SOCIO-DEMOGRAPHIC AND OTHER FACTORS CONTRIBUTING TO EXCESSIVE LEISURE SCREEN TIME IN PREADOLESCENT CHILDREN

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SUMMARY

Objectives: Excessive screen use in early school age is associated with worsened health habits and negative child development in later age. We aimed to assess the time spent on modern and traditional screen-based devices and examine its associations with socio-demographic characteristics.

Methods: This population-based cross-sectional observation study was conducted in Czechia, Slovakia and Finland between April and June 2021. Participants (N = 1,915) were parents/caregivers of children attending elementary school grades 1 to 3, selected by stratified random sampling. Children's daily leisure screen time (LST) based on parental reports was the main outcome. Descriptive statistics, mean comparison and linear regression analysis were used for the analysis.

Results: The average daily LST was found to be as high as 3.5 hours and significantly associated with most socio-demographic variables. Eighty percent of children exceeded the threshold of two hours of LST per day, which was formerly introduced by the American Academy of Pediatrics. The most important predictor of LST in children was having their screen-based device(s) for their exclusive personal use (EPU). Linear regression with all predictors assessed together confirmed the significant effect of the screen-based devices' EPU, the child's sex and grade, the child's birth order and the parent's education, even when controlled for media parenting practices.

Conclusions: Given the widespread availability of smartphones for exclusive personal use among young children, the regulation of EPU and the reinforcement of effective media parenting practices, particularly in families with lower education and income, are critical public health strategies to mitigate the negative impact of excessive screen time on child development and overall well-being.

Key words: screen use, screen time, smartphone, tablet, computer, television, prevention, early school age, children

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INTRODUCTION

Children's excessive use of modern devices with electronic screens (including smartphones, tablets, computers, gaming consoles, and TV) is of concern to parents, scholars and health professionals (1). The balanced use of screens may be beneficial (1); for example, educational media fostering academic skills (2) and high-quality screen use together with caregivers are positively associated with children's language skills (3). However, children are currently exposed to a large variety of screen devices and activities associated with the increased amount of time that they spend with screens daily (4). Children's excessive use of screens can have negative consequences associated with obesity (5), sleep problems (6–8), higher levels of emotional distress and depressive symptoms (9), attention problems (10), impaired visual function (11), academic performance (12), cognition (2), and other unfavourable conditions (13). To prevent harm associated with excessive screen use and provide timely intervention, it is necessary to understand the emergence of at-risk screen use during childhood.

Most studies on screen use have focused predominantly on preschoolers or adolescents. Recent studies on preschoolers have suggested that the average daily leisure screen time (LST), i.e., time spend with various screen-based devices, is relatively high (14–16) and exceeds the recommended limits (17). Similar evidence exists for adolescents (18–20). Evidence concerning early primary school-aged students is limited, especially for children in grades 1–3 who are aged 6–9 years. The recent systematic literature review identified 53 studies on screen use among school-aged children aged 6–14 years (21). From these, sixteen

provided screen time (ST) in the form of continuous variable and based on them the estimated average ST was 2.77 hours per day. All were based on pre-COVID-19 data. The other 37 studies reported ST in the form of discrete variable, most often (in 35 studies) using threshold 2 hours of LST per day (i.e., reporting the proportion of children with <2 h per day and ≥ 2 h of LST per day). The results showed that 46.4% of primary and middle school students aged 6 to 14 years had LST higher than 2 h per day. It should be noted that most reviewed studies focused on TV and computers; only few studies analysed the combination of TV, computers and portable devices (smartphones, tablets) to estimate LST (21), which might lead to underestimation of LST as it has been argued that TV watching is being accompanied by the use of new digital media (22).

The most relevant study was conducted among 6–9 years old children from 19 countries (including Czech Republic as a part of Eastern Europe) in 2015 and 2017 as a part of the project focused on child obesity. The average LST (across TV and electronic devices such as computer, tablet, smartphone, or other) for children in Eastern Europe was 1.7 hours per day (SD = 1.0), which was slightly higher than in South Europe, but slightly lower than in Northern Europe (23).

Importantly, the authors of the above-mentioned review observed a growth trend when comparing studies using data from before and after the COVID-19 outbreak. The average rates of school-aged children, who had LST higher than 2 h per day, were 41.3% and 59.4% before and after January 2020, respectively (21). However, evidence on screen use during the COVID-19 pandemic concerning preadolescents (children aged 6–10 years) is still scarce. Two studies using very small US samples, reported daily LST to be close to four hours in 6- to 10-year-olds (24) and 2- to 13-year-olds (25). Although these average ST may seem high, it was similar to pre-pandemic ST (3.8 hours) measured in the large sample of US children aged 9–10 years (26).

This opens the question about the definition of excessiveness in screen media use among school-aged children. When assessing LST in school-aged children, many studies use 2-hours per day as a threshold suggesting excessive screen use (21). It is probably due to the first appearance of the 2-hour limit in respect to TV viewing, which paediatricians – according to the American Academy of Paediatrics (AAP) were supposed to recommend to parents of children and adolescents: "Limit children's total media time (with entertainment media) to no more than 1 to 2 hours of quality programming per day" (27). The 2-hour recommendation was repeated in 2011 in relation to TV viewing and obesity: "Paediatricians should continue to counsel parents to limit total noneducational screen time to no more than 2 hours/day. In a recent study of 709 7- to 12-year-olds, children who did not adhere to the American Academy of Paediatrics guidelines of less than 2 hours/day of screen time and 11,000 to 13,000 pedometer steps per day were 3 to 4 times more likely to be overweight" (28). Also in the more recent AAP documents, the 2-hour threshold appeared. For instance, the threshold was mentioned when suggesting the displacement of TV viewing by the new digital media: "Despite these decreases, the majority of parents still reported that their children watched TV for 2 or more hours per day." (22). In the same document in relation to ST-related risk of obesity, the 2-hour limit was questioned as being maybe too mild: "In a 1996 study of 5- to 10-year-olds, the odds of being overweight were 4.6 times greater for youth watching more than 5 hours of TV per day compared with those watching 0 to 2 hours. This study greatly influenced the AAP recommendations for 2 hours or less of sedentary screen time daily for children 2 through 18 years of age. However, a more recent study in the Netherlands of children 4 through 13 years of age found that watching TV over 1.5 hours per day was a significant risk factor for obesity. These more recent studies suggest that setting limits of TV viewing to between 1 and 1.5 hours a day may be more effective to prevent obesity than the 2 hours per day standard presented in earlier AAP recommendations" (22). Similar to that 2-hours limit appeared in another AAP document from 2016 again in the context of TV viewing "...among children aged 8 years and older, average daily TV time remains over 2 hours per day." (1), but it is not present in the recommendations to parents which are advised to "place consistent limits on hours per day of media use as well as types of media used" (1), with no further specification on the number of hours. It should be noted that the most recent AAP guidelines for families explicitly warned against overly relying on screen time limits and emphasized the importance of media content, open communication about media, not using media for calming children, and other aspects of screen media use (29).

The guidelines concerning LST are continuously developing as well as it is screen media landscape. Recent information on major sources of LST, sex- and age-based differences in LST and the socio-demographic family factors contributing to excessive screen use is lacking, especially in European school-aged children.

Our aim was to fil this gap and examine LST (and its sources) in elementary school children aged between 6 and 10 years. Specifically, we assessed ST on several screen-based devices and analysed the associations between LST and child, parent, family and socio-demographic characteristics.

MATERIALS AND METHODS

A baseline cross-sectional study was part of a larger study*.

Data Collection

We conducted the study in three European countries – Czechia, Slovakia and Finland. Alongside two Central European countries, we included Finland to enhance the generalizability of the findings beyond Central Europe. The three countries share many similarities, such as size, strong social welfare systems, well-regarded educational systems, and relatively homogeneous populations, with most people sharing the same ethnicity and language. However, they also have differences reflected, e.g., by the human development index (HDI); Finland belongs to the most developed European countries (11th place worldwide, 9th in Europe), while Czechia is around average (22nd in Europe) and Slovakia slightly below the average (29th in Europe) (30). Other differences are reflected in the cultural dimension of Power Distance which describes the degree of acceptance and following of authority (31). Finland scores low on the Power Distance dimension which means a preference for independence, equal

*Protocol available at https://osf.io/93qx4

rights, participative communication, and coaching style instead of control whereas Czechia is in the middle and Slovakia is on the opposite end of spectrum. Regarding digital technology, Finland has a strong tradition in the area of portable devices (32) and gaming (33). Finally, the previous study on European countries Northern European school-aged children showed the higher LST compared to East and North (23). It was therefore possible to directly compare screen use of children in three countries with differing HDI, power distance rankings, and previously found extent of screen media use.

Households of children attending grades 1–3 of elementary school were accessed through schools in Czechia, Slovakia, and Finland selected based on stratified random sampling to obtain national representative samples. Data were collected between April and June 2021. Children were the primary target population, but information on them and families was provided by their parents/caregivers. Parents/caregivers were accessed through cooperating schools and invited to fill the online questionnaire (powered by LimeSurvey), which took them approximately 20 minutes. In Czechia, pen-and-paper data collection was also used. In such cases a cooperating school received envelopes with printed surveys and distributed them to parents/caregivers of children in target age. Then parents/caregivers returned filled questionnaire in the sealed envelopes to teachers responsible for data collection, which delivered them to the research team. In Czechia, data collection partially interfered with the period of online (at-home) schooling caused by the COVID-19 pandemic lock-down. In Slovakia and Finland, data collection started after the end of COVID-19 related lockdowns in their countries. Parents/caregivers did not receive any incentive to participate or any reward for their participation, which was strictly voluntary.

Data from participants with consent (N=2,836) were checked for validity and missing data. The inclusion/exclusion criteria were based on the registration protocol: provided informed consent for participation; had less than 25% missing values in the questionnaire (excluded, n=871); the child was between 6 and 11 years old (excluded, n=7); the child attended school in the time of data collection (i.e., s/he was not ill or quarantined, excluded, n=43). The final sample consisted of 1,915 participants. The sample from Czechia was divided into two subsamples based on whether schools were closed or open in relation to the COVID-19 pandemic (Table 1).

Measures

Leisure screen time (LST) in children was measured using eight items on time spent with different types of screen-based devices for entertainment purposes. The types of devices were portable devices (smartphone or tablet), gaming console, personal computer, and television. For each type of devices, a parent reported time spent on the device during a typical weekday and weekend day in two separate items. The combination of device and type of day (weekday/weekend day) led to eight individual items. The minutes reported for each of four types of screen-based device during a typical weekday/weekend day were summed to calculate weekday/weekend day LST. Weekday LST was multiplied by 5, weekend LST by 2. Daily LST was a sum of both divided by 7. The range of daily LST was 0 (no LST) to 960 minutes (240 or more minutes spent with all types of devices, including combined use of the devices).

Based on daily LST we categorized children into two groups reflecting whether they spend with screens 2 hours or less per day. Despite 2-hours limit being gradually abandoned and replaced by more sophisticated approaches to screen media use (29, 34), we used it in our study for the sake of easy comparability with other studies (21).

Another question asked which device(s) a child has available for his/her exclusive personal use (EPU). EPU was defined by no need to share the device with neither parent nor sibling in case of portable devices and computer; and by having the device in child's room in case of gaming console and television. The types of devices were smartphone, tablet, gaming console, personal computer, television, i.e., 5 items in total. Response options were "yes" or "no".

Socio-demographic variables such as child's age, sex, grade, parent's gender, age, education, and family income were assessed as correlates of children's ST (Table 1).

Media parenting was included as a control variable, which could affect (confound) the relationship between EPU and LST. Giving children device(s) for their exclusive personal use is a parental decision which may be related to the parental approach to screen media and willingness to regulate their use in children. The presence/absence of parental regulation has been found to affect LST in younger children (35–38) and therefore it is important to control for the effect of media parenting practices when analysing relationships between EPU and LST. Media parenting practices were assessed via Media Parenting Inventory (MEPA) (39), which consisted of active mediation subscale: e.g., I chat with my child about time that s/he spends using screens, I help my child to find suitable content (e.g., videos, games, apps, websites, texts, and pictures); rules subscale: e.g., we have agreed rules about screen time, we have rules specifying situations in which my child is or is not allowed to watch/use screens; control subscale: e.g., I do not let my child use screens longer than agreed, I do not let my child consume other content than agreed; and overprotection subscale: e.g., I constantly check my child's screen activities, in our family we set rules which almost never allow children to use screens for entertainment.

Alongside the above-mentioned variables, other variables were part of the questionnaire, which were not analysed within this study; namely general parental warmth and control – PARQ/C questionnaire (20 items), parental stress (4 items), parental technoference (6 items), and parental excessive screen use (9 items). All variables were measured using parental reports.

Ethics

The study was approved by the Ethical Committee of the Faculty of Education, Charles University, Prague, Czech Republic. All participants provided informed consent with their participation. Parental informed consent was obtained for those younger than 18 years of age. The study procedures were carried out in accordance with the Declaration of Helsinki.

Statistical Analysis

First, we estimated the socio-demographic differences between country samples to assess their comparability. We also examined the proportion of devices' EPU in each sample. Chi-square tests and mean comparisons (ANOVA with Games-Howell post hoc

Table 1. *Characteristics of study population of children using screen-based devices from Czechia, Finland, and Slovakia (N = 1,915)*

Variable	Whole sample n (%)	Czechia (at-home schooling) (n = 570) n (%)	Czechia (n = 529) n (%)	Finland (n = 369) n (%)	Slovakia (n = 447) n (%)	Difference between samples
Gender						
Girls	926 (48.8)	275 (48.8)	242 (46.0)	174 (47.5)	235 (52.9)	χ^2 (3) = 4.90 ns
Boys	973 (51.2)	288 (51.2)	284 (54.0)	192 (52.5)	209 (47.1)	
Grade (year of study)						
Grade 1	679 (35.5)	177 (31.3)	210 (39.7)	131 (35.5)	161 (36.0)	
Grade 2	660 (34.4)	212 (37.2)	167 (31.6)	136 (32.4)	145 (32.4)	χ^2 (6) = 11.40 ns
Grade 3	576 (30.1)	181 (31.8)	152 (28.7)	102 (27.6)	141 (31.5)	
Child's mean age, years (SD)	8.4 (1.0)	8.4 (1.0)	8.3 (1.1)	8.7 (0.9)	8.3 (1.2)	F (3,1017) = 20.90***
Child's position among siblings						
Only child	356 (19.3)	98 (17.9)	109 (21.3)	59 (16.7)	90 (20.7)	
Youngest child	658 (35.6)	205 (37.4)	186 (36.4)	129 (36.5)	138 (31.8)	χ^2 (9) = 22.60**
Middle child	209 (11.3)	66 (12.0)	54 (10.6)	55 (15.6)	34 (7.8)	
Oldest child	623 (33.7)	179 (32.7)	162 (31.7)	110 (31.2)	172 (39.6)	
Intact family	1,498 (78.5)	427 (75.2)	405 (77.1)	285 (77.2)	381 (85.4)	χ^2 (3) = 17.30***
Family income						
Less than 1,200 EUR	226 (13.2)	87 (18.2)	73 (15.7)	12 (3.5)	54 (12.9)	
1,200–1,799 EUR	428 (25.1)	131 (27.4)	126 (27.0)	43 (12.5)	128 (30.5)	χ^2 (9) = 143.00***
1,800–2,399 EUR	606 (35.5)	132 (27.6)	126 (27.0)	169 (49.1)	179 (42.7)	
More than 2,400 EUR	447 (26.2)	128 (26.8)	141 (30.3)	120 (34.9)	58 (13.8)	
Family residence in rural/urban area						
Up to 999 inhabitants	185 (10.0)	56 (10.1)	79 (15.6)	1 (0.3)	49 (11.3)	
1,000–4,999 inhabitants	346 (18.7)	85 (15.3%)	71 (14.0)	46 (12.9)	144 (33.3)	
5,000–19,999 inhabitants	363 (19.6)	62 (11.2)	62 (12.3)	138 (38.8)	101 (23.3)	χ^2 (12) = 316.00***
20,000–99,999 inhabitants	511 (27.6)	168 (30.3)	130 (25.7)	125 (35.1)	88 (20.3)	
100,000 or more inhabitants	445 (24.1)	184 (33.2)	164 (32.4)	46 (12.9)	51 (11.8)	
Responding parent's sex						
Female	1,628 (85.5)	491 (86.9)	459 (87.1)	308 (84.4)	370 (83.0)	χ^2 (3) = 4.68 ns
Male	275 (14.5)	74 (13.1)	68 (12.9)	57 (15.6)	76 (17.0)	
Responding parent's mean age, years (SD)	39.1 (5.64)	39.4 (5.96)	39.4 (5.55)	39.2 (5.61)	38.5 (5.3)	F (3,966) = 2.74*
Parental education						
Elementary/practical	290 (15.3)	130 (23.0)	93 (17.7)	24 (6.6)	43 (9.7)	
High school	691 (36.4)	215 (38.0)	211 (40.1)	122 (33.8)	143 (32.2)	χ^2 (6) = 88.20***
University	916 (48.3)	221 (39.0)	222 (42.2)	215 (59.6)	258 (58.1)	
Devices for child's exclusive personal use						
Smartphone	1,132 (59.1)	310 (54.4)	273 (51.6)	348 (94.3)	201 (45.0)	χ^2 (3) = 244.00***
Tablet	639 (33.4)	191 (33.5)	195 (36.9)	89 (24.1)	164 (36.7)	χ^2 (3) = 19.30***
Gaming console	213 (11.1)	51 (8.9)	61 (11.5)	59 (16.0)	42 (9.4)	χ^2 (3) = 13.00**
Computer	437 (22.8)	164 (28.8)	149 (28.2)	34 (9.2)	90 (20.1)	χ^2 (3) = 60.70***
Television	389 (20.3)	124 (21.8)	127 (24.0)	48 (13.0)	90 (20.1)	χ^2 (3) = 17.40***

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Number of child's own devices[1]						
0 devices	292 (15.2)	95 (16.7)	85 (16.1)	17 (4.6)	95 (21.3)	
1 device	874 (45.6)	235 (41.2)	227 (42.9)	199 (53.9)	213 (47.7)	
2 devices	453 (23.7)	156 (27.4)	119 (22.5)	105 (28.5)	73 (16.3)	χ^2 (12) = 73.00***
3 devices	186 (9.7)	50 (8.8)	63 (11.9)	27 (7.3)	46 (10.3)	
4 or 5 devices	110 (5.7)	34 (6.0)	35 (6.6)	21 (5.7)	20 (4.5)	

[1]Groups were established based on responses for each type of device; 32 children with five devices were merged with the group with four types of devices.
*p < 0.05, **p < 0.01, ***p < 0.001, ns – not significant (p > 0.05)

tests) were used. Second, we examined mean and median ST in socio-demographic categories and based on devices' EPU and socio-demographic variables. Welch's ANOVA with Games-Howell post hoc tests or Welch's t tests were used. Third, we conducted linear regression analysis with daily screen time as an outcome and those variables that were found to be significant in separate analyses (step two) as predictors. Predictors were included step by step to determine their effects on the model fit.

Missing Values

The overall percentage of missing values in the final sample was low (M = 2.21, SD = 4.19), and 1,031 (53.5%) participants had no missing values. No imputations were made to replace missing values. Complete case analyses were conducted.

RESULTS

Participant Characteristics

The whole sample and country-specific samples are shown in Table 1. We found significant differences between country samples in a variety of socio-demographic characteristics (Table 1). More importantly, we found significant differences between samples based on devices' EPU (namely, smartphones' EPU). Compared to Finland, where the prevalence of smartphones' EPU was very high (94%), in Czech and Slovak samples smartphones' EPU was much lower (55% and 45%, respectively).

Screen Time

The mean and median values of reported daily ST in participating countries are shown in Table 2. We found significant omnibus differences in daily ST between subsamples: F (3; 1,032) = 6.96, $p \leq 0.001$ (Table 2). Post hoc comparisons are shown in Supplementary Table S1.

The 2-hour daily screen time threshold was exceeded in 80% of the whole sample. The proportion was highest in Finland (89%), followed by the Czechia-at-home schooling sample (83%), Czechia (78%), and Slovakia (71%). Differences between countries were significant: χ^2 (3) = 44.2, $p < 0.001$.

Correlates of Screen Time

Boys showed significantly higher LST than girls (Table 2). Children in the 3rd grade had the highest LST (Table 2, Table S2). Higher LST was found in the only child and youngest child compared to other siblings (Table 2, Table S3). Children from intact families had lower LST than children living in nonintact families (Table 2). Children from low-income families had the highest LST (Table 2, Table S4). Children of low-educated parents had the highest LST and vice versa (Table 2, Table S5). Parental gender and age were not significantly associated with LST (Table 2).

We found significant differences in LST based on whether child has had device(s) for their exclusive personal use – Table 2. Having device for EPU was associated with significantly higher daily screen time for all types of devices (Table 2); the effects were large for gaming console, television and smartphone, moderate for computer, and small for tablet. More types of devices for EPU meant higher LST (Table 2, Table S6).

Media parenting was found to be only weakly associated with LST (Table 2). Active mediation, rules and control were weak but significantly negatively correlated to LST; overprotection showed close to zero insignificant positive correlation with LST.

To simultaneously assess the effect of the previously identified correlates, linear regression was performed with daily LST as the outcome predicted by the number of devices a child has for EPU, socio-demographic variables, and media parenting. All included predictors remained significant (Table 3) except intactness of the family and family income. However, both these variables were significantly associated with parental education ($p < 0.001$). The model explained 22% of the variance (20% without media parenting). The predictors differed in the number of minutes by which they increased the intercept level. The major contributors were the number of devices for child's EPU and low parental education.

DISCUSSION

Median daily LST in children attending grades 1–3 of elementary school was 3.5 hours and 80% of children exceeded 2 hours in front of screen. Child's daily LST was associated with most socio-demographic characteristics (low educated parents, being a boy, being 3rd grader, being the youngest child in the family) and having device/s for exclusive personal use (EPU). The device which was the most often available to children for EPU was smartphone (59% of children, ranging from 45% in Slovak to 94% in Finnish sample). Each additional device for child's EPU increased LST substantially. LST was negatively associated with media parenting, namely rules and control.

We found that a relatively large number of children have at least one screen-based device for their exclusive personal use. Having television in bedroom has been consistently found to be

Table 2. *Associations between daily leisure screen time and study variables*

	Daily screen time (minutes)		Between-groups difference in daily screen time	
	Mean/median	SD	Omnibus differences/Post hoc tests[a]	Effect size
Country and home/present schooling			F (3; 1,032) = 6.96***	η^2 = 0.011
a) Czechia present schooling	225/210	125		
b) Czechia at-home schooling	243/227	131		
c) Slovakia present schooling	208/189	120		
d) Finland present schooling	233/214	104		
Gender			t (1,884) = 4.97***	d = 0.23
a) Girls	214/197	113		
b) Boys	242/223	130		
Child's age[1]			r = 0.15***	
Grade (year of study)			F (2; 1,254) = 22.70***	η^2 = 0.024
a) Grade 1	208/184	121	< b* < c***	
b) Grade 2	224/214	118	< c***	
c) Grade 3	255/240	125		
Child's position among siblings			F (3; 717) = 10.10***	η^2 = 0.016
a) Only child	239/231	116	> c*** > d***	
b) Youngest child	241/223	121	> c*** > d***	
c) Middle child	211/184	125		
d) Oldest child	209/189	121		
Family intactness			t (640) = 4.16***	d = 0.23
a) Intact family	221/206	121		
b) Nonintact family	250/236	124		
Family income[+]			F (2; 1,704) = 15.80***	η^2 = 0.018
a) Less than 1,799 EUR	272/261	149	> b** > c***	
b) 1,800–2,399 EUR	235/225	117	> c***	
c) More than 2400 EUR	225/210	117		
Responding parent's sex			t (377) = 1.25 ns	d = 0.08
a) Female	229/210	122		
b) Male	219/206	120		
Responding parent's age[1]			r = 0.012 ns	
Responding parent's education			F (2; 730) = 47.30***	η^2 = 0.058
a) Elementary/Practical	283/274	153	> b*** > c***	
b) High school	239/231	110	> c***	
c) College	201/180	113		
Devices for child's exclusive personal use				
Smartphone				
Yes	251/236	125	t (1,795) = 10.60***	d = 0.49
No	194/180	111		
Tablet				
Yes	242/227	120	t (1,311) = 3.59***	d = 0.17
No	221/197	124		
Gaming console				
Yes	303/296	134	t (255) = 8.79***	d = 0.67
No	218/201	118		

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Computer				
Yes	264/253	131	t (659) = 6.80***	d = 0.38
No	217/197	118		
Television				
Yes	285/274	135	t (541) = 9.56***	d = 0.57
No	213/197	115		
Number of devices for child's exclusive personal use			F (4; 472) = 72.30***	η^2 = 0.133
a) 0 devices	152/133	97.4	< b*** < c*** < d*** < e***	
b) 1 device	215/197	110.2	< c*** < d*** < e***	
c) 2 devices	255/240	123.5	< e***	
d) 3 devices	275/264	112.7	< e**	
e) 4 or 5 devices	336/317	148.5		
Media parenting – active mediation[1]			r = −0.072**	
Media parenting – rules[1]			r = −0.120***	
Media parenting – control[1]			r = −0.163***	
Media parenting – overprotection[1]			r = 0.028 ns	

[a]Only statistically significant post hoc tests are reported; *p < 0.05, **p < 0.01, ***p < 0.001, ns – not significant (p > 0.05). All post-hoc tests are reported in supplementary Tables S1–S6.
SD – standard deviation.
[1]The association between LST and the variable was analysed using Pearson's correlation test.
[+]Given the low number of cases in the income group less than 1,200 EUR in Finland, we merged it with the group 1,200–1,799 EUR.

Table 3. *Regression model predicting daily leisure screen time based on number of screen-based devices for exclusive personal use, socio-demographic characteristics and media parenting (N = 1,915)*

Predictor	Estimate	SE	95% CI		t	p-value
			Lower	Upper		
Intercept[a]	223.988	25.21	174.53	273.45	8.88	< 0.001
Number of devices for child's exclusive personal use[1]						
1 device	41.307	9.19	23.28	59.33	4.50	< 0.001
2 devices	72.515	10.35	52.20	92.83	7.00	< 0.001
3 devices	84.410	12.72	59.46	109.36	6.64	< 0.001
4 or 5 devices	147.286	15.37	117.12	177.45	9.58	< 0.001
Grade[2]						
2nd	3.724	7.10	−10.20	17.65	0.52	0.600
3rd	21.548	7.54	6.76	36.33	2.86	0.004
Sex[3]						
Boy	22.629	5.87	11.11	34.15	3.85	< 0.001
Child's position among siblings[4]						
Middle child	−11.308	9.93	−30.80	8.18	−1.14	0.255
Only child	0.195	8.63	−16.73	17.12	0.02	0.982
Youngest child	22.390	7.13	8.39	36.39	3.14	0.002
Intact family[5]						
0–1	5.407	7.71	−9.72	20.53	0.70	0.48
Family income[6]						
Less than 1,799 EUR	20.202	8.66	3.21	37.19	2.33	0.020
1,800–2,399 EUR	14.752	7.60	−0.15	29.66	1.94	0.052
Responding parent's education[7]						
Elementary/Practical	53.326	10.43	32.87	73.79	5.11	< 0.001
High school	21.495	6.84	8.07	34.92	3.14	0.002

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Media parenting – active mediation	−1.351	6.21	−13.53	10.83	−0.22	0.828
Media parenting – rules	−7.598	5.35	−18.09	2.89	−1.42	0.155
Media parenting – control	−22.656	6.11	−34.65	−10.68	−3.71	< 0.001
Media parenting – overprotection	4.242	4.63	−4.83	13.32	0.92	0.359
Country sample[8]						
Czechia – at-home schooling	23.166	7.98	7.52	38.81	2.90	0.004
Finland	17.873	9.07	0.09	35.66	1.97	0.049
Slovakia	10.709	8.55	−6.06	27.47	1.25	0.210

[a]Represents reference level. Reference levels for predictors were: [1]0 devices, [2]1st, [3]girl, [4]oldest child, [5]yes, [6]more than 2,400 EUR, [7]university, [8]Czechia
$R^2 = 0.22$

associated with excessive LST (40), our study suggested that also having smartphones and other types of devices for the exclusive use in age 6–11 years increased LST. This was in line with the results of a recent small-scale study with preschool and school-aged children (14, 41). It may suggest that preventing excessive LST require parental regulative effort (it does not come from child's own wish and/or self-regulation) as it has been suggested previously (1, 29, 42); and the regulation is more required when children have devices for their exclusive personal use. The effect of EPU remained significant even when the analysis was controlled for media parenting practices. Therefore, parents and the relevant professions should be informed about the suitability of regulation and provided with further support to enhance their regulative efforts.

The daily LST reported in our study could be considered high in respect to the2-hour daily limit previously established by AAP (27, 28) and previously reported LST. European studies, in which data was collected prior to COVID-19 pandemic, reported lower proportions, such as the Irish 10-year-old cohort (43) with just over 30% of the sample exceeding the limit, and based on review of pre-pandemic studies from all over the world, the proportion for age group 6–14 was 41.3%. Specifically for Central Europe region, based on data from 2015 and 2017 the average recreational ST among European children was 1.7 hours per day for East Europe, 1.4 for South Europe and 1.9 for North Europe (23). However, the recent systematic literature review captured the ST increase after COVID-19 pandemic outbreak (21), which was further suggested by study using direct comparison of pre and during COVID-19 outbreak data (25). In addition, the daily LST values obtained within this study in Czech, Slovakia and Finland were comparable with recent data from the US (24–26), suggesting that excessive screen use in school-aged children is likely to be a global phenomenon that may need to be addressed despite acknowledging that the mere extent of screen media use is not as important as the quality of content and other aspects of screen media use accentuated by the recent expert guidelines (29).

The most protective constellation of excessive screen use was being a girl attending the first (or second) grade with no screen-based device for her exclusive personal use, and have a parent (mother) with a university degree, who controls child's screen media activities (checking screen time and content and provides restrictions). It seems that being the middle child or the oldest child is associated with lower LST. Parental education was an important socio-demographic predictor of child's LST with children of mothers with elementary or practical education having more than 1 hour of daily LST more than children of mothers with university degree. This finding is in congruence with previous findings that children from lower-income families are exposed to longer screen times and are less likely to view educational content on screen-based devices than children from higher-income families or those with more highly educated mothers (44). Even though high LST itself could not be problematic, the combination of high LST and lower-quality content may be disadvantageous for children from families with lower socioeconomic status. Previous studies suggested that using screen media for entertainment may be deliberately promoted by parents in pursuit of providing relatively cheap and safe leisure activity for their children, especially when living in problematic neighbourhood (45). Therefore, the motivation of families with lower socio-economic status for screen media regulation must be further explored in order to develop optimal intervention for child excessive LST.

Being the youngest child in the family (i.e., having older siblings but no younger ones) seemed to be a risk factor for excessive LST. This may be attributed to lower capacity and willingness of parents to provide surveillance over their school-aged child, which may be relatively safely left under the partial care of older sibling(s). Previous studies have accentuated the importance of parental regulation for preventing children's excessive LST (35–38), and having a working mother was previously identified as a risk factor for excessive screen use (46). The ability of a parent to regulate his or her older child's screen use might be higher when the parent stays at home with his or her younger child/ren. Additionally, the screen use of the youngest child in the family may be regulated less due to the pressure of older children in the family on parents to loosen the rules for screen media use within family. Such pressure on parents by their preadolescent children has been evidenced in the recent qualitative study (47). Finally, it has been shown that birth order affects parenting (48, 49), but the effects on screen use regulation should be examined in future studies.

Strengths and Limitations

This study contributed to filling the knowledge gap related to factors contributing to excessive LST in preadolescents (children aged 6–10 years). Further, we were able to analyse differences in child LST based on a comparison of cohorts from three different countries. Finally, the study was conducted during the COVID-19 pandemic that allowed us to collect evidence on screen use during this period.

Relying on parental reports of screen time was the major limitation of this study. In addition, we used an interval scale with an upper limit of 240 minutes for each screen-based device rather than letting participants report screen time freely. In order to increase the participation (response) rate we simplified the questionnaire to a substantial degree which could have led to less precise data on screen time and underestimation of screen time. However, the median values of daily screen time were found to be lower than the mean values, and only a minority of participants (< 10%) used the upper limit of the scale in the case of screen time on portable devices and on television; and even less (< 2%) in the case of other devices. This finding suggests that setting the upper limit may not have affected the underestimation of daily screen time. Despite the effort to obtain a representative sample, intact families and highly educated parents were overrepresented in the study, especially in the Slovak and Finnish samples. This could be due to a relatively low response rate and could result in obtaining lower screen time values, while low parental education was found to be associated with higher screen time. Family income was not adjusted across countries, which limited the explanatory power of this variable in the case of Finland. We assessed only the associations between screen time and socio-demographic variables and did not control the analysis for potentially important covariates such as parental screen use. Finally, this study focused on screen time as an important aspect of screen use, but other important aspects, such as the content and context of screen use (34), were not analysed.

CONCLUSIONS

Children's daily recreational screen time based on parental reports was found to be high compared to the recommended 2-hour limit and was significantly associated with most socio-demographic variables. Child's ownership of device/s significantly increased ST, while the most owned device in this age group was the smartphone. These findings contribute significantly to the ongoing debate about the negative, yet preventable, factors that increase daily recreational screen time in children. The findings may be of interest to practitioners, educators, and parents as well as policy and decision makers when balancing the safety and accessibility of electronic devices. Support should be provided to both children and parents to reduce excessive ST through empowering the regulative skills of children and the regulative efforts of parents.

Authors' Contributions

KL, RG – design of the study; KL, MB – initial draft; KL, MS – literature review; KL, JV – all analyses. All other authors contributed to the interpretation of data and refinement of the paper. All authors approved the final version of the article.

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Conflicts of Interest

Roman Gabrhelík is the shareholder of Adiquit Ltd., which is currently developing apps for addictions recovery. Nevertheless, no funding was related to this study and the activities had no role in the study design or the data collection, analysis, and interpretation of the data, writing the manuscript, or the decision to submit the paper for publication. The remaining authors have no conflicts of interest to declare.

Availability of Data and Materials

The datasets generated and/or analysed during the current study are available in the Open Science Framework repository: https://osf.io/5qnm9/.

Electronic Supplementary Materials

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