

Screen time and its correlates among children aged 3–10 years during COVID-19 pandemic in Nepal: a community-based cross-sectional study

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ABSTRACT

Objective This study aims to determine the prevalence of high screen time among schoolchildren aged 3–10 years in Bhaktapur, its correlates and the parents' strategies to reduce screen time during the COVID-19 pandemic in Nepal.

Methods and analysis This cross-sectional descriptive study was conducted during March 2021. A total of 630 households were selected for the study from 21 randomly selected clusters in Bhaktapur, Nepal. Correlates of high screen time were determined using a logistic model. $P < 0.002$ was taken as significant.

Results Among all the participants, the mean (SD) age was 7.0 (2.2) years, with 50.3% male participation. Few participants had online classes ($n=24$, 3.8%). The prevalence of high screen time among the participants was very high (55.2%, 95% CI=51.3% to 59.1%), which is even higher in boys (61.8%, 95% CI=58.0% to 65.6%). The median screen time before the COVID-19 pandemic was 1.0 hours (mean rank=275.8) which increased to 2.2 hours (mean rank=116.6) during the pandemic ($p < 0.001$).

Participants having smartphones were about seven times (adjusted OR=6.9, 95% CI=1.5 to 31.3, $p=0.013$) more likely to have high screen time than those who did not have the device. Most parents used to reprimand and urge their children to play outside to limit their screen usage.

Conclusion During the COVID-19 pandemic, about one in two schoolchildren of 3–10 years had higher screen time than before the COVID-19 pandemic. Parents' strategies to reduce screen time were not effective. An intervention study is recommended to design and test effective strategies to reduce screen time and its negative effects on children's health.

INTRODUCTION

The use of the internet, computers, smartphones and other electronic devices in all parts of the world has increased dramatically.¹ Screen time begins in early childhood, with studies indicating that use of screen devices is high in children under 2 years and is continuously growing across all age groups.² Discretionary use of screen devices is becoming children's primary experience

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Most children worldwide are addicted to screen devices and use them more than recommended for their age.
- ⇒ The COVID-19 pandemic has increased screen time among children globally.

WHAT THIS STUDY ADDS

- ⇒ The effect of the COVID-19 pandemic on Nepali children's screen time.
- ⇒ Parents' strategies to control their children's screen time.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ These findings could be used as evidence to formulate strategies to control screen time among children.

and environment, influencing their brain development.³ Recent evidence shows that on average, people aged 16–24 years old in the UK are now spending more time on media and communications than sleeping.³ Screen time is associated with the risk of obesity/adiposity, higher energy intake, behavioural problems, anxiety, hyperactivity and poor attention.^{4–6} This has raised concerns over a child's cardiometabolism and other medical outcomes, including emerging screen-related addictive behaviour known as screen dependence disorders.^{7–8} Findings have also shown a link between overall screen time and depression and suicidal behaviour among adolescents.⁹ Smartphone access of children up to 8 years has increased from 52% in 2011 to 75% in 2013.¹⁰ Similarly, the average screen time of children aged 8–18 years old also increased from 6.2 hours per day in 1999 to 7.4 hours in 2009.⁹ The screen time was increased to 9.1 hours per day during the COVID-19 lockdown.¹¹ The

Table 1 Characteristics of the participants

Characteristics	n	%
Gender		
Male	317	50.3
Female	313	49.7
Age (years)		
3–4	99	15.7
5–10	531	84.3
School type		
Institutional	468	74.3
Public	162	25.7
Class		
Preschool	261	41.4
Basic level	369	58.6
Mode of teaching		
Fully online	5	0.8
Fully classroom	606	96.2
Partial online partial classroom	19	3.0
Family type		
Single father/mother	11	1.7
Nuclear	413	65.6
Joint	2	0.3
Extended	204	32.4
Socioeconomic status of family		
Upper lower	147	23.3
Lower middle	296	47.0
Upper middle	179	28.4
Upper class	8	1.3
Type of digital devices families have (multiple answers)		
Laptop	100	15.9
Tablet/iPad	56	8.9
Smartphone	604	95.9
Video game console	4	0.6
Television	464	73.7
Desktop computer	17	2.7
Children have their own digital device		
Before the start of the COVID-19 pandemic	16	2.5
During the COVID-19 pandemic	62	9.8
Purpose (multiple answers)		
Playing games	562	89.0
Online class/study	176	27.9
YouTube/TikTok	116	18.4

average screen time during the COVID-19 pandemic among children aged 6–10 years increased by 1.4 hours per day as compared before the pandemic.¹² More

than 80% of preschool children use screen devices more than the recommended time,¹³ whereas most of the children used their devices during meals.⁶ The average sleeping time of children before the pandemic has decreased by more than 1 hour compared with the previous century.¹⁴

Teaching–learning activities in schools of Nepal¹⁵ have forcefully changed classroom teaching to screen-dependent online education, which continued for a few months each year with the rise of COVID-19 cases. This situation might increase screen dependency and negatively impact schoolchildren, including preschoolers. There is a paucity of evidence on the screen viewing behaviour of children, which may become a potential future public health problem in Nepal. Therefore, we aimed to determine the prevalence of high screen time, its correlates and the parents' strategies to reduce the use of screen devices among schoolchildren aged 3–10 years in Bhaktapur district.

MATERIALS AND METHODS

Study design and study population

This is a community-based descriptive cross-sectional study done among schoolchildren aged 3–10 years in Bhaktapur district in Nepal during March 2021. This was just before the COVID-19 second wave in Nepal, as during the intervening period, children mostly had physical classes in school.¹⁶ The minimum sample size was 606, calculated using the formula: $n = ((z^2 p(1-p)) / e^2) \times \text{design effect}$, where $z = 1.96$ at the 95% confidence level, $p = 0.5$ (the estimated prevalence of high screen time among schoolchildren is taken as 50%, as these data are not yet available for Nepal), e (allowable error) = 0.05, design effect = 1.5 and adding a 5% non-response rate. We selected household children by applying a multi-stage sampling technique. Two out of four municipalities (Changunarayan and Suryabinayak Municipality) of the Bhaktapur district were randomly selected in the first stage. Then, 144 wards from the 2011 census (available smallest population unit) were taken as a cluster and formed the sampling frame for the study. The required clusters were obtained by dividing the sample size (606 household children) by 30 (cluster size), 20.2–21 clusters. Thus, 630 (21 clusters \times 30 samples) were the samples included in this study. All clusters (wards) from selected municipalities were included in the sampling frame. Twenty-one clusters (wards) were determined by systematic random sampling from the sampling frame. Then, 30 household children were selected consecutively for the interview, and children from 3 to 10 years were enrolled as study participants. The enumerators visited two more times those households where responding parents were absent or busy during an initial visit for data collection. Regarding child selection, if there were more than one eligible child, we selected the younger child as a study participant.

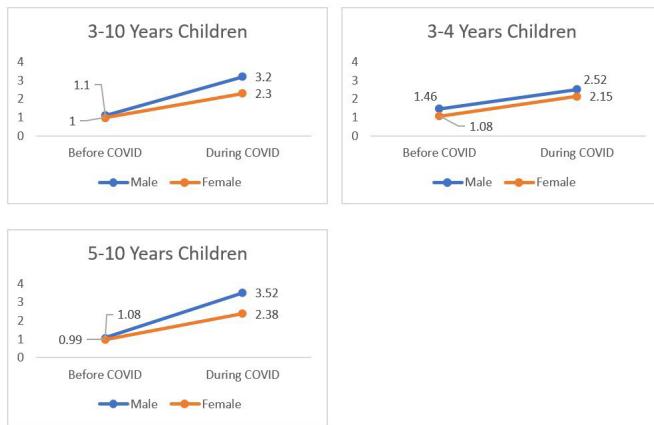


Figure 1 Mean screen time (hours) before and during the COVID-19 pandemic.

Data collection, data entry and statistical analysis

Face-to-face interviews with parents of eligible schoolchildren as the proxy respondent were conducted through household visits. The tool used included socio-demographic variables, access to screen devices, screen time-related variables, strategy to reduce screen time and variables related to its perceived negative impact. The tool was developed according to the study's objective through an extensive literature review involving ophthalmologists, optometrists and public health researchers, and pretested in a small sample of same-age children at Madhyapur Thimi municipality. Enumerators were trained on the study tool to increase the reliability and repeatability and used the same tool by all enumerators for data collection.

The average screen time of more than 1 hour for children up to 4 years and more than 2 hours for children from 5 to 10 years was considered high screen time.^{17 18} Socioeconomic status of households was estimated using modified Kuppaswamy's socioeconomic scale for Nepal.¹⁹ Perceived change in children's vision and amount of food eaten during the pandemic were assessed through a structured questionnaire.

Data were entered in EpiData V.3.1 data entry format provided with checks to avoid errors in data entry. Data were cleaned, categorised and analysed using SPSS V.26.0. The data were presented in mean, median, SD, frequency and percentage, and shown in tables. A χ^2 test with Bonferroni correction was done to find the association between independent and dependent categorical variables. Wilcoxon signed-rank test was applied in non-normal continuous variables. To determine the correlates, a two-step modelling approach was undertaken. First, a bivariate logistic regression analysis of each explanatory variable and outcome variable was conducted to identify the associations. Second, those variables with p values of <0.1 were included in a multivariate logistic regression analysis to determine the effect adjusted for each potential explanatory variable. Following Bonferroni correction, a p value of <0.002 denoted statistical

significance in the final model obtained by dividing 0.05 by the number of variables included in the model (n=18).

Patient and public involvement

Patients or the public were not involved in this research's design, conduct or reporting.

RESULTS

Among 630 households interviewed from 21 clusters in the Bhaktapur district, 37 houses were visited more than once to complete data collection. An almost equal number of boys and girls (male=317, female=313) participated in the study. The participants' mean (SD) age was 7.0 (2.18) years. Almost one-fourth (n=468, 74.3%) of the participants studied at private schools, and more than half were in basic education (n=369, 58.6%). Few participants (n=24, 3.8%) had full or partial online classes during the data collection period. Most of the participants (n=413, 65.6%) lived in a nuclear family followed by an extended family (n=204, 32.4%). Most households (n=604, 95.9%) had a smartphone that children could use, followed by television (n=464, 73.7%). Very few households (n=4, 0.6%) had a video game console. Around 1 in 10 households (n=56, 8.9%) had tablets/iPad that their children use. About 1 in 10 children had their own screen devices during the COVID-19 pandemic. Before the pandemic, only 2.5% of children had their screen devices. Around 9 in 10 participants (n=562) used the screen devices to play games, followed by an online class or other study purposes (n=176, 27.9%). Screen devices were also used for YouTube videos and TikTok by 116 (18.4%) participants. Around half of the households (n=296, 47.0%) were from lower-middle socioeconomic status, and only a small proportion (n=8, 1.3%) were from upper socioeconomic status. None of the households was of lower socioeconomic status (table 1).

Change in participants' behaviour due to COVID-19 pandemic

The mean daily screen time was increased in both gender and age groups. A male child had more screen time than a female child, and regardless of gender, mean daily screen time was higher in the 5–10 years old group than in the lower age groups (figure 1).

The median screen time of the participants before the pandemic was 1.0 and increased to 2.2 hours during the pandemic. Mean rank screen time before and during the COVID-19 pandemic was 116.6 and 275.8, significantly different (p<0.001). The difference in sleeping and playing time was also considerably different, with a p value of <0.001. The median playing time (excluding the playing using a screen device) decreased during the pandemic compared with before (2 hours vs 1 hour a day) (online supplemental table 1).

The prevalence of high screen time among all participants was 55.2% (95% CI=51.3% to 59.1%), where the prevalence was higher in male (61.8%, 95% CI=58.0% to 65.6%) than female participants (48.6%, 95% CI=44.7% to 52.5%). Among sociodemographic correlates, gender,

**Table 2** Screen time according to different characteristics

Correlates	Normal	High	χ^2 p value*
	n (%)	n (%)	
All	282 (44.8)	348 (55.2)	
Sociodemographic			
Gender			
Male	121 (38.2)	196 (61.8)	0.001†
Female	161 (51.4)	152 (48.6)	
Age			
3–4 years	33 (33.3)	66 (66.7)	0.013†
5–10 years	249 (46.9)	282 (53.1)	
Mode of teaching			
Online	10 (41.7)	14 (58.3)	0.756†
Physical class	272 (44.9)	334 (55.1)	
Family type			
Nuclear family/single parent	203 (47.9)	221 (52.1)	0.024†
Joint/extended family	79 (38.3)	127 (61.7)	
School type			
Private	178 (38.0)	290 (62.0)	<0.001†
Public	104 (64.2)	58 (35.8)	
School level			
Preschool	135 (51.7)	126 (48.3)	0.003†
Basic level	147 (39.8)	222 (60.2)	
Socioeconomic status			
Upper lower	83 (56.5)	64 (43.5)	0.013‡
Lower middle	120 (40.5)	176 (59.5)	
Upper middle	76 (42.5)	103 (57.5)	
Upper class	3 (37.5)	5 (62.5)	
Children's access to screen devices (multiple answers)			
Children own screen devices			
Yes	6 (9.7)	56 (90.3)	<0.001†
No	276 (48.6)	292 (51.4)	
Laptop			
Yes	17 (17.0)	83 (83.0)	<0.001†
No	265 (50.0)	265 (50.0)	
Tablet			
Yes	11 (19.6)	45 (80.4)	<0.001†
No	271 (47.2)	303 (52.8)	
Smartphone			
Yes	258 (42.7)	346 (57.3)	<0.001†
No	24 (92.3)	2 (7.7)	
Video game console			
Yes	0 (0.0)	4 (100.0)	0.132§
No	282 (45.0)	344 (55.0)	
Television			
Yes	161 (34.7)	303 (65.3)	<0.001†
No	121 (72.9)	45 (27.1)	

*Significance was defined as $p < 0.05$ unless otherwise noted.

†Bonferroni-corrected $\alpha < 0.0125$.

‡Bonferroni-corrected $\alpha < 0.0031$.

§Fisher's exact test was done; χ^2 test was among remaining.

school type and school level were significantly associated with high screen time. Regarding the children's access to screen devices, high screen time was significantly associated with access to all types of screen devices except for video game consoles (table 2).

Perceived children's vision problems due to COVID-19 pandemic

Nearly 3% of caretakers and parents perceived that their children's vision worsened due to increased screen time during the COVID-19 pandemic. About 9 out of 10 parents reported no change in their children's eating behaviour during and before the pandemic, as shown in online supplemental table 2.

Parental knowledge, perception, control and strategies employed for reducing children's high screen time and adverse health effects

More than four in five parents knew about their children's daily allowable screen time. Regarding the effects of high screen time on children's health, 97.5% ($n=614$) said it could cause negative effects. The most common perceived effect was eye problems, followed by sleep disorders (table 3). More than 6 in 10 parents also perceived that high screen time affects their child's studies.

Scolding the children was the most used strategy by more than 6 of 10 parents to reduce high screen time, whereas 3.0% used the parental screen control smartphone application (table 4). About 9 in 10 parents had not consulted for eye health services to reduce the effect of high screen time on their children's eye health.

Correlates of high screen time

Participants from private schools were two times (adjusted OR (AOR)=2.4, 95% CI=1.5 to 3.9, $p < 0.001$) more likely to have high screen time than those from public schools. Participants who had a smartphone were about seven times (AOR=6.9, 95% CI=1.5 to 31.3, $p=0.013$) more likely to have high screen time than those who had no smartphones. Participants who used screen devices for playing games were two times (AOR=2.5, 95% CI=1.3 to 4.9, $p=0.008$) more likely to have high screen time than those not playing games. Participants whose parents perceived vision problems as the effect of increased screen time were about eight times (AOR=7.8, 95% CI=1.6 to 38.1, $p=0.011$) more likely to have high screen time than those who did not perceive it to be. Participants whose parents turned off Wi-Fi to curb screen time were, in fact, three times more likely to land up in more screen time (AOR=3.5, 95% CI=0.8 to 15.2, $p=0.093$), though not statistically significant (table 4). The model was fit ($p=0.285$) and could explain a 42.0% association of increased screen time with the correlates (Nagelkerke $R^2=0.420$).

DISCUSSION

The present study explored the burden of higher screen time than allowable for schoolchildren aged 3–10 years.

Table 3 Knowledge and perception of the negative effects of high screen time on children's health

Characteristics		n	%
Parent's knowledge	Allowable screen time	525	83.3
Parent's perception of possible negative effects (multiple answers)	Cause eye problem	548	87.0
	Cause obesity	29	4.6
	Impair study	401	63.7
	Sleep disorder	214	34.0
	Make children irritable	204	32.4
	Make children lonely	261	41.4
	No effect	16	2.5
	Do not know	54	8.6
Strategies to reduce screen time use	Scold	396	62.9
	Encourage to play (except playing using screen devices)	215	34.1
	Spend time with children	192	30.5
	Provide them playing materials	183	29.0
	Parents don't use the screen devices in their children's presence	129	20.5
	Allow screen time for study purpose only	103	16.3
	Using screen devices is not allowed during eating	44	7.0
	Turn off Wi-Fi	24	3.8
	Parental screen control of smartphone applications	19	3.0
	Other (hide device/remote/charger, enrol in tuition class, engage in drawing/other tasks)	22	3.8
Eye health seeking behaviour of parents to reduce negative effects of high screen time on eye health	Did eye consultation 6 monthly	5	0.8
	Did eye consultation yearly	55	8.7
	Eye consultation never done	570	90.5

These results suggest that the average daily screen time during the COVID-19 pandemic was higher (2.8 hours) than allowable. This is almost like a 14-country study.²⁰ Most studies assessed the screen time during the lockdown when children were confined to their homes; in contrast, there was no restriction in Nepal during our data collection. As expected, children used to have more screen time when they were restricted. Children in Spain used about 3.9–4.7 hours a day of screen time during confinement due to COVID-19; this was more than double the average screen time used by children before

the pandemic.²¹ The studies done in other countries revealed that the increase in screen time has increments varying from 55 min to 2.9 hours.^{20 21} In Chile, during this pandemic, the average screen time of children aged 1–5 years was 3.0 hours per day, increasing by 174 min per day compared with before the pandemic.²² The present study found that one in two children aged 3–10 years had more screen time daily than the limit recommended. In contrast, only 31% of schoolchildren below 13 years in China had higher screen time before the COVID-19 pandemic.²³ In another study done before the pandemic, 57% of extremely preterm children and 55.3% of healthy preschool children had high screen time, and 266 (64%) had a television/computer in their bedroom.^{24 25} Among the schoolchildren aged 3–13 years in China, 77% engaged in prolonged screen time.²⁶ Neighbouring India has few studies on screen time; 84%–89.4% of children aged 2–5 years had screen time of more than 1 hour a day.^{27 28}

Correlates of high screen time among children

Older boys, children of higher socioeconomic groups and those studying in private schools with longer hours of online courses correlated with higher screen time. The screen time increased as age increased, consistent with other literature findings.^{20–22 29} The screen devices were used mainly for gaming purposes, which may be one of the reasons why boys are using screen devices. This might be because boys have greater freedom in our part of the world. In contrast, children in the USA used screen devices for educational use, and girls' screen time increased more than boys.³⁰ Since the start of the pandemic, online classes have significantly increased; about 27.9% of students use screen devices for online classes; thus, this may be one reason why senior children use screen devices for more extended periods than junior ones due to more classes. Other important factors could be the knowledge and skill that could be developed through digital media and the internet among children, although we did not explore these factors in this study.²⁹ Children from the family having higher socioeconomic status, having their digital devices and studying in private schools have a higher prevalence of high screen time. In this study, the availability of television, smartphones and laptops increased the chances of increased screen time by more than fourfold to eightfold. Access to media devices at home appeared to determine mobile screen use.²⁹ In this study, 20.5% of parents do not use screen devices in the presence of their children, although it does not have positive associations with low screen time, as seen in other studies.^{31 32}

COVID-19 pandemic and high screen time

This study shows that screen time during this pandemic has doubled more than before the start of the pandemic. As supported by other literature findings, the reciprocal effect was seen in playing time, which also decreased by half during the pandemic.²² This study does not find

Table 4 Correlates of high screen time from the multivariate logistic regression model

Correlates		Unadjusted OR (95% CI)	Adjusted OR (95% CI)	P value***
Gender	Male	1.7 (1.2 to 2.3)**	1.5 (0.9 to 2.2)	0.053
Family type	Nuclear/single parent	1.5 (1.1 to 2.1)*	1.0 (0.6 to 1.6)	0.974
School type	Private	2.9 (2.0 to 4.2)**	2.4 (1.5 to 3.9)	<0.001
Education level	Basic level	1.6 (1.2 to 2.2)*	1.0 (0.7 to 1.5)	0.069
Socioeconomic status	Lower middle	1.9 (1.3 to 2.8)*	1.1 (0.6 to 1.8)	0.764
	Upper middle	1.7 (1.1 to 2.7)*	0.6 (0.3 to 1.2)	0.164
	Upper class	2.2 (0.5 to 9.4)	1.3 (0.2 to 9.7)	0.779
Laptop	Yes	4.9 (2.8 to 8.4)**	4.0 (1.9 to 8.1)	<0.001
Tablet	Yes	3.6 (1.8 to 7.2)**	1.4 (0.5 to 3.4)	0.504
Smartphone	Yes	16.1 (3.8 to 68.7)**	6.9 (1.5 to 31.3)	0.013
Television	Yes	5.1 (3.4 to 7.5)**	4.2 (2.6 to 6.7)	<0.001
Screen devices used for playing games	Yes	2.9 (1.7 to 4.9)**	2.5 (1.3 to 4.9)	0.008
Screen devices used for YouTube/Facebook/TikTok	Yes	2.0 (1.3 to 3.1)*	1.8 (1.0 to 3.2)	0.037
Perceived eye problem	Yes	4.0 (2.4 to 6.7)**	1.1 (0.5 to 2.2)	0.777
Perceived impair study	Yes	2.8 (1.9 to 3.9)**	1.4 (0.9 to 2.3)	0.140
Perceived loneliness	Yes	2.6 (1.9 to 3.7)**	1.7 (1.1 to 2.6)	0.018
Perceived vision problem	Increased	6.7 (1.5 to 29.6)*	7.8 (1.6 to 38.1)	0.011
Scolding	Yes	3.4 (2.4 to 4.7)**	2.8 (1.8 to 4.5)	<0.001
Turned off Wi-Fi	Yes	5.9 (1.8 to 20.2)*	3.5 (0.8 to 15.2)	0.093
Parental control of smartphone applications	Yes	3.1 (1.0 to 9.5)*	1.1 (0.3 to 4.2)	0.915

* $\alpha < 0.05$; ** $\alpha < 0.001$; ***Bonferroni-corrected $\alpha < 0.002$.

any difference in sleeping time, though different literature findings showed children were late in bedtime and wake-up time, and total sleeping time also increased.^{22 33} Children spent less time on physical activity and more time on screen devices during confinement than before the pandemic. Similarly, a study in Chile found an increase in sleeping time by 1.4 hours per day though sleep quality declined (-0.75 hour/day).²² The increase in screen time has also increased the adverse effects among children's health. Eye problems, impaired study performance and loneliness were the few negative effects parents perceived of long screen time. Parents think that visual impairment has increased due to increased screen time even though less than 1% of children got their eyes checked regularly or 6 monthly. Although we did not measure the refractive error status of the children in this study, a study was done in China that suspected a possible increase in myopia due to screen time of >2 hours. Before COVID-19, high screen time contributed to adverse cognitive and executive function and behaviour outcomes at ages 6–7 years in children born at less than 28 weeks.^{24 26} Other potential health issues increased during and 3 months before the pandemic, such as obesity, cardiovascular diseases and mental health issues.²⁶

Parents' strategies to reduce high screen time among their children

Although 83.3% of parents knew they should limit their children's screen time, this knowledge did not help reduce their children's screen time. Most parents have used scolding as a strategy for discouraging their children to use screen devices for a long time. Parents may use this common strategy in most low/middle-income countries. Another strategy used by parents was encouraging their children to play or spending more time with their children; it was a much more desirable approach. At the same time, a minority used a parental control application on smartphones and turned off Wi-Fi frequently to limit screen time. Although different strategies are used, none seem beneficial in reducing screen time. Parental control applications used on smartphones are counterintuitive as they increased high screen time by about ninefold. Children feel happy to spend more time with their parents to take them away from screen exposure, as giving a reward works better than punishment in children's behaviour. Therefore, interventions for parental education seem to be as important as counselling the students.

Formulating the guidelines for screen exposure

Most global studies on high screen time focus on children less than 5 years, although screen time was very

high in higher-aged children. This may be due to the availability of clear guidelines from the WHO.¹⁷ The literature regarding allowable screen time for children above 5 years is not available except for few country-specific guidelines.^{17 18} Global and national guidelines for children of all ages, including strategies to decrease screen time and halt the adverse health effects of high screen time, should be developed and implemented to tackle this emerging public health problem.

LIMITATIONS

This study may under-report the prevalence of high screen time as the children had mostly physical classes during the data collection period. The study used parents as the proxy respondent of the participating children. The wards chosen through cluster sampling in this study may have sampling errors as the clusters may not have included varied population demographics.

Conclusion

During the COVID-19 pandemic, one in two schoolchildren aged 3–10 years in Bhaktapur district had higher screen time than allowable for their age who used smartphones to play games. Types of school and having digital screen devices correlated with increased screen time among the children. No strategy used by parents seemed to work to control the high screen time of their children. Children-focused interventions should be explored to reduce high screen time and tested through an intervention study. Conducting awareness programmes through stakeholders' engagement in mitigating negative health impacts is also recommended.

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