Passive Screen Exposure and Developmental Outcomes in Early Childhood

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ABSTRACT

Screen time is often a focus of discussion regarding early childhood development. However, the amount of time spent in front of a screen does not necessarily correlate with the risk of developmental delays. To examine this relationship, data from 121 children aged 1–3 years, comprising 57 boys and 64 girls, were analysed using a cross-sectional design. Screen time was limited to passive viewing without active parental involvement, whilst child development was assessed Denver II, which covers four domains of development. Analysis was used Spearman's correlation analysis. Results of this study is a weak and non-significant association between screen time and developmental delay scores ($\rho = 0.10$; $p = 0.274$). Similar results were observed in boys ($\rho = 0.129$; $p = 0.338$) and girls ($\rho = 0.061$; $p = 0.634$). Interaction analysis also failed to reveal any significant differences in the relationship based on gender ($b = -0.436$; $p = 0.243$; 95% CI [−1.171; 0.300]). These findings suggest that screen exposure duration, when considered in isolation, does not adequately account for the variation in developmental delay scores within this sample.

Keywords: screen time, developmental delay, toddlers, ecological development, digital media use

INTRODUCTION

Since a very early stage, the use of digital devices has become part of children's lives. Televisions, tablets, and smartphones are increasingly common in children's daily lives, even among those aged 1–3 years. This situation has raised concerns about its impact on child development. One of the most commonly used measures to assess this risk is screen time—that is, how long a child is exposed to screens in a day. This has led to a fairly simple assumption: the longer a child uses screens, the greater the likelihood of developmental problems (Sticca, Brauchli, & Lannen, 2025).

That hypothesis form the logic that the more children spend watching screens, the less time they spend playing, talking, moving, and interacting with others. Several studies reported that more screen time is associated with language delays and some cognitive issues in children (Massaroni et al., 2024; Yang et al., 2023). On the other hand, screen time has been reported not to contribute to child development, especially when other factors in the child's environment are also taken into account (Xie et al., 2024). Study with systematic review also shows how screen time and developmental delay tend to be small and may vary depending on the child's age, how screen time is measured, and the environmental context in which the child is raised (Bal et al., 2024). These inconsistent findings lead us to a more fundamental question: Is screen time alone sufficient to explain the risk of developmental delays in young children?

In Fact, "screen time" is actually different experience for every child. Two children might both spend an hour in front of a screen, but their experiences can be very different. One child might watch a video alone without interacting with others, while another might use a video call to talk with family members or watch content with a parent. Similarly, an educational app used interactively is certainly different from a television that's on in the background. This means that the same duration does not necessarily provide the same developmental experience (Sanders et al., 2019; Kar et al., 2025). Children development is influenced not only by the presence or absence of screen time but also by daily interactions with parents, caregivers, siblings, the

environment, and the various experiences the child has. Therefore, if screen time duration does indeed affect development, this relationship should be consistently observable. Conversely, if the relationship is weak or not found, it is possible that duration alone is not a sufficient indicator to describe a child's developmental risks.

Another issue to consider in previous studies is how researchers measured the variable of developmental delay. The last studies have used a variety of measurement methods, ranging from self-reports by parents to various developmental screening tools. These differences in measurement tools may help explain why research results are not always consistent. Therefore, the relationship between screen time and development needs to be examined using tools that provide a more comprehensive picture of a child's development. Given these issues, this study focuses on a simple yet important question: Is the duration of screen time alone sufficient to predict developmental delays in children aged 1–3 years? This question must be answered by considering two factors simultaneously: how children's development is measured and how screen time is defined. Both of these factors are important because research findings on screen time depend not only on how long children use screens, but also on what "screen time" actually means and how children's development is assessed.

Recent studies have used various tools to assess child development. First, the Ages and Stages Questionnaire, Third Edition (ASQ-3)**,** Second, the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III)**,** and third, the Denver Developmental Screening Test II (Denver II)**.** These instruments serve different purposes. The ASQ-3 is a parent-completed screening tool covering communication milestones, gross motor, fine motor, problem-solving, and personal-social skills. Madigan et al. (2019), for example, used the ASQ-3 to assess children's development at 24, 36, and 60 months and found that higher screen time was associated with poorer developmental screening scores. In addition, the Bayley-III instruments provide in-depth assessment through direct testing by qualified examiners. Zaky et al. (2024) used the Bayley-III to study cognitive, language, and motor development, while Gastaud et al. (2023) used it to measure cognitive development.

The Denver II has additionally been used in research on screen time and child development. Chaibal and Chaiyakul (2022) assessed 85 children, with a common age of around four years, using the Denver II and recorded their smartphone and tablet display time over seven days. They found a significant relationship between the display time and their gross motor development. More recently, Okenwa-Vincent et al. (2025) used the Denver II in combination with the 2030 Early Childhood Development Index to look at screen exposure and school readiness among 144 children aged 2–5 years. Their findings indicate that children who exceeded the recommended screen time had a lower chance of being ready for school. In comparison, parental monitoring was associated with a greater chance of readiness.

The ASQ-3, Bayley-III, and Denver II have different characteristics in assessing child development. The ASQ-3 is relatively easy to use in studies with a large number of participants, although the results depend on the information provided by parents. The Bayley-III allows for direct and more in-depth assessment of development, but its administration requires a trained examiner and takes longer. Meanwhile, the Denver II covers four areas of development: personal-social, fine-motor and adaptive, language, and gross motor skills. In this study, the Denver II was chosen because it can be used to screen for several developmental areas simultaneously, taking into account the age range of 1–3 years. It should be noted that the Denver II is not used to establish a diagnosis of developmental disorders, but rather to identify potential delays that require further evaluation.

Besides selecting the appropriate developmental measure, careful consideration is also needed when defining screen exposure. Many studies have summarised this exposure as total hours or minutes per day, which could potentially blend different types of screen use into a single measure. As a result, it is challenging to determine whether the association with development reflects the duration itself or differences in the content and context of the exposure. Although recent research has begun to account for parental supervision and the home media environment, the meaning of total screen time becomes limited when diverse viewing experiences are lumped together.

For the purposes of this study, we define 'screen time' as children's activities involving the viewing of digital content without direct parental supervision, such as watching films, YouTube videos or TikTok content on

their own. Screen use for video calls and viewing activities with parents who are actively supervising is not included in the measurement. This distinction is important because the time children spend in front of a screen does not necessarily reflect the same experience. When watching alone, children may simply be passively viewing content, whereas when supervised, screen time may be accompanied by conversation or parental responses to the content being watched. Furthermore, we note that children in other settings may have different patterns of screen exposure and may be exposed to different types of media. Therefore, the findings of this study should be interpreted specifically within the context of the passive screen exposure examined here and cannot be generalized to all forms of digital media use by children.

Accordingly, this study examines whether the duration of passive, one-way screen exposure is associated with possible developmental delays among children aged 1–3 years, using Denver II to assess four developmental domains. If a relationship is found, duration may provide useful information about developmental risk within this specific type of exposure. If no relationship is found, the result would suggest that duration alone may not be a sufficient indicator of developmental risk. The central aim is therefore not to assume that screen exposure necessarily harms development, but to test whether knowing how long children watch screens is enough to identify developmental risk when the type of exposure is more clearly defined.

METHOD

Study Design

The design of this study was a quantitative cross-sectional study that examined the relationship between screen time and the development of children aged 1–3 years. Screen time was limited to passive viewing of videos or films without active interaction with parents. Screen time was then analysed to examine its association with children's developmental assessment results and to assess whether screen time alone is sufficient to indicate a risk of developmental delay.

Participants

This study involved parents and their children. Following the data screening and cleaning process for the initial 164 participants, 121 children aged 1–3 years met the criteria for analysis. The sample comprised 47 per cent boys and 53 per cent girls. Participants selected using convenience sampling based on ease of access and suitability for the study criteria. Children were included if they had been exposed to screen-based media, such as smartphones, tablets, televisions or computers, within the past month. This age range was chosen as it is a critical period for children's language development, motor skills and socio-emotional development.

Measures

Denver Developmental Screening Test II (Denver II), a screening tool designed to assess children's development across four domains: personal-social, fine motor-adaptive, gross motor, and language was used to measure developmental delay. In this study, screen time was measured using a questionnaire completed by parents regarding their estimate of the average daily time their child had spent using screen-based devices over the past month. The devices in question included smartphones, tablets, televisions and computers. Duration was chosen as a measure of screen time as it is commonly used in previous research. However, this study also sought to examine whether duration alone is sufficient to describe its association with child development.

Procedure

Data collected via questionnaires completed by parents and through direct assessments of the children's development. Parents provided information on their children's screen-use habits, whilst the developmental assessments were carried out by trained staff to ensure consistency in the assessment process. Prior to analysis, the data were checked to identify any incomplete or inconsistent responses. Following this process, a total of 121 participants were included in the final analysis.

Data Analysis

Data analysis using JASP version 0.18. The results of the Shapiro–Wilk test show the data were not normally distributed ($p < .001$). Consequently, the relationship between screen time and developmental delay was analysed using Spearman's rho correlation. This analysis was chosen as it is suitable for data that do not meet the assumption of normality. The strength of the relationship was subsequently interpreted based on effect size criteria to assess not only statistical significance but also the magnitude of the relationship between the two variables.

RESULTS

The observed association between screen time duration and developmental delay was weak and not statistically significant (Spearman's $\rho = .10$, $p = .274$). Consequently, the data from this study do not yet provide sufficient evidence to suggest that the longer a child is exposed to screens, the higher their developmental delay score will be. That finding suggests that screen time alone provides limited information to explain differences in children's developmental scores within this sample. However, this finding does not imply that screen time is unrelated to development. Rather, these results raise a more fundamental question: Is the amount of time children spend in front of a screen sufficient to capture their overall experience of digital media use and their developmental environment?

Table 1. Association between screen time duration and developmental delay in children aged 1–3 years (N = 121)

Participant characteristics

Total sample
N = 121
(from 164 initial participants)

Age range
1–3 years
M (SD) = 2.1 (0.6) years

Sex distribution
47% boys
53% girls

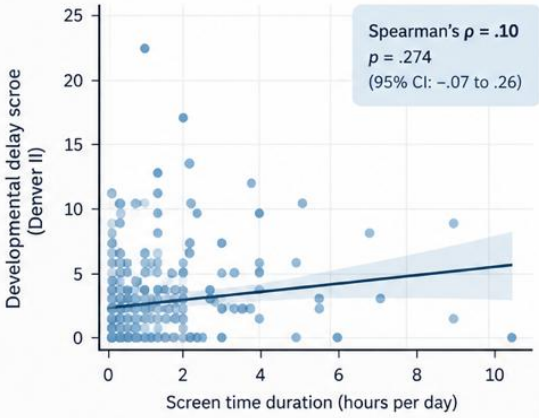
Measurement and analysis

Developmental outcome
Denver Developmental Screening Test II
(assessed by trained assessors)

Screen time duration
Parent-reported average daily screen use (past month)

Statistical method
Spearman's rank-order correlation
(JASP v. 0.18)

Screen time duration and developmental delay



Statistical results

Analysis	Result
Normality test (Shapiro–Wilk)	$p < .001$
Correlation coefficient (Spearman's ρ)	.10
p-value	.274
95% CI	−.07 to .26
Effect size (Cohen's guideline)	Small ($\lvert\rho\rvert = 0.10$)

Interpretation
There was a positive but very weak and non-significant association between screen time duration and developmental delay.

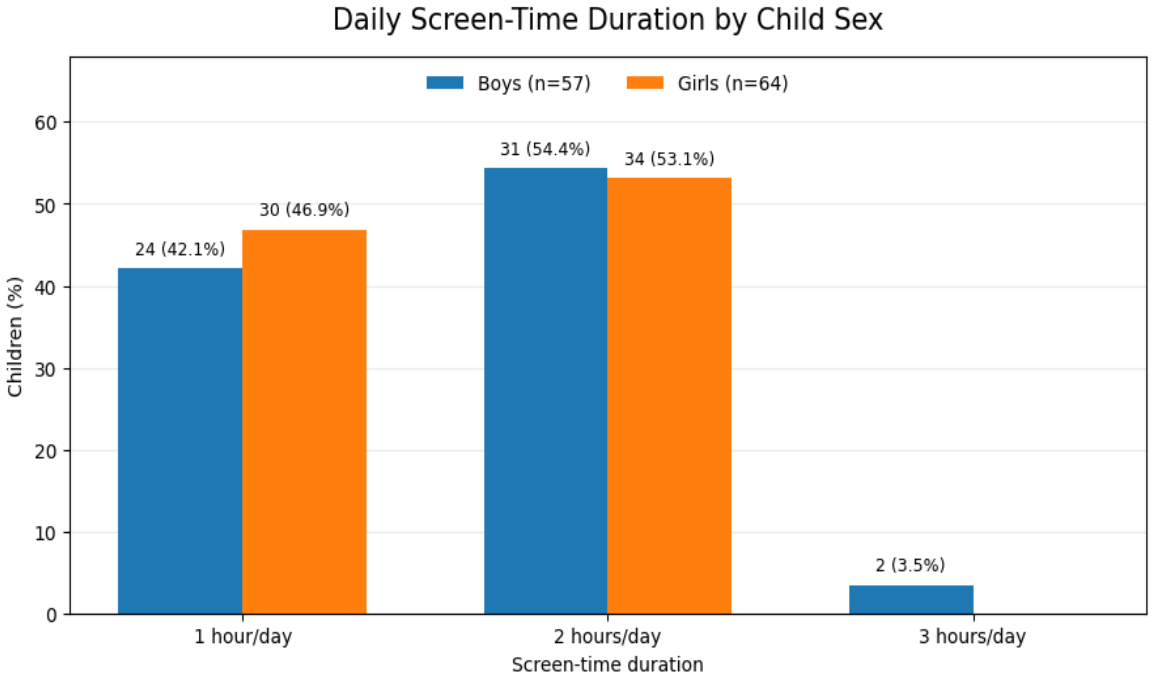
What is new?
- Challenges the widely held assumption that longer screen time is inherently linked to greater developmental risk.
- Uses a multidimensional and standardized developmental assessment (Denver II) conducted by trained assessors.
- Provides empirical evidence from a sample of 1–3-year-old children in Indonesia, a context that remains underrepresented in global research.

What does it mean?
- Screen time duration alone explains minimal variation in developmental outcomes.
- Developmental impacts may depend more on the quality, content, and context of screen use, as well as broader environmental and relational factors.

Implications
- Guidelines should move beyond a reductionist focus on limiting screen time.
- Future studies should examine qualitative and contextual aspects of digital media use, including content type, parental mediation, and parent–child interaction.
- Longitudinal designs are needed to clarify potential cumulative and context-dependent effects.

An additional analysis was conducted to examine whether daily screen time duration differed between boys and girls. Boys had a higher mean screen time duration (M = 1.61 hours/day, SD = 0.56) than girls (M = 1.53 hours/day, SD = 0.50), although the median was 2 hours/day in both groups. A Mann–Whitney U test was not statistically significant (U = 1,945, p = .472), with a negligible rank-biserial correlation (r = .07). These findings provide no clear evidence of a difference in screen time duration by child sex in this sample. This finding is significant because gender differences cannot be directly assumed to correspond to differences in screen usage patterns. Duration of screen time may be more closely linked to family habits, rules governing

device use, the availability of carers, and daily routines. However, these factors were not directly measured in this study and therefore require further investigation.



Mann–Whitney U = 1,945; p = .472. One record with unknown sex was excluded (analytic N = 121).

To explore possible differences in the relationship between screen time and development by gender, Spearman's correlation analysis was evaluated for boys and girls. Among boys, a weak and non-significant positive correlation was found ($\rho = 0.129$; $p = 0.338$). Similar results were found among girls, with a correlation of $\rho = 0.061$ ($p = 0.634$). This means that, in both groups, screen time duration did not show a significant association with developmental delay scores. An exploratory regression analysis incorporating the interaction between screen time and gender also failed to yield significant results ($b = -0.436$; $p = 0.243$; 95% CI [−1.171; 0.300]). These results do not yet provide sufficient evidence that the relationship between screen time and developmental scores differs between boys and girls.

DISCUSSION

Overall, this study found no significant association between screen time and developmental delay scores in children aged 1–3 years. Further analysis also revealed no significant differences in screen time by gender, nor was there sufficient evidence that gender moderated the relationship between screen time and development. These findings should be interpreted with caution. Non-significant results do not necessarily imply that screen time is unrelated to children's development, but rather that this study has not yet found sufficient statistical evidence to support such a relationship.

To interpret these findings, it is important to bear in mind that screen time does not always reflect a child's experience whilst using digital media. In this study, the association between screen time and developmental delay scores was very weak. This means that differences in the amount of time spent watching screens do not sufficiently explain the differences in children's developmental scores within the sample studied. These results provide grounds for questioning the use of duration as the sole measure of risk, rather than concluding that screen time has no consequences for development. Varadarajan et al. (2021) found a link between excessive screen exposure and developmental delays in children. Meanwhile, Sticca et al. (2025) emphasized the importance of understanding screen use within the broader context of early childhood development. Neither of these studies provides a relevant comparison to the findings of this study, which did not show a significant association between the duration of passive screen exposure and developmental delay scores. The differences across studies indicate that screen exposure may be related to child development in ways that go beyond the

amount of time spent in front of a screen. Further research is needed to understand how the content children watch and the circumstances in which they use screens may shape developmental outcomes.

These findings can also be understood through the ecological perspective of Bronfenbrenner and Morris (2006), which situates child development within the context of interactions between the individual and their environment. If the duration of screen time does not show a significant association with developmental delay scores, one possibility that warrants further investigation is that this measure has not captured differences in children's experiences whilst watching. The same duration of exposure may occur within different caregiving situations and patterns of interaction, including in terms of language stimulation and parental engagement. However, as these aspects were not measured in this study, this explanation remains a possibility rather than an empirical conclusion. Consequently, the findings of this study expand upon previous discussions: the limitations of duration as a measure of screen time relate not only to differences in content but also to the relational context in which screen use takes place.

Overall, the results of this study indicate that screen exposure duration alone is insufficient to explain the variation in developmental delay scores among children aged 1–3 years. Our results does not imply that exposure duration can be disregarded, but rather highlights the need to consider these results within the context of the measurement methods and characteristics of screen use examined in the study. In this study, duration was recorded based on parental reports and limited to three categories; consequently, more detailed variations in exposure could not be captured. Furthermore, convenience sampling limits the representativeness of the sample, whilst the cross-sectional design does not allow for the tracking of changes in exposure and development over time, nor does it permit the drawing of causal conclusions. Therefore, further research needs to measure duration in greater detail whilst also considering the type of content, parental involvement, and children's interactions during screen use. A longitudinal design is also required to determine whether the relationship between screen exposure and development changes with age or varies according to the context of use. Such an approach could help to further explain why duration of exposure did not show a significant association in this study's sample, without assuming that duration is the sole factor relevant to child development.

Results of this study raise two important points. Theoretically, the absence of a significant association suggests that screen time alone cannot adequately explain developmental delay scores in this sample. This finding calls for a more careful examination of how screen time is measured, whilst not ruling out the possibility of an association under certain conditions. Moreover, suggest that limiting screen time alone does not necessarily provide a complete picture of a child's digital experience. Attention should also be directed towards what children are watching, whether parents are involved during screen time, and whether such activities reduce opportunities for play or face-to-face interaction. However, this study did not examine these factors, so their relative importance cannot yet be determined. Consequently, these findings are better suited as a basis for broadening the assessment of screen use rather than as a reason to disregard duration or alter existing recommendations without further evidence.

CONCLUSION

This study show no significant association between the duration of passive screen exposure and developmental delay scores in children aged 1–3 years. We conclude that, in terms of development scores, differences in the duration of passive screen exposure cannot account for the variation observed in this study sample. However, results do not imply that passive screen exposure is unrelated to child development. The lack of a significant association must be interpreted in light of sample characteristics, limited variation in exposure duration, and the use of a developmental screening instrument.

These findings also highlight the limitations of using passive screen exposure duration as the sole indicator for assessing child development. Although exposure has been specifically defined, the number of hours spent watching does not provide a complete picture of children's experiences during screen exposure. We did not directly measure the characteristics of the content viewed, patterns of interaction between children and caregivers outside of screen time, or daily activities accompanying screen use. Since these factors cannot be

used to explain the results of current research, they may serve as directions for further investigation in future works.

IMPLICATIONS

In practical terms, however, we cannot conclude from these findings that limiting the duration of passive screen time is unnecessary. Rather, these discoveries show that assessments of developmental risks cannot rely solely on the number of hours spent watching. Exposure duration needs to be considered alongside other relevant information about the child's daily life, without assuming that these factors have been proven to account for the study's results. Direct monitoring of early childhood development remains crucial for parents and those working with young children and cannot be replaced by assessments based solely on screen exposure duration.

Additional research could develop more detailed measures of passive screen exposure, including more precisely measured durations and characteristics of the content viewed. Scholars could also examine the role of the caregiving environment and children's interaction patterns through study designs specifically tailored to measure these factors. Longitudinal designs and more comprehensive developmental assessment instruments could help clarify whether patterns of passive screen exposure are associated with developmental changes over time. Such steps are essential to ensure that conclusions regarding screen exposure are based not only on the presence or absence of a correlation with duration, as well as on stronger evidence regarding the nature of these relationships and the accompanying contextual factors.

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