

Exploring the effect of digital applications on toddlers' cognitive and language abilities: frequency and duration

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Abstract. Toddlers' lives are increasingly reliant on digital apps, which has led to worries about how they may affect their linguistic and cognitive development. In order to help educators and caregivers promote healthy digital behaviors, this study looks at how smartphone usage length and frequency affect these skills. Purposive sampling was used to pick 37 respondents using a cross-sectional methodology and a correlational design. A questionnaire was used to gather information on smartphone usage, and the Capute Scale was used to evaluate linguistic and cognitive development. Longer smartphone use had a negative impact on cognitive development ($p=0.003$; $CC=0.469$), while higher usage frequency was associated with lower FSDQ scores ($p=0.006$; $CC=0.444$) and worse overall cognitive and language development ($p=0.008$; $CC=0.429$), according to analysis using the Rank Spearman test. This study's result emphasizes the detrimental relationship between excessive smartphone use and developmental outcomes, emphasizing the necessity for educators and caregivers to keep an eye on students' digital exposure. It is recommended that more study be done to examine these dynamics in a variety of populations and improve recommendations for healthy developmental practices.

1 Introduction

Low-level technological advancements cannot be stopped. In a national context, internet usage is rather low in Indonesia. Around 66,48% of Indonesians had internet access as of the year 2022. Most people access the internet using mobile phones [1]. A smartphone is currently the gadget that the general public uses the most and is the most well-liked among almost all segments of society, including children [2].

This has significantly changed how children interact with the world, especially through digital applications. Particularly with the increasing accessibility of smartphones, tablets, and

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other electronic devices, older people and the elderly frequently highlight digital applications for health and education purposes.

In Indonesia, the percentage of five-year-old children using a gadget for media consumption was 38% in 2011 and 72% in 2013, with a further increase to 80% in 2015. Approximately 90% of people know that their children older than two years old are exposed to some electronic media. A study on family media usage revealed that 40% of adults play with their children for a full day and 28% play with their children for a majority of the day. Adults also reported that they discourage their children from playing with them because it gives them more time to do other things [3]. Every day, gadgets are used as a means of entertainment to entice children, making them more accustomed to using gadgets as daily gaming partners [4].

Smartphone use by children needs to be limited in length. It is stated by the American Academy of Paediatrics (AAP) that children under the age of two cannot go to bed and that children between the ages of two and five can sleep better at three hours a day [5]. The use of less-than-ideal media should be limited to children aged 0–12 who are unable to use media, or children aged 2–7 who are unable to use media for more than one hour each day, as recommended by the World Health Organisation [5]. In Indonesia, children experience developmental issues at a rate of 13–18% [6]. Numerous investigations have examined the function of digital media on kids' educational journeys, yielding diverse outcomes. Excessive screen use and improper content have been linked in some studies to attention issues, cognitive decline, and delays in language acquisition [7]. According to Kurniati et al.'s research findings, children's language development may suffer if they play with electronics for extended periods [5], [8]. Up to 90.3% of individuals who had impairments in their speech and language development utilized electronic devices, according to research by Al Hosani et al [5].

A smartphone can provide both positive and negative effects. Devices can provide positive effects if used properly by children, such as enhancing knowledge, strengthening family ties, simplifying communication, developing children's creativity, helping them adjust to their environment, and developing their maternal bonds [4]. Conversely, if a device is used carelessly, it may have unfavorable effects such as impairing the growth process, harming a child's health, causing problems, and making it difficult for a child to understand how to communicate and interact with others [9].

At the early stages of childhood, cognitive and language development in the brain are very important. Language learning is a natural process that starts with language acquisition and instruction through written language. According to Piaget's theory, before a child can walk, they must first learn to communicate through body language and facial expressions. Subsequently, the child begins to practice formal, declarative, and reflective writing. After the first year of life, an infant's ability to learn will increase and be correlated with the level of cognitive development and language interaction between 1.5 and 3 years of age [10]. Due to this, the spread of foreign languages in the United States requires human interaction and requires active child care [6]. Researchers have shown that environmental factors such as linguistic stimulants and social interactions have a crucial role in bridging this gap [11]. A study published in *Language in Society* investigated how young children integrate novel vocabulary into their speech during conversation. Results showed that children repeated novel vocabulary items about twice as often as other novel information, thus suggesting that repetition in conversational contexts is an important component of vocabulary development. These findings suggest that early interactions with caregivers may have long-lasting implications for children's language development and that the degree to which parents initiate interactions with their infants is especially important [12]. Additionally, a study published in *Child Development* linked children's language growth with socioeconomic differences in language input. The findings of the research confirm that children from higher-income

families have more diversified linguistic surroundings that includes a better effect on their language development [13]. A 2022 study published in *Frontiers in Psychology* examined the effects of screen exposure on young children's cognitive development. The study found that when co-viewing educational content, it enhances learning outcomes because interactions help children process and understand the content better [14].

Therefore, to support parents, educators, and health professionals in making decisions regarding digital exposure, it is crucial to establish the frequency and duration of digital application usage in toddlers as well as its relationship to developmental outcomes. The purpose of this study is to investigate how toddler children's cognitive and language abilities are affected by the frequency and length of use of digital applications. By identifying these variables, this study hopes to further the ongoing discussion over the advantages and disadvantages of digital technology for the development of young children and offer insight into usage patterns that can maximize developmental results.

2 Method

This research involved 37 mothers with toddlers aged 1-3 years who were registered at Posbindu Margo Sari Ledug Village and had given smartphones to their children. The research uses a correlational method with a cross-sectional approach to understand the relationship between gadget use and the development of toddlers' intelligence. Inclusion criteria include mothers who have toddlers aged 1-3 years, provide smartphones to children, and are willing to be respondents. Exclusion criteria were mothers who were uncooperative or had children with congenital defects, to ensure valid results regarding cognitive and language development of toddlers.

This study uses a questionnaire to assess the intensity of smartphone use which has been tested for validity and reliability. The results of the reliability test using Cronbach's alpha coefficient show a value of 0.9, which indicates that the questionnaire is reliable and can be used to measure the intensity of smartphone use among toddlers. Apart from that, this study also evaluated Developmental Quotients in toddlers, especially Full-Scale Developmental Quotient (FSDQ), using the Capute Scale. The Capute Scale was tested for validity and showed comparable results to the Bayley Scales of Infant Development (BSID), which is known as the gold standard in measuring child development. This indicates that the Capute Scale has very good validity and is reliable for assessing cognitive and language development in toddlers.

Data analysis was conducted using univariate and bivariate methods (Spearman-Rank), facilitated by statistical software. Ethical approval for the research was obtained from the Harapan Bangsa University Health Ethics Committee, reference number B.LPPM-UHB/745/07/2024. Informed consent was also secured from all participants before data collection commenced.

3 Results

Table 1 presents the characteristics of the respondents. The findings indicate that among the 37 participants, 19 reported introducing smartphone usage to their children within the toddler age range of 12 to 36 months. The predominant type of applications used are games. Generally, the duration of smartphone use per session for these children is 60 minutes or less, with usage occurring two or more times per day.

Table 1. Characteristics of the Respondents Based on Age, Type of Application, Duration, and Frequency of Smartphone Use(n=37)

Characteristic	f	%
<i>Age of first playing with smartphone</i>		
Baby's age (< 12 months)	18	48,6
Toodler age (12 – 36 months)	19	51,4
<i>Type of application used</i>		
Video/Youtube	15	40,5
Game	22	59,5
<i>Duration of playing smartphone</i>		
≤ 60 minutes	29	78,4
> 60 minutes	8	21,6
<i>Frequency of playing smartphone</i>		
< 2 times/day	6	16,2
≥ 2 times/day	31	83,8

Table 2 illustrates the relationship between duration and cognitive development. Notably, 16.5% of toddlers who engaged with a smartphone for less than 60 minutes displayed normal cognitive development. Meanwhile, Table 3 depicts the correlation between frequency of use and FSDQ scores, indicating that toddlers who use smartphone at a frequency of two or more times per day are more likely to experience delayed FSDQ, categorized as abnormal.

Table 2. Relationship between duration and children's cognitive development (n=37)

Variable	Cognitive Development				CC	p-value
	Normal		Abnormal			
	n	%	n	%		
<i>Duration of playingsmartphone</i>						
≤ 60 minutes	20	16,5	9	12,5	0,469	0,003
> 60 minutes	1	4,5	7	3,5		

Table 3. Relationship between frequency of use and FSDQ (n=37)

Variable	<i>Full-Scale (Composite) Developmental Quotient</i>				CC	P-value
	Normal		Abnormal			
	n	%	n	%		
<i>Frequency of playing gadgets</i>						
< 2 times/day	5	2,1	1	3,9	0,444	0,006
≥ 2 times/day	8	10,9	23	20,1		

The relationship between the frequency of playing gadgets and toddlers' cognitive and language abilities can be seen in Table 4.

Table 4. Relationship Between Frequency of Use and Cognitive and Language Abilities in Toddlers (n=37)

	Cognitive and Language Abilities						CC	P-Value
	Normal		Suspect		Communication Disorder			
	n	%	n	%	n	%		
<i>Frequency of playing smartphone</i>								
< 2 times/day	5	3,4	1	2,6	0	0	0,42	0,008
≥ 2 times/day	8	10,9	20	17,6	3	2,5	9	

Table 4 demonstrates that the frequency of gadget use significantly affects toddlers' cognitive and language abilities. Specifically, toddlers who engage with gadgets two or more times per day are identified as having suspected impairments in these areas.

4 Discussion

The research results show that children in the toddler age range, namely 12 to 36 months, are starting to be introduced to smartphones by their parents or caregivers. The use of smartphones at this age is dominated by gaming applications, which are the main activity. The average duration of smartphone use was less than or equal to 60 minutes per session, with a fairly high frequency of use, namely more than or equal to twice per day. These findings indicate that gadgets have become part of children's daily routine at an early age, especially in the form of entertainment through digital games. Smartphones have become an attractive and easily accessible alternative medium for children, because of their features, such as dynamic visual displays, interactive sound, bright color variations, and interesting music. These characteristics make smartphones a very popular device for children, allowing them to engage in play activities for longer periods. This ease of operation and sensorial appeal tends to make children feel comfortable and entertained, but on the other hand, it can increase the risk of excessive use, which has the potential to impact children's cognitive, emotional, and social development if not managed properly [15].

According to earlier studies, toddlers who spent a lot of time on mobile devices showed worse language development. Children who used mobile devices for one to two hours a day were more likely to struggle with language comprehension (Adjusted Odds Ratio [AOR] = 1.30), while those who used them for two or more hours had significantly higher odds (AOR = 1.42). Likewise, the AORs for expressive language skills issues were 1.19 for one to two hours of screen use and 1.46 for two or more hours [16]. Furthermore, studies cited by the American Academy of Pediatrics indicate that excessive screen time may contribute to behavioral difficulties that are part of social and emotional skills, like increased aggression and attention concerns [17].

The introduction of smartphones to children from an early age is seen by some parents as having practical benefits in that children tend to be calmer and less fussy, thus allowing parents to focus more on completing their work. Relevant research results show that the reason parents give gadgets to their children at an early age is to meet physical development needs, as well as improve speaking skills, telling stories, recognizing pictures, and understanding colors [18]. This finding is in line with previous research which revealed that 77% of parents allow their children to access smartphones, even when gathering with family at home. Furthermore, 74% of parents think that smartphones can function as a second nanny, which makes children calmer and does not interfere with parents' activities. This shows that smartphone use in the family context is becoming increasingly accepted, although it is important to remember that there are potential long-term negative impacts that need to be taken into account [19]. Guidelines for gadget use in children, by recommendations from the

Centers for Disease Control and Prevention (CDC), recommend that children aged 1 to 7 years only be exposed to gadgets for 30 minutes to 1 hour per day [20]. Research conducted in the United States and Canada shows that children aged 0 to 2 years should not be exposed to smartphones at all. Meanwhile, children aged 3 to 5 years are recommended to limit their gadget use to one hour per day. This recommendation aims to prevent potential developmental disorders and serious health risks, which can arise due to uncontrolled exposure to gadgets [19].

The results of the research analysis show that there is a significant correlation between the length of smartphone use and children's cognitive development, with a value of $p=0.003$. Apart from that, a significant relationship was also found between the frequency of playing smartphones and toddler development intelligence (FSDQ), with a value of $p=0.006$. This research also reveals that children who use gadgets more than twice a day have a 17.6% chance of experiencing problems with cognitive and language skills. Bivariate analysis shows a relationship between frequency of smartphone use and cognitive and language abilities in toddlers, with a value of $p=0.008$.

Cognitive development in early childhood includes the ability to understand and think about the environment around them. Various environmental factors, such as parenting patterns, educational services, and other aspects of daily life, can influence this cognitive development [21]. Although the use of gadgets in early childhood can have positive impacts, such as ease in obtaining new information, increased ability to digest information, enrichment of vocabulary, and quick response to new stimulation through moving shows and songs, the negative impacts also need to be considered [22]. Research conducted in Saudi Arabia indicated that children who spent more than 2 hours per day using gadgets had a significant risk of experiencing delays in language development, with a value of $p=0.034$ [23]. In line with other research, gadget usage time of more than 2 hours per day is significantly related to speech delays ($p<0.001$) because children do not have skills in learning words through media [24].

Studies regarding the use of smartphone in early childhood reveal that there is a delay in cognitive development or children's memory by 81.8%. This phenomenon can be caused by excessive duration of gadget use, which often stems from parents' habits of allowing children to use gadgets freely. The assumption that gadgets can make children calmer and function as a means to showcase children's talents in operating technology also contributes to this situation [25]. Children who show results interpreting suspect cognitive development require intensive supervision. Child development is a progressive process, where each function or aspect develops in a certain order. The results of this suspect interpretation indicate that these children have a high risk of experiencing delays in cognitive and language development [26].

5 Conclusion

Parental involvement in choosing educational applications and supervising gadget use is very important to stimulate children's cognitive and language development. Monitoring the duration and frequency of gadget use can maximize the benefits of technology while reducing the potential negative impact on children's development.

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