Digital media overuse may be associated with poor cognition among school-age children in Kinshasa, Democratic Republic of Congo
Usage excessif d'écrans numériques et faible cognition chez les enfants en âge de scolarité à Kinshasa, République Démocratique du Congo

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Résumé

Contexte et objectif. Un temps d'écran excessif (TEE) peut affecter les performances cognitives et scolaires des enfants, particulièrement dans les pays où les recommandations sont inexistantes. L'objectif de la présente étude était d'explorer l'association entre temps d'écran, cognition et performances scolaires. *Méthodes*. Étude transversale descriptive a été conduite sur 58 dyades mères-enfants à Kinshasa, République Démocratique du Congo (RDC), de septembre 2022 à mai 2023. Le TEE retenu était de plus de deux heures par jour selon les directives OMS. La batterie neuropsychologique de Kaufman, 2e édition (K-ABC-II) a été utilisée pour évaluer la cognition. *Résultats.* L'âge médian des enfants était de 9.5 ans (EIQ 8-10 ans). La majorité (64,9 %) avait un TEE en semaine et les week-ends. Le co-visionnage augmentait significativement le temps d'écran (p < 0,05). Le score de l'Indice Non-verbal (INV) au K-ABC-II était corrélé négativement avec le nombre d'écrans (Spearman r = -0.35, p = 0.04) mais positivement aux performances scolaires (Spearman r = 0.42, p = 0.01). Le score de planification du K-ABC-II corrélait positivement avec les performances scolaires (Spearman r = 0.42, p = 0.01). *Conclusion.* L'utilisation excessive des médias électroniques serait négativement associée aux performances cognitives. Des études approfondies devront en évaluer l'impact sur les performances scolaires pour des besoins de recommandations nationales dans le numérique en RDC.

Mots-clés : cognition, enfants d'âge scolaire, médias électroniques, performance scolaire, temps écran

Summary

Context and objective. Excessive screen time (ST) may affect children's cognitive and school performance (SP), particularly in countries where regulatory policies are lacking. The objective of the present study was to explore the relationships between ST, cognition, and SP. *Methods.* A cross-sectional assessment of screen use was conducted in 58 mother-child dyads in Kinshasa, DRC, from September 2022 to May 2023. Excessive ST was defined as more than 2 hours per day according to WHO's Guidelines. The Kaufman Assessment Battery for Children, Second Edition (K-ABC-II) was used to assess cognition. *Results.* The children's median age was 9.5 years (IQR: 8–10 years). Most (64.9%) children exceeded ST limits during both weekdays and weekends. Co-viewing with relatives increases ST (p < 0.05). K-ABC-II planning domain scores positively correlated with SP (Spearman r = 0.42, p = 0.01). Cognitive Non-verbal index (NVI) scores on the K-ABC-II correlated negatively with the number of digital media accessible to children (Spearman r = -0.35, p = 0.04) but positively with SP (Spearman r = 0.41, p = 0.01). *Conclusion.* The overuse of digital media may have a negative impact on cognitive performance. In-depth studies need to explore the impact on SP and better inform public health policies on digital media in the DRC.

Keywords: cognition, digital media, school-age children, school performance, screen use

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Introduction

Digital devices such as smartphones, tablets, computers, video games, televisions (TV), and other wearable technologies have become a standard part of modern family life worldwide. These digital media deliver content via the Internet or other computer networks. The use of these digital media has raised growing concerns due to the amount of time spent in front of a screen, known as screen time (1). The World Health Organization (WHO) reports that excessive use of digital media is considered a public health issue (2). The health crisis caused by the SARS-CoV-2 outbreak and containment measures has significantly increased digital media use (3). During this health crisis, which led to a shift from in-person to virtual interactions, there was a notable increase in screen time among children aged 3-13, particularly in Europe, the United States, and Canada. The average educational and recreational screen time was 174 minutes per day, an increase of approximately 82% (3). In Africa, Mozambique's children aged 9 to 11 in urban areas spend about 5-7 hours per day in front of screens (4). While digital media has transformed how we learn, work, and communicate, its use can also negatively affect human health, particularly in children (5). Various cognitive areas, including attention (6), executive functions (7), sensorimotor skills (8), language abilities (9-10), and academic performance (11-12), can be affected. A child's brain is shaped by genetic factors, experience, and environment (13). Therefore, it is plausible that each early childhood experience has a significant influence on brain development. Scientific organizations like the WHO, the Canadian Pediatric Society, the American Academy of Pediatrics (AAP), the French Association of Ambulatory Pediatric Medicine, and the South African Guidelines recommend a limit of two hours per day, with more than two hours of screen time considered excessive for children (14–17).

Studies from South Africa, Mozambique, and Kenya emphasize national and contextualized 24-hour movement guidelines, including specific recommendations about children's sedentary behaviors with the same limits on recreational screen time as other scientific organizations (4,16,18). Sadly, in the Democratic Republic of the Congo (DRC), there are no specific guidelines regarding media use among children. Unpublished data from a 2019 study on smartphone addiction conducted in Kinshasa among adolescents indicate that many adolescents are addicted to social networks, mainly Instagram.

While many studies have examined the links between screen time, cognition, and school achievement in high-income countries, there is limited data available from sub-Saharan Africa. As digital technology becomes more available in the DRC, understanding its impact on children's cognitive and academic outcomes is increasingly important. This study aimed to explore the relationship between screen time, cognition, and school performance among school-aged children in the DRC, offering new insights from a largely understudied region.

Methods

Study design and participants

We conducted a cross-sectional study of mother-child dyads with children attending primary or secondary schools in Kinshasa, DRC, between September 2022 and May 2023. Participants were selected using a multi-stage sampling model adapted from the Lot Quality Assessment Sampling (LQAS) model to ensure that the socio-demographic characteristics of children in Kinshasa were considered. A total of 58 dyads consented to participate in the study. Excluded from the study were any dyads whose child was born premature (< 37 weeks), or whose birth weight was lower than 2500 g,

or children with a brain or motor disability that could impair their cognitive abilities.

Neuropsychological assessments

All children were subject to neuropsychological assessments using the Kaufman Assessment Battery for Children, second edition (K-ABC II) for cognition. The K-ABC II is a validated tool to assess cognitive functions in different areas (sequential for short-term memory, simultaneous for visual-spatial processing, learning for long-term storage and retrieval, planning for fluid reasoning, and delay recall). The K-ABC II yields a separate global score for two theoretical models: The global score measuring general mental processing ability (Mental Processing Index (MPI), and the global score measuring general cognitive ability (the Fluid-Crystallized Index) (19). Grades at the end of the school year (in percentages), which occurred during the study period, were used as indicators of school performance.

Digital media usage and screen time

The number of devices easily accessible to children (e.g., TVs, smartphones, video games) was recorded in each household. Screen time and school performance were evaluated using two questionnaires adapted by the principal investigator: the US Department of Health and Social Services surveillance questionnaire (20) and the questionnaire 3-6-9-12 for students and parents (21). These two questionnaires were selected because they had been previously used in surveys with the same age group as our study, and for their ease of use, cultural neutrality, and suitability to the study's environment and goals. Excessive screen time was defined as more than 2 hours per day, following the WHO guidelines. Other variables included the age at which the child started screen exposure, whether they viewed alone, with a mother, or with a third party, the hours of screen time before bedtime, the number of screens at home, the type of screens used, interest in other activities, interactions with other children, screen use during meals, outbursts related to screen withdrawal, and language delay. Sociodemographic variables encompassed the child's age, sex, mother's marital status, parents' or caregivers' education level and occupation, and socio-economic status.

Statistical analyses

Data were summarized as proportions for categorical variables and medians for continuous variables. As deemed appropriate, comparisons of interest were made using the Pearson chi2 test, exact Fisher's test, and/or the Mann-Whitney test. The Spearman correlation test was used to assess the relationship between the number of screens and scores on the K-ABC-II test. Data were analyzed using SPSS version 27 at a p-value of .05 for statistical significance.

Ethical considerations

The study was conducted following the Declaration of Helsinki and approved by the School of Public Health Ethics Committee of the University of Kinshasa (Approval No: ESP/CE/214/2022).

Written informed consent was obtained from the parents of all participants before their inclusion in the study. Participation was voluntary, and confidentiality was ensured throughout the research process.

Results

Socio-demographic characteristics of the studied population

The median age of the children was 9.5 years (interquartile range: 8-10). Twenty-five children (43.1%) were female. Most mothers were married (60.3%) and employed (67.2%). Almost half of the mothers (53.4%) had a secondary level of education, whereas most fathers (64.3%) had completed higher education.

Digital media usage and screen time

We found an average of seven screens per household, ranging from a maximum of 17 to a minimum of one. The screen most frequently utilized by children was the TV (89.7%), followed by smartphones (74.1%), and tablets (25.9%), with game consoles and computers ranking lowest (15.5% each). The most prevalent content was cartoons (98.3%), followed by games (74.1%). Children spent more than two hours on screen during weekdays (55.2%) and weekends (75.9%) (Figure 1).

Distribution of screen time and content watched by children

(a) Child's screen time
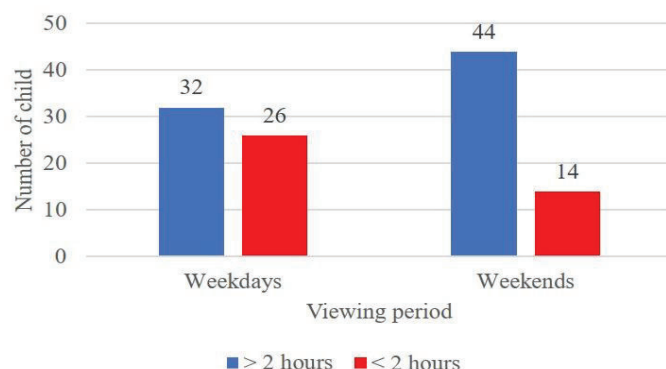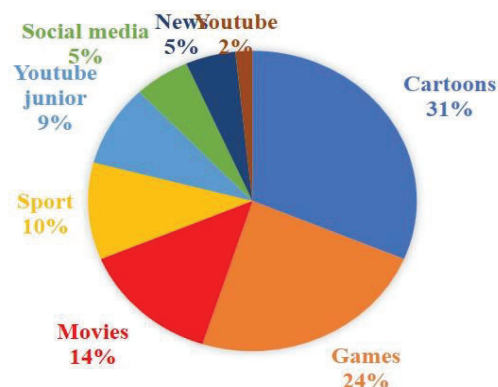
(b) Child's watched content

Figure 1. Screen time distribution and types of content viewed among school-aged children (n=58) in Kinshasa, DRC

The left panel displays the average proportion of screen time during weekdays versus weekends. The right panel shows the percentage breakdown of the most commonly viewed content types, including cartoons, games, movies, and other types of content.

Of the 58 children in the study, 91.4% had started using screens during their first three years of life. The majority of parents reported that their children showed interest in activities other than screens (32/58, 52%) and interacted with other children (51/58, 87.9%). Less than half of the children were engaged in drawing activities (28%), reading books (29%), using a

screen at the table (34.5%), or throwing tantrums when screens were taken away (24%). There were no statistically significant differences in sociodemographic characteristics between children who used less or more screen time, nor was there a significant association between sociodemographics and screen time. However, we found an early exposure during the two first years of life (91.4%) and a signficiant association between excessive screen time, age of exposure (p = 0.04), co-viewing with either the mother (p=0.03) or with a third party (p=0.01) during the weekends, and time to turn off screens before bedtime during the week-ends (p = 0.03) (**Table 1**).

Table 1. Characteristics of screen time use among school-aged children in Kinshasa, Democratic Republic of the Congo

	N	Screen time on weekdays (n)		P-value	Screen time on the Weekend (n)		
		≤2 hours (n=26)	> 2 hours (n=32)		≤2 hours (n=14)	> 2 hours (n=44)	P-value
Age of exposure							
0 - 2 years	53	21	32	**0.01**	11	42	**0.04**
3 - 5 years	4	4	0		3	1	
6 - 8 years	1	1	0		0	1	

Co-viewing with a third party							
More often accompanied by a parent	6	5	1	0.17	4	2	**0.01**
More often alone	8	2	6		3	5	
More often accompanied by an older brother/sister	25	11	14		4	21	
More often accompanied by a younger brother/sister	18	7	11		2	16	
More often accompanied by a visitor	1	1	0		1	0	
Co-viewing with the mother							
All the time	9	6	3	0.14	5	4	**0.03**
Sometimes	39	18	21		6	33	
Never	10	2	8		3	7	
Number of hours before bedtime							
Less than 1 hour	45	17	28	0.32	12	33	**0.03**
1 hour	4	3	1		1	3	
2 hours	3	2	1		0	3	
More than 3 hours	1	1	0		0	1	
The child falls asleep while watching	5	3	2		1	4	

Association between screen time, cognition, and school performance

Of the 58 dyads included in the study, only 36 completed the cognitive assessment with the KABC-II. We found no statistically significant association between screen time and cognitive performance scores. However, a significant association was found between the number of digital media (devices) readily available to children and cognition performance as measured by the global non-verbal index (NVI) scores at the K-ABC-II testing (Spearman $r = -.35$; $p = 0.04$). The association between screen use and academic performance remained unremarkable. NVI and K-ABC-II planning domain scores showed positive correlations with academic performance (Spearman $r = .41$, $p = .01$ and $r = .42$, $p = .01$, respectively).

Discussion

Our study revealed that most children spend excessive screen time (more than two hours), particularly when watching TV or using smartphones to play games. Courage and Frizzell demonstrate that TV remains the preferred screen for children aged two to eight (19), which aligns closely with our study group. Smartphones are widely used as alternatives to TV due to frequent power outages in Kinshasa. Due to increasing insecurity and limited street lighting at night, parents prefer their children to stay at home in front of screens rather than playing outside, which may lead to excessive screen time.

In our study, most children were introduced to screens before age two, which significantly diverges from the guidelines established by the

AAP, WHO, and the American Psychological Association (4,15,17). Screen time on both school days and weekends was significantly linked to the age at which children first encountered electronic devices (p = 0.01 or 0.04, respectively). This may reflect the persistence of early-formed habits, as earlier exposure to screens increases the likelihood of becoming avid users (20). Certain and Kahn found that children who used screens for more than two hours at the age of two were more likely to continue doing so at the age of six (21). Oflu *et al.* showed that children who began using screens before 12 months accumulated over four hours of daily screen time between ages two and five (22). This finding aligns with results from the French ELFE cohort, where only 13.5% of families adhered to screen time recommendations for children under two (23) and other studies (24). These findings suggest non-compliance with screen time guidelines for toddlers may occur across different cultures. In the Congolese context, non-compliance may stem from limited access to extracurricular activities and entertainment, while in Western settings, over-commercialization of electronic devices may promote excessive use.

Co-viewing with a third party and the mother was linked to children's weekend screen time. Our findings generally align with international studies that report parental screen habits and the presence of siblings at home influence children's electronic media use (25). This trend can be explained by imitation behaviors and the idea that weekends are leisure time for the whole family. With limited entertainment options in Kinshasa, parents and children often gather to watch TV for leisure, thereby increasing their screen time. Parents of children who spent less than two hours on screens during weekends attributed this to outdoor activities, such as church events, walks, or family gatherings after church. Church-organized recreational activities appear to provide children with opportunities to engage in alternatives to screen use.

Our study found no statistically significant link between screen time and cognitive performance scores. This lack of significance may partly result from the limited sample size, which could have reduced the ability to detect subtle effects. Additionally, in low-resource settings, digital media can serve as a source of cognitive stimulation, potentially offsetting some of the adverse impacts elsewhere. Empirical evidence indicates that positive stimulation and recreational activities can improve children's cognitive performance (26-27). However, debate continues about the relationship between the time spent on electronic devices and children's cognitive abilities. Despite this, a significant association was observed between overall cognitive performance, as measured by the non-verbal index, and the number of screens accessible to the child. This may be because increased access to screens leads to higher screen time and fewer opportunities for interaction with the physical and social environment (28). Furthermore, attention, a key component of the non-verbal index, likely becomes fragmented when multiple screens are present. From a neurodevelopmental perspective, this diversion of attention reflects the well-documented effects of media multitasking and divided attention (20-21). Similarly, split attention studies show that processing multiple streams simultaneously increases cognitive load and hampers performance. Neuroimaging studies also suggest that greater access to various screens is associated with decreased functional connectivity within brain networks responsible for attention and cognitive control, such as the dorsal attention and salience networks (29). This supports the idea that many screens can fragment attentional resources and impair non-verbal cognitive performance.

School performance was not influenced by either screen time or the number of screens available to the child. This appears to align with a report by the Adolescent Brain Cognitive Development study, which concluded that it is unlikely that increased screen time would directly impact children's academic performance (26-27).

Our results should be interpreted cautiously due to study limitations, including but not limited to a small sample size, a cross-sectional design, and school performance assessments based on the overall final grade for the year rather than specific subdomains like literacy or mathematics. Nonetheless, we have demonstrated that the time children spend in

front of screens on weekdays and weekends exceeds international guidelines, which underscores the need for regulations. Excessive screen time has been linked to various factors, such as the age at which screens were first introduced, co-viewing with the mother, and co-viewing with a third party. A longitudinal study addressing these limitations may provide more insights into the potential relationships between screen time, cognition, and school performance in the DRC.

The strength of this study lies in raising awareness and providing valuable data on screen time among school-aged children in Kinshasa, DRC. To our knowledge, it is the first study to investigate the association between screen time, cognitive performance, and academic performance among children in the DRC. Our findings suggest the need for further parental supervision and public health policies to regulate digital media usage among school-aged children in the DRC.

Conflict of Interest

The authors declare no conflicts of interest.

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Project administration: G.M.B., E.K.-A., and D.L.E-A.O. All authors have read and agreed to the published version of the manuscript.

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