A Case Control Study on Impact of Screen Time on Language Development in Children Between 2–5 Years of Age

Dr. Shikhar Gupta[1],Dr. Shally Awasthi[1],
Dr. Chandrakanta[1], Dr. Gunjan Parasher[1]

King George's Medical University, Lucknow,
Uttar Pradesh, India

Address for correspondence Dr. Gunjan Parasher
King George's Medical University
Lucknow, Uttar Pradesh – 226003
Phone: +91-8171968211 / +91-8853268150
Email: parashergunjan1@gmail.com

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Abstract

Introduction: This study attempts to find a correlation between parental reported language delay in children and their screen media usage habits. Various other factors like the effect of the type of content viewed and behavior changes have been studied.

Aims and Objectives: To evaluate the association between screen media usage patterns—including duration, type of content, and behavioral changes—and parental reports of language delay in children.

Materials & Methods: A case-control study was conducted in outpatients' setting of a tertiary care center. Controls were selected based on normal developmental milestones, after excluding any chronic illnesses. Cases exhibited language delay according to the LEST (Language Evaluation Scale Trivandrum scale) excluding any functional, structural, and syndromic conditions. The DSEQ (Development and Evaluation of the Digital Screen Exposure Questionnaire) was used to assess media usage habits of both cases and controls. Screen time data was collected and analyzed separately for television and handheld electronic devices.

Results: A total of 54 cases and 54 controls were recruited from November 2022 to October 2023. On univariate analysis, total screen time exceeding two hours increased the odds (OR=4.48 95% CI 1.98-10.17) (p-value<0.05) of language delay while watching poems, rhymes and other educational videos as primary content - reduced the odds of developing language delay (OR= 0.34 95% CI 0.13 to 0.89) (p-value=0.02). On conditional logistic regression, an excess screen exposure increased the risk (OR = 1.68 95%CI 1.01-2.80) while watching educational content had a protective effect (OR=0.21 95% CI 0.06-0.68) from language delay, controlling for age and gender.

Conclusion: Children developing language delay had significantly higher exposure of screen time as compared to normally developing children. Language developmental delay might be associated with the type of content watched by the children. Hence awareness about effects of screen time on language development has to be informed to the parents and society.

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- Screen Time
- Language Delay,
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Introduction:

In India, accessibility to technology has boomed over the past decade, outpacing the understanding of its moderation by the consumers. These changes particularly affect growing children who are eager to divulge. Consequently, parents bear the responsibility of regulation of media and fostering social interactions. Various studies highlight a surge in screen time among preschoolers, surpassing recommended limits set by the Indian Academy of Pediatrics (IAP). One of its studies published in 2019 shows around 50-80% of children were exposed to screen for a duration that was much above the daily limit [1]. In view of the escalating prevalence of screen usage, the IAP recommends no screen time for children under 2 years and no more than 1 hour for those of age 2-5 years. A cross-sectional study conducted in 2019 in western India reported only 17.2% of participants met these recommendations[2].

Handheld devices, now more prevalent than television, serve as common babysitters and recent literature suggests it can be more harmful than beneficial for our children. The IAP states that introducing digital screens and audio at an early stage can impede the development of social skills in toddlers and preschoolers. Karani et al did a systematic review to describe the multifactorial effect of screen time on language development of a child [3]. Not just the language, but the quality of programs along with increasing screen time has also been linked to a child's language development as well as their sleep patterns [4,5].

Language delay can manifest as primary (with no underlying disorder) or secondary, stemming from underlying conditions such as autism spectrum disorder, hearing loss and selective mutism among others [6]. Our study encompassed the[4] post-covid pandemic view on screen habits of children with primary language delay, comparing it with normally developing children. We wished to investigate a correlation between development of language delay in a child with duration of exposure to screen. Apart from duration of screen exposure, we also enquired about the content quality and behavioral changes in the two groups.

Increased screen time and language development delay lacks independent studies in the Indian subcontinent and the scarcity of data on primary language delay exacerbates the challenge of late diagnosis and treatment. This is worrisome since persistent delays burden children with attention and social difficulties later in life [7,8,9].

Few pre-pandemic studies from different parts of the world show a positive correlation between language delay and screen time and identified a high screen time as an important risk factor for developing language delay [3,10,11]. Our case-control study delves into the screen habits of children with language delays, comparing various parameters to typically developing children.

Materials & Methods:

Study Design and Sample Population This study employed a case-control design, spanning data collection from November 2022 to October 2023, at the Pediatric Outpatient Department of a tertiary medical center located in North India. The presence of language delay was determined by Language Evaluation Scale Trivandrum (LEST) available for age ranges of 0-3 years and 3-6 years [12,13] followed by evaluating for secondary causes of language delay in parent reported cases of language delay as our study focuses only on primary language delay. To gauge screen time habits, the Development and Evaluation of Digital Screen Exposure Questionnaire (DSEQ) was utilized [14] in all participants of the study.

A case was a child presenting with parent reported language delay to our OPD and who screen positive with our language assessment tool (i.e. LEST). Children were included only after evaluating for all of the following- concurrent global developmental delay, autism spectrum disorder, attention deficit hyperactivity disorder, birth asphyxia, or those with previously diagnosed neurological conditions. Such children were excluded from the study. Additionally, all cases had to exhibit

normal audiometry. Followed by relevant history, examination and investigations necessary to rule out secondary causes, parents were asked for their consent to participate in the study. DSEQ (our tool to assess screen habits) was filled by the parents (if literate) or by our co-authors on their behalf (if parents could not read and/or write).

Similarly, controls were included in the study. Controls were also children attending our OPD but with acute illnesses that apparently did not influence overall[6] growth or any particular domain of development. The selection of controls was based on exact one-to-one matching, based on age and gender, and a set-criteria, which included - normal development in all domains and the absence of any history of chronic medical illness (ear problems, severe infectious diseases, surgical procedures, cleft palate, low birth weight, premature birth, any previously documented disorders like Down syndrome, epilepsy or birth asphyxia). A child who could be matched for any one of the cases (based on age and gender) and satisfying rest of the inclusion criteria was included in the study following informed consent. The DSEQ

questionnaire was applied to controls alike to assess their screen habits.

Finally, 54 cases and 54 controls were included in the study. Measurement The Language Evaluation Scale Trivandrum (LEST) was employed to assess language delay in children within the age brackets of 0-3 years and 3-6 years. This tool, specifically developed in India, was chosen for its alignment with our socio-demographic context, ease of availability and applicability. It primarily focuses on expressive speech delay and categorizes children as either having or not having language delay.

The data collection instrument, the Development and Evaluation of the Digital Screen Exposure Questionnaire (DSEQ), is a self-reporting questionnaire. The initial section of this questionnaire contains essential information such as the child's age, gender, place of residence, and details about the occupation and income of each family member. These details were amalgamated to gauge the socioeconomic status.[7]

To reduce potential confounding variables, age and gender were matched, allowing for a permissible variance of +/- 2 months in age matching.

Subsequently, screen time was calculated as an average of daily usage during weekdays and weekends, with separate considerations for mobile and television screen habits. The questionnaire inquired about the type of content viewed, the duration of each program, the frequency of media device usage throughout the day, and supervision (e.g., whether the child uses a mobile on weekdays, for how long does he normally sit in front of mobile/television, the frequency of usage in a day, and involvement in video games, is there always a guardian to monitor the screen habits of the child?). The third section of the questionnaire focused on behavioral changes, such as imitation of characters on screen, discussions about characters, mood alterations (e.g., whether the child becomes aggressive or did not eat when denied access to a mobile or television or the reverse- if the child stopped crying or completed the food only and only if given some screen exposure or if choices of food were affected by programs watched?) and sleep alterations. Here, sleep alterations were judged by parent's experience if the child slept on most nights only after seeing some mobile or television screen or if it has increased the sleep latency, affecting the sleep timings of the child as compared to before. Questions like 'Do you feel mobile or television screen has become a necessity for your child, before going to sleep?' were put up in case of ambiguity. Categorical variables required a "yes" or "no" response format.

Statistical Analysis:

The analysis involved coding variables from the questionnaire, including gender (male or female), age (in years), locality (urban or village or urbanized village), and8 socioeconomic status (upper or middle or lower). Furthermore, it included the durationof mobile, television, and overall screen time (in hours). Responses gathered in a "yes" or "no" format were- video games as the primary share of screen time, poems

and rhymes as the primary share of screen time, imitating the content viewed, experiencing aggression when denied access to mobile devices, and compromising on food or sleep (as explained above). Co-viewing was not incorporated into the final analysis due to incomplete data.

For continuous data, descriptive statistics were presented as both mean and standard deviation, while categorical data were conveyed as median values, percentages, and counts. Univariate analysis was conducted to compare cases and controls, utilizing two-tailed t-tests for continuous data and chi-square tests for discrete values. We performed multivariate conditional logistic regressions using forward selection method. All the variables with association between the case and control groups at $p<0.1$ from univariate analysis were incorporated in the conditional logistic regression analyses .Other variables were included one by one to obtain model with highest sensitivity. Analysis was done using SPSS version 29 (Chicago II, USA).

Results:

Table 1 furnishes the foundational characteristics of our dataset. A total of 108 matching cases and controls were analyzed. The average age was 3.35 and 3.40 years for cases and controls respectively($p=0.82$). In each group, the total number of male participants was higher, comprising 74% of the sample (n=40). The median screen time usage among cases amounted to 3 hours (interquartile range (IQR)=1.5-5 hours), approximately threefold the duration reported in the control group, which was 1.05 hours (IQR=0.5-2.63).

Table 1: Sociodemographic characteristics of Cases and Controls

	Cases	**Controls**	**P value**
Total	54	54	-
Gender*: Male	40(74%)	40(74%)	
: Female	14 (26%)	14(26%)	
Average age* (in Years)	3.35	3.40	0.82
Socio-economic Status			
Upper (includes upper and upper middle)	7 (13.4%)	9(16.6%)	0.5
Middle (includes middle and lower middle)	33(61%)	30(55.5%)	Ref
Lower (includes upper lower and lower)	14 (25.6%)	15(24%)	0.7
Average Screen Time (in Hours)	3.48	1.90	<0.01

The daily total screen time usage was higher in cases (mean=3.48, standard deviation (SD)=2.5, 95% confidence interval [(CI) 2.78-4.15)] compared to controls (mean=1.90, 95% CI 1.37 to 2.43) (p=0.0005, alpha level 0.5) (Figure 1). This observation underscores a robust correlation between excessive screen time and the presence of language delay. The elevated daily average of screen time was primarily attributed to an increased mobile screen time among cases (mean=2.38, SD=2.15, 95% CI 1.79-2.97) in comparison to controls (mean=1.08, SD=1.08, 95% CI 0.79-138) (p<0.05, alpha level 0.05) (Figure 1). The duration of television viewing did not yield statistically significant results.

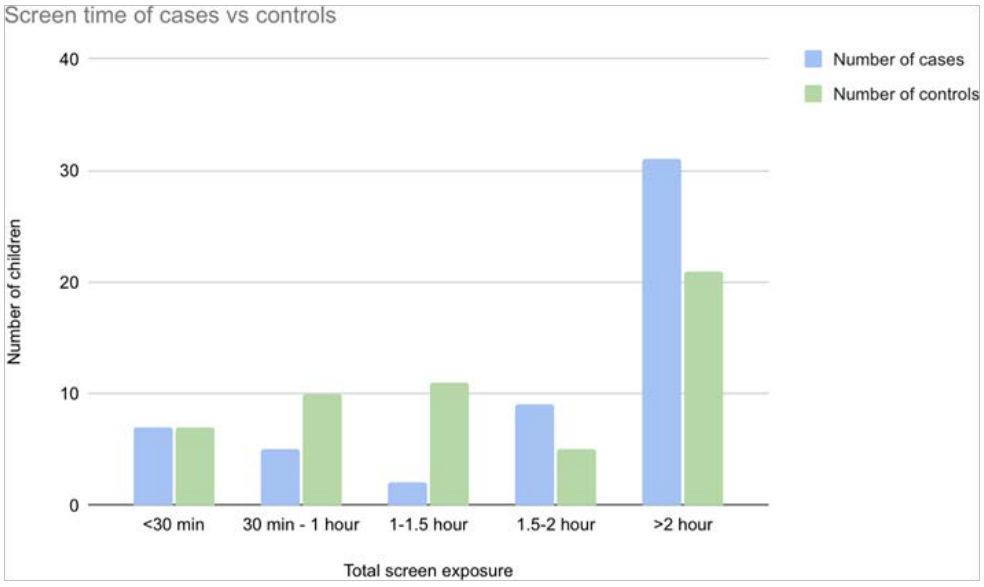

Fig 1 – Distribution of screen exposure among cases and controls.

On univariate analysis, it was determined that an overall screen time exceeding 2 hours (OR=4.48 95% CI 1.98-10.17) (p-value<0.005) was a significant risk factor (Table 2). Children who watched poems, rhymes or some form of educational content as major share of screen time had around 70% lesser odds of developing language delay than those who didn't (other content included games, YouTube shorts and adult10 content) (OR= 0.34 95%CI 0.13 to 0.89) (p-value=0.02). No other factors, such as type of locality, behavioral aspects, or manifestations of aggression, exhibited a significant association (Table 3).

Table 2: Univariate analysis between screen time and language delay

Variable		Cases(n=54)	Control(n=54)	p value
Age (in years)	2-3	30	30	
	3-4	12	12	
	4-5	12	12	
Gender	Male	40	40	
	Female	14	14	
Locality	Urban	29	27	0.7
	Non-urban	25	27	
Total Screentime	<1 hour	7	17	ref

	1-2 hour	7	16	0.9
	>= 2 hours	40	21	<0.05 (OR=4.48 ;95%; CI 1.98-10.17)
TV usage in hours	<1 hour	34	36	ref
	1-2 hour	4	10	0.17
	>= 2 hours	16	8	0.12
Mobile usage in hours	<1 hour	25	29	ref
	1-2 hours	10	9	0.6
	>= 2 hours	19	16	0.07

Variable		Cases(n=54)	Controls(n=54)	p-value
Content	Poems/ rhymes	8	18	0.02
	Non informative content/ videos and games	46	36	OR= 0.34 95%CI 0.13 to 0.89
Imitate/Talk to character on screen	YES	23	29	0.24
	NO	31	25	
Aggression	Yes	18	16	0.67
	No	36	38	
Compromise on food/sleep	Yes	10	10	1
	No	44	44	

Table 3: Univariate analysis of Screen Related Habits with Language Delay.

	Odds Ratio[exp(b)]	95%CI	p-value
Gender	1.0		
Age	1.0		
Overall screen time exceeding 2 hours	1.68	1.01-2.80	0.04

Imitate characters	0.46	0.17-1.23	0.12
Poems/rhymes as prime share of screen time	0.21	0.06-0.6	<0.01

Multivariate regression was performed to identify the risk factors of language delay inchildren with and without the disease. The dependent variable for logistic regression wasthe presence or absence of language delay i.e. 1 for cases and 0 for controls. Sinceage and gender were used as matching variables, they were included in the regressionmodel. Total screen time (sum of both mobile and television screen time) andindividual screen time from mobile or television were not included together in onemodel because of risk of multicollinearity. In the final model, we included 5parameters- age, gender, total screen time, watching poem as predominant content andimitation of characters on screen - for our regression model as they yielded the highestsensitivity. Total screen time exceeding 2 hours (OR = 1.68 95% CI 1.01-2.80) wasassociated with increased odds while watching poems, rhymes or educational content(OR=0.21 95% CI 0.06-0.68) was associated with a reduced odds ratio ($p<0.05$) (Table 3). Changes in behavior such as imitation of characters did not yield significantresults (p value=0.12). Excess screen exposure and type of content viewed were thetwo most consistent factors for influencing development of language delay in ouranalysis.

DISCUSSION:

By analyzing the Digital Screen Exposure Questionnaire (DSEQ) completed by parents, we observed that 40 cases (74%) and 21 controls (38.8%) reported screen time usage exceeding 2 hours. The average media consumption was much higher in cases (3.48 hours) as compared to controls (1.9 hours). Upon analysis, it was evident that surpassing a total screen time of 2 hours has an increased risk of language delay concurring with many studies from different parts of the world that have shown increased risk of developing language delay with more screen usage [3,9-11,15-20].

Since the COVID-19 pandemic, education and recreation have undergone a significant change. Accessing knowledge has become easier with smartphones and the internet. Parents now also use these devices for their children's leisure activities. Schools conduct classes online and students submit homework via platforms like WhatSapp. In such a scenario, we expect to see increased screen time in the general population as well. In our sample, children's preferred content consisted of cartoons in their mother tongue, poems, video games, and, during unsupervised sessions, a diverse range of YouTube shorts spanning non-child-friendly categories. These patterns align with the observations made in the study by Hudon et al [4], which ascribed poor quality viewing and solitary viewing as a potential risk factor. Hudon et al mention that quantity and quality are two completely different factors influencing language development and should not be correlated. Two other studies [3,17] reiterate that the quality of shows watched affected the outcome of language skills in children.

Our study and previous literature clearly demonstrated viewing informative content like poems, stories or rhymes had some positive effect on child's language[12] acquiring skills and reduced the odds of developing language delays significantly. One possible explanation could be that they help in improving a child's vocabulary by giving similar information provided in schools but in a colorful and interactive way.

Many organizations recommend children's complete abstinence of screen time. We believe a more pragmatic approach involves actively engaging in the education of children, regarding responsible smartphone usage. Parents must be educated on 'what should be' and 'what should not be' seen by their children on smartphones and television.

Garrison et al [5] in their study concluded that increase in night time usage of media devices as well as violent content, increased sleep problems in children(between 3-5 years of age). Instances of imitation and aggression when denied access to screen, and compromises on sleep (like throwing tantrums or increased sleep latency) were reported consistently by both cases and controls (i.e. normally developing children) in our study too. However, it was not related to language delay. A study by Perdana et al [11] did not find any factor other than increased screen time in development of language delay. While a few other study [8,18] showed that language delay is attributed to multiple socioeconomic factors (like mother education and home environment) and family history. In our study, no correlation was found between socioeconomic factors and its influence on the language development of children.

Moyle et al [9] did an extensive review of the genetic and environmental factors that predicate the learning process. They explain how multiple complex neurobiological interactions play a role in development of speech. From the earlier literature that explained the complex mechanism of language development in a child during growing years [9], we certainly know that a single factor (like an increased screen time) cannot be attributed in development of the entire disease process. However, with the latest evidence, including our study, early exposure to screen time does seem to influence, in some way, the development of language in a child, especially when unregulated.

Despite various studies (aforementioned) and fair acceptance of the linkage, we have been unable to develop a diagnostic protocol and competitive therapy for children suspected of developing language delay due to media divulgence. Prevention has been outlined in various studies as the key. From our experience of meeting with guardians of children with language delay, we believe studies should take into account variables like parental education and work hours to formulate dynamic guidelines. It is also important to address parental attitudes regarding introduction and use of technology to children. Additionally, pediatricians as well as psychiatrists should be trained for diagnosis and behavioral therapy specific to this circumstance.

The study's brief duration and constrained sample size hinders broad generalizations of the findings. The tools used to assess language delay were chosen because of regional factors and may be improved in subsequent studies. Being a single center study, we could not ascertain the prevalence of language delay. The cases were not followed up, to see future implications of the disease. Nonetheless, the study's results are unanimous with preceding studies and requires steady action to safeguard the holistic development of the children[14,15].

Conclusion:

In our study, we found that an overall increase in screen time predisposed a child to the risk of language delay. Excess mobile and television usage posed a risk factor for language delay, while watching educational content reduced the risk. Our study highlights one of the reiterated facts in recent times – increasing screen time among children and its harmful effect on their development. We should focus on the 'quantity' as well as the 'quality' of social media content consumed by children.

WHAT THIS STUDY ADDS ?

Our study is one of the very few studies done to compare screen viewing habits of normal children with those having language delay.

It points towards a direct correlation between duration of screen time and language delay in children. Quality and Quantity of screen time have shown to produce different effects on language development in children

Conflicts of Interest

None

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Ethics Approval:

Institutional Ethics Committee gave approval for the study (ECR/262/Inst/UP/2013/RR-19)

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