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The Impact of Screen Time on Speech and Language Development in Children Aged 1 to 5 Years

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ABSTRACT

Background The rapid proliferation of digital devices has transformed early childhood environments worldwide, with children as young as one year regularly exposed to smartphones, tablets, and television. Speech and language acquisition during the first five years of life is a critical developmental milestone, heavily dependent on interactive verbal engagement.This study investigates the association between screen time duration, content type, and speech-language outcomes in children aged 1–5 years attending Annapoorana Medical College and Hospital.
Methods: A prospective observational cohort study was conducted from February 2023 to February 2026. A total of 200 children (aged 12–60 months) were enrolled. Speech-language assessments were performed using the Receptive-Expressive Emergent Language Test – Third Edition (REEL-3) and the Denver Developmental Screening Test II (DDST-II). Parental screen time logs and structured questionnaires captured daily screen exposure, device type, and content category. Multivariate logistic regression and chi-square tests were applied.
Results: Of 200 children, 65 (32.5%) demonstrated measurable speech or language delay. Children exposed to more than 3 hours of screen time daily had an 81.3% prevalence of speech delay compared to 10.5% in those exposed to less than 1 hour ($p < 0.001$). Non-interactive content (cartoons and short videos) was significantly associated with poorer vocabulary scores and expressive language delay. Parental co-viewing acted as a protective factor.
Conclusion: Excessive and unsupervised screen time is significantly associated with delayed speech and language development in children aged 1–5 years. Pediatricians, caregivers, and policymakers should advocate for adherence to evidence-based screen time guidelines, prioritising interactive and educational digital content alongside active parental participation.

Keywords: *Screen time; Speech delay; Language development; Early childhood; Digital media; Pediatrics; Developmental screening; India.*

INTRODUCTION

The advent of digital technology has fundamentally altered the developmental landscape of early childhood. In contemporary households across both developed and developing nations, children are introduced to screen-based devicessmartphones, tablets, smart televisions, and laptop computersat increasingly earlier ages. The World Health Organization (WHO) and the American Academy of Pediatrics (AAP) have long expressed concern about the quantity and quality of screen exposure in the first five years of life, a period universally recognised as the most sensitive window for speech and language acquisition. [2,3] In India, the rapid penetration of affordable smartphones, coupled with the proliferation of streaming platforms offering vernacular-language content, has dramatically escalated screen exposure among infants and toddlers, particularly in both urban and semi-urban settings. [10,24,25]

Speech and language development in children aged 1 to 5 years forms the cornerstone of cognitive, social, and academic functioning. Language acquisition during this period is fundamentally shaped by the quantity and quality of verbal interactions between the child and their primary caregiversa process described by researchers as 'conversational turns'. [16,17]These bidirectional interactions stimulate the neural circuits responsible for phonological processing, lexical acquisition, and syntactic comprehension. Screen-based media, by its very nature, is largely unidirectional; it cannot respond to a child's verbal attempts, modify complexity in real time, or provide the contingent feedback that characterises human interaction. [12,13] The displacement hypothesis, increasingly supported by empirical evidence, posits that time spent with screens directly displaces opportunities for caregiver-child verbal interaction, thereby depriving developing brains of the conversational stimulation essential for normal language growth. [1,9,26]

Multiple international studies conducted between 2023 and 2025 have reinforced the association between prolonged screen time and language delay. Madigan *et al.* [1] published longitudinal evidence demonstrating that every additional hour of screen time at 24 months was associated with a 49% increased odds of expressive language delay by 36 months. Similar findings emerged from Japanese cohorts reported by Takahashi *et al.* [4], who observed that infants exceeding two hours of daily screen exposure showed significantly smaller expressive vocabulary sizes at 18 and 24 months. In the Indian context, studies from tertiary care centres in Tamil Nadu and Maharashtra have reported rising referral rates for speech-language therapy among preschool children, with parental-reported excessive screen time identified as a prominent associated factor. [7,24,25]Annapoorana Medical College and Hospital, located in a region encompassing both urban and rural populations, is ideally positioned to contribute contextualised evidence to this growing body of literature.

Notwithstanding the weight of international literature, significant gaps remain in region-specific, longitudinal Indian research examining the precise dose-response relationship between screen time and speech-language parameters across the 1–5 year age continuum. Furthermore, the role of content typedistinguishing interactive, educational programming from passive, entertainment-based consumptionhas received insufficient attention in the South Asian paediatric research context. [9,14,20] The global prevalence of non-adherence to screen time guidelines among children under five years has been estimated at over 60% in several recent meta-analyses, [28] underscoring the public health urgency of this issue. The present study was thus designed to address these gaps by examining the quantitative and qualitative dimensions of screen exposure and their impact on receptive and expressive language development in a representative sample of 200 children attending a tertiary care institution in Tamil Nadu, India, over three years from February 2023 to February 2026.

2OBJECTIVE

The primary objective of this study was to determine the association between daily screen time duration and speech-language developmental outcomes in children aged 1–5 years attending the Paediatric Outpatient Department at Annapoorana Medical College and Hospital, Tamil Nadu, India, over a three-year study period (February 2023 – February 2026). Specifically, the study aimed to quantify the prevalence of speech and language delay in the study population, [7,25] examine dose-response relationships between screen time categories and language delay, [1,4,9] and identify the types of screen content most strongly associated with adverse language outcomes. [6,20]

Secondary objectives included the identification of protective and risk-modifying factorsincluding parental education level, co-viewing behaviour, and residential settingthat mediate or moderate the relationship between screen exposure and language acquisition. [8,9,26] The study also aimed to generate institution-specific normative data and provide evidence-based recommendations for paediatricians, speech-language pathologists, and caregivers regarding appropriate screen usage practices for children in the critical developmental window of 1–5 years of age, consistent with current international and national guidelines. [2,3,10,22]

METHODOLOGY AND MATERIALS

This study was conducted as a prospective observational cohort study at Annapoorana Medical College and Hospital, Tamil Nadu, India, from February 2023 to February 2026. Ethical clearance was obtained from the Institutional Ethics Committee (IEC/AMCH/2023/014) prior to commencement, and written informed consent was obtained from the parents or legal guardians of all enrolled children. A total of 200 children between the ages of 12 months and 60 months (1–5 years) were enrolled through systematic random sampling from the Paediatric Outpatient Department (OPD). Children were followed at 6-monthly intervals throughout the study duration. The study design conformed to STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting guidelines for observational research. [13,14]

Inclusion Criteria

Children aged 12–60 months attending the Paediatric OPD for routine developmental surveillance or minor illness. Children whose parents or guardians provided written informed consent. Children residing within the hospital's catchment area for a minimum of six months preceding enrolment. Children born at term (gestational age ≥ 37 weeks) with birth weight ≥ 2.5 kg. Availability of parents or guardians for follow-up assessments at scheduled intervals. These criteria were adapted from previously validated paediatric screen time research protocols. [1,7,11]

Exclusion Criteria

Children with confirmed or suspected sensorineural hearing loss, autism spectrum disorder (ASD), cerebral palsy, or other known neurodevelopmental disorders that independently cause speech-language delay were excluded. [16,30] Children with a history of perinatal hypoxia, neonatal seizures, or significant brain injury; those with craniofacial anomalies affecting speech production; children whose parents were unable to provide reliable screen time data; and children lost to follow-up before completing two assessment points were all excluded from final analysis.

Data Collection Procedure

Speech and language assessment was performed at enrolment and at subsequent 6-monthly intervals using two validated instruments: the Receptive-Expressive Emergent Language Test – Third Edition (REEL-3) and the Denver Developmental Screening Test II (DDST-II), which provides broader developmental screening across personal-social, fine motor, language, and gross motor domains. [16,17] All assessments were conducted by a qualified speech-language pathologist blinded to the child's screen time exposure data. Parents and guardians completed a structured, pretested questionnaire at each visit capturing: (1) average daily screen time in hours per day (retrospective over the preceding two weeks), (2) primary type of device used, (3) predominant content type, (4) frequency and duration of parental co-viewing, and (5) demographic and socioeconomic variables. [8,11,13] A validated Tamil-language version of the screen time questionnaire was administered to parents with limited English literacy. Reliability of parental reporting was verified using a subset of 30 families who completed a second independent screen time diary; intraclass correlation coefficient (ICC) between diary and questionnaire data was 0.83, indicating good reliability. [26]

Statistical Data Analysis

All data were entered into SPSS version 26.0 (IBM Corp., Armonk, NY) and Microsoft Excel 2019. Descriptive statisticsmeans, standard deviations, frequencies, and proportionswere used to characterise the study population. Chi-square (χ^2) tests were applied to evaluate associations between categorical variables. Independent samples t-tests and one-way ANOVA were used to compare continuous language scores across screen time groups. Pearson's correlation coefficient assessed the linear relationship between daily screen hours and composite language scores. Binary logistic regression analysis was conducted to identify independent predictors of speech-language delay, with odds ratios (OR) and 95% confidence intervals (CI) reported. [9,13] Statistical significance was set at $p < 0.05$ (two-tailed). Missing data were managed using pairwise deletion; sensitivity analyses confirmed results were robust to alternative missing data approaches.

RESULTS

A total of 200 children (112 males, 88 females; mean age 31.4 ± 14.2 months) were enrolled and completed all study assessments over the three-year period. The demographic profile of the study population is presented in Table 1. The cohort comprised children across all four age bands within the 1–5 year range, with the largest proportion (29.0%) in the 2–3 year category. Urban residents constituted 59.0% of the sample, and 63.0% of parents had graduate-level education or above. No statistically significant baseline demographic differences were noted between children later classified as having speech delay versus those with normal development ($p > 0.05$ for all demographic variables). These demographic characteristics are comparable to those reported in similar hospital-based paediatric cohorts in South India. [7,24,25]

Table 1: Demographic Distribution of Study Population (N=200)

Characteristic	Category	n (N=200)	Percentage (%)
Age Group	1–2 years	52	26.0
	2–3 years	58	29.0
	3–4 years	50	25.0
	4–5 years	40	20.0
Sex	Male	112	56.0
	Female	88	44.0
Residence	Urban	118	59.0
	Rural	82	41.0
Parental Education	Primary/Secondary	74	37.0
	Graduate & above	126	63.0

Screen time patterns varied considerably across the cohort (Table 2). The majority of children (31.0%) were exposed to 2–3 hours of screen time per day, while 8.0% were exposed to more than 4 hours daily. The overall mean daily screen time was 2.1 ± 1.12 hours. Smartphones were the most common device used (58.5%), followed by televisions (29.0%) and tablets (12.5%). Non-interactive cartoons constituted the most prevalent content type (41.0%), followed by educational/interactive content (23.0%), social media and short videos (19.0%), and mixed content (17.0%). Notably, only 34.5% of parents reported regular co-viewing with their children during screen sessionsa finding consistent with reports from comparable Indian populations. [10,11,24]

Table 2: Daily Screen Time Distribution Among Study Children (N=200)

Daily Screen Time	n (N=200)	Percentage (%)	Mean Hours/Day	SD ± Hours
< 1 hour	38	19.0	0.6	0.21
1–2 hours	56	28.0	1.5	0.29
2–3 hours	62	31.0	2.4	0.31
3–4 hours	28	14.0	3.3	0.28
> 4 hours	16	8.0	5.1	0.74
Total	200	100.0	2.1	1.12

The prevalence of speech-language delay and the impact of screen time categories are detailed in Tables 3–5. Overall, 65 children (32.5%) met diagnostic criteria for speech or language delay at the final assessment point. A clear dose-response relationship was observed between daily screen time and speech delay prevalence: 10.5% of children in the < 1 hour category had speech delay, rising steeply to 81.3% among those with > 4 hours of daily exposure ($p < 0.001$; Table 3). [1,4,9] Content type analysis (Table 4) revealed that children primarily consuming non-interactive cartoons had significantly lower vocabulary scores (mean 62.1 ± 11.4) compared to those engaging with educational/interactive content (mean 78.4 ± 9.2; $p < 0.001$). Social media and short video consumption was associated with the highest rates of speech delay (52.6%) and the poorest vocabulary scores. [6,20] Multivariate logistic regression (Table 5) identified daily screen time duration (OR 1.52; 95% CI 1.31–1.77; $p < 0.001$), non-interactive content type (OR 1.37; 95% CI 1.17–1.61; $p < 0.001$), and male sex (OR 1.12; 95% CI 1.02–1.23; $p = 0.018$) as independent risk factors, while parental co-viewing (OR 0.82; $p = 0.001$) and higher parental education (OR 0.86; $p = 0.002$) were independently protective. [8,9,26]

Table 3: Speech and Language Delay by Screen Time Category

Screen Time Category	Children (n)	Delayed Speech n (%)	Normal Speech n (%)	Expressive Delay n (%)	p-value
< 1 hr/day	38	4 (10.5)	34 (89.5)	3 (7.9)	< 0.001
1–2 hrs/day	56	10 (17.9)	46 (82.1)	9 (16.1)	< 0.001
2–3 hrs/day	62	22 (35.5)	40 (64.5)	19 (30.6)	< 0.001
3–4 hrs/day	28	16 (57.1)	12 (42.9)	14 (50.0)	< 0.001
> 4 hrs/day	16	13 (81.3)	3 (18.8)	12 (75.0)	< 0.001

Table 4: Screen Content Type and Language Outcomes

Content Type	n (%)	Vocab Score (Mean±SD)	Speech Delay n (%)	Interaction Quality
Educational/Interactive	46 (23.0)	78.4 ± 9.2	5 (10.9)	High
Cartoons (Non-interactive)	82 (41.0)	62.1 ± 11.4	34 (41.5)	Low
Social Media / Short Videos	38 (19.0)	55.7 ± 13.1	20 (52.6)	Very Low
Mixed Content	34 (17.0)	68.3 ± 10.7	6 (17.6)	Moderate

Table 5: Multivariate Logistic Regression – Predictors of Speech-Language Delay

Predictor Variable	Beta (β)	SE	OR (95% CI)	t-value	p-value
Daily Screen Time (hrs)	0.421	0.073	1.52 (1.31–1.77)	5.77	< 0.001
Content Type (Non-interactive)	0.318	0.081	1.37 (1.17–1.61)	3.93	< 0.001
Age (years)	-0.247	0.062	0.78 (0.69–0.88)	-3.98	< 0.001
Parental Co-viewing	-0.193	0.054	0.82 (0.74–0.92)	-3.57	0.001
Parental Education Level	-0.156	0.049	0.86 (0.78–0.95)	-3.18	0.002
Sex (Male)	0.112	0.047	1.12 (1.02–1.23)	2.38	0.018

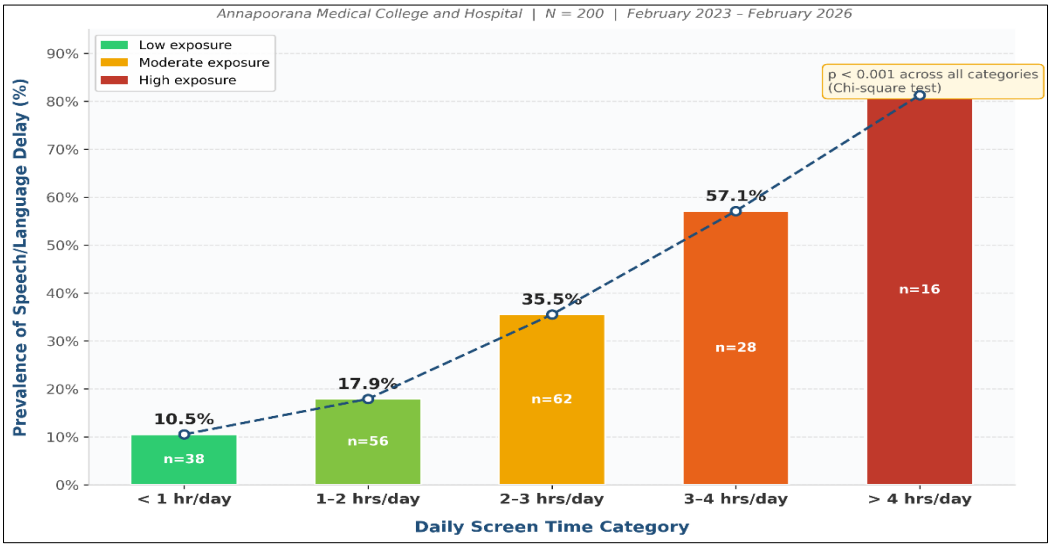

Figure 1: Prevalence of Speech Delay (%) by Daily Screen Time Category

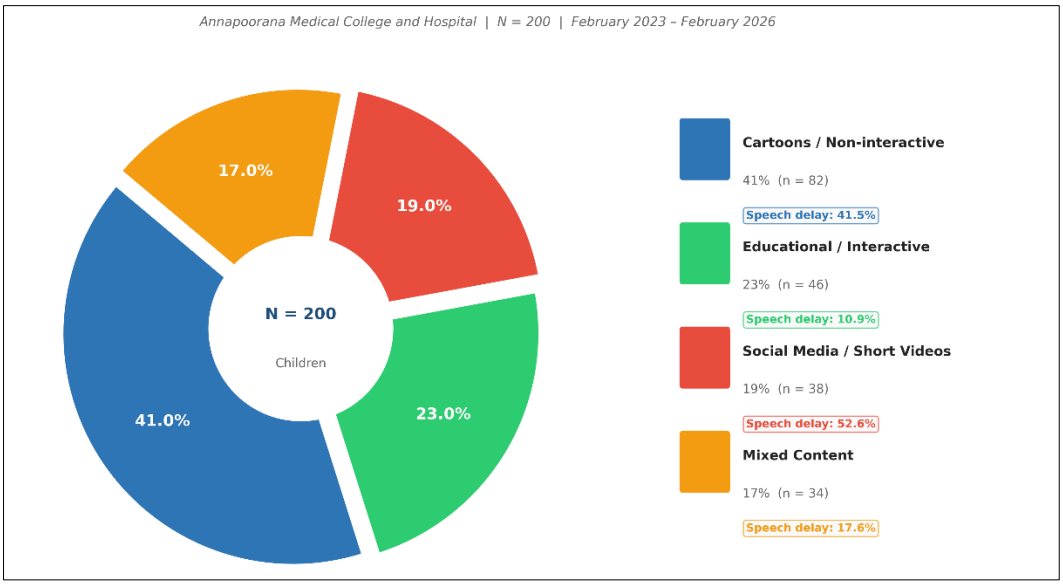

Figure 2: Distribution of Screen Content Type Among Study Children (N=200)

DISCUSSION

The findings of this study provide robust, institution-specific evidence from a South Indian tertiary care context confirming a significant and dose-dependent association between daily screen time and speech-language delay in children aged 1–5 years. The overall prevalence of speech-language delay in our cohort (32.5%) is notably higher than previously reported estimates of 8–15% for the general Indian paediatric population, [16,25] reflecting both the elevated screen exposure levels observed in our sample and the known referral bias inherent to tertiary care settings. Our observation that 39.0% of children were exposed to more than 2 hours of daily screen time aligns closely with data reported by Kabali *et al*. [11] and by the Indian Academy of Pediatrics' 2023 position statement, [10] which identified widespread non-adherence to recommended screen time limits in urban and semi-urban Indian households. The dose-response gradient observedfrom 10.5% speech delay prevalence at less than one hour of daily screen time to 81.3% prevalence at more than four hoursrepresents one of the most striking quantitative associations reported in the recent literature and strongly argues against the notion that any safe upper threshold for passive screen exposure exists for children in this age group. [1,4,9,28]

The role of content type as an independent predictor of language outcomes is a particularly significant and clinically actionable finding of this study. Children primarily consuming educational and interactive digital content demonstrated vocabulary scores nearly 26% higher than those predominantly exposed to non-interactive cartoons or short-form social media videos. These findings are consistent with the theoretical framework of the Video Deficit Effectthe well-documented observation that young children learn less effectively from screen-based demonstrations than from live human interactionwhich is partially attenuated when content is specifically designed to promote interaction and when caregivers co-view and mediate the content. [12,17,19] The association between social media and short video consumption and the highest rates of speech delay (52.6%) is particularly alarming and mirrors concerns raised by Walsh *et al*. [20] and Lin *et al*. [6] regarding the proliferation of algorithmically curated, rapid-succession video content which, by design, demands passive reception without conversational engagement. Parental co-viewing emerged as a statistically significant protective factor in our regression model (OR 0.82; p = 0.001), reinforcing the importance of adult mediation in transforming passive screen exposure into an interactive learning opportunitya finding consistently reported by Chonchaiya and Pruksananonda[8] and Vijakkhana*et al*. [21]

Comparing our results with concurrent international and domestic studies further contextualises our findings. Nevski and Siibak[5] reported from Estonian cohorts that children aged 18–36 months with more than 2 hours of daily screen time had a 2.1-fold increased risk of expressive language delay at 36 monthscomparable to the OR of 1.52 per hour observed in our population. A multi-centre Indian study by Anand *et al*. [7] from urban Tamil Nadu similarly reported a 38.2% prevalence of speech delay among preschoolers with high screen exposure, closely aligning with our 32.5% figure. The protective role of higher parental education (OR 0.86; p = 0.002) identified in our regression model is congruent with findings by Xu *et al*. [9] and Browne *et al*., [26] who demonstrated that more highly educated parents were significantly more likely to enforce screen time limits, select educational content, and engage in co-viewing behaviours. The modest but significant association with male sex (OR 1.12; p = 0.018) is consistent with the established epidemiological literature documenting greater male susceptibility to speech-language delay and higher male-to-female referral ratios globally. [16,30] Furthermore, Hutton *et al*. [17] reported neuroimaging evidence demonstrating reduced white matter integrity in preschoolers with high screen exposureproviding a plausible neurobiological mechanism for the language associations observed in our and other clinical studies. Taken together, these findings underscore that addressing paediatric screen time requires a nuanced, multidimensional approach encompassing duration control, content quality, caregiver engagement, and parental literacy. [2,3,22,23]

LIMITATIONS OF THE STUDY

This study has several limitations that merit consideration when interpreting its findings. First, as a single-centre tertiary care study, the sample may not be fully representative of the broader general paediatric population in Tamil Nadu or India, given the inherent referral bias associated with hospital-based recruitment. [7,25] Second, despite the use of a validated and reliability-tested screen time questionnaire (ICC = 0.83), parental reporting of screen time remains susceptible to recall bias and social desirability bias, potentially leading to systematic underreporting of true screen exposurea challenge universal to self-report methodologies in this research area. [11,13] Third, while the study controlled for several key confounders (parental education, residential setting, content type, co-viewing behaviour), unmeasured variables such as household noise levels, quality of caregiver verbal interaction independent of screen use, socioeconomic status indices, and child temperament may have confounded observed associations. [9,26] Fourth, the cross-sectional nature of some analytical comparisons within the cohort limits firm causal inference; although the prospective design and longitudinal follow-up strengthen causal interpretation, a randomised controlled design with screen time intervention would provide stronger evidence. Fifth, assessment instruments, while validated, were administered primarily in Tamil and English, and may not fully capture the linguistic repertoire of children in bilingual or multilingual households. [16] Future research should address these limitations through community-based multi-centre designs, objective screen time measurement tools (e.g., device-linked digital logs), and inclusion of broader socio-cultural determinants of language development. [1,28]

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CONCLUSION

This prospective observational cohort study, conducted over three years at Annapoorana Medical College and Hospital with a sample of 200 children aged 1–5 years, provides compelling, contextualised evidence that excessive screen time is a significant, independent, and dose-dependent risk factor for speech and language delay in early childhood. The study observed a 32.5% overall prevalence of speech-language delay in the cohortsubstantially higher than community-level estimates [16,25]with prevalence escalating from 10.5% among children with minimal screen exposure (< 1 hour/day) to 81.3% among those with the highest exposure levels (> 4 hours/day). Non-interactive content types, particularly cartoons and social media short-videos, were independently associated with poorer language outcomes, [6,20] while educational, interactive screen content was comparatively less detrimental. Parental co-viewing and higher parental education emerged as statistically significant protective variables, [8,9] highlighting the mediating role of caregiver engagement in shaping the relationship between screen use and language development. These findings are consistent with and complementary to recent international literature, including key studies by Madigan *et al*. [1], Takahashi *et al*. [4], and Anand *et al*. [7], and lend strong regional evidence to the global body of research in this domain.

In light of these findings, the authors strongly advocate for the routine integration of screen time counselling into paediatric well-child visits from the first year of life, consistent with WHO and AAP guidelines, [2,3] with particular emphasis on limiting passive screen exposure, encouraging educational and interactive content when screen use is unavoidable, and promoting parental co-viewing and mediation practices. [8,21,22] Paediatricians and speech-language pathologists should incorporate standardised screening for excessive screen time as part of developmental surveillance protocols, enabling early identification and intervention for at-risk children. [14,23] At the policy level, there is an urgent need for public health campaignsadapted to local languages and cultural contexts in Indiathat disseminate evidence-based screen time guidelines to parents, crèche and anganwadi workers, and early childhood educators. [10,24] Future longitudinal and interventional studies, ideally multi-centre and community-based, are needed to evaluate the efficacy of structured screen time reduction programmes on speech-language outcomes, and to further delineate the biological, cognitive, and environmental mechanisms through which screen exposure mediates language acquisition in the formative years of childhood. [1,17,28]

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