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ORIGINAL RESEARCH

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Association between digital device dependency and oral health outcomes in children with speech delay: a cross-sectional observational study

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Abstract

Background: Excessive digital device exposure may influence feeding behaviours and oral hygiene practices, potentially affecting oral health in children with speech delay. This study aimed to evaluate the association between digital device dependency and oral health outcomes in children with speech delay. **Methods**: A hospital-based cross-sectional observational study was conducted among 112 children aged 3–6 years with clinically diagnosed speech delay attending speech clinics and the Department of Paediatric and Preventive Dentistry from August 2024 to April 2025. Participants were categorized into a control group (Group A; limited digital device exposure) and a study group (Group B; high digital device exposure) using a structured parent-reported questionnaire. Feeding practices, oral hygiene behaviours, and dental visit patterns were recorded. Clinical examination assessed Simplified Oral Hygiene Index (OHI-S), Gingival Index, and deft scores. Data were analysed using the independent *t*-test, Chi-square test, and Spearman's correlation analysis; $p < 0.05$ was considered statistically significant. **Results**: Children with higher digital device exposure had significantly higher OHI-S, Gingival Index, and deft scores ($p < 0.05$). Food pouching (87.5% *vs.* 42.9%) and eating during digital device use were significantly more prevalent in the study group. Among the study group, 39.3% always and 30.4% frequently used digital devices during meals, whereas 42.9% of controls never did so. Oral malodour was more frequent in the study group (82.1% *vs.* 33.9%). Screen time showed strong positive correlations with OHI-S and deft scores and a moderate correlation with gingival inflammation. Dental visit patterns did not differ significantly. **Conclusions**: Higher digital device exposure was associated with poorer oral hygiene, increased gingival inflammation, and greater caries experience among children with speech delay. Assessment of digital device use and related lifestyle behaviours should be incorporated into routine paediatric dental history taking.

Keywords

Child behaviour; Dental caries; Digital device exposure; Feeding behaviour; Oral health; Paediatric dentistry; Speech delay

1. Introduction

The increasing use of digital devices and media has significantly influenced lifestyle behaviours among children. Although these technologies provide benefits related to communication, learning, and information access, they are now frequently used for entertainment and behavioural management during early childhood [1]. Their widespread accessibility has resulted in prolonged and often poorly regulated screen exposure, raising concerns regarding potential effects on child development and overall health [2].

Early childhood represents a critical period for speech and language development, which depends largely on reciprocal caregiver–child interaction and adequate environmental stimulation [3]. Speech and language development progresses through age-specific developmental milestones during infancy and early childhood [4]. Clinically relevant speech delay is generally considered when language or speech development progresses at less than 75% of the expected developmental rate for age, based on established developmental milestones. Delayed vocabulary acquisition, impaired phrase formation, and failure to achieve age-appropriate expressive language abilities may indicate delayed speech development [4].

Children with speech delay may experience difficulties in communication and social interaction [5]. In addition to developmental challenges, these children may experience difficulties affecting oral health maintenance. Impaired communication, behavioural cooperation difficulties, altered feeding

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patterns, and increased dependence on caregivers may contribute to compromised oral hygiene practices and increased susceptibility to dental diseases [6]. Problematic feeding and eating behaviours, including food pouching, selective eating, and prolonged food retention, may contribute to an increased risk of dental caries [7]. Moreover, barriers to maintaining routine oral hygiene practices and accessing preventive dental care may further compromise oral health in this population [8]. Together, these developmental and behavioural factors suggest that children with speech delay may represent a high-risk group requiring increased attention toward oral health promotion [6, 8].

Excessive digital device exposure may further reduce opportunities for meaningful interpersonal interaction, as passive screen engagement provides limited feedback and may interfere with attention, communication, and language acquisition [9–11]. Previous studies have reported associations between prolonged screen exposure and expressive language delay, reduced conversational interaction, sedentary behaviours, and unhealthy lifestyle habits among children [5, 11].

In addition to developmental concerns, excessive digital device use may influence behaviours that adversely affect oral health [12]. The use of digital devices during feeding has become increasingly common and may result in distracted eating, inadequate chewing, prolonged food retention, and food pouching behaviour [13]. These behaviours increase exposure of the teeth to fermentable carbohydrates and compromise oral clearance, thereby predisposing children to dental caries [13]. Excessive screen engagement may also interfere with routine oral hygiene practices, with greater screen exposure being associated with unsupervised and infrequent toothbrushing [14].

Several studies have reported associations between prolonged screen exposure, sedentary lifestyle behaviours, unhealthy dietary habits, and increased caries experience in children [13, 15, 16]. Screen viewing during meals may prolong oral clearance time, particularly in the presence of adhesive foods, thereby increasing cariogenic risk [17, 18]. However, although previous literature has explored the relationship between screen exposure, behavioural habits, and oral health outcomes in children, evidence evaluating digital device dependency as a behavioural determinant of oral health among children with speech delay remains limited. Existing studies have largely investigated screen exposure or oral health outcomes independently, with limited emphasis on developmental communication disorders as modifying factors influencing oral health behaviours [15, 19, 20].

To the best of our knowledge, no previous study has specifically investigated the association between digital device dependency and oral health outcomes in children with speech delay while simultaneously exploring behavioural factors influencing feeding practices and oral hygiene. Therefore, the present study was undertaken to address this existing knowledge gap and evaluate the association between digital device dependency and oral health outcomes in children with speech delay, with particular emphasis on feeding practices and oral hygiene behaviours.

1.1 Null hypothesis

There is no significant association between digital device dependency and oral health outcomes in children with speech delay.

1.2 Alternate hypothesis

There is significant association between digital device dependency and oral health outcomes in children with speech delay.

2. Materials and methods

2.1 Study design

This hospital-based cross-sectional observational study was conducted among children aged 3–6 years diagnosed with speech delay who attended the Department of Paediatric and Preventive Dentistry between August 2024 and April 2025. The study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Eligible participants were recruited following screening according to predefined eligibility criteria. Written informed consent was obtained from parents or legal guardians prior to enrolment. Data collection was performed sequentially to ensure methodological consistency and reproducibility. Initially, demographic characteristics, screen-use patterns, digital device dependency-related behaviours, feeding practices, oral health–related practices, and parental regulation of screen exposure were recorded using a structured parent-reported questionnaire. Parents or guardians completed the questionnaire under investigator supervision, and clarification was provided when required to ensure uniform understanding.

Following questionnaire assessment, clinical oral examination was performed under adequate illumination by a single trained examiner using standardized clinical criteria. Oral hygiene status was assessed using the Simplified Oral Hygiene Index (OHI-S), gingival health was evaluated using the Gingival Index, and caries experience was recorded using the decayed, extracted, and filled primary teeth (deft) index. Participants were subsequently categorized into study and control groups based on screen exposure characteristics obtained through questionnaire assessment.

2.2 Speech delay assessment

Speech delay status was determined based on prior clinical diagnosis by qualified speech therapists before participant recruitment. Diagnosis was established according to developmental criteria consistent with established speech and language milestones, wherein clinically relevant speech delay was considered when language or speech development progressed at less than 75% of the expected developmental rate for age [4].

Children included in the study demonstrated delays in age-appropriate speech and language development, including delayed vocabulary acquisition, delayed phrase formation, reduced expressive verbal communication, delayed speech sound production, or delayed attainment of expected speech milestones, as documented in speech-language assessment records and clinical evaluation by qualified speech therapists.

Participants included children previously diagnosed with speech delay who required speech-language intervention or follow-up care.

Where available, clinical records and history of speech therapy consultation were reviewed to support diagnosis. This approach ensured reliable identification of children with speech delay within the clinical setting. Severity of speech delay was not considered as an eligibility criterion, and children were enrolled based on the presence of a prior clinical diagnosis irrespective of severity.

2.3 Assessment of digital device dependency

Digital device dependency-related behaviours were assessed using selected dependency constructs adapted from the Problematic Media Use Measure–Short Form (PMUM-SF), which were integrated into the structured parent-reported questionnaire. The dependency assessment evaluated behavioural characteristics associated with problematic media use, including withdrawal-related behaviours, screen-use characteristics, and dependency-associated behavioural patterns. The final integrated questionnaire underwent content validation before implementation.

2.4 Questionnaire assessment

Data collection was performed using a structured parent-reported questionnaire developed by integrating selected questionnaire items assessing screen exposure characteristics, feeding practices, oral health–related behaviours, and dependency-related constructs adapted from the Problematic Media Use Measure–Short Form (PMUM-SF). The PMUM-SF dependency constructs were incorporated using a modified binary response format to facilitate parent reporting within the study population.

The final integrated questionnaire underwent content validation by experts from Paediatric Dentistry, Paediatrics, Psychology, and Speech and Language Pathology before implementation. Standardized questionnaire administration procedures were followed for all participants to ensure uniformity during data collection. Parents completed the questionnaire under investigator supervision, and clarification was provided when necessary to ensure consistent interpretation of questionnaire items.

Behavioural variables assessed through the questionnaire included screen exposure duration, parental regulation of screen exposure, purpose of digital device use, dependency-related digital device behaviours, feeding practices during digital device exposure, eating habits during screen exposure, food pouching behaviour, signs of oral discomfort or pain, oral malodour, and oral health–related practices including dental attendance patterns.

2.5 Eligibility criteria

Inclusion Criteria:

Children were included in the study if they met the following criteria:

• Aged between 3 and 6 years at the time of enrolment.

• Clinically confirmed diagnosis of speech delay established through prior evaluation by qualified speech therapists.

• History of digital device exposure of varying duration.

• Availability of a parent or legal guardian willing to provide informed consent.

Exclusion Criteria:

Children were excluded from the study if they presented with:

• Diagnosed developmental disorders other than speech delay, such as autism spectrum disorder or global developmental delay, that could independently influence behaviour or oral health.

• Chronic systemic illnesses known to affect oral health status.

• Hearing impairments that could interfere with speech development.

• Parents or guardians unwilling to participate in the study.

2.6 Sampling method

Consecutive sampling was adopted for participant recruitment. All eligible children aged 3–6 years with clinically confirmed speech delay attending the Department of Paediatric and Preventive Dentistry during the study period who fulfilled the inclusion criteria were recruited consecutively until the required sample size was achieved. Information regarding screen-use characteristics was subsequently obtained from parents or legal guardians using the structured questionnaire. The participant recruitment and allocation process followed during the study is illustrated in Fig. 1.

2.7 Group allocation

A comparative cross-sectional observational design was adopted, comprising two groups. The control group (Group A) included children with speech delay and regulated or limited screen exposure, whereas the study group (Group B) consisted of children with speech delay and high screen exposure. Group allocation was performed based on parent-reported questionnaire responses assessing screen-use patterns and problematic digital device use behaviours.

Categorization of screen-time exposure was guided by age-specific sedentary screen exposure recommendations proposed in the Australian 24-Hour Movement Guidelines for the Early Years, whereby children below 5 years were recommended to have no more than 1 hour/day of screen exposure and children aged 5–6 years no more than 2 hours/day. Participants with screen exposure within recommended limits were categorized into the control group, whereas those exceeding age-appropriate recommended limits (2–4 hours/day and 4–6 hours/day) were categorized into the study group. Assessment of problematic digital device use behaviours using the Problematic Media Use Measure–Short Form (PMUM-SF) was additionally considered during participant categorization.

2.8 Sample size

A total of 112 children were included in the study, with 56 participants in each group.

The sample size was calculated using N*Master software

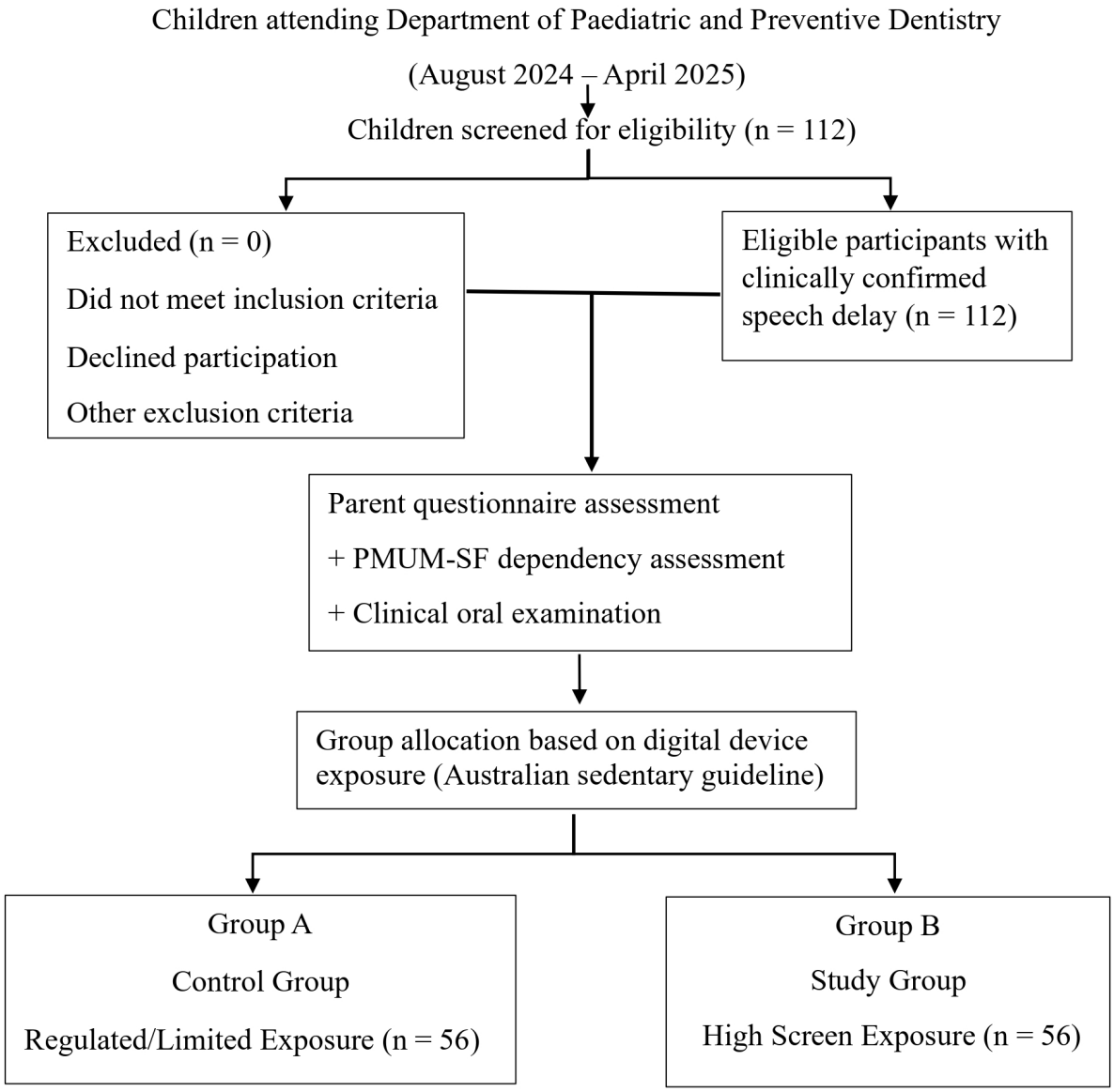


FIGURE 1. Flowchart illustrating participant recruitment and group allocation. PMUM-SF: Problematic Media Use Measure–Short Form.

(Version 2.0, Department of Biostatistics, Christian Medical College, Vellore, India), with reference to a previously published study evaluating screen exposure and oral health-related outcomes in children [19]. The sample size parameters were adapted to the objectives and study design of the present investigation. The calculation considered a standard deviation of 4.2 in Group I and 3.6 in Group II, an expected mean difference of 2.39, and an effect size of 0.6128. The alpha error was set at 5%, with a 95% confidence interval, statistical power of 90%, and a two-sided test. Based on these parameters, a minimum sample size of 56 participants per group was determined, resulting in a total sample size of 112 participants. No participant withdrawals or dropouts occurred during the study period.

2.9 Examiner training and calibration

Clinical examination was performed by a single trained examiner under standardized clinical conditions. Prior to study initiation, the examiner underwent training, calibration, and standardization under faculty supervision to ensure uniform application of diagnostic criteria and consistency in recording the Simplified Oral Hygiene Index (OHI-S), Gingival Index (GI), and decayed, extracted, and filled primary teeth (deft) scores.

To ensure measurement reproducibility, intra-examiner calibration was performed on a random subset comprising approximately 13% (n = 15) of the total study population. These participants were re-examined by the same investigator after a 7-day interval to minimize memory bias. Intra-examiner reliability was evaluated using the Two-Way Mixed-Effects, Absolute Agreement, Single-Rater Intraclass Correlation Coefficient (ICC). The ICC values obtained for OHI-S, GI, and deft scores were 0.851, 0.852, and 0.849, respectively, indicating good intra-examiner reliability and clinical reproducibility. Inter-examiner reliability assessment was not applicable, as all clinical examinations were performed by a single calibrated examiner.

2.10 Bias

As this was a cross-sectional observational study, randomization and blinding were not applicable. However, several measures were adopted to minimize potential bias. Standardized criteria were used for clinical oral examinations, and all assessments were performed under uniform clinical conditions. A structured parent-reported questionnaire was used to collect data regarding screen exposure characteristics and associated behavioural variables. Additionally, speech delay status was determined based on prior clinical diagnosis by qualified speech therapists, thereby reducing the possibility of misclassification bias.

Consecutive recruitment of eligible participants was adopted to minimize selection bias. Potential confounding variables, including feeding practices, behavioural factors, parental regulation patterns, screen exposure characteristics, and oral hygiene practices, may have influenced oral health outcomes and should therefore be considered while interpreting the study findings. Residual confounding could not be completely excluded because of the observational cross-sectional study design.

2.11 Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software version 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including mean, standard deviation (SD), frequency, and percentage, were used to summarize demographic variables, questionnaire responses, and oral health findings. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages.

Data normality was assessed using the Shapiro–Wilk test. Considering the equal sample sizes (n = 56 per group) and the robustness of parametric methods under mild deviations from normality, the independent *t*-test was used for comparison of continuous variables, including OHI-S scores, Gingival Index scores, and deft scores, between the study and control groups. The Chi-square test was used to analyse categorical variables such as feeding practices and behavioural patterns associated with screen exposure. Spearman's rank correlation analysis was performed to assess associations between screen exposure and oral health parameters. Interpretation of correlation strength was performed according to classification criteria proposed by Schober *et al.* [21]. No missing data were observed for the analysed variables. A 95% confidence interval was adopted, and a *p*-value of less than 0.05 was considered statistically significant.

2.12 AI use disclosure

The authors utilized an artificial intelligence (AI)-assisted language tool (ChatGPT, Version 5.5, OpenAI, San Francisco, CA, USA) to improve language clarity, grammar, and overall organization of the manuscript. All scientific content, data interpretation, and conclusions were independently developed, reviewed, and verified by the authors.

3. Results

A total of 112 children (56 per group) were included in the study.

3.1 Sociodemographic characteristics

The sociodemographic characteristics of the study participants are presented in Table 1. Age and gender distributions were comparable between the study and control groups, whereas socioeconomic status differed significantly between the groups.

TABLE 1. Sociodemographic characteristics.

Variable	Category	(Group A) Control n (%)	(Group B) Study n (%)	χ^2 Chi-square	*p*-value
Age					
	3 yr	19 (33.9)	16 (28.6)		
	4 yr	12 (21.4)	6 (10.7)	4.425	0.219
	5 yr	11 (19.6)	19 (33.9)		
	6 yr	14 (25.0)	15 (26.8)		
Gender					
	Male	31 (55.4)	27 (48.2)		
	Female	25 (44.6)	29 (51.8)	0.322	0.571
Socioeconomic status					
	Low SES	8 (14.3)	28 (50.0)		
	Middle SES	18 (32.1)	24 (42.9)	31.851	<0.001**
	High SES	30 (53.6)	4 (7.1)		

*χ^2: Chi-square statistic; SES: Socioeconomic status; n: Number of participants; **: Statistically significant at $p < 0.001$. Chi-square test applied for intergroup comparison; statistical significance set at $p < 0.05$; total sample size n = 112. Age and gender distributions were comparable between the (Group B) study and (Group A) control groups ($p > 0.05$). However, socioeconomic status differed significantly between groups ($p < 0.001$), with a higher proportion of children in the (Group B) study group belonging to the low socioeconomic category.*

3.2 Digital device exposure characteristics

The digital device exposure characteristics of the study participants are summarized in Table 2. Significant differences in screen exposure patterns were observed between the study and control groups.

3.3 Feeding practices and oral health behaviour

Table 3 presents the comparison of feeding practices and oral health behaviours between the study and control groups. Children with higher digital device exposure demonstrated significantly less favourable feeding and oral hygiene behaviours.

3.4 Digital device dependency outcomes

The digital device dependency-related outcomes assessed using the PMUM-SF questionnaire are presented in Table 4. The study group demonstrated significantly higher PMUM-SF scores compared with the control group.

3.5 Clinical oral health outcomes

Table 5 presents the comparison of clinical oral health outcomes between the study and control groups. Children with higher digital device exposure exhibited significantly poorer oral hygiene status, increased gingival inflammation, and greater caries experience.

All intergroup differences were statistically highly significant ($p < 0.001$).

3.6 Correlation analysis

The correlation between screen time and oral health parameters is presented in Table 6. Screen time demonstrated positive correlations with oral hygiene status, gingival inflammation, and caries experience.

Table 7 presents the correlation between age, digital device use, and oral health outcomes. Age showed weak correlations with oral health parameters, whereas digital device use demonstrated stronger positive associations with poorer oral health outcomes.

4. Discussion

The present study evaluated oral health outcomes among children with speech delay in relation to digital device dependency, with particular emphasis on behavioural factors influencing feeding practices and oral hygiene. The findings demonstrated that children with higher digital device exposure exhibited significantly poorer oral hygiene status, increased gingival inflammation, and greater caries experience compared with children with regulated screen exposure. These observations suggest that digital device dependency may adversely influence oral health primarily through behavioural and lifestyle-related factors.

Age and gender distributions were comparable between groups, whereas socioeconomic status differed significantly, with a higher proportion of children in the study group belonging to the low socioeconomic category. As socioeconomic status is an established determinant of oral health [22], its potential influence should be considered when interpreting the study findings.

Previous literature has suggested a possible association between excessive digital device exposure and impaired speech and language development during early childhood. A recent systematic review by Alamri *et al*. [23] reported that prolonged smart media exposure was associated with reduced expressive vocabulary, poorer language skills, and increased speech delays in children, particularly when screen exposure occurred at an early age and without parental supervision. The review further emphasized that passive screen engagement may replace meaningful interpersonal interactions necessary for speech and cognitive development. These behavioural mechanisms may partially explain the coexistence of higher digital device dependency and poorer oral health outcomes observed among children with speech delay in the present study.

Excessive digital device exposure has been shown to alter daily routines and reduce meaningful caregiver–child interaction, both of which are essential for behavioural regulation and habit formation during early childhood [5, 9]. In the present study, children with higher screen exposure more frequently demonstrated distracted feeding practices, including eating during digital device use and food pouching behaviour. Such practices may reduce awareness of eating patterns, prolong oral clearance time, and increase plaque accumulation, thereby contributing to greater cariogenic risk. Similar findings have been reported in previous studies evaluating screen-based feeding practices, increased snacking frequency, and altered dietary habits among children [17, 18].

The significantly higher OHI-S scores observed in the study group indicate compromised oral hygiene among children with greater digital device exposure. This finding may be attributed to reduced parental supervision, irregular brushing habits, and decreased child cooperation during oral hygiene practices. Children with speech delay often require structured behavioural guidance and caregiver-assisted oral hygiene measures; therefore, excessive screen engagement may further disrupt the establishment of consistent oral hygiene routines. Similar observations have previously been reported, highlighting the influence of lifestyle-related behaviours, parental factors, and supervised oral hygiene practices on oral hygiene status among children [24, 25].

Increased Gingival Index scores observed in the study group reflect greater gingival inflammation, likely secondary to inadequate plaque control. Gingival health is closely associated with oral hygiene practices, and the findings suggest that digital device dependency may indirectly influence periodontal health through behavioural mechanisms rather than direct biological effects. Previous studies have similarly reported strong associations between irregular brushing habits and gingival inflammation in children [26, 27].

The higher deft scores observed among children with greater digital device exposure indicate increased caries experience, which may be attributed to a combination of distracted feeding, prolonged food retention, and irregular oral hygiene practices. Food pouching behaviour, which was significantly more prevalent in the study group, may further contribute to prolonged exposure of teeth to fermentable carbohydrates, thereby

TABLE 2. Digital device exposure characteristics.

Variable	Category	(Group A) Control n (%)	(Group B) Study n (%)	χ^2 Chi-square	*p*-value
Screen Timings					
	<1 h	28 (50.0%)	0 (0.0%)		
	1–2 h	28 (50.0%)	0 (0.0%)	112.0	<0.001**
	2–4 h	0 (0.0%)	26 (46.4%)		
	4–6 h	0 (0.0%)	30 (53.6%)		
Digital Device Usage					
	Gaming Console	6 (10.7%)	0 (0.0%)		
	Laptop	1 (1.8%)	6 (10.7%)		
	Smartphone	31 (55.4%)	30 (53.6%)	10.23	0.037*
	Tablet	6 (10.7%)	9 (16.1%)		
	Television	12 (21.4%)	11 (19.6%)		
Online Classes					
	No	25 (44.6%)	50 (89.3%)		
	Yes	31 (55.4%)	6 (10.7%)	25.22	<0.001**
Screen Time Limit					
	No	13 (23.2%)	48 (85.7%)		
	Yes	43 (76.8%)	8 (14.3%)	41.62	<0.001**
Purpose of Use					
	Education	34 (60.71%)	7 (12.5%)		
	Entertainment	22 (39.29%)	49 (87.5%)	26.01	<0.001**

*χ^2: Chi-square statistic; n: Number of participants; **: Statistically significant at $p < 0.001$. Chi-square test applied for intergroup comparison; *: Statistical significance set at $p < 0.05$; total sample size n = 112. Significant differences were observed between the (Group B) study and (Group A) control groups with respect to screen exposure duration, online class attendance, parental screen-time regulation, and purpose of digital device use ($p < 0.001$). Smartphones were the most commonly used digital devices in both groups, with statistically significant difference in device type usage ($p = 0.037$).*

TABLE 3. Feeding practices and oral health behaviour.

Variable	Category	(Group A) Control n (%)	(Group B) Study n (%)	χ^2 Chi-square	*p*-value
Eats Food with Digital Device					
	Always	9 (16.1%)	22 (39.3%)		
	More often	7 (12.5%)	17 (30.4%)		
	Never	24 (42.9%)	0 (0.0%)		
	Sometimes	16 (28.6%)	17 (30.4%)	33.65	<0.001**
Pouches Food Frequently					
	No	32 (57.1%)	7 (12.5%)		
	Yes	24 (42.9%)	49 (87.5%)	22.66	<0.001**
Signs of Oral Discomfort/Pain					
	No	31 (55.4%)	16 (28.6%)		
	Yes	25 (44.6%)	40 (71.4%)	7.19	0.007**
Bad Breath					
	No	37 (66.1%)	10 (17.9%)		
	Yes	19 (33.9%)	46 (82.1%)	24.78	<0.001**
Regular Dental Checkups					
	No	33 (58.9%)	35 (62.5%)		
	Yes	23 (41.1%)	21 (37.5%)	0.04	0.847

*χ^2: Chi-square statistic; n: Number of participants; **: Statistically significant at $p < 0.001$. Chi-square test applied for intergroup comparison; statistical significance set at $p < 0.05$; total sample size n = 112. Feeding practices and oral health–related behavioural variables differed significantly between groups. Children in the (Group B) study group demonstrated significantly higher frequencies of eating during digital device use, food pouching behaviour, oral discomfort, and bad breath ($p < 0.05$). No statistically significant difference was observed in regular dental checkup patterns between groups ($p = 0.84$).*

TABLE 4. Mean descriptive values of PMUM-SF scores and inter group comparison between (Group A) control and (Group B) study groups.

Variable	(Group A) Control Group (n = 56) Mean ± SD	(Group B) Study Group (n = 56) Mean ± SD	Mean Difference (95% CI)	*t*-value	*p*-value
Problematic Media Use Short Form (PMUM-SF) Total Score	1.71 ± 1.17	6.43 ± 1.32	4.71	19.999	<0.001**

*PMUM-SF: Problematic Media Use Measure–Short Form; SD: Standard deviation; CI: Confidence interval; **: Statistically significant at $p < 0.001$. An Independent Student's t-test demonstrated a statistically significant difference in PMUM-SF dependency scores between the (Group A) control and (Group B) study groups ($t(110) = 19.999$, $p < 0.001$). Children in the high screen exposure study group exhibited significantly higher dependency scores (6.43 ± 1.32) compared to the regulated exposure control group (1.71 ± 1.17), with a mean difference of 4.71 points (95% CI: 4.25–5.18), indicating increased problematic digital device–related behaviours among children with prolonged screen exposure.*

TABLE 5. Mean descriptive values of index scores and intergroup comparison between study and control groups.

Group	N	Mean	Standard Deviation	Mean Difference	*t*	*p* Value
OHI-S Score						
(Group B) Study	56	3.817	1.348			
(Group A) Control	56	2.117	0.783	1.700	6.183	<0.001**
Gingival Index Score						
(Group B) Study	56	1.832	0.518			
(Group A) Control	56	1.190	0.579	0.642	8.165	<0.001**
deft Score						
(Group B) Study	56	4.643	1.432			
(Group A) Control	56	1.750	1.283	2.893	11.258	<0.001**

*OHI-S: Simplified Oral Hygiene Index; deft: Decayed, extracted, and filled primary teeth; **: Statistically significant at $p < 0.001$. Independent Student's t-test was used for intergroup comparison. Statistical significance was set at $p < 0.05$. The (Group B) study group demonstrated significantly poorer oral health status compared to the (Group A) control group. Mean OHI-S scores were higher in the (Group B) study group (3.82 ± 1.35) than in the (Group A) control group (2.12 ± 0.78). Gingival Index scores were also higher in the (Group B) study group (1.83 ± 0.52) compared to the (Group A) control group (1.19 ± 0.58). Similarly, the mean deft score was significantly higher in the (Group B) study group (4.64 ± 1.43) than in the (Group A) control group (1.75 ± 1.28).*

TABLE 6. Correlation between Screen time and oral health.

Variables	Spearman's (ρ)	*p* value
Screen time ↔ OHI-S	+0.63	<0.001
Screen time ↔ Gingival Index	+0.46	<0.001
Screen time ↔ deft	+0.71	<0.001

ρ: Spearman's rank correlation coefficient; OHI-S: Simplified Oral Hygiene Index; deft: Decayed, extracted, and filled primary teeth. Statistical significance was set at $p < 0.05$. Spearman's correlation analysis demonstrated a moderate positive correlation between screen time and OHI-S scores ($\rho = 0.63$, $p < 0.001$) as well as Gingival Index scores ($\rho = 0.46$, $p < 0.001$). A strong positive correlation was observed between screen time and deft scores ($\rho = 0.71$, $p < 0.001$), indicating that increased screen exposure was associated with poorer oral health outcomes.

TABLE 7. Correlation between age, digital device use and oral health outcomes.

Variables	Spearman's (ρ)	*p* value
Age ↔ Screen time	+0.134	0.159
Age ↔ OHI-S	+0.080	0.404
Age ↔ Gingival Index	−0.053	0.581
Age ↔ deft	+0.131	0.170

ρ: Spearman's rank correlation coefficient; OHI-S: Simplified Oral Hygiene Index; deft: Decayed, extracted, and filled primary teeth. Statistical significance was set at $p < 0.05$. Spearman's Correlation analysis demonstrated weak positive correlations between age and screen time ($\rho = 0.134$, $p = 0.159$) as well as age and deft scores ($\rho = 0.131$, $p = 0.170$). Negligible correlations were observed between age and OHI-S scores ($\rho = 0.080$, $p = 0.404$) and between age and Gingival Index scores ($\rho = -0.053$, $p = 0.581$). However, none of these correlations were statistically significant ($p > 0.05$).

increasing cariogenic risk [13].

The correlation analysis further supports these findings, demonstrating a strong positive association between screen exposure and deft scores, and a moderate association with OHI-S and gingival inflammation. These findings reinforce the concept that increasing screen exposure is associated with progressive deterioration in oral health status, primarily mediated through feeding-related and oral hygiene–related behaviours and no correlation between age, device exposure and oral hygiene.

Parental behaviour may significantly influence the relationship between excessive digital device use and oral health outcomes in children. Previous literature has suggested that media-centric parenting practices, wherein electronic devices are extensively integrated into children's daily routines, may contribute to increased screen exposure, unhealthy dietary habits, and neglect of essential self-care behaviours, including oral hygiene. Excessive screen engagement and reduced parental supervision during meals and daily activities may promote distracted feeding practices, increased consumption of sugary snacks, irregular brushing routines, and prolonged sedentary behaviours. The literature further emphasizes that parental regulation of screen exposure, co-viewing practices, and establishment of structured routines play important roles in promoting healthier lifestyle and oral hygiene habits among children [28]. These behavioural mechanisms may partially explain the poorer oral health outcomes observed among children with higher digital device dependency in the present study.

Importantly, no significant difference was observed in dental visit patterns between the groups, suggesting that the observed differences in oral health outcomes may be more strongly influenced by daily behavioural habits than by access to dental care services [29].

From a clinical perspective, children with speech delay represent a high-risk group in whom digital device dependency may further compromise oral health. Incorporating assessment of screen-use patterns and feeding-related behaviours into routine paediatric dental history taking may aid in early identification of at-risk children. Parental counselling focused on limiting screen exposure during meals and reinforcing supervised oral hygiene practices may serve as effective preventive strategies.

Although the cross-sectional design limits causal inference, the findings support a significant association between digital device dependency and adverse oral health outcomes in children with speech delay. Future longitudinal studies are required to evaluate the long-term impact of modifying screen-use behaviours on oral health outcomes in this population.

5. Conclusions

The present study demonstrated a significant association between digital device dependency and adverse oral health outcomes among children with speech delay. Children with higher screen exposure exhibited poorer oral hygiene status, increased gingival inflammation, and greater caries experience compared with children with regulated digital device use.

The findings suggest that excessive digital device exposure may adversely influence oral health through feeding-related and oral hygiene–related behaviours, including distracted feeding practices, food pouching behaviour, and irregular oral hygiene routines. No significant difference in dental visit patterns was observed between the groups, indicating that daily lifestyle and behavioural habits may play a more important role than access to dental care services in determining oral health outcomes in this population.

6. Clinical relevance and implications

The findings of the present study highlight the importance of incorporating assessment of digital device usage patterns, feeding-related behaviours, and oral hygiene practices into routine paediatric dental history taking. Children with speech delay should be considered a high-risk group in whom excessive and poorly regulated digital device use may further compromise oral health.

Parental counselling should emphasize limiting screen exposure during meals, encouraging age-appropriate feeding practices, and reinforcing supervised oral hygiene routines. A multidisciplinary approach involving paediatric dentists, speech therapists, and caregivers may contribute to more comprehensive behavioural guidance and improved oral health outcomes in this population.

7. Limitations

The present study has certain limitations that should be considered while interpreting the findings. The cross-sectional observational design precludes establishment of causal relationships between digital device dependency and oral health outcomes. In addition, data regarding screen exposure, feeding practices, and associated behavioural variables were parent-reported and may therefore be subject to recall and reporting bias.

The study population was limited to a specific geographic region and clinical population of children with speech delay, which may affect the generalizability of the findings to the broader paediatric population. Furthermore, qualitative aspects of digital media content and long-term behavioural outcomes were not evaluated in the present study.

8. Future scope

Future research should employ longitudinal study designs to establish temporal relationships between digital device dependency and oral health outcomes. Incorporation of objective screen-time assessment methods, such as digital tracking tools, may further improve the accuracy and reliability of exposure assessment.

Expanding the study population across diverse geographic and socio-economic settings would improve the generalizability of the findings. Interventional studies evaluating the impact of screen-time regulation, parental counselling, and behaviour-based preventive strategies on oral health outcomes are also warranted.

Further exploration of biological parameters, including salivary characteristics and oral microbiome alterations, may help elucidate the mechanisms linking excessive digital device ex-

posure with increased oral disease risk.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

HSSY—designed the research study and performed the research; wrote the manuscript. AAS—provided help and advice on the research. KR—analysed the data; helped in rectifying mistakes and fine tuning the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study protocol was approved by the Institutional Ethics Committee of the participating institution (ETHICS/IEC/440/2024). Written informed consent was obtained from the parents or legal guardians of all participating children prior to enrolment.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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