no screen-time, five reported <30 minutes/day, and one reported 30 minutes to 1 hour/day. There was more screen-time allowed based on observation: two allowed 30 minutes to 1 hour/day and one allowed 1–2 hours/day, but no child exceeded the 2 hour/day state regulation.²⁹ Children's TPA, MVPA, and sedentary time did not vary based on whether there was screen-time allowed based on director report or observation.

TV access. Six directors reported no TVs available for children's use and four provided varying access [in most classrooms ($n=1$), in some classrooms ($n=1$), or stored outside classrooms except for occasional use ($n=2$)]. TVs were observed in five classrooms; two were in centers where the director reported no TVs. Four classrooms had a DVD player; no video games or electronic toys were observed. Children's TPA, MVPA, and sedentary time did not vary by children's access to TV based on director report or observation. No TV time was observed.

Computer access. Computer access was variable, with most directors ($n=7$) reporting no access or <15 minutes/day ($n=3$). Children attending centers that reported offering

≤ 15 minutes/day of computer use had higher engagement in TPA ($p=0.0015$) and lower sedentary time ($p=0.0015$) than others, but MVPA did not differ.

Computers were the only screens observed [in seven classrooms, including desktop computers ($n=5$), Smartboard ($n=1$), and tablets/iPads ($n=1$)]. One computer was in a center where the director reported no computers. Children's TPA, MVPA, and sedentary time did not vary by observed computer access. Computer usage totaled 232 minutes at five centers, averaging 46.4 minutes of total screen-time in each (range: 27–85 minutes). Observed computer activities included "Dora the Explorer" game and Microsoft Paint on a desktop computer; a PBS activity on a Smartboard; and literacy, maze, and puzzle games on iPads built into a table. There were two adult-led computer activities for the entire classroom, including a teacher demonstrating a cartoon learning computer game for 30-minutes and an outside technology group delivering a 30-minute lesson on how to use desktop computers.

Educational nature of screen-time. Seven directors reported that TV/DVD viewing at preschool included only commercial-free, age-appropriate, educational programming that was integrated with the curriculum, with one director reporting mostly and two reporting some. In centers where directors reported only using appropriate TV/DVD content integrated within the curriculum, children engaged in more TPA ($p=0.04$) and MVPA ($p=0.03$) and less sedentary time ($p=0.04$).

Eating occasions. Nine directors reported rarely/never allowing TV/DVD viewing during meals/snacks; one director reported allowing this some of the time. Screen-time during eating occasions was observed at three centers. Children's TPA, MVPA, and sedentary time did not vary by eating occasions in front of the screen based on director report or observation.

Screens as rewards. All directors reported never/rarely using screens as rewards, and there were no observations of screens used as rewards. Without variance, further analysis was not possible.

Provider supervision. Most directors reported that providers supervise and watch children during screen-time activities all the time; one reported some of the time and one reported rarely/never. During observations, providers were always present in the room during screen-time. Children's TPA, MVPA, and sedentary time did not vary by provider supervision based on director report or observation.

Provider and parent training. Four directors reported providing screen reduction and media literacy training to providers at least yearly, and five directors reported providing training to parents. There were no differences in children's TPA, MVPA, or sedentary time between these groups.

Discussion

Policies and practices limiting screen time in ECE centers were significantly related to children's TPA, MVPA, and sedentary time. These relationships persisted independent of minutes of active play, suggesting that screen-time practices influence children's activity levels independently from physical activity practices. Specific policies/practices related to computer usage were more influential: higher computer access was related to less physical activity, whereas providing only educational screen-time rather than noneducational screen-time was related to more physical activity. The 10-component screen-time policies/practices tool may be useful for researchers and practitioners to more comprehensively evaluate the influence of screen-time in ECE centers on children's activity levels, particularly by including an examination of all types of screen usage and not only TV viewing.

The main results are in the expected direction but do contradict two prior studies in 29 centers that observed the reverse relationship: increased access to TVs/computers was related to *higher* physical activity levels in children.^{25,30} These data were collected before 2006, and associations may be confounded by centers with screen access also having greater financial resources and staff training.²⁵ Now that screens are becoming more readily accessible across income and education levels,³⁶ an inverse association between screen practices and young children's physical activity is emerging indicating the importance of monitoring screen usage at ECE centers.

No screen-time was observed in five centers, whereas the other five centers provided on average 46 minutes/day screen-time: this falls in the middle of the 0.1–1.3 hours/day of screen-time at ECE centers observed in previous studies.²² Because the state's regulations allow up to 2 hours/day screen-time at the ECE center, every center in the present study met the state policy. Yet, allowing 2 hours/day exceeds current national guidelines of 1 hour/day total screen-time^{8–10} and does not take into account children's screen-time outside of the ECE center. Therefore, more restrictive state policies are needed to ensure that children do not exceed screen-time limits throughout the day.

The amount of observed computer usage is higher than previous reports, such as a study of 842 ECE centers conducted in 2010–2012, in which 64% reported limiting computer time to ≤ 1 hour/week.³⁷ ECE centers now include other screen devices, including desktop computers, tablets/iPads, and Smartboards; indeed, all observed screen-time in the present study was computer-based. Since previous studies observed TV viewing as the predominant or exclusive screen-time,^{22,38,39} the present findings contribute updated information on screen usage in ECE centers and indicate that children's screen usage in ECE settings is diversifying beyond TV.

Most of the screen-time content was deemed by the directors as educational, age-appropriate, and integrated into

the curriculum, which aligns with a study of 168 child care facilities, in which over 90% of directors reported that TV was used for *educational or educational and entertainment* purposes.³⁹ In the present study, centers that only used educationally appropriate content also had more physically active and less sedentary children. The present study observed two instances of adult-led screen-time integrated within the curriculum; the other screen-time was independent play with content predominantly focused on literacy and math skills. Examining not only duration but also quality of screen-time aligns with the American Academy of Pediatrics guidelines,⁸ which recommend that screen-time should be high-quality programming that is covieved with an adult who helps children understand what they are seeing and apply what they learn. Similar approaches are endorsed by Canadian and Australian guidelines.^{9,10} Based on these guidelines, screen-time policies and practices should include recommendations on the educational content/quality and the role of an adult to coviev and integrate screen-time within the educational context.

All centers had a written screen-time policy, which may be attributed to state regulations²⁹ and national guidelines⁸ that caution practitioners on the negative associations of screen-time and young children's development. While many of the directors' reported practices aligned with classroom observation, the few discrepancies indicate that the directors' policies and expectations are not necessarily implemented in the classroom. Therefore, the classroom observation of practices was an important objective measure in addition to the director-report.

Children's physical activity levels were higher than previous estimates. The majority (61%) of children exceeded 1 hour/day MVPA, contrasting a review in which children failed to meet this threshold in 9 of 10 studies.⁴⁰ One reason for this discrepancy may be inconsistencies in physical activity measurement among preschool children⁴¹⁻⁴³; the Pate et al. cut-points were selected for the present study because these were validated against indirect calorimetry in preschool children.³⁴ However, using the same cut-points, nearly all children met guidelines of >15 minutes/h TPA in the present study, whereas just half of children met the recommended 15 minutes/h TPA in two studies of 38 ECE centers.¹¹ Reasons for this higher prevalence of physical activity, such as improved physical activity practices and environments, warrant further investigation. Interventions to promote physical activity and reduce screen-time may need to focus on centers where children are not meeting physical activity guidelines, as well as specifically support individual children who do not meet recommendations.

Future research should explore other factors that may influence screen-time policies and practices, including the centers' rating on the Quality Start system. In addition, the training of providers and parents in media literacy and screen-time reduction strategies is an opportunity for improvement, as training was not offered by many centers. Provider training contributes to healthy weight-related

practices in child care centers,³⁹ and parent training may reduce the likelihood of using screens as a calming rather than educational tool.⁴⁴ Other avenues of exploration include examining screen-time during eating occasions, of which there were three observed instances, for potential negative consequences for weight-related behaviors.⁴⁵ Future research should also expand to family child care homes, as high TV usage has been reported for these settings.^{37,46}

Strengths of the study include the use of the EPAO, which is a validated tool and highly cited in the international literature, the use of accelerometry to objectively measure children's physical activity, diversity among the children and ECE centers, and the extensive focus on screen-time usage and practices. Limitations of this study include limited generalizability as all 10 centers were located in one city, although the centers were diverse in type, size of student enrollment, and receipt of government funding. A second limitation is the use of 1 day's observation in one classroom in each center, although observations were scheduled to not conflict with special events, field trips, or bad weather. While the teachers and director were not explicitly told the reason for the study until after data collection, it is possible that social desirability bias led teachers to change their practices during the observation period.

In conclusion, children were more physically active and less sedentary in ECE centers that limited children's screen-time, particularly those that limited access to computers and ensured that content was educational and integrated within the curriculum. A comprehensive screen-time assessment may help practitioners and researchers to better understand the potential utility and harms of screen-time on young children's behavior.

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