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Published in:
Public Health in Practice

DOI:
10.1016/j.puhip.2025.100596

Publication date:
2025

Document version:
Final published version

Document license:
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Citation for pulished version (APA):
Slater, S. O., Arundell, L., Grøntved, A., & Salmon, J. (2025). Age of first digital device use and screen media use at age 15: A cross-sectional analysis of 384,591 participants from 55 countries. *Public Health in Practice*, 9, Article 100596. <https://doi.org/10.1016/j.puhip.2025.100596>

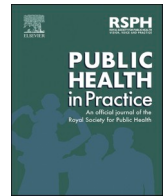
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Age of first digital device use and screen media use at age 15: A cross-sectional analysis of 384,591 participants from 55 countries

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ARTICLE INFO

Keywords:

Screen time
Children
Adolescent

ABSTRACT

Objectives: We investigated the associations between age of first digital device use and screen media use at age 15. **Study design and methods:** Utilizing cross-sectional data from the 2018 Program for International Student Assessment, we analyzed responses from 384,591 fifteen-year-olds (50 % girls) from 55 countries on their age of first device use and current frequency of 12 screen behaviours. Behaviors were categorized as social, gaming, recreational, educational/practical (grouped into regular [every day; almost every day] and non-regular users [once or twice a week; once or twice a month; never or hardly ever]). Generalized linear regression, adjusted for highest level of schooling of mother/father and with student sampling and replicate weights to account for the sampling design was used to estimate prevalence ratios (PR) for regular use of each screen activity per additional year of age when first using devices.

Results: Higher age of first device use was associated with lower prevalence of being a regular user for nine screen behaviours at age 15, with some sex differences. The strongest association was found for using email* (PR per increasing year of first device use for total sample: 0.956 [95%CI 0.935; 0.977]; boys: 0.956 [95%CI 0.928; 0.986]) and playing collaborative online games (girls: 0.947 [95%CI 0.905; 0.991]). Later first use of devices was associated with decreased prevalence of regular use for social purposes at age 15.

Conclusion: The later children start using digital devices, the less likely they are to be regular users at 15 years, especially social use. Delaying children's introduction to digital devices may decrease future use.

1. Introduction

The access to and use of digital devices has increased at a remarkable rate in recent decades [1]. Previous studies have found that excessive screen time among children and adults, is related to poorer physical and mental health [2,3]. However, research shows that children are using digital devices at an increasingly younger age [4]. Furthermore, the amount of screen media use increases with age [5] and the average amount of recreational screen media use is approximately 8.5 h/day among U.S. teens (13- to 18-years old), with boys spending 1 h and 14 min more on screen media per day compared to girls [6]. Previous studies have shown device-specific associations with health and wellbeing [7,8]. For example, passive screen time (e.g., television) is negatively associated with locomotive skills, physical strength, adiposity and cognitive and socioemotional development [8], while educational screen time (e.g., computer for homework) and interactive screen time

(e.g., video games) are associated with positive educational outcomes [7]. Health behaviours during adolescence are crucial as they typically impact behaviour, health and wellbeing later in life [9]. It is therefore essential to develop healthy behavioural habits during childhood and adolescence.

Delaying children's first screen exposure may help with improved behavioural and health outcomes later in life. A study from 2023 including 27,969 18–24-year-olds found better mental wellbeing among those who started using smartphones or tablets later in childhood [10]. Furthermore, a meta-analysis from 2020 found that later use of screen media was associated with stronger child language skills among children below 12 years [11]. Additionally, a study from 2019 found an association between age of first screen use and emotional and behavioral difficulties at age 2- to 5-year old children [12]. However, to our knowledge no previous study has investigated age of first screen use and frequency of screen use in adolescence. This is a significant gap, as

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<https://doi.org/10.1016/j.puhip.2025.100596>

Received 31 July 2024; Received in revised form 21 January 2025; Accepted 22 January 2025

Available online 13 February 2025

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screen media use during childhood and later in life may impact both physical and mental health. Understanding the factors that contribute to excessive screen media use in adolescents is crucial for informing policies and practices aimed at preventing such behavior. Therefore, the aim of the current study was to investigate the association between age of first digital device use and use of digital devices for different screen behaviours at age 15, with stratification by sex given the differences in screen time between boys and girls [6].

2. Method

2.1. Sample

This cross-sectional study used data from the Organisation for Economic Co-operation and Development (OECD) conducted Program for International Student Assessment (PISA), which started in 2000 and collects data from 15-year olds every three years [13]. PISA utilizes a two-stage survey design incorporating probabilistic, stratified, and clustered methods for the participating countries. In the first stage, the schools are categorized into different strata, and then a minimum of 150 schools are randomly chosen from each country, with the probability of selection proportional to school size [13]. The second stage of the sampling focuses on students within the selected schools. From the list of students in each school, either 42 or 35 students are chosen with equal probability for computer and paper-based self-report assessments. In cases where the target number of students is not met, all students on the list are selected [13]. The current study includes data from the PISA 2018 database with $n = 612,004$ 15-year-old students from 79 countries [13]. The measures used in the current study were included in the PISA 2018 Information and Communications Technology (ICT) familiarity questionnaire. Detailed information about the data collection procedure and questionnaire content can be found in the PISA 2018 technical report [13].

2.2. Measurement of age of first screen use

The question “How old were you when you first used a digital device?” was used to assess age of first digital device use. The response categories were: 1) 3 years or younger; 2) 4–6 years; 3) 7–9 years; 4) 10–12 years; 5) 13 years or older; and 6) I have never used digital devices until today. To enable the analysis, this variable was re-coded to be used as a continuous exposure variable as: 3 years or younger = 1.5; 4–6 years = 5, 7–9 years = 8, 10–12 years = 11, 13 years or above = 14; and I have never used digital devices until today = 15.

2.3. Measurement of screen use at age 15

To measure the use of digital devices at age 15, participants were asked about their use of 12 different screen behaviors, “How often do you use digital devices for the following behaviours outside of school?”: 1) playing collaborative online games; 2) using email; 3) playing one-player games; 4) playing online games via social networks (e.g. Farmville, The Sims Social); 5) obtaining practical information from the Internet (e.g. locations, dates of events); 6) reading news on the Internet (e.g. current affairs); 7) downloading music, films, games or software from the internet; 8) downloading new apps on a mobile device; 9) uploading your own created contents for sharing (e.g. music, poetry, videos, computer programs); 10) chatting online (e.g. MSN); 11) browsing the Internet for fun (such as watching videos, e.g. YouTube); and 11) participating in social networks (e.g. Facebook, Myspace). The response categories were: 1) Never or hardly ever, 2) Once or twice a month, 3) Once or twice a week, 4) Almost every day, and 5) Every day. The participants were dichotomized into two groups “regular users” (every day; almost every day) and “non-regular users” (once or twice a week; once or twice a month; never or hardly ever). Screen time behaviours were each analyzed separately and also grouped into the

following categories: social (using email; chatting online; participating in social networks), gaming (playing collaborative online games; playing one-player games; playing online games via social networks), recreational (downloading music, films, games or software from the internet; uploading your own created contents for sharing; browsing the internet for fun), or education/practical (reading news on the internet; obtaining practical information from the Internet; downloading new apps on a mobile device). A total screen time variable was also created by combining all screen media behaviours into one variable. Participants were identified as regular users if they reported their use as at least ‘almost every day’ to all variables included in each group, including the total screen time variable.

2.4. Additional measurement

The highest level of schooling for mother or father was reported by the adolescent at age 15.

2.5. Statistical analyses

The PISA 2018 data were downloaded from the OECD PISA website (OECD 2018, Student questionnaire data files, accessed on 16/1/2023). Sex difference in the number of included boys and girls were analyzed using Wilcoxon ranksum test, while sex difference in age was analyzed using two sample *t*-test. Difference between boys and girls according to age of first digital device use and percentage of regular users in the different screen behaviours were analyzed using chi-squared test. The Generalized Linear Model with poisson distribution and log link function was used to investigate the association between age of first digital device use and prevalence of being a regular user for each screen time activity (separately), screen time behaviours groups (social, gaming, recreational or education/practical purposes), and total screen time behaviours at age 15 [14]. The results were reported as prevalence ratios (PR) with 95 % CI, as PR have shown to be more appropriate than e.g. odds ratio when analysing cross-sectional data [15]. All models were fitted for the full sample as well as separately for boys and girls. All analyses were adjusted for highest level of schooling for mother or father and country. The analysis including all participants were furthermore adjusted by sex. Student sampling weight and replicate weights were implemented to account for the sampling design as per the PISA study protocol [13]. Ordinal logistic regression was conducted as sensitivity analysis to investigate the association between age of first digital device use and each screen time activity (separately), screen time behaviours groups (social, gaming, recreational or education/practical purposes), and total screen time behaviours at age 15. The analysis were conducted in STATA version 18 and statistical significance was set at the 0.05 level.

3. Results

The current study included 384,591 participants from 55 countries (Table 1). Characteristics of participants are shown in Table 1. A significant difference was found between boys and girls for age of first use and for all screen behaviours, except “uploading your own created contents for sharing” and “browsing the internet for fun”. Boys had a higher percentage of regular users in all screen behaviours, except “downloading music, films, games or software from the internet”, “chatting online”, “participating in social networks” and screen behaviours with a social purpose.

3.1. Age of first use of a digital device and use of screen behaviours at age 15

The results showed that higher age of first use of digital devices was associated with a lower prevalence of regular users of eleven of the measured screen time behaviours at age 15 among the total sample (Table 2). The strongest association was found for ‘using email’ where

Table 1
Characteristics of included participants.

	All participants	Boys	Girls	p-value
N	384,591	192,085	192,506	0.007
Age in years (mean (SD))	15.8 (0.3)	15.8 (0.3)	15.8 (0.3)	0.052
Age of first use of digital devices (%) ^a				
2 years	7.53	9.41	5.68	<0.001
4–6 years	27.83	29.81	25.87	<0.001
7–9 years	35.56	34.06	37.03	<0.001
10–12 years	21.07	19.00	23.12	<0.001
13 years or older	6.85	6.29	7.40	<0.001
I have never used a digital device	1.16	1.42	0.90	<0.001
Regular users ^b of each of the screen behaviours (%) ^a				
Playing collaborative online games	50	55	38	<0.001
Using email	39	41	36	<0.001
Playing one-player games	48	52	41	<0.001
Playing online games via social networks	46	49	42	<0.001
Obtaining practical information from the Internet	46	48	45	<0.001
Reading news on the Internet	48	49	47	<0.001
Downloading music, films, games or software from the internet	51	50	51	<0.001
Downloading new apps on a mobile device	40	42	39	<0.001
Uploading your own created contents for sharing	45	45	44	0.399
Chatting online	65	64	66	<0.001
Browsing the Internet for fun	65	66	64	0.017
Participating in social networks	66	64	68	<0.001
Regular users ^b of the groupings of screen behaviours (%) ^{a,c}				
Social	57	55	58	<0.001
Gaming	28	38	18	<0.001
Recreational	40	42	37	<0.001
Education/practical	35	39	31	<0.001
Total use	17	22	12	<0.001

^a Reported as survey-weighted proportions.

^b Regular user defined as performing the activity 'every day' or 'almost every day'.

^c Social (using email; chatting online; participating in social networks), gaming (playing collaborative online games; playing one-player games; playing online games via social networks), recreational (downloading music, films, games or software from the internet; uploading your own created contents for sharing; browsing the internet for fun), or education/practical (reading news on the internet; obtaining practical information from the Internet; downloading new apps on a mobile device).

every increase in age of first use of digital devices was associated with an estimated 4.4 % lower prevalence rate of regular users at age 15 ($p < 0.001$). No significant associations were found for 'uploading your own created contents for sharing' (Table 2).

When stratified by sex, results showed that an increase in age of first use of digital devices was associated with decreased prevalence of regular users for nine of the digital devices for boys and girls (Table 2). Among boys the strongest association was found for 'using email' where every increase in age of first digital device use was associated with a 4.4 % decrease in the prevalence rate of regular users at age 15. Among girls the strongest association was found for 'playing collaborative online games' where every increase in age of first digital device use was associated with a 5.3 % decrease in the prevalence of regular users at age 15. No association was found for 'playing online games via social networks', 'downloading new apps on a mobile device', 'uploading your own created contents for sharing' among either boys or girls (Table 2).

Associations between age of first use of digital devices and screen behaviours for social, gaming, recreational and education/practical

purposes (Table 3) showed that for every increase in age of first digital device use there was an estimated 2.3 % decrease in the prevalence of regular users of digital devices for social purposes among the total sample ($p < 0.001$). For boys and girls, every increase in age of first digital device use was associated with a 2.2 % and 2.4 % decrease in the prevalence of regular users of digital devices for social purposes, respectively (boys: $p = 0.012$, girls: $p = 0.016$). No associations were found for the other grouped screen behaviours, or for total screen use.

3.2. Sensitivity analysis

In alignment with the results above, the ordinal logistic regression showed that the odds of being in a lower frequency category of screen use (e.g., "almost every day," "once or twice a week," or less frequent use) decreases with higher age at first use of screen media devices according to 11 of the 12 measured screen time behaviours at age 15 among the total sample and 9 for boys and girls (see Table 1 in Supplementary file 1). The strongest association was found for 'browsing the internet for fun' where each additional year of delay in the age at first use, the odds of being in a lower frequency category of screen use decrease by 9 % among boys ($p < 0.001$) (see Table 1 in Supplementary file 1). Furthermore, the ordinal logistic regression showed that for each additional year of delay in the age at first digital device use, the odds of being in a lower frequency category of screen use for social purposes decrease by 4 %, 2 % and 6 % among the total sample, boys and girls, respectively (see Table 2 in Supplementary file 1). No association was found for the other grouped screen behaviours, or for total screen use (see Table 2 in Supplementary file 1).

4. Discussion

This cross-sectional study aimed to investigate the association between age of first digital device use and use of digital devices for different screen behaviours at age 15. The main finding of the current study is that the later adolescents started using digital devices in childhood, the lower the prevalence of being a regular user at age 15. The association was significant for 11 out of the 12 screen behaviours among the total sample and 9 screen behaviours among boys and girls. There was only one significant finding when the screen time activities were grouped into different purposes. A statistically significant inverse association was found between age of first digital device use and the prevalence of regular users of digital devices for social purposes at age 15. These findings suggest it is important to delay initial access to digital devices in childhood to decrease the regular use of screens later in life. However, given many children globally are using digital devices at increasingly younger ages [4], and that the amount of screen media use increases with age [5], this remains a challenge for families.

As mentioned above age of first digital device use was significantly associated with 11 out of the 12 screen behaviours among the total sample. In the current study almost 2/3 of the sample were regular users of chatting online, using the internet for fun, and participating in social networks, which aligns with a study from 2021 showing that 77 % of adolescents aged 13–18 years watch online videos and 62 % use social media everyday [6]. Interestingly, the screen behaviours of 'browsing the internet for fun', and 'participating in social networks' had some of the highest percentages of regular users at age 15 in the current study, which align with the fact that 62% of adolescents use social media every day [6]. Given this, there may need to be strategies to help families manage social media or internet use in addition to delayed first use.

The results from the sex stratification in the current analysis showed similar prevalence ratio of being a regular user of most of the screen behaviours among the total sample, as well as boys and girls separately. The inverse association between age of first digital device use and being a regular user of 'Chatting online' was only statistically significant among both boys and girls. However, a previous study showed a greater use of social screen use by girls from the age of 14 compared to boys

Table 2
Association between age when using digital devices for the first time and use of digital device for different activities at age 15.

	All participants			Boys			Girls		
	PR	95 % CI	P-value	PR	95 % CI	P-value	PR	95 % CI	P-value
Playing collaborative online games	0.959	0.944; 0.973	0.000	0.961	0.945; 0.978	0.000	0.947	0.905; 0.991	0.020
Using email	0.956	0.935; 0.977	0.000	0.956	0.928; 0.986	0.004	0.956	0.921; 0.991	0.016
Playing one-player games	0.962	0.946; 0.979	0.000	0.966	0.947; 0.985	0.001	0.954	0.917; 0.993	0.020
Playing online games via social networks	0.973	0.951; 0.997	0.027	0.978	0.947; 1.010	0.165	0.966	0.931; 1.002	0.067
Obtaining practical information from the Internet	0.970	0.956; 0.984	0.000	0.969	0.952; 0.987	0.001	0.970	0.948; 0.993	0.011
Reading news on the Internet	0.972	0.953; 0.986	0.000	0.971	0.953; 0.990	0.003	0.973	0.952; 0.996	0.021
Downloading music, films, games or software	0.975	0.962; 0.988	0.000	0.972	0.954; 0.990	0.003	0.978	0.959; 0.998	0.032
Downloading new apps on a mobile device	0.976	0.957; 0.995	0.013	0.975	0.949; 1.002	0.072	0.976	0.949; 1.005	0.104
Uploading your own created contents for sharing	0.980	0.958; 1.003	0.086	0.979	0.946; 1.012	0.208	0.983	0.951; 1.016	0.298
Chatting online	0.981	0.973; 0.990	0.000	0.978	0.965; 0.992	0.002	0.985	0.972; 0.998	0.024
Browsing the Internet for fun	0.976	0.968; 0.984	0.000	0.976	0.965; 0.988	0.000	0.975	0.964; 0.986	0.000
Participating in social networks	0.976	0.968; 0.985	0.000	0.975	0.962; 0.988	0.000	0.978	0.966; 0.989	0.000

Estimates are from the Generalized Linear Model with poisson distribution and log link function adjusted for highest level of schooling for mother or father and country. The analysis including all participants were furthermore adjusted by sex. Student sampling weight and replicate weights were implemented to account for the sampling design.

PR = Prevalence Ratio per increasing year of first device use.

Table 3
Association between age of first digital device use and use of digital device grouped into social, gaming, recreational and education/practical and total use of digital devices.

	All participants			Boys			Girls		
	PR	95 % CI	P-value	PR	95 % CI	P-value	PR	95 % CI	P-value
Social	0.977	0.966; 0.989	0.000	0.978	0.962; 0.995	0.012	0.976	0.957; 0.995	0.016
Gaming	1.003	0.983; 1.024	0.738	0.995	0.969; 1.021	0.702	1.021	0.978; 1.064	0.338
Recreational	0.997	0.981; 1.014	0.749	0.996	0.975; 1.017	0.696	1.000	0.971; 1.028	0.954
Education/practical	0.993	0.976; 1.011	0.429	0.991	0.968; 1.014	0.437	0.995	0.964; 1.028	0.770
Total use	1.027	0.998; 1.057	0.072	1.016	0.979; 1.054	0.407	1.047	0.990; 1.106	0.107

Estimates are from the Generalized Linear Model with poisson distribution and log link function adjusted for highest level of schooling for mother or father and country. The analysis including all participants were furthermore adjusted by sex. Student sampling weight and replicate weights were implemented to account for the sampling design.

PR = Prevalence Ratio per increasing year of first device use.

[16]. This may indicate that chatting online is a part of girls lives no matter when they are introduced to digital devices for the first time.

No association was found between age of first digital device use and total use of digital devices for screen behaviours at age 15. This highlights the importance of examining screen behaviours separately, as total screen media use may be less sensitive to pick up differences in specific devices. Furthermore, previous studies have shown that screen media behaviours are differently related to children and adolescents' health [7,8]. A previous study in children showed that TV viewing and videogames were associated with an unfavorable temperament, lower health-related quality of life, and poorer health outcomes, while educational screen time (e.g. computer for homework) was positive associated with educational outcomes and had no negative association with other outcomes [7]. In addition, a systematic review found that video gaming was correlated with more severe depressive symptoms [8]. Therefore, the results from the current study showing a negative association between age of first digital device use and decreased prevalence of participants regularly playing video games, encourage parents to delay their child's introduction to gaming. However, the fact that the later children start using digital devices, the less likely they are to be regular users at 15 years may not be preferred for all screen behaviours. As mentioned above, it has been shown that screen behaviours with educational purposes is positively associated with educational outcomes [7]. Therefore, some of the digital device behaviours in the current study may be beneficial for the participants, e.g., reading news on the Internet and obtaining practical information from the internet. Furthermore, a previous study showed that children who start using a computer earlier than the age of 7, have significantly higher perceived competence and autonomy in information and communications technology usage at the age of 15 [17]. The above indicates that earlier use of digital devices

may be positive for the use of digital devices and educational outcomes later in life. Hence, it might not simply be advantageous that the decreased prevalence of regular users at age 15 is linked to the age when using digital devices for the first time.

A strength of the current study was the large sample size which made it possible to divide the screen time behaviours into different purposes of digital device use and explore associations among boys and girls separately. However, a limitation was the use of self-report, which may introduce recall and social desirability bias. Reporting the first usage of digital devices by 15-year-olds could pose a challenge due to the difficulty of recalling such specific details. Another limitation is that the variable with data on the participants age of first digital device use was categorical in the questionnaire. The use of a continuous variable for age of first use and screen media use at age 15 would allow more sensitive analyses, particularly if there is an 'optimal age' when digital devices could be introduced in childhood. Future studies would benefit from investigating the duration (as a continuous variable) instead of the frequency of the use of digital devices at age 15 to get a better understanding of the relationships assessed. In addition, a more exhaustive list of screen media behaviours would build on the current findings. Future studies should consider collecting information about which devices the child used when they used digital devices for the first time, as e.g., television and smartphones may have different effects on the lifestyle. Finally, it would be beneficial to assess why they started using digital devices at that specific time point, e.g., did they have access to digital devices before that time point but was not interested or did they use digital devices as soon as they have access?

In conclusion, the later the participants start using digital devices, the lower the prevalence of regular users of digital devices for most of the different screen behaviours at 15 years of age. Therefore, it is

important that parents delay their child's introduction to digital devices to decrease the use of screen media later in life.

Data availability

The current study includes data from the PISA 2018 database which can be found at their webpage <https://www.oecd.org/pisa/data/2018/database/>.

Author contributions

SOS did the analysis and interpretation of data, and drafted the article. LA, AG and JO supported the analysis and interpretation of the data, and revised the article. All authors approved the final version of the article.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. AG is supported by Novo Nordisk Foundation (Grant number NNF20SH0062965), Centre for Childhood Health (2024_F_011), and Independent Research Fund Denmark (ID 4262-00092B). LA is supported by an Australian Research Council Discovery Early Career Researcher Award (DE220100847). JS is supported by a Leadership Level 2 Fellowship, National Health and Medical Research Council of Australia (APP 1176885).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank all involved participants.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhip.2025.100596>.

[org/10.1016/j.puhip.2025.100596](https://doi.org/10.1016/j.puhip.2025.100596).

References

- [1] A. Schleicher, PISA 2018: Insights and Interpretations, Organisation for Economic Co-operation and Development (OECD), 2019.
- [2] G. Lissak, Adverse physiological and psychological effects of screen time on children and adolescents: literature review and case study, *Environ. Res.* 164 (2018) 149–157.
- [3] N. Stiglic, R.M. Viner, Effects of screentime on the health and well-being of children and adolescents: a systematic review of reviews, *BMJ Open* 9 (2019) e023191.
- [4] S. Chaudron, M.E. Beutel, V. Donoso Navarrete, M. Dreier, B. Fletcher-Watson, A. Heikkilä, et al., Young Children (0-8) and Digital Technology: A Qualitative Exploratory Study across Seven Countries: JRC, ISPRA, Italy, 2015.
- [5] E. Kontostoli, A.P. Jones, N. Pearson, L. Foley, S.J.H. Biddle, A.J. Atkin, Age-related change in sedentary behavior during childhood and adolescence: a systematic review and meta-analysis, *Obes. Rev.* 22 (2021) e13263.
- [6] V. Rideout, A. Peebles, S. Mann, M.B. Robb, The common sense census: media use by tweens and teens, in: San Francisco, CA: Common Sense 2021, 2021.
- [7] T. Sanders, P.D. Parker, B. del Pozo-Cruz, M. Noetel, C. Lonsdale, Type of screen time moderates effects on outcomes in 4013 children: evidence from the Longitudinal Study of Australian Children, *Int. J. Behav. Nutr. Phys. Activ.* 16 (2019). N.PAG-N.PAG.
- [8] S. Domingues-Montanari, Clinical and psychological effects of excessive screen time on children, *J. Paediatr. Child Health* 53 (2017) 333–338.
- [9] H.M. Al-Hazzaa, N.A. Abahussain, H.I. Al-Sobayel, D.M. Qahwaji, A.O. MUSAIGER, Physical activity, sedentary behaviors and dietary habits among Saudi adolescents relative to age, gender and region, *Int. J. Behav. Nutr. Phys. Activ.* 8 (2011) 140.
- [10] SAPIEN LABS, Age of First Smartphone/Tablet and Mental Wellbeing Outcomes2023 May 15, 2023.
- [11] S. Madigan, B.A. McArthur, C. Anhorn, R. Eirich, D.A. Christakis, Associations between screen use and child language skills: a systematic review and meta-analysis, *JAMA Pediatr.* 174 (2020) 665–675.
- [12] J. Lin, I. Magiati, S.H.R. Chiong, S. Singhal, N. Riard, I.H.-X. Ng, et al., The relationship among screen use, sleep, and emotional/behavioral difficulties in preschool children with neurodevelopmental disorders, *J. Dev. Behav. Pediatr.* 40 (2019).
- [13] OECD, PISA 2018 Technical Report, 2018.
- [14] W. Chen, J. Shi, L. Qian, S.P. Azen, Comparison of robustness to outliers between robust Poisson models and log-binomial models when estimating relative risks for common binary outcomes: a simulation study, *BMC Med. Res. Methodol.* 14 (2014) 82.
- [15] A.R. Tamhane, A.O. Westfall, G.A. Burkholder, G.R. Cutter, Prevalence odds ratio versus prevalence ratio: choice comes with consequences, *Stat. Med.* 35 (2016) 5730–5735.
- [16] M. Leonhardt, S. Overå, Are there differences in video gaming and use of social media among boys and girls?—a mixed methods approach, *Int. J. Environ. Res. Publ. Health* 18 (2021) 6085.
- [17] L. Juhaňák, J. Zounek, K. Záleská, O. Bárta, K. Vlčková, The relationship between the age at first computer use and students' perceived competence and autonomy in ICT usage: a mediation analysis, *Comput. Educ.* 141 (2019) 103614.