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Gadget, Parenting Style, Work Stress, and Toddler Speech Delay: A Retrospective Analysis in Industrial Area of Bekasi

Anom Dwi Prakoso[1)], Ice Marini[1,2)]

[1)]Department of Health Administration, Universitas Medika Suherman, Cikarang, Indonesia
[2)]Undergraduate and Professional Program in Veterinary Medicine,
Universitas Nusa Cendana, Kupang, Indonesia

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ABSTRACT

Background: Speech delay affects around 20% of toddlers in Indonesia and is prevalent in industrial areas where parents face long working hours. This study aimed to analyze the relationship of screen time, parenting style, and parental work stress with speech delay in toddlers.

Subjects and Method: This retrospective case-control study was conducted in Bekasi industrial area, August- September 2025. A total of 60 toddlers (13 with speech delay, 47 controls) were selected purposively. Speech delay was diagnosed using Denver II and MacArthur-Bates CDI. Independent variables included screen time, parenting style, and work stress, measured with validated questionnaires. Data were analyzed using Chi-square and logistic regression.

Results: The prevalence of speech delay was 21.7%. Screen time >1 hour/day was significantly associated with a higher risk of speech delay (OR=13.61; 95% CI=3.21 to 28.94; p=0.002). High parental work stress also increased the risk (OR=10.84; 95% CI=2.13 to 21.77; p=0.013). Parenting style showed no significant association (OR=2.73; p=0.233). Qualitative analysis revealed six themes including digital parenting, alternative stimulation, interactions that limit work stress, responsive vs. permissive parenting, awareness and intervention, and socioeconomic influences.

Conclusion: Excessive screen time and parental work stress are dominant risk factors for toddler speech delay in industrial families. Prevention efforts should focus on digital literacy for parents, responsive parenting, and stress management programs at community and workplace levels.

Keywords: speech delay, toddler, screen time, parenting style, work stress.

Correspondence:
Anom Dwi Prakoso. Department of Health Administration, Universitas Medika Suherman, Jl. Industri, Cikarang, West Java, Indonesia. Email: anomdwiprakoso@gmail.com

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BACKGROUND

Speech delay is a developmental condition characterized by delayed speech acquisition that does not correspond with a child's chronological age (Brown, Parikh and Patel, 2020). This delay is particularly concerning as speech ability plays a central role in social interaction, learning processes, and holistic cognitive development. Children with speech delay are typically able to produce words but experience difficulties in combining and linking them into meaningful expressions (Nur et al., 2023; Zulkarnaini et al., 2023). Other sclinical manifestations include

restricted vocabulary, limited expressive capacity, and difficulties in comprehension. Without timely interventions and adequate professional support, speech delay may result in long-term adverse outcomes, including reduced intellectual capacity and behavioral problems later in life (Hasibuan, 2023).

In Indonesia, speech delay has become an increasingly common phenomenon and is emerging as a public health concern. Data indicate that in 2022, the prevalence of children with speech delay increased by 20% nationwide (Ivandio, 2022). Several risk factors have been highlighted, including excessive gadget use among children, inappropriate parenting practices, and insufficient parent–child interaction (Astuti, 2023). Prolonged screen exposure in early childhood has been associated with disruptions in language development (Kusdaryanto et al., 2023). Recent evidence confirms that gadget use significantly raises the risk of speech delay among toddlers, where children exposed to gadgets are nearly twice as likely to experience language delays compared to those with limited or no gadget exposure (Purnama et al., 2024).

The widespread use of gadgets in daily life has transformed parenting practices, particularly in calming or occupying toddlers (Mahanani et al., 2024; Tri, 2017). Although practical, this practice reduces opportunities for communication and interaction between children and parents, which are critical for speech and language development. Parents are therefore expected to regulate and control gadget exposure to mitigate potential developmental risks (Saefudin, 2019; Wahyuni and Fajrah, 2022).

Bekasi Regency represents the largest industrial zone in Southeast Asia and has been formally designated as an industrial hub to reduce national unemployment (Bekasi District Government, 2023). Parents working in this sector often face long working hours and physically demanding schedules, which limit the time and quality of interaction with their children. High occupational stress further encourages reliance on gadgets as an easy solution for child care (Amalia and Setyowati, 2019). However, many parents remain unaware of the adverse consequences of excessive gadget use on child development, particularly in relation to speech and language delay (Damayanti et al., 2020).

Although previous studies in Indonesia have investigated the relationship between gadget use and speech delay (Amalia and Setyowati, 2019; Wahyuni and Fajrah, 2022), most have employed cross-sectional designs and considered limited variables. To date, there is a paucity of research integrating screen time, parenting style, and parental occupational stress, especially within the context of industrial worker families. Moreover, few studies have employed retrospective mixed-methods designs with standardized instruments such as the Denver II and the MacArthur-Bates Communicative Development Inventory (CDI).

Therefore, the present study aims to analyze the association between gadget use (screen time), parenting style, and parental occupational stress with the risk of speech delay among toddlers in the Bekasi industrial area, and to identify the dominant contributing factors through a mixed-methods approach.

SUBJECTS AND METHOD

1. Study Design

This research employed a retrospective observational design with a mixed-methods case–control approach. Quantitative and qualitative data were combined to provide a more comprehensive understanding of the phenomenon. The study was conducted in

the industrial area of Bekasi, West Java, Indonesia, between August and September 2025.

2. Population and Sample

The target population comprised toddlers aged 1–3 years and their parents residing in the Bekasi industrial zone. A total of 60 toddlers were purposively selected, consisting of 13 children with speech delay (case group) and 47 without speech delay (control group). Inclusion criteria included toddlers aged 1–3 years, parents employed in the industrial sector, and willingness to participate through signed informed consent. Exclusion criteria were toddlers with medical conditions (such as hearing impairment or autism), those who had previously undergone speech therapy, or parents who declined/withdrew consent.

3. Study Variables

The dependent variable in this study was speech delay, assessed using the standardized instruments Denver II and the MacArthur–Bates Communicative Development Inventories (CDI). The independent variables consisted of screen time, defined as the average daily duration of toddlers' gadget use; parenting style, categorized based on parental authority and responsibility; and parental work stress, measured with a validated self-report questionnaire. To minimize potential confounding factors, the study also controlled for child's sex, maternal education, and family socioeconomic status.

4. Operational Definition of Variables

Speech delay: A developmental condition diagnosed when a child fails to achieve age-appropriate speech milestones, as measured by the Denver II and the MacArthur–Bates Communicative Development Inventories (CDI).

Screen time: The average daily exposure of toddlers to electronic devices (smartphones, tablets, television, computers), categorized into ≤1 hour/day and >1 hour/day.

Parenting style: Classified according to Baumrind's typology (authoritative, authoritarian, permissive, neglectful) using a structured questionnaire, and further simplified into two categories: low authority and responsibility versus high authority and responsibility.

Parental work stress: Assessed using a validated occupational stress scale, categorized into low (<18.8) and high (≥18.8).

Control variables: Child's sex (male/female), maternal education (low/high), and family socioeconomic status (below/above the Bekasi District Minimum Wage = Rp 5,558,515).

5. Study Instruments

Speech delay was assessed using Denver II and the CDI. Screen time was measured through parent-reported questionnaires, parenting style was evaluated using a structured questionnaire adapted from Baumrind, and parental work stress was measured using a standardized stress scale (cut-off: 18.8). Sociodemographic data including child's sex, maternal education, and family income were collected through structured interviews and questionnaires.

6. Data analysis

Quantitative data were analyzed using SPSS version 26.0 through descriptive statistics, Chi-square tests, and logistic regression to identify dominant risk factors for speech delay. Qualitative data were collected via in-depth interviews and focus group discussions (FGDs), transcribed verbatim, and thematically analyzed using NVivo 12 Plus. Findings from both approaches were integrated using a convergent mixed-methods design to enhance validity and provide richer contextual interpretation.

7. Research Ethics

This study received ethical clearance from

the Research Ethics Committee of Universitas Medika Suherman (Ethical Clearance Number: 002949/Universitas Medika Suherman/2025). Participation was voluntary, informed consent was obtained in writing, and respondents' confidentiality and anonymity were fully maintained.

RESULTS

1. Sample Characteristics

A total of 60 toddlers participated in the study, consisting of 13 children with speech delay (cases) and 47 without speech delay (controls). The majority were female (66.7%). Most families had a socioeconomic status above the Bekasi District Minimum Wage (81.7%). More than half of the parents reported high levels of occupational stress (56.7%). Regarding parenting style, 60% of parents applied high levels of authority and responsibility, while 40% of toddlers were exposed to screen time exceeding one hour per day. Overall, the prevalence of speech delay in this study was 21.7%.

Table 1. Sample characteristics (categorical data)

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	20	33.3
	Female	40	66.7
Socioeconomic Status	< UMK (Rp 5,558,515)	11	18.3
	≥ UMK (Rp 5,558,515	49	81.7
Screen Time	≤ 1 hour/day	36	60.0
	> 1 hour/day	24	40.0
Parenting Style	Low authority and responsibility	24	40.0
	High authority and responsibility	36	60.0
Parental Work Stress	Low (<18.8)	26	43.3
	High (≥18.8)	34	56.7
Speech Delay	Yes	13	21.7
	No	47	78.3

2. Bivariate Analysis

Table 2 presents the bivariate analysis of factors associated with speech delay in toddlers. Screen time duration showed a significant association (p = 0.006); children exposed to screens for more than 1 hour per day were more likely to experience speech delay (41.7%) than those with ≤1 hour (8.3%), with an OR of 7.51. Parental work stress was also significantly associated (p = 0.048); toddlers of parents with high stress levels (≥18.8) had a higher risk of speech delay (32.4%) compared to those with low stress levels (7.7%), with an OR of 3.89. In contrast, parenting style was not significantly associated (p= 0.654), although the proportion was slightly higher in children raised with a high-authority style (25.0%) than with a low-authority style (16.7%). Overall, screen time and parental work stress were significant predictors of speech delay, whereas parenting style was not.

3. Multivariate analysis

Logistic regression found that toddlers with screen time exceeding one hour per day were 13.6 times more likely to experience speech delay compared to those with ≤1 hour/day (OR = 13.61; 95% CI = 2.59 to 71.53; p = 0.002). Similarly, children of parents with high occupational stress were 10.8 times more likely to experience speech delay compared to those with lower stress (OR =

10.84; 95% CI = 1.64 to 71.51; p = 0.013). Parenting style with low authority and responsibility was associated with a 2.7-fold increase in risk compared to high authority and responsibility, though this result was not statistically significant (OR = 2.73; 95% CI = 0.53 to 14.02; p = 0.233). The logistic regression model demonstrated strong explanatory power, with a Nagelkerke R^2 value of 0.624, indicating that approximately 62.4% of the variation in speech delay risk could be explained by the variables studied.

Table 2. Bivariate analysis of independent variables and speech delay

Independent variables	Speech Delay				OR	p
	No		Yes			
	N	%	N	%		
Screen time						
≤ 1 hour	33	91.7	3	8.3	7.51	0.006
> 1 hour	14	58.3	10	41.7		
Parenting style						
Low authority and responsibility	20	83.3	4	16.7	0.20	0.654
High authority and responsibility	27	75.0	9	25.0		
Parental Work Stress						
Low (<18.8)	24	92.3	2	7.7	3.89	0.048
High (≥18.8)	23	75.0	11	32.4		

Table 3. Logistic regression analysis of risk factors for speech delay

Independent Variables	b	OR	95% CI		p
			Lower limit	Upper limit	
Screen time (>1 hour)	2.61	13.61	2.59	71.53	0.002
Parenting style (high)	1.00	2.73	0.53	14.02	0.233
Parental Work Stress (low)	2.38	10.84	1.64	71.51	0.013
N observation= 60					
-2 log likelihood= 42,73					
Nagelkerke R^2= 62.4%					

DISCUSSION

Logistics regression analysis identified two significant risk factors for toddler speech delay: screen time and parental work stress. Toddlers exposed to screens for more than one hour per day were 13.6 times more likely to experience speech delay than those with ≤1 hour/day (OR = 13.61; 95% CI= 2.59–71.53; p= 0.002). Likewise, children of parents reporting high levels of occupational stress were 10.8 times more likely to have speech delay compared to those with lower stress (OR = 10.84; 95% CI = 1.64–71.51; p = 0.013). Parenting style with low authority and responsibility showed a tendency toward increased risk (OR= 2.73; 95% CI = 0.53–14.02; p = 0.233), though this association was not statistically significant. The model demonstrated strong explanatory power (Nagelkerke R^2= 0.624), indicating that these variables substantially contributed to variations in speech delay risk.

1. Screen time and speech delay

Our findings are consistent with the large-scale cohort study by Takahashi et al., (2023) which demonstrated a dose–response relationship between screen exposure at age one and communication delays at ages

two to four. Increased exposure was linked to higher risks of both language and problem-solving delays, reinforcing the argument that early screen use reduces opportunities for parent–child interaction, shared attention, and vocabulary growth.

Similarly, a nationwide study in Denmark revealed that children with ≥1 hour of daily screen time scored lower on both receptive and expressive language measures, further validating the one-hour/day cut-off used in this study (Rayce, Okholm and Flensborg, 2024). Device type also matters: frequent use of portable electronics (e.g., smartphones or tablets) at 18 months has been strongly correlated with expressive language delay, suggesting heightened risks during critical periods of phonological and word production development (Van Den Heuvel et al., 2019).

Evidence from case–control research in Dubai involving toddlers aged 12–48 months also indicated that prolonged gadget exposure significantly increased the risk of speech delay (Al Hosani et al., 2023). These findings align with developmental theories by Piaget, which emphasize sensorimotor exploration, and Vygotsky, which highlights the role of social scaffolding in early language acquisition (Yafie, 2024).

From a policy perspective, the WHO recommendation of limiting screen time to ≤1 hour/day for children aged 2–4 years provides a normative benchmark (Wold Health Organization, 2019). In addition to screen duration, the quality of content and parental involvement must be addressed to ensure interactive and safe digital exposure. Our results underscore the need for strict monitoring of toddlers' screen time, particularly in industrial families where gadgets are often used as substitutes for direct interaction.

Parental digital literacy education should emphasize both quality including age-appropriate, interactive content and active parental supervision and quantity, to ensure that children are not exposed to harmful content or spend excessive time on screens. The findings of this study indicate that excessive screen time is a significant predictor of speech delay in toddlers, underscoring the need for collective awareness and the implementation of strict screen-time limitations within families of industrial workers.

2. Parental Work Stress and Speech Delay

High parental work stress was also a significant predictor of toddler speech delay (OR= 10.8). According to Lazarus and Folkman's transactional model, stress depletes attentional, emotional, and self-regulation resources, which diminishes parents' responsiveness and frequency of meaningful verbal interactions. Evidence from Korea showed that parents under high occupational stress often substituted direct interaction with screen-based distractions as a coping mechanism (Kim et al., 2023)

In Indonesia, pandemic-related research highlighted how increased workloads and financial strain were associated with family psychosocial difficulties and child adjustment problems, suggesting that occupational stress undermines the linguistic environment at home (Riany and Morawska, 2023). Longitudinal studies have further shown that positive parent–child verbal exchanges protect against poor language outcomes, whereas stress-driven reductions in such interactions heighten the risk of delay (Feagans and Hines, 2014). In addition, recent research has shown a link between positive parenting behaviors during play and children's language development. Therefore, if stress reduces these positive behaviors, the risk of delayed language development in children will increase (Rivero et al., 2023).

Work family conflict also plays a critical role. When occupational demands intrude on family responsibilities, parenting quality and time spent with children decline, often accompanied by parental anxiety and fatigue. These conditions reduce opportunities for "serve and return" interactions, which are fundamental to language development (Cooklin et al., 2015).

Workplace based stress management programs including counseling services, flexible scheduling, and childcare facilities may therefore enhance the home linguistic environment. Combined with training in responsive communication, such interventions could reduce reliance on digital devices and improve children's language outcomes.

3. Parenting style and speech delay

Although parenting style was not statistically significant in this study, a trend was observed: toddlers raised under low authority and responsibility conditions had higher risks of delay. This finding aligns with prior evidence showing that positive parenting practices such as warmth, contingent responsiveness, and language scaffolding (e.g., expanding a child's utterances) strongly predict children's speech and comprehension outcomes (Rivero et al., 2023). Systematic reviews have also confirmed that consistent parental responsiveness in early years is crucial for long-term language development (Levickis et al., 2023).

However, time constraints and parenting stress can erode the consistency of positive behaviors. Research indicates that the interaction between non-parental caregiving, parental stress, and socioeconomic risks contributes to slower language development (Dore et al., 2023). Within industrial settings characterized by long working hours, parenting style may exert less influence compared to screen time and occupational stress. Thus, parenting interventions should focus on practical and language-enriching practices, such as responsive talk, shared book reading, and symbolic play, designed for families with limited time.

4. Integration of Findings and Model Strengths

The Nagelkerke R^2 value of 0.624 confirms that screen time, work stress, and parenting style together significantly explain variations in speech delay risk. These findings support the WHO's recommendations on limiting screen exposure and are consistent with work family conflict literature emphasizing workplace policies as key preventive strategies.

5. Study limitations

This study has several limitations. Its retrospective design and relatively small sample size restrict generalizability. Measurements of screen time, parenting style, and parental work stress relied on self-reports, which may introduce bias. Additionally, only selected sociodemographic factors were controlled, leaving other potential confounders such as quality of parent child interaction, social support, and biological characteristics of children unaddressed.

6. Conclusion and policy implications

In conclusion, excessive screen time and high parental work stress emerged as dominant risk factors for toddler speech delay in industrial communities, while parenting style showed no significant effect. These findings highlight the importance of parental digital literacy, workplace-based stress management programs, and community support mechanisms (such as integrated health posts and early childhood education centers) to foster parent child interaction.

Policy implications include the need for collaboration among local governments, industrial companies, and early education institutions to establish family friendly measures, such as on-site childcare, flexible work arrangements, and digital parenting

education. These efforts align with Sustainable Development Goals (SDG) 3 (Good Health and Well-being), SDG 4 (Quality Education), and SDG 8 (Decent Work and Economic Growth).

AUTHORS CONTRIBUTION

Anom Dwi Prakoso conceptualized and designed the study, supervised data collection, conducted quantitative and qualitative analysis, interpreted the findings, and drafted as well as critically revised the manuscript.

Ice Marini contributed to the development of the study framework, validated research instruments, assisted in data interpretation, and reviewed the final manuscript for intellectual content and language clarity.

Both authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare no commercial or financial conflicts of interest that could be construed as influencing the outcomes of this study.

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