

Types of On-Screen Content and Mental Health in Kindergarten Children

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 Supplemental content

IMPORTANCE Excessive screen time has been associated with a higher risk for mental health problems, but whether the associations differ by screen content types is unclear.

OBJECTIVE To examine the allocation of and longitudinal changes in screen exposure across different content types and to explore their associations with mental health in children aged 3 to 6 years.

DESIGN, SETTING, AND PARTICIPANTS This cohort study used 3-wave, lagged generalized estimating equation models to analyze data from the Shanghai Children's Health, Education and Lifestyle Evaluation-Preschool (SCHEDULE-P) study in Shanghai, China. The cohort was a representative sample of kindergarten children. Data were collected between November 2016 and May 2019 when children were aged 3 to 4 years (wave 1), 4 to 5 years (wave 2), and 5 to 6 years (wave 3). Data analysis was performed between June 2022 and May 2023.

EXPOSURE Screen exposure (total daily time and time with each type of content, including educational programs, entertainment programs, non-child-directed programs, electronic games, and social media) was collected when children were aged 3, 5, and 6 years.

MAIN OUTCOMES AND MEASURES Mental health of children at age 3, 5, and 6 years was reported by parents using the Strengths and Difficulties Questionnaire.

RESULTS Of the 15 965 children included in the representative sample, 8270 were males (51.7%) and the mean (SD) age at wave 1 was 3.73 (0.30) years. As children developed from ages 3 to 6 years, the proportion of screen exposure to educational programs (≤ 1 hour per day: 45.0% [95% CI, 43.5%-46.5%] to 26.8% [95% CI, 25.3%-28.3%]) and entertainment programs (≤ 1 hour per day: 44.4% [95% CI, 42.8%-45.9%] to 32.1% [95% CI, 30.4%-33.9%]) decreased, whereas exposure to social media increased (≤ 1 hour per day: 1.5% [95% CI, 1.2%-1.9%] to 27.1% [95% CI, 25.5%-28.7%]). The associations between on-screen content and mental health varied. For a given total screen time, a higher proportion of screen exposure to educational programs was associated with a lower risk for mental health problems (adjusted odds ratio [AOR], 0.73; 95% CI, 0.60-0.90), whereas non-child-directed programs were associated with a higher risk for such problems (AOR, 2.82; 95% CI, 1.91-4.18). Regardless of the content, total screen time was consistently associated with mental health problems.

CONCLUSIONS AND RELEVANCE Results of this study indicated that both total screen time and different types of content were associated with mental health problems in children aged 3 to 6 years. Limiting children's screen time, prioritizing educational programs, and avoiding non-child-directed programs are recommended.

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JAMA Pediatr. 2024;178(2):125-132. doi:10.1001/jamapediatrics.2023.5220
Published online December 4, 2023.

Mental health problems are an important public health issue as they account for a large portion of the global burden of disease.¹ Mental health problems can manifest in early childhood and persist into adolescence and adulthood and have been associated with other adverse outcomes^{2,3} such as worse academic attainment, substance use disorder, and higher rates of disability and mortality.⁴⁻⁷ Therefore, it is critical to identify the risk factors for mental health problems in early childhood.^{8,9} Screen exposure is considered an emerging factor, as younger children have become the fastest-growing users of screens.¹⁰ Research has found that excessive screen time in early childhood is associated with a higher risk for mental health problems.¹¹ Furthermore, the content shown on screens is increasingly recognized as a critical factor.^{12,13}

Studies have found that different types of on-screen content to which young children are exposed have different associations with their mental health problems.¹⁴⁻²⁰ For instance, Barr et al²¹ found an adverse association between mental health and self-control skills when kindergarten children were exposed to non-child-directed television programs. Zimmerman and Christakis²² found that children exposed before age 3 years to more entertainment television had a higher risk for mental health problems a few years later and that violent entertainment content was more detrimental, whereas exposure to educational television content, especially that with prosocial components,²³ showed no adverse outcomes.^{16,22} The constraints of such research, however, need to be recognized. The amount of total screen time and the choice of on-screen content both play an important role in children's mental health.²⁴ Previous studies, however, focused solely on either total screen time or time spent on specific content types, and few studies considered the implications of these factors together. Additionally, current research does not have repeated measurements and thus could not elucidate the lagged associations between on-screen content and children's mental health over time.

We aimed to address these limitations by using repeated measurements in a longitudinal, population-based cohort of kindergarten children in Shanghai, China. The study examines the allocation of and longitudinal changes in screen exposure across different content types and explores their associations with mental health in children aged 3 to 6 years.

Methods

Study Design and Participants

This cohort study used data from the Shanghai Children's Health, Education and Lifestyle Evaluation-Preschool (SCHEDULE-P) study. The SCHEDULE-P was a large population-based cohort study that investigated the implications of family environment and lifestyles for the health of children aged 3 to 6 years.²⁵ Briefly, a randomized, stratified, 2-stage cluster sampling was adopted to select the SCHEDULE-P cohort, and more details of this process are provided in the eMethods in [Supplement 1](#). The first stage of sampling included newly enrolled children aged 3 to 4 years in 191 randomly selected kindergartens in Shanghai. After providing online informed consent, parents of those children were invited to complete online questionnaires in 3 waves:

Key Points

Question What are the associations between screen exposure to different content types and mental health in children aged 3 to 6 years?

Findings In this cohort study of 15 965 kindergarten children, screen exposure was consistently associated with risk for mental health problems, but the associations varied by content type. Specifically, under a given total screen time, children with a higher proportion of screen exposure to educational programs had a lower risk for mental health problems, whereas the non-child-directed programs were associated with a higher risk for such problems.

Meaning Findings of this study suggest that both screen time and on-screen content matter for children's mental health.

entrance to kindergarten (November 10-24, 2016; aged 3-4 years), middle of kindergarten (April 12-26, 2018; aged 4-5 years), and graduation from kindergarten (April 22-May 5, 2019; aged 5-6 years). The study was approved by the Institutional Review Board of the Shanghai Children's Medical Center, Shanghai Jiao Tong University. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

Measures

Parents were asked to report the amount of time their child at ages 3, 5, and 6 years spent on a typical weekday and weekend day in the latest month watching different content types: educational programs (with explicit cognitive or prosocial components [eg, *Sesame Street* and *QiaoHu*, a similar program in China]), entertainment programs (eg, *Thomas & Friends* and *Super Flying Man*), non-child-directed programs (any program not designed for children), electronic games, and social media (including WeChat) using all screen devices (television, computer, cellular phone or smartphone, and tablet).²⁶ Total screen time per day was calculated using the following formula: $[(\text{weekday screen time} \times 5)] + [(\text{weekend screen time} \times 2)]/7$. We capped the maximum amount of total screen time per day at 16 hours.²⁷ To analyze the risks of screen content, we excluded participants with no screen exposure during any of the 3 waves. We also calculated the proportion of screen exposure to each content type, using the following formula: $(\text{time spent on a certain on-screen content per day})/(\text{total screen time per day})$. Total screen time was categorized into 5 groups: 1 hour or less per day, more than 1 hour to 2 hours or less per day, more than 2 hours to 3 hours or less per day, more than 3 hours to 4 hours or less per day, and more than 4 hours per day. The proportion of screen exposure to each content type was used as the continuous variable in the analyses.

The Strengths and Difficulties Questionnaire (SDQ), which is an internationally recognized survey tool with good reliability and validity for Chinese children aged 3 to 17 years,^{28,29} was completed by parents and was used to assess the children's mental health status during the 3 waves. The reliability of the SDQ has been tested by internal consistency, and the Cronbach α coefficient ranged from 0.30 to 0.83 in the subscales.²⁹ The total difficulties groups and subscales of the SDQ were used as categorical variables in the analyses (eMethods in [Supplement 1](#)).

Table 1. Baseline Characteristics

Characteristic	Participants, No. (%) ^a
All participants	15 965
Child age, mean (SD), y	3.73 (0.30)
Child sex	
Male	8270 (51.7)
Female	7695 (48.3)
Maternal educational level	
≤Junior high school	886 (6.8)
High school diploma and junior college	5678 (38.1)
Undergraduate degree	7597 (44.9)
≥Master's degree	1762 (9.9)
Unknown	42 (0.3)
Paternal educational level	
≤Junior high school	731 (5.3)
High school diploma and junior college	5633 (37.3)
Undergraduate degree	7140 (42.9)
≥Master's degree	2398 (14.0)
Unknown	63 (0.4)
Annual family income, in thousands, ¥	
≤100	2975 (21.0)
>100 to 300	8163 (52.3)
>300	3871 (20.7)
Unknown	955 (6.0)
Missing data	1 (0)
Single-child status	
No	4012 (25.8)
Yes	11 953 (74.2)
Parental divorce or separation	
No	15 210 (95.2)
Yes	464 (2.8)
Unknown	291 (2.0)
Primary caregiver	
Mother	8912 (55.2)
Father	820 (5.5)
Grandparents or others	6233 (39.3)
CPCIS score, mean (SD) ^b	2.74 (0.96)
SDQ total difficulties score, mean (SD)	12.06 (4.93)
Normal	11 524 (71.6)
At risk ^c	4441 (28.4)

Abbreviations: ¥, yuan renminbi (to convert to US dollar, multiply by 7.30); CPCIS, Chinese Parent-Child Interaction Scale; SDQ, Strengths and Difficulties Questionnaire.

^a Estimates used sampling weights.

^b 25 Samples had missing data on CPCIS.

^c Total difficulties score over 14 points indicated mental health was at risk.

At all 3 waves, parents reported their children's sex and age, annual family income, maternal educational level, paternal educational level, single-child status, parental divorce or separation, primary caregiver, and parent-child interactions. All measurements are described in the eMethods in [Supplement 1](#).

Statistical Analysis

Statistics on maternal educational level for those who declined to participate or withdrew from the survey vs those who were included in the final analytical sample were determined (eTable 1 in [Supplement 1](#)). Multiple imputation was performed to address the missing data (eMethods in [Supplement 1](#)). The data set used

Table 2. Screen Exposure by Wave

Characteristic	Mean (95% CI) ^a		
	Wave 1 (n = 15 965)	Wave 2 (n = 15 965)	Wave 3 (n = 15 965)
Total screen time, h/d	2.64 (2.60-2.69)	3.38 (3.33-3.44)	3.13 (3.06-3.20)
Screen content, h/d			
Educational programs	0.86 (0.85-0.88)	0.99 (0.97-1.01)	0.65 (0.63-0.67)
Entertainment programs	1.02 (1.00-1.04)	0.99 (0.97-1.01)	0.76 (0.74-0.78)
Non-child-directed programs	0.17 (0.16-0.18)	0.22 (0.21-0.23)	0.22 (0.21-0.24)
Electronic games	0.53 (0.51-0.54)	0.61 (0.59-0.63)	0.66 (0.63-0.68)
Social media	0.07 (0.06-0.07)	0.58 (0.56-0.59)	0.84 (0.82-0.86)

^a Estimates used sampling weights.

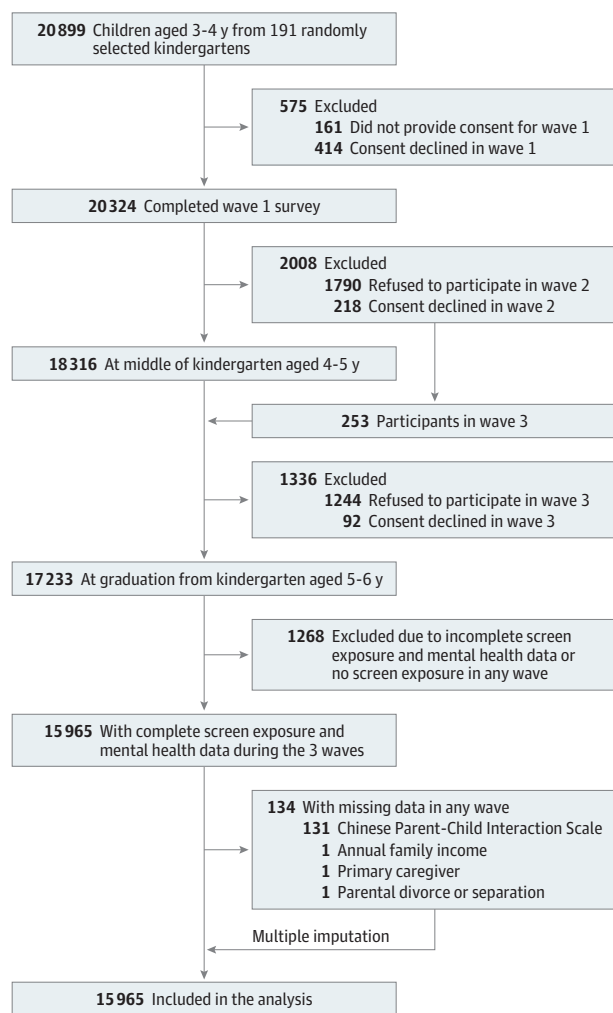
in this study contained 15 965 observations, among which 15 831 participants completed all variables during the 3 waves. Descriptive characteristics (mean [SD] and number [%]) were used to describe the baseline characteristics of children included in the analysis and children with complete data, and statistical tests (group mean comparison unpaired, 2-tailed *t* tests and χ^2 tests) were used to determine the differences between children with complete data and children with missing data (eTable 2 in [Supplement 1](#)).

Stratified cluster random sampling weights were computed with inverse probability weighting and were used to ensure representativeness of sample sizes in descriptive and regression analyses. Characteristics and screen exposure (time and proportion of exposure to each content) in each survey were described in [Table 1](#), [Table 2](#), and eTable 3 in [Supplement 1](#). The associations between children's screen exposure to each content at an earlier wave and total difficulties groups at a later wave were analyzed through lagged generalized estimating equations models that accounted for total screen time and other covariates. A logit link was used for binary outcomes, and an independent working covariance matrix was used. The main advantage of generalized estimating equation was that it allowed accounting for within-person correlation. Adjusted odds ratios (AORs) with 95% CIs were calculated. The association between total screen time and total difficulties groups was estimated (eTable 4 in [Supplement 1](#)).

Using the same models, we calculated the interactive associations between screen exposure and maternal educational level with total difficulties groups (eTables 5 and 6 in [Supplement 1](#)) and the associations between the proportion of screen exposure to each content and subscales of the SDQ (eTable 7 in [Supplement 1](#)). Several sensitivity analyses were conducted (eMethods; eTables 8-11 in [Supplement 1](#)). All models controlled for children's sex and age, annual family income, maternal educational level, paternal educational level, single-child status, parental divorce or separation, primary caregiver, and parent-child interactions.

All tests were 2-sided, with *P* < .05 denoting statistical significance. Data analyses were conducted in Stata, version 16.0 (StataCorp LLC), between June 2022 and May 2023.

Figure. Flowchart of Analytical Sample



Results

The initial cohort consisted of 20 899 children aged 3 to 4 years. A total of 20 324 children completed the wave 1 survey (response rate of 97.2%), among whom 3344 children did not finish the wave 2 or wave 3 survey due to refusal to participate or to provide informed consent. We included children who participated in all 3 surveys with complete data on screen exposure and mental health. To analyze the outcome of screen exposure to different content types, we excluded participants with no screen exposure during any of the 3 waves. Thus, the final representative sample for analysis included 15 965 participants (Figure). Compared with the sample included, the sample lost during follow-up had lower maternal educational level (eTable 1 in Supplement 1).

The characteristics of the study population using data sets after multiple imputation and adjusted with sampling weights are displayed in Table 1. Among the 15 965 children, 8270 were males (51.7%) and 7695 were females (48.3%). The mean (SD) age of the children during wave 1 of data collection was 3.73

(0.30) years. Children with missing data were found to have lower socioeconomic status and be more likely to have siblings (eTable 2 in Supplement 1).

Children were exposed to a mean of 2.64 (95% CI, 2.60-2.69) hours per day of total screen time at age 3 years, 3.38 (95% CI, 3.33-3.44) hours per day at age 5 years, and 3.13 (95% CI, 3.06-3.20) hours per day at age 6 years (Table 2). For the time spent on certain content types, educational programs and entertainment programs were prominent. Children spent a mean of 0.53 (95% CI, 0.51-0.54) hours per day on electronic games at age 3 years, 0.61 (95% CI, 0.59-0.63) hours per day at age 5 years, and 0.66 (95% CI, 0.63-0.68) hours per day at age 6 years. The proportion of screen exposure to different content types changed across the 3 waves (Table 3). Specifically, the proportion of exposure to educational programs (≤ 1 hour per day: 45.0% [95% CI, 43.5%-46.5%] to 26.8% [95% CI, 25.3%-28.3%]) and entertainment programs (≤ 1 hour per day: 44.4% [95% CI, 42.8%-45.9%] to 32.1% [95% CI, 30.4%-33.9%]) decreased from wave 1 to wave 3, whereas the proportion of exposure to social media increased (≤ 1 hour per day: 1.5% [95% CI, 1.2%-1.9%] to 27.1% [95% CI, 25.5%-28.7%]). The proportion of exposure to non-child-directed programs and electronic games remained steady. Moreover, children with different amounts of total screen time showed different proportions of exposure to on-screen content.

The associations between the proportion of screen exposure to different content types and risk for mental health problems are presented in Table 4. Under a given total screen time, a higher proportion of screen exposure to educational programs (or a lower proportion of exposure to other content types) was associated with a lower risk for mental health problems after controlling for all covariates (AOR, 0.73; 95% CI, 0.60-0.90). While a higher proportion of screen exposure to non-child-directed programs was associated with a higher risk for mental health problems (AOR, 2.82; 95% CI, 1.91-4.18), no associations between mental health and entertainment programs, electronic games, or social media were found. Furthermore, increased total screen time was associated with a higher risk for mental health problems (> 4 hours per day: AOR, 1.34; 95% CI, 1.17-1.54) (eTable 4 in Supplement 1). The results were robust in different sensitivity analyses (eTables 10 and 11 in Supplement 1). The associations between the proportion of screen exposure to different content types and the subscales of the SDQ after controlling for all covariates are displayed in eTable 7 in Supplement 1.

Discussion

Using longitudinal data from a representative sample of kindergarten children, we analyzed their total screen time and proportion of screen exposure to different content types. We found that the associations between the proportion of screen exposure to different content types and children's mental health varied. Under a given total screen time, a higher proportion of screen exposure to educational programs was associated with a lower risk for mental health problems after controlling for all covariates, whereas a higher proportion of exposure to

Table 3. Proportion of Exposure to On-Screen Content Stratified by Total Screen Time and Wave

Wave	On-screen content	Mean total screen time, h/d (95% CI) ^a				
		≤1	>1 to ≤2	>2 to ≤3	>3 to ≤4	>4
1	Educational programs	45.0 (43.5-46.5)	39.2 (38.3-40.2)	35.7 (34.8-36.5)	31.2 (30.3-32.1)	27.5 (26.8-28.3)
	Entertainment programs	44.4 (42.8-45.9)	45.9 (44.9-46.9)	42.3 (41.5-43.2)	38.6 (37.6-39.6)	33.7 (32.9-34.5)
	Non-child-directed programs	3.6 (3.1-4.1)	3.2 (2.9-3.6)	4.3 (3.8-4.8)	4.7 (4.1-5.3)	9.1 (8.5-9.8)
	Electronic games	5.6 (5.0-6.1)	10.5 (9.8-11.2)	16.6 (15.7-17.5)	24.3 (23.1-25.4)	25.6 (24.8-26.5)
	Social media	1.5 (1.2-1.9)	1.1 (0.9-1.3)	1.1 (0.9-1.3)	1.2 (1.0-1.5)	4.0 (3.6-4.4)
2	Educational programs	39.4 (37.7-41.0)	35.3 (34.5-36.1)	33.4 (32.7-34.2)	30.0 (29.2-30.8)	26.7 (26.2-27.2)
	Entertainment programs	36.4 (34.8-38.0)	35.4 (34.5-36.3)	33.1 (32.2-33.9)	29.7 (29.0-30.4)	26.4 (25.9-26.9)
	Non-child-directed programs	3.9 (3.3-4.4)	3.9 (3.6-4.3)	3.7 (3.3-4.0)	4.3 (3.8-4.7)	8.2 (7.8-8.6)
	Electronic games	6.6 (5.8-7.4)	9.7 (9.1-10.3)	13.6 (12.8-14.4)	18.1 (17.2-18.9)	21.2 (20.7-21.7)
	Social media	13.8 (12.5-15.1)	15.7 (14.8-16.6)	16.2 (15.4-17.1)	18.0 (17.1-18.8)	17.5 (17.0-18.0)
3	Educational programs	26.8 (25.3-28.3)	24.4 (23.3-25.6)	21.6 (20.9-22.4)	20.1 (19.2-21.0)	19.7 (19.2-20.1)
	Entertainment programs	32.1 (30.4-33.9)	27.8 (26.9-28.6)	25.2 (24.3-26.1)	23.4 (22.5-24.3)	22.8 (22.2-23.3)
	Non-child-directed programs	4.8 (4.1-5.4)	5.2 (4.8-5.7)	5.6 (5.0-6.1)	5.2 (4.6-5.8)	8.7 (8.1-9.2)
	Electronic games	9.2 (8.3-10.0)	14.0 (13.2-14.8)	19.1 (18.3-20.0)	22.7 (21.7-23.8)	23.2 (22.7-23.8)
	Social media	27.1 (25.5-28.7)	28.6 (27.5-29.7)	28.4 (27.4-29.5)	28.5 (27.5-29.6)	25.7 (25.0-26.3)

^a Estimates used sampling weights.

Table 4. Associations Between Proportion of Screen Exposure to Different Content Types and Total Screen Time With Risk for Mental Health Problems

Variable	Risk for mental health problems ^a									
	Model of educational programs		Model of entertainment programs		Model of non-child-directed programs		Model of electronic games		Model of social media	
	AOR (95% CI) ^b	P value	AOR (95% CI) ^b	P value	AOR (95% CI) ^b	P value	AOR (95% CI) ^b	P value	AOR (95% CI) ^b	P value
Proportion of exposure to screen content										
Educational programs	0.73 (0.60-0.90)	.002	NA		NA		NA		NA	
Entertainment programs	NA		0.97 (0.79-1.18)	.74	NA		NA		NA	
Non-child-directed programs	NA		NA		2.82 (1.91-4.18)	<.001	NA		NA	
Electronic games	NA		NA		NA		0.98 (0.76-1.27)	.90	NA	
Social media	NA		NA		NA		NA		1.26 (0.91-1.73)	.16
Total screen time, h/d										
≤1	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
>1 to ≤2	1.01 (0.89-1.15)	.85	1.03 (0.90-1.17)	.69	1.03 (0.91-1.17)	.64	1.03 (0.90-1.17)	.69	1.02 (0.90-1.17)	.71
>2 to ≤3	1.00 (0.87-1.16)	.95	1.02 (0.89-1.18)	.75	1.03 (0.89-1.18)	.72	1.03 (0.89-1.18)	.72	1.02 (0.89-1.17)	.77
>3 to ≤4	1.14 (0.98-1.33)	.08	1.18 (1.01-1.37)	.03	1.18 (1.01-1.37)	.03	1.18 (1.01-1.38)	.03	1.17 (1.01-1.36)	.04
>4	1.29 (1.12-1.48)	<.001	1.34 (1.16-1.54)	<.001	1.28 (1.12-1.47)	<.001	1.35 (1.16-1.56)	<.001	1.33 (1.16-1.53)	<.001

Abbreviations: AOR, adjusted odds ratio; NA, not applicable.

^a Total difficulties score of the Strengths and Difficulties Questionnaire over 14 points indicated that mental health was at risk.^b Estimates used sampling weights after multiple imputation. Values were

adjusted by child sex and age, annual family income, maternal educational level, paternal educational level, single-child status, primary caregiver, parental divorce or separation, and parent-child interaction.

non-child-directed programs was associated with a higher risk. In addition, increased total screen time was associated with a higher risk for mental health problems, regardless of the on-screen content.

The results showed that mean total screen times were 2.64 hours per day for children aged 3 years (wave 1), 3.38 hours per

day for children aged 5 years (wave 2), and 3.13 hours per day for children aged 6 years (wave 3), which were comparable with exposures in other countries.^{30,31} Excessive screen exposure in preschool children is a problem in many parts of the world. Besides, the changes in screen exposure to different content types varied. The increasing proportion of screen exposure to

social media may be attributed to children's accelerated acquisition of social skills in early years,³² indicating an eagerness for social interaction and communication with their peers.³³ Although the proportion of screen exposure to educational and entertainment programs decreased at each wave, such exposure was still dominant across time. Parents may deliberately expose their children to educational programs as learning materials, believing that they can enhance their children's early cognitive skills and language development.^{34,35} Entertainment programs, with engaging storylines and strong narrative features, can easily capture attention and generate great interest among children and, thus, are commonly used as an electronic babysitter.^{36,37}

There was a consistent association between total screen time and risk for mental health problems, regardless of the on-screen content. This finding reinforced the importance of screen time and provided evidence in support of the recommendations of the American Academy of Pediatrics to limit children's screen time.²⁴ There might be 2 explanations for this result. First, excessive screen time may be associated with impediments in cognition processing,^{38,39} emotional understanding,⁴⁰ and emotion-regulation ability⁴¹ as well as excitative response state⁴²⁻⁴⁴ in children. Second, the displacement hypothesis assumes that engaging with media would displace other critical activities that might be protective for mental health,⁴⁵ such as sleep⁴⁶ and parent-child interactions.²⁶

Meanwhile, the findings also highlighted the importance of on-screen content along with screen time. As described, a higher proportion of screen exposure to educational programs was associated with a lower risk for mental health problems. This finding suggested that educational programs, compared with other content types, present a lower risk for mental health problems in children. Some studies have found that the pacing of programs may play a role in overstimulation of the developing brain and impaired executive function; educational programs, however, have a slower pace.^{22,47,48} Educational programs with prosocial elements and with characters who talk or sing directly to the audience could be a means to scaffold children's developing abilities,^{14,49,50} which is essential to their social functioning and psychological well-being.⁵¹ Importantly, the results do not suggest that more time spent on educational programs is beneficial for children's mental health.

As for electronic games, there was no association with mental health in this study. Children spent less than 40 minutes on electronic games per day, possibly avoiding the adverse outcomes shown in previous studies to be associated with higher levels of screen exposure (1.5 hours per day) in adolescents.^{52,53} The types of game also matter⁵⁴; in particular, violent elements are of concern.⁵⁵ Young children might be exposed to less violent electronic games and thus may be subjected to fewer risks.^{54,56}

The proportion of exposure to non-child-directed programs was associated with both internalizing and externalizing mental health problems. It is assumed that non-child-directed programs are incomprehensible for children, as more perceptually salient stimuli are needed to capture their attention, which can disrupt their inhibitory control and can be a factor in more externalizing problems.^{21,57} Non-child-directed

programs also may contain inappropriate elements, such as violence, that could increase the risk for antisocial behavior due to behavior imitation and violence desensitization.^{17,18} Moreover, non-child-directed programs might adversely affect the quantity and quality of parent-child interactions.^{58,59} Parents who are immersed in non-child-directed programs may be less sensitive and engaged with their children,^{60,61} which could be associated with more internalizing and externalizing problems.^{62,63}

Strengths and Limitations

To our knowledge, this study was the first to examine children's screen exposure to different content types across the developmental ages of 3 to 6 years. By using a representative cohort, we were able to characterize the associations between screen exposure and mental health across on-screen content types. Several limitations of this study, however, should be mentioned.

First, the study indicated only the longitudinal associations between screen exposure and mental health rather than cause-and-effect outcomes. We could not exclude the possibility that children at a higher risk for mental health problems tend to have more screen exposure, as screens can be used by parents as a behavioral regulation tool for children with hyperactivity and inattentive conditions.^{64,65} In a previous study, parents reported offering entertainment programs to calm their children⁶⁶; thus, such programs are less likely to change the present study's findings about non-child-directed programs.

Second, screen exposure information was parent-reported, which makes it subject to social desirability bias and imprecision. Nevertheless, parent reports have been widely used and allow the examination of this topic in larger sample sizes. Anderson et al⁶⁷ stated that parent reports of children's screen time were associated with objective measures. Third, the participants lost during follow-up had a lower maternal educational level. Nevertheless, we found consistent associations between screen exposure and mental health regardless of maternal educational level; thus, the results would not be affected. Fourth, children who did not attend kindergarten were not included in the sampling frame. In Shanghai, the kindergarten enrollment rate was more than 97%,⁶⁸ which might slightly affect the estimates of screen exposure of children aged 3 to 6 years.

Fifth, we could not control for maternal mental health with data collected only at wave 3. We used the cross-sectional data set of wave 3 and found that the associations between screen exposure and children's mental health were consistent with or without controlling for maternal mental health. Sixth, the participants were from a high-income district, which might change the generalizability of the findings in lower-income districts in which children may exhibit different patterns of screen exposure.^{69,70} Furthermore, in the study, on-screen content referred to the actual content types and not the specific elements of the content (eg, prosocial,²³ violent,¹⁸ or fast-paced⁷¹). Future research is needed to analyze different elements in each content and to provide a more in-depth understanding of the association between different content types and mental health.

Conclusions

This cohort study showed that both screen time and the proportion of screen exposure to different content types were significantly associated with children's mental health from ages

3 to 6 years. Parents, pediatricians, and other stakeholders in children's health should pay attention to the amount of time and the content choice of screen exposure in children. The highest priority should be placed on constraining aggregated screen time, and educational programs should be chosen and non-child-directed programs should be avoided.

ARTICLE INFORMATION

Accepted for Publication: September 24, 2023.

Published Online: December 4, 2023.

doi:10.1001/jamapediatrics.2023.5220

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Author Contributions: Prof Jiang had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Ms Wang and Dr Zhao are co-first authors.

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Obtained funding: Zhao, Jiang.

Administrative, technical, or material support: Zhao, Zhu, Dong, Jiang.

Supervision: Zhao, Yu, Zhang, Jiang.

Conflict of Interest Disclosures: None reported.

Funding/Support: This study was supported by grant 82103864 from the National Natural Science Foundation of China, grant SQ2022RA2C000254 from Ministry of Science and Technology of People's Republic of China, grant 2022you1-2 from Shanghai Municipal Education Commission, grant 21YF1428000 from the Science and Technology Commission of Shanghai Municipality, and grant 2020CXJQ01 from Shanghai Municipal Health Commission. The Shanghai Children's Health, Education and Lifestyle Evaluation, Preschool (SCHEDULE-P) study was funded by Shanghai Education Committee.

Role of the Funder/Sponsor: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Data Sharing Statement: See Supplement 2.

Additional Contributions: We are grateful for the excellent work and commitment of the SCHEDULE-P study team, which included

education experts, all kindergarten teachers, and the fieldwork team from Shanghai Children's Medical Center. We also thank all study participants.

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