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Gadget addiction among school-going children and its association to cognitive function: a cross-sectional survey from Bangladesh

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ABSTRACT

Background People are becoming more dependent on technology than ever before. Today's children and adults are heavily plugged into electronics, which raises concerns for their physical and cognitive development. This cross-sectional study was conducted to assess the relationship between media usage and cognitive function among school-going children.

Methods This cross-sectional study was conducted in 11 schools in 3 of Bangladesh's most populous metropolitan areas: Dhaka, Chattogram and Cumilla. A semistructured questionnaire with three sections was used to obtain data from the respondents: (1) background information, (2) PedsQL Cognitive Functioning Scale and (3) Problematic Media Use Measure Short Form. Stata (V.16) was used for statistical analysis. Mean and SD were used to summarise quantitative variables. Qualitative variables were summarised using frequency and percentage. The χ^2 test was used to explore bivariate association between categorical variables, and a binary logistic regression model was fit to investigate the factors associated with the cognitive function of the study participants after adjusting for confounders.

Results The mean age of total of 769 participants was 12.0±1.8 years, and the majority (67.31%) were females. The prevalence of high gadget addiction and poor cognitive function was 46.9% and 46.5%, respectively, among the participants. After adjusting the factors, this study found a statistically significant relationship (adjusted OR 0.4, 95% CI 0.3 to 0.7) between gadget addiction and cognitive function. In addition, the duration of breast feeding was a predictor of cognitive function as well.

Conclusion This study found digital media addiction as a predictor of decreased cognitive performance in children who use digital gadgets regularly. Although the cross-sectional design of the study precludes causal relationships from being determined, the study finding deserves further examination via longitudinal research.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ School age is a time of rapid physical and mental growth for children.
⇒ Both children and adults are excessively immersed in electronic gadgets in today's times.
⇒ Digital addiction has a detrimental effect on 'students' performance in the classroom.
⇒ Boys have a higher score of addiction to gadgets (66.3%).

WHAT THIS STUDY ADDS

⇒ This study found a significant proportion of school-going children are addicted to digital gadgets. Gadget addiction has a statistically significant relationship with the cognitive function of school-going children.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study recommends regular screening of gadget addictions among school-going children and future interventions and policies on daily recommended time limits of digital media device usage in children.

INTRODUCTION

Around the world, people are increasing their reliance on technology devices at a rate that has never been seen before.[1] Not only adults but also children are excessively immersed in electronic gadgets in today's times, which generates issues and worries regarding the effects these devices have on children in terms of their physical and cognitive development.[2 3] Regarding the situation in Asia, a prior study that was carried out in six Asian nations concluded that children aged from 12 to 18 years held ownership of smartphones at a rate of 62% overall.[3]

Numerous developments have taken place in the public sphere of the modern period, leading to an explosion of new forms of data transmission, social interaction and leisure time activities. As technology continues to grow on a global scale, it is nearly impossible to live without any digital screen.[4] Technological progress brings about inevitable lifestyle changes, particularly in children. These

changes include the habit of playing with gadgets, eating habits, physical activity levels and the impacts of these changes.[5] There are identified benefits of digital device use, such as helping children acquire new vocabulary, languages and stay engaged in the classroom.[6] However, the possible negative impact of digital device use and its problematic usage is also common. A study has shown that digital addiction has a detrimental effect on students' performance in the classroom.[7] Children who spend an excessive amount of time in front of screens may have decreased levels of productivity.[3] Above-mentioned studies indicate that there are a variety of advantages as well as drawbacks associated with the use of the various forms of the digital screen.

A cognitive function is any psychological process that is involved in the process of acquiring knowledge, the manipulation of information or the logical derivation of conclusions.[8] The capabilities of perceiving, remembering, learning, paying attention, deliberating and communicating are all included in the cognitive processes.[8] People who use digital screens for prolonged periods have been reported to have impaired cognitive regulation and cognitive inflexibility.[9] According to the findings of another study, digital addiction is connected with an increased number of reported cognitive failures.[10]

School age is a time of rapid physical and mental growth for children.[11] There are increasing concerns about the effects of children's excessive screen usage on their growth and development.[12] According to the results of a survey, around two-thirds of students use the digital screen while they should be paying attention in class, studying or completing assignments.[7] The distraction that is resulted from this multitasking is one of the factors that has been proven to have a negative impact on students' academic performance.[7] There are limited evidences of digital addiction among children and its correlates in this geographic area. Therefore, this cross-sectional study was carried out to determine the extent of media use, and its association with cognitive function among school-going children in the study region.

METHOD

Study design, setting and sample

This cross-sectional study was carried out among children aged 8–14 enrolled in grades 4–7 at five private schools, five public schools and one madrasah (a specially adapted institution for Islamic education and culture) in Bangladesh. The study locations were chosen using convenient sampling. A printed questionnaire with instructions was used to obtain information from the parent, while trained volunteers performed face-to-face interviews with the participant.

Participants in the selected schools were sent informational pamphlets, parental consent forms and questionnaires. In addition, the pamphlets included a contact number for any more inquiries. Cognitive function assessment interviews were conducted with (n=769) children who provided written parental consent and completed the questionnaire within 1 week.

Measures

A semistructured questionnaire with three sections was used for data collection. Section 1 included questions on sociodemographic factors (age, gender, residence, family type, family income and parental education status), birth order (the order in which the child is born in comparison to other sibling), method of delivery (how the child was given birth: normal vaginal delivery or caesarean section), Expanded Programme on Immunisation (EPI) vaccination status (If the child received all vaccination according to the EPI schedule), duration of breast feeding (for how long the child was breastfed) and deworming status (The interval at which the child received deworming medication: never, occasionally or regularly). Sections 2 and 3 included two validated questionnaires (PedsQL Cognitive Functioning Scale and Problematic Media Use Measure Short Form (PMUM—SF)) for measuring cognitive function and gadget addiction, respectively. The parents received sections 1 and 3 with precise instructions for completion. The remainder of the questionnaire (section 2: PedsQL Cognitive Functioning Scale) was completed by a trained volunteer after the participant's face-to-face interview.

PedsQL Cognitive Functioning Scale

The PedsQL Cognitive Functioning Scale consists of six questions ('It is hard for me to keep my attention on things;' 'It is hard for me to remember what people tell me;' 'It is hard for me to remember what I just heard;' 'It is hard for me to think quickly;' 'I have trouble remembering what I was just thinking;' 'I have trouble remembering more than one thing at a time.'). This scale was developed through focus group discussions, cognitive interviews, pretesting and field-testing measurement development techniques.[13] A five-point Likert scale was used to assess this scale, with 0 denoting never, 1 denoting nearly never, 2 denoting sometimes, 3 denoting often and 4 denoting almost always. All responses were reverse-scored and then linearly translated to a 0–100 scale (0=100, 1=75, 2=50, 3=25, 4=0), in accordance with established scoring protocols. Any score below the mean was considered as poor cognitive functioning and higher scores indicated higher functioning.

Problematic Media Use Measure Short Form

The PMUM–SF was used to determine the level of screen addiction among all of the children in our study cohort. It includes nine components. Each answer was based on a five-point Likert scale: (1) never, (2) seldom, (3) sometimes, (4) often and (5) always. Children who scored 3 or higher on at least five questions were deemed to have a high level of device addiction.

Pretesting

A pretesting was done on 20 participants from government and private schools to check the feasibility and

reliability of the study. Necessary modifications were made to simplify the data collection without affecting the data quality. The inclusion of a helpline number in leaflets was considered on the suggestions of the pilot participants.

Statistical analysis

All analyses were performed using Stata (V.16). Descriptive statistics were calculated as mean and SD for quantitative variables or frequency and relative frequency for categorical variables. The bivariate association of two categorical variables was explored using the χ^2 test. A binary logistic regression model was fitted to assess the association between cognitive function and gadget addiction. Variables with a $p \leq 0.2$ in the bivariate analysis entered in the multivariate model in a forward stepwise selection method. A two-tailed $p<0.05$ was considered statistically significant.

Public involvement

Members of the public were involved in several stages of the study including design and conduct. We received input from children and their parents and implemented them in our study design. We intend to disseminate the main results to study participants and will seek public involvement in the development of an appropriate method of dissemination.

RESULT

Of the 836 questionnaires and consent forms provided to the participants, 67 were ineligible (30 did not meet inclusion criteria and 37 did not consent), resulting in 769 potential responders. A total of 769 responses out of 836 amounted to a response rate of 91.9%.

Background information of the study participants is presented in table 1. Among the 769 participants, 67.3% were female and hailed from urban areas. About 78% of the participants were from nuclear families, and most of the participants' birth orders were second or more. Most of the participants' family income was in between BDT10 000 and BDT20 000 (42.4%). Regarding parental education, 40.9% of parents had 8–12 years of schooling. In terms of birth, 26.3% of participants' modes of delivery were by caesarean section, and 67.8% were normal vaginal delivery. Most of the participants (90.6%) were EPI vaccinated. 10.8% of participants' duration of breast feeding was less than 6 months, whereas 47.8% of participants were more than 24 months. About 3% of participants were never dewormed, whereas 49.08% were occasionally and 48.1% were regularly. The prevalence of high gadget addiction and poor cognitive function were 46.9% and 46.5%, respectively, among the participants (figure 1).

Table 2 includes all the potential variables and demonstrates the adjusted result. After adjusting for age, gender, residence, family type, birth order, family income, parental education, mode of delivery, EPI vaccination

Table 1 Background information of study participants (n=769)

Variables	Frequency	Percentage
Age (in years), mean±SD	12.0±1.8	
Gender		
Male	251	32.7
Female	518	67.3
Residence		
Rural	296	38.5
Urban	473	61.5
Type of family		
Nuclear	597	77.6
Joint	172	22.4
Birth order		
First or second	569	74.0
Third or more than third	200	25.9
Monthly family income (in BDT)		
Less than BDT10 000	178	23.1
BDT10 000–BDT20 000	326	42.4
More than BDT20 000	265	34.4
Maximum years of parental education		
<8	166	21.6
8 to 12	314	40.9
>12	288	37.5
Mode of delivery		
Do not know	45	5.9
NVD by others	183	23.8
NVD by doctor	339	44.0
C/S	202	26.3
EPI vaccination		
No	73	9.4
Yes	696	90.6
Duration of breastfeeding (in months)		
Less than 6 months	83	10.8
6–12 months	123	15.9
12–24 months	196	25.5
More than 24 months	368	47.8
Deworming		
Never	22	2.8
Occasionally	377	49.0
Regularly (3 monthly)	370	48.1
Gadget addiction		
Low gadget addiction	408	53.0
High gadget addiction	361	46.9

BDT, Bangladeshi Taka; C/S, caesarean section; EPI, Expanded Programme on Immunisation; NVD, normal vaginal delivery.

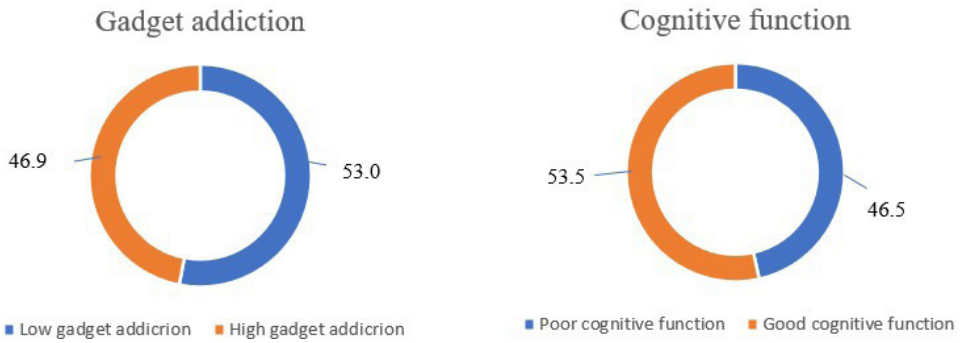

Figure 1 Prevalence of gadget addiction and cognitive function among school-going children (n=769)

status, duration of breast feeding and deworming status, participants with high gadget addiction had 56% less chance of good cognitive function than those with low gadget addiction. Also, participants whose duration of breast feeding was 6–12 months (adjusted OR, AOR 2.5, 95% CI 1.1 to 5.4, p=0.02), 12–24 months (AOR 2.0, 95% CI 1.0 to 4.2, p=0.05) and more than 24 months (AOR 2.4, 95% CI 1.0 to 4.7, p=0.01) had a higher chance of having good cognitive function than those who were breastfed for less than 6 months. Responses regarding the PMUM questionnaire are presented in table 3.

DISCUSSION

The objective of this study was to determine the prevalence of gadget addiction and its association with cognitive functions among school-going children in Bangladesh. Using a semistructured questionnaire, data were collected on background information, and data estimating cognitive functions and gadget addictions via the PedsQL Cognitive Functioning Scale and PMUM-SF, respectively. In this study, a high gadget addiction score (46.9%) was found in the participants; this result is similar to other studies reporting the growing prevalence of gadget addiction in different parts of the world. Similarly, previous research consisting of two systematic reviews and meta-analysis[2 14] confirm the increasing prevalence trend of gadget addiction over time in children and children. An Indian study among school-going children, where 57.55% were female, found that 10.69% of technology users were addicted, with 8.91% addicted solely to their phones.[15]

The PMUM-SF scale is a validated and reliable tool used to estimate screen media addiction in children by measuring child screen time and psychosocial functioning.[16–18] The high gadget addiction score estimated by PMUM was found to be across all age groups, and of the total participants in this study, the median age was 12.0 years with females being the majority (67%). This is in contrast to a study conducted in India, which reported boys as having a higher gadget addiction score (66.3%) because they had longer screen time than girls.[19] Other studies suggest that the prevalence of problematic media use or gadget addiction among children and young adults often varies (ranging from 5% to 50%).[16 20]

Although the significance could not be established, it was observed that majority of the participants were from urban areas, belonged to nuclear families, had family income ≥BDT15 000/month, and had parents with some level of education. These elements could potentially be indicative of higher socioeconomic status and, therefore, children born from such families are more at risk of excessive screen exposure and gadget addiction. A few studies have demonstrated the link between high family income and screen or internet addiction, thus confirming our theory.[21 22]

Using the PedsQL Cognitive Functioning Scale which is a reliable and valid measure of cognitive functioning in children,[13 23] we estimated the cognitive function of all participants in the study and determine their association with children with gadget addiction. Overall, it was found that 53.5% of the children had a good cognitive function score, and children identified to have high gadget addiction scores had 57% less chance (AOR 0.4, 95% CI 0.30 to 0.6, p<0.001) of having a good cognitive function compared with those with low gadget addiction. The adjusted logistic regression analysis showed that as gadget addiction increases the level of poor cognitive function increases as well. A previous study conducted on children under 12 years of age in India, found that gadget media addiction has a close association with decreased cognitive function.[19] The study findings indicated that increased screen time and gadget addiction were significantly associated with parental concerns in some cognitive elements such as problem-solving, communication and personal-social development.[19] Previous research further supports this, reporting the significant association between increased screen time and delays in cognition, language and developmental motor milestones.[24] Similarly, there is evidence to show that parents who frequently use digital media devices to calm upset children lead to increase concerns in socialemotional development in toddlers.[25] A few studies observed increased ADHD problems in children with excessive televison (TV) use,[26 27] while the cognitive development of children was found to improve when screen time was reduced to less than 2 hours per day.[28] It was reported that the use of electronic media in preschool-age children was associated with behavioural difficulties over time.[29] Hyperactivity or inattention

Table 2 Cognitive function of the study participants and associated factors (n=769)

Variables	AOR	P value	95% CI		
Gadget addiction					
Low gadget addiction	Reference				
High gadget addiction	0.4	**<0.001**	0.3	to	0.7
Age (in years)	1.0	0.4	0.9	to	1.2
Gender					
Male	Reference				
Female	1.1	0.6	0.7	to	1.7
Residence					
Rural	Reference				
Urban	0.9	0.6	0.5	to	1.5
Type of family					
Nuclear	Reference				
Joint	0.9	0.9	0.6	to	1.6
Birth order					
First or second	Reference				
Third or more than third	0.9	0.6	0.6	to	1.4
Monthly family income (in BDT)					
Less than BDT10 000	Reference				
BDT10 000–BDT20 000	0.9	0.6	0.5	to	1.5
More than BDT20 000	0.9	0.8	0.5	to	1.8
Maximum years of parental education					
<8	Reference				
8 to 12	0.9	0.96	0.59	to	1.7
>12	0.9	0.80	0.5	to	1.7
Mode of delivery					
Do not know	Reference				
NVD by others	1.0	0.9	0.3	to	3.8
NVD by doctor	1.5	0.5	0.4	to	5.2
C/S	1.2	0.8	0.3	to	4.2
EPI vaccination					
No	Reference				
Yes	1.1	0.8	0.5	to	2.7
Duration of breastfeeding (in months)					
Less than 6 months	Reference				
6–12 months	2.5	0.02	1.1	to	5.4
12–24 months	2.0	0.05	1.0	to	4.3
More than 24 months	2.4	0.01	1.0	to	4.7
Deworming					
Never	Reference				
Occasionally	0.7	0.6	0.2	to	2.3
Regularly (3 monthly)	0.9	0.9	0.3	to	3.3

p<0.05 is in bold.
AOR, adjusted OR; C/S, caesarean section; EPI, Expanded Programme on Immunisation; NVD, normal vaginal delivery.

Table 3 Problematic media use measure questionnaire and responses of the participant

Digital addiction question	Never	Seldom	Sometimes	Frequently	Always	Mean score
	Score 1	Score 2	Score 3	Score 4	Score 5	
It is hard for my child to stop using screen media	47.6	11.0	33.0	2.0	5.3	2.0
Screen media is the only thing that seems to motivate my child	51.0	11.4	26.4	3.2	7.9	2.0
Screen media is all that my child seems to think about	54.0	8.8	27.2	3.7	5.4	1.0
My child's screen media use interferes with family activities	47.0	11.0	31.9	2.9	7.1	2.1
My child's screen media use causes problems for the family	67.4	8.8	18.5	1.5	3.8	1.7
My child becomes frustrated when he/she cannot use screen media	64.6	10.6	19.8	1.0	3.0	1.7
The amount of time my child wants to use screen media keeps increasing	61.8	13.1	17.0	4.0	2.9	1.7
My child sneaks using screen media	75.7	7.4	14.3	1.2	1.4	1.5
When my child has had a bad day, screen media seems to be the only thing that helps him/her feel better	52.6	9.8	29.4	1.8	6.4	2.0

problems were associated with baseline use of mobile phones, while emotional and conduct problems were associated with internet or computer usage.[29]

To the best of our knowledge, this is the first study to examine gadget addiction and its association with cognitive function in children in Bangladesh, using the PMUM-SF and PedsQL Cognitive Functioning Scales. The measurement of cognitive function may not be accurate considering the absence of clinical test. Still, the questionnaire used in this study was developed from validated scales, thus, enhancing the strength of our research. Another strength of this study is the large sample size used, which allows for greater precision and generalisability of the findings. One of the limitations of this study is that we could only present the association between gadget addiction and cognitive function, rather than causality due to our research methodology. Due to convenience sampling methods employed in this study, there may be sampling bias, however, we attempted to minimise this by sampling 769 children from 11 schools in three of Bangladesh's most populous metropolitan areas of Bangladesh (Dhaka, Chattogram and Cumilla). Recall and social desirability bias are likely to have occurred since part of the data was drawn from parental reports. Future research is needed to establish cause and effect on this topic and, therefore, draw definitive conclusions.

We conclude that there is a positive association between gadget addiction and poor cognitive function among children who use digital devices frequently. Therefore, interventions and education programmes should be developed to increase public awareness of harmful gadget addictions in children. However, additional longitudinal research is required to obtain a clearer data.

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Data availability statement The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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