



# Screen media use in hospitalized children: a prospective observational study

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## Abstract

Screen media use in hospitalized children is more prevalent than such media use in a home setting. Research on characteristics and extent to which screen media are used in hospitalized children in addition to associated factors is scarce. This study aims to examine the duration and factors associated with screen media use in hospitalized children. From February to November 2020, a cross-sectional study was conducted in hospitalized children (age range 1–194 months, median age 44.5 (IQR 14–123.5) months) and their caregivers at a single tertiary care hospital using a media questionnaire combined with a thorough interview. Of 254 participants who were enrolled, 239 (94%) had been exposed to screen media in the hospital with a median duration of exposure of 6 (IQR 2–11) h/day. Children who used more than one screen media device (standardized beta ( $\beta$ )=0.16,  $p < 0.001$ ), having difficulty stopping media use ( $\beta = 0.16$ ,  $p < 0.001$ ), having lower numbers of positive discipline techniques over media use ( $\beta = 0.16$ ,  $p = 0.001$ ), and less media co-viewing with verbal interaction with their caregivers ( $\beta = 0.12$ ,  $p = 0.004$ ) were significantly associated with longer screen media use in a hospital setting.

**Conclusion:** Hospitalized children spent 6 h/day on screen media. Fostering positive discipline over media use and co-viewing with verbal interaction during screen time may minimize screen media overuse in hospitalized children.

## What is Known:

- Screen media use in hospitalized children is often observed during ward rounds.
- Hospitalized children had increased access to screen media in hospital rooms compared to their homes.

## What is New:

- Difficulty stopping media use, having lower numbers of positive discipline techniques over media use, and less media co-viewing with caregivers were associated with longer screen media use in hospitalized children.
- Fostering positive discipline over media use and verbal interaction from caregivers during media co-viewing may minimize screen media overuse in hospitalized children.

**Keywords** Co-view · Hospitalized children · Media · Positive discipline · Screen time

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## Abbreviations

CI	Confidence interval
COVID-19	Coronavirus disease 2019
IQR	Interquartile range
TV	Television
SE	Standard error

## Introduction

In the era of advancing technology and particularly in the COVID-19 pandemic, screen media use has been tremendously increasing in young individuals since they are able to engage in electronic media devices anywhere and anytime

[1–4]. Although the World Health Organization has recommended to avoid excessive screen time in young children [5], such a recommendation is challenging for parents to follow, particularly in this era and when other alternative activities are limited in settings such as during hospitalization. Excessive screen media exposure since early childhood is associated with adverse developmental, emotional, and behavioral outcomes [6–10].

Screen media use in hospitalized children is ubiquitous, as often observed clinically during ward rounds. During observations in hospital settings, screen media was used in 21–80% of hospitalized children [4, 11, 12]. Caregivers of those children also reported much higher rates of watching both TV and non-TV screen media including computers, videogame consoles, handheld videogames, and devices when compared with a home setting [4, 12, 13]. Moreover, hospitalized children were more likely to have access to screen media in hospital rooms compared to their homes [4]. Screen media has been successfully used to distract children from the pain of medical procedures. Conversely, the increased use of screen media in the hospital might put hospitalized children at risk for adverse outcomes, particularly those who require prolonged hospitalization. Heavy screen media use during a hospital stay could conceivably carry on into non-hospitalized times. Characteristics of screen media use including duration and interaction between parents and children during screen time may be different by culture and socioeconomic backgrounds between those in developed and developing countries [14–16]. Such above differences might also be observed in a hospital setting. There were few studies investigating patterns and characteristics of screen media use in addition to factors associated with increased duration of screen time in hospitalized children [4, 11–13, 17]. Furthermore, three of the previous studies were conducted more than 3 decades ago in North America where those studies mainly focused on TV viewing [11, 12, 17].

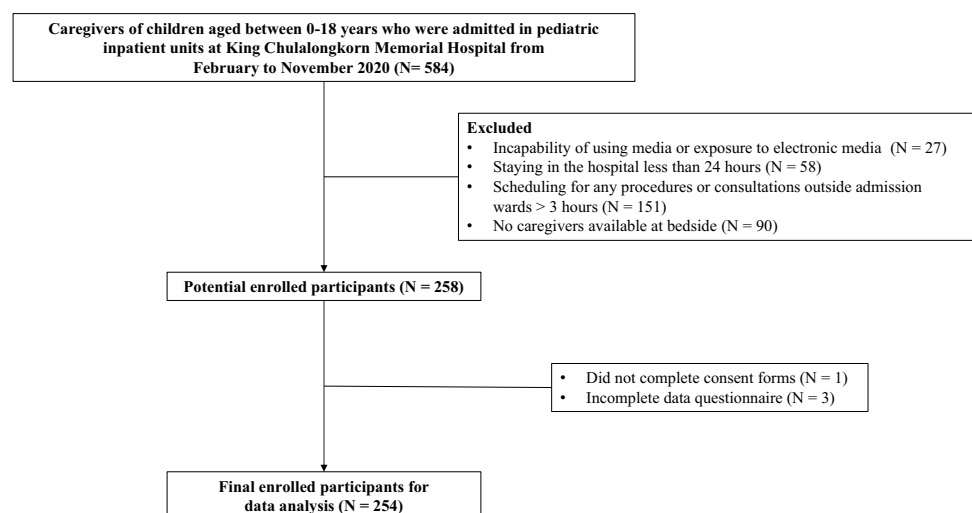
To our knowledge, research on characteristics and the extent to which screen media are used in hospitalized children in Asian countries is scarce. Understanding such patterns, characteristics, and factors associated with screen media use in hospitalized children in developing countries will shed light on further steps for a customized hospital media use plan. As a result, this study aims to examine the average duration and factors associated with screen media use in hospitalized children.

## Materials and methods

### Study participants

From February to November 2020, caregivers of children aged between 0 and 18 years who were admitted in pediatric inpatient units at King Chulalongkorn Memorial Hospital, a tertiary care hospital in Bangkok, Thailand, were invited to participate in this cross-sectional study. Exclusion criteria included caregivers of pediatric patients with incapability of using or exposure to electronic media such as those with assisted ventilation, blindness, and hemodynamic instability, staying in the hospital less than 24 h, scheduling for any procedures or consultations outside admission wards for more than 3 h on data collection date, and no caregivers available at bedside. To minimize the difference of disease severity for each patient and maintain the integrity of the interviewing process, data ascertainment was obtained from each pediatric patient's caregiver at 1 to 2 days before discharge from the hospital. A flow of study participant recruitment is displayed in Fig. 1. This study was approved by the Institutional Review Board, Faculty of Medicine, Chulalongkorn University (Number 846/62). Participants' caregivers provided written informed consent and participants aged at least 7 years provided assent.

**Fig. 1** A flow of study participant recruitment



## Demographic characteristics

Baseline demographic characteristics were completed by participants' caregivers whereas variables regarding hospitalization including primary disease diagnosis, length of hospitalization, number of roommates, and the child's mobility status were obtained from electronic medical records. Child characteristics included age, gender, and primary caregiver. Caregivers' characteristics included paternal, maternal, and other caregivers' age, education, occupation, and family income.

## Screen media exposure data

Each main caregiver was thoroughly interviewed to estimate total time of primary, secondary, and tertiary electronic screen media devices that the child had been exposed to in the last 24 h. Such devices included TV, videogames, computer, smartphone, tablet, and digital music player with a touchscreen-based user interface, starting from the time children awoke in the morning until 12 p.m., 12 p.m. to 6 p.m., and then 6 p.m. to sleep onset at night. Specific questions regarding each time interval were ascertained, for instance: "How long did the exposure last since the child awoke in the morning until 12 p.m.? The researcher wrote the estimated duration of media exposure in minutes or hours for each time interval and checked one option including < 30 min, 30–60 min, > 1–2 h, > 2–3 h, > 3–4 h, > 4–5 h, and > 5–6 h." The total duration of primary, secondary, and tertiary hospitalized media use in hours was summed based on estimated total time of electronic screen media of all time intervals. Duration of screen media exposure data for hospitalized children is included in the supplementary material. As a result, the measurement of screen media exposure was a structured interview that basically asked established questionnaire-based media use questions in an interview format. The percentage of media co-viewing and verbal interaction about the screen between children and their caregivers during screen time in the hospital was obtained based on a 5-point Likert scale as follows: (1) 0%, (2) < 25%, (3) 25 to < 50%, (4) 50–75%, and (5) > 75%. Those who reported 4 and 5 were classified as having media co-viewing with verbal interaction about the screen at least half of the time with their caregivers. Such screen media data were ascertained using a media questionnaire adapted from a 24-h media diary which is used extensively in media research [7, 18, 19].

It is noteworthy that reasons for hospitalized media use, caregiver's discipline and rules over the child's screen media use, caregivers' activities during children's media use, and the child's non-media activities during hospitalization were

factors of interest that might have associations with duration of hospitalized media use. However, such data were not comprehensively measured in previous literature and had no questionnaires specific to screen media use in a hospital setting, particularly in the Thai cultural context. As a result, such questionnaires were developed based on clinical experiences during ward rounds, previous articles on media research, and an agreement by a team consensus composed of three developmental and behavioral pediatricians who had expertise in the field [2–4, 7, 11, 12, 14, 18, 20, 21]. The internal consistency of the questionnaires regarding the reasons for hospitalized media use and caregiver's discipline and rules over the child's screen media use in our study participants had Cronbach's alpha of 0.76 and 0.74, respectively.

Reasons for hospitalized media use in addition to caregiver's discipline and rules over the child's screen media use were completed by caregivers based on a 5-point Likert scale of each item listed in Table 2 as follows: (1) not true at all, (2) slightly true, (3) somewhat true, (4) mostly true, and (5) certainly true. To be consistent with the cut-off criteria used for media co-viewing and verbal interaction about the screen between children and their caregivers during screen time in the hospital based on a similar 5-point Likert scale, the cut-off choices for the reasons for hospitalized media use and characteristics of the caregiver's discipline and rules over the child's screen media use were similarly defined. As a result, those who reported 4 and 5 were main reasons of their children's hospitalized media use and also were characteristics of the caregiver's discipline and rules over the child's screen media use in that particular item as "mostly true" and "certainly true." Additionally, socially desired responses on our questionnaires especially caregiver's discipline and rules over the child's screen media use could be possible. Caregivers were more likely to overestimate their discipline and rules over the child's screen media use. As a result, stringent cut-off criteria of discipline were originally preferred to determine that caregivers should have certain levels of discipline over the child's screen media use because real-world disciplining practices on the child's screen media use are likely to be very challenging [7, 14, 18, 20, 21]. To be classified as having positive discipline over the child's screen media use as "mostly true" and "certainly true," caregivers should rate 4 or 5 for each item. The number of positive discipline techniques and rules over the child's screen media use rated as "mostly true" and "certainly true" was finally computed based on the above criteria.

A specific question regarding caregivers' activities during children's media use was also obtained as follows: "What were you doing while the child was using screen media during hospitalization?" Moreover, the child's non-media

activities during hospitalization were determined as follows: “If the child did not use screen media for some time during hospitalization, what was (were) his or her non-media activities?” Caregivers could choose all options that represented their activities during children’s media use and the child’s non-media activities during hospitalization. All responses are listed in the “**Results**” section and Table 2, respectively. Finally, caregivers were also asked whether their children had difficulty stopping screen media use when they were requested based on a 5-point Likert scale from (1) not having difficulty to (5) having the most difficulty stopping screen media use. The response of 4 and 5 was defined as having difficulty in this particular issue.

The first author collected the data from participants via questionnaire and an in-depth interview and checked for data completion. Only 5 children did not have father’s age and income data since their parents were separated and their mothers did not know the income. Nonetheless, those fathers were not the children’s main caregivers. There were no further missing data.

### Statistical analysis

Continuous data were reported as median and interquartile ranges (IQR) whereas categorical data were presented as frequency and percentage. Simple correlations among total duration of hospitalized media use per day, media co-viewing with verbal interaction about the screen at least half of the time between children and their caregivers, using more than one screen media device, number of positive discipline techniques and rules over the child’s screen media use, each reason for hospitalized media use, difficulty stopping media use, caregivers’ activities during children’s media use, and each child’s non-media activities during hospitalization, demographic characteristics of children, and caregivers were performed using Pearson or Spearman correlations depending on the normality assumption of these variables. Finally, multiple linear regression analyses were conducted according to the significant observed associations among various variables on correlations mentioned above, adjusting for potential confounding factors including chronological age, gender, mobility status, length of hospitalization, parental education in years, and family income. Furthermore, assumptions of multiple linear regression models were respected. In the multiple regression model, standardized regression coefficients and unstandardized regression coefficients ( $\beta$ ) were computed with standard error (SE) of each independent variable and 95% confidence interval (CI). Statistical significance was defined as  $p$  values  $< 0.05$ . All statistical analyses were conducted with SPSS version 22 (IBM Inc., Bangkok, Thailand) for Windows with the support by Chulalongkorn University.

## Results

In total, 254 hospitalized participants were enrolled in this study. Hospitalized children had a median age of 44.5 (IQR 14–123.5) months. There were 217 (85%) mothers, 3 fathers (1.2%), and 34 (13%) others including grandparents, aunts, and a sister who accompanied and took care of these participants during hospitalization at the day of data collection. Fathers and mothers had median education of 14 (IQR 12–16) and 12 (IQR 9–16) years, which is consistent with vocational certificate/diploma and senior high school level for Thai formal education, respectively. Participants had median family income of 30,000 (IQR 20,000–40,000) Baht/month where 15,000 Baht/month (or equivalent to 449.83 USD/month and 397.64 Euro/month) was the minimum wage according to the Ministry of Labor, Thailand. Other demographic characteristics of study participants are shown in Table 1.

### Screen media exposure data

Two hundred and thirty-nine (94%) hospitalized children were reported to have been exposed to screen media devices at a median duration of exposure of 6 h (IQR 2–11) per day. A smartphone was the main primary screen media device (95%) used by these children in the hospital, followed by a tablet (2.9%), television (1.7%), and a notebook (0.4%), respectively. Apart from the primary screen media device, only 20 (8.4%) of those who used screen media during hospitalization also reported using other screen media devices. There were only 58 (24%) caregivers who reported media co-viewing and had verbal interaction about the program on the screen for at least half of the time with their children. Regarding the caregiver’s discipline and rules over the child’s screen media use, the median number of positive discipline techniques and rules over the child’s screen media use was 3 (IQR 1–6) out of 11 items.

Caregivers’ activities during children’s media use included using screen media with their children (43%), eating (42%), doing their own work (37%), going out of the child’s admission room (37%), using their own screen media (36%), talking with other children’s caregivers (32%), talking with physicians (29%), sleeping (25%), and reading (7.9%), respectively. Furthermore, 84 out of 239 (35%) participants reported that their children had difficulty stopping screen media use when requested. Other media exposure characteristics are presented in Table 2.

### Factors associated with hospitalized media use

Based on simple correlations among the total duration of hospitalized media use per day and various screen media

**Table 1** Demographic characteristics of study participants

Characteristics	Number (%)
<b>Child (N = 254)</b>	
Female gender	135 (53)
Primary disease diagnosis	
Hematologic/oncologic disease	69 (27)
Infectious disease	61 (24)
Gastrointestinal disease	33 (13)
Nephrologic disease	20 (7.9)
Respiratory disease	18 (7.1)
Neurologic disease	17 (6.7)
Allergic disease	15 (5.9)
Cardiologic disease	14 (5.5)
Endocrinologic disease	7 (2.8)
Numbers of roommates	
1 person	51 (20)
2–4 persons	88 (35)
≥ 5 persons	115 (45)
Able to walk and move in the patient's room and the in-patient unit	190 (75)
Length of hospitalization (days), median (IQR)	4 (3–12)
<b>Caregivers</b>	
<b>Fathers (N = 249)</b>	
Age (years), median (IQR)	35 (30–45)
Education (years), median (IQR)	14 (12–16)
Occupation	
Unemployed	20 (8.0)
Temporary worker	49 (20)
Permanent employee/company employee	71 (29)
Government officer	40 (16)
Self-employed/manager	69 (28)
<b>Mothers (N = 254)</b>	
Age (years), median (IQR)	34 (28–40)
Education (years), median (IQR)	12 (9.0–16)
Occupation	
Unemployed	72 (28)
Temporary worker	40 (16)
Permanent employee/company employee	56 (22)
Government officer	32 (13)
Self-employed/manager	54 (21)
<b>Others (N = 33)</b>	
Age (years), median (IQR)	54 (48–60)
Education (years), median (IQR)	6 (6–9)
Occupation	
Unemployed	24 (73)
Temporary worker	1 (3.0)
Permanent employee/company employee	2 (6.1)
Government officer	1 (3.0)
Self-employed/manager	5 (15)

variables mentioned in the “**Statistical analysis**” section, total duration of hospitalized media use per day was positively associated with using more than one screen media device (simple correlation coefficient ( $r = 0.33$ ,  $p < 0.001$ ), reasons for hospitalized media use as habitual media use ( $r = 0.46$ ,  $p < 0.001$ ), helping the child to relax ( $r = 0.23$ ,  $p < 0.001$ ), and having no alternative activities to do during hospitalization ( $r = 0.14$ ,  $p = 0.029$ ) in addition to difficulty stopping media use ( $r = 0.33$ ,  $p < 0.001$ ). Moreover, media co-viewing with verbal interaction about the screen at least half of the time between children and their caregivers ( $r = -0.56$ ,  $p < 0.001$ ) and number of positive discipline and rules over the child's screen media use ( $r = -0.54$ ,  $p < 0.001$ ) had inverse associations with total duration of hospitalized media use per day. Although the reason for hospitalized media use as habitual media use appeared to be significantly associated with duration of hospitalized media use in simple correlation, such a reason had no significant association with duration of hospitalized media use in the final multiple linear regression model listed in Table 3. Other screen media variables including other reasons for hospitalized media use, caregivers' activities during children's media use, and each child's non-media activities during hospitalization were not associated with duration of hospitalized screen media use. Furthermore, all other screen media variables mentioned above should not be simultaneously included in the same model because there was multicollinearity among those variables that ultimately violate assumptions of the multiple linear regression analysis. As a result, this could explain why other screen media variables were not included in the final multiple linear regression model illustrated in Table 3.

According to the multiple linear regression analysis shown in Table 3, longer total duration of hospitalized media use per day was positively associated with using screen media on more than one device, having difficulty stopping media use, and specific reasons for hospitalized media use led to increased screen time, particularly caregivers who allowed their children to use screen media in the hospital to help them to relax and those who reported not having alternative activities to do during hospitalization adjusting for potential confounding factors listed in Table 3. In contrast, caregivers who co-viewed screen media and had verbal interaction about the screen at least half of the time with their children and those with a higher number of positive discipline techniques and rules over the child's screen media use had significant associations with a shorter duration of hospitalized media use. To simplify such results, caregivers who co-viewed and had verbal interaction about the screen at least half of the time with their children and caregivers with one positive discipline



**Table 2** Media exposure characteristics of study participants ( $N=239$ )

Characteristics	Number	%
<b>Reasons for hospitalized media use (mostly true and certainly true)</b>		
Habitual media use	92	39
Helping the child to relax	183	77
Relieving the child's pain during the treatment	139	58
Decreasing the child's fear and anxiety toward medical personnel	151	63
Helping the child to cooperate with treatment	171	72
No alternative activities to do during hospitalization	223	94
Promoting child development and learning	64	27
Helping the child to eat more	25	11
Helping the child to fall asleep	82	34
Distracting the child from frustration/crying	116	49
<b>Caregiver's discipline and rules over the child's screen media use (mostly true and certainly true)</b>		
Having discipline and rules over the child's screen media use	37	16
Set limits in daily screen media duration	19	7.9
Set specific time for screen media use	27	11
Set programs or games appropriate for the child's age	83	35
Discourage screen media use after 7 p.m	100	42
Capable of implementing discipline and rules over the child's screen media use during hospitalization	23	9.6
Praise the child when following media rules	106	44
Supervise and monitor the child's media use	119	50
Recommend the child how to use screen media appropriately	94	39
Remind the child to stop using screen media if exceeding time limits	177	74
Be confident of setting limits on the child's screen media use	98	41
<b>Child's non-media activities during hospitalization</b>		
Playing by themselves	73	31
Playing with roommates	63	27
Playing with caregivers	135	57
Playing in a designated play area in the ward	36	15
Drawing/coloring	100	42
Reading/listening to books or stories	63	26
Doing homework/school assignments	59	25
Sleeping	104	44
Eating food/snacks	46	19

technique increase over the child's screen media use, their children's total duration of hospitalized media use per day was likely to decrease by approximately 1.5 (unstandardized coefficient  $\beta -1.54$ ) and 0.3 h (unstandardized coefficient  $\beta -0.33$ ) or approximately 90 and 20 min, respectively (see Table 3).

## Discussion

To the best of our knowledge, this is the first study determining the extent, characteristics, and factors associated with screen media use in hospitalized children in a developing country. We found a much higher proportion of children

spent time on screen media in the hospital compared to previous studies [4, 11, 12]. In addition, the duration of hospitalized media use in this current study was 6 h/day whereas previous studies found lower media viewing time with approximately 2–3.5 h daily [12, 13]. Possible explanations for such discrepancies could be that previous studies were conducted decades ago with different methods of screen media ascertainment and mainly focused on TV viewing [11–13, 17]. Nowadays, children have more choices regarding screen media devices and are more likely to access to electronic media anywhere and anytime than previous generations [2, 3, 22], which resulted in a higher duration of screen media use in this current study.

**Table 3** Factors associated with hospitalized media use

Variables in the final model	Unstandardized coefficients B (SE)	95% CI	Standardized coefficients $\beta$	<i>p</i>
Age (months)	0.04 (0.01)	0.04–0.05	0.46	<0.001
Gender	−0.30 (0.43)	−1.15–0.55	−0.03	0.491
Mobility	0.76 (0.57)	−0.36–1.89	0.06	0.182
Length of hospitalization	0.00 (0.01)	−0.01–0.02	0.00	0.943
Paternal education in years	0.07 (0.10)	−0.13–0.27	0.04	0.506
Maternal education in years	−0.06 (0.10)	−0.26–0.13	−0.04	0.533
Family income (Baht/month)	4.59 (0.9) × 10 <sup>−5</sup>	2.80–6.40 × 10 <sup>−5</sup>	0.23	<0.001
Media co-viewing with verbal interaction about the screen at least half of the time with their children	−1.54 (0.62)	−2.76 to −0.32	−0.12	0.014
Using more than one screen media device	3.45 (0.88)	1.71–5.19	0.16	<0.001
Number of positive discipline and rules over the child's screen media use	−0.33 (0.10)	−0.54 to −0.13	−0.16	0.001
Reasons for hospitalized media use				
Helping the child to relax	1.45 (0.52)	0.44–2.47	0.11	0.005
No alternative activities to do during hospitalization	1.87 (0.93)	0.04–3.69	0.08	0.045
Difficulty stopping media use	1.97 (0.48)	1.02–2.91	0.16	<0.001

Dependent variable: total duration of hospitalized media use (hours), adjusted  $R^2=0.690$ . Adjusted analyses based on multiple linear regression models including chronological age, gender, mobility status, length of hospitalization, paternal and maternal education in years, and family income as covariates

All variables listed in the table and confounding factors mentioned above were included in the final multiple linear regression model

Other screen media variables including other reasons for hospitalized media use, caregivers' activities during children's media use, and each child's non-media activities during hospitalization were not associated with duration of hospitalized screen media use. Furthermore, other screen media variables mentioned above should not be simultaneously included in the same model because there was multicollinearity among those variables that ultimately violate assumptions of the multiple linear regression analysis. As a result, this could explain why other screen media variables were not included in the final multiple linear regression model

With respect to factors associated with hospitalized media use, the amount of screen media use increased with age, which supported previous findings [12, 23, 24]. As children grew up, they were able to easily access more screen devices and spent time on a wide range of media programs [22]. Although the pattern of screen media multitasking was not directly captured in this present study [20, 22, 25], using screen media on more than one device on a daily basis was associated with a longer daily total duration of hospitalized media use in our study. An increased use of screen media on more than one platform might make children more accustomed to being around such devices, leading to more time spent on various screen devices, even in a hospital setting. Regarding reasons for hospitalized media use, helping the child to relax and having no alternative activities to do during hospitalization were both significantly associated with increased screen media use in the hospital. Such reasons were completely different from a previous study of non-hospitalized children where most caregivers let their children use mobile devices because they wanted to do housework, keep children calm in public places, and run errands [22]. However, other diversionary activities such as playing with toys, reading books, drawing, and singing between hospitalized children and their caregivers or child life specialists should be promoted during hospitalization to help the child

relax and have other interesting activities to do beyond consuming only screen media.

Another interesting finding of this current study was that caregivers with higher numbers of positive discipline techniques and rules over the child's screen media use had inverse associations with the total duration of hospitalized media use per day. Furthermore, children who co-viewed media and had verbal interaction at least half of the time with their caregivers spent less time on hospitalized screen media. These findings were in agreement with previous studies in which positive discipline and parent–child interaction were associated with decreased screen media use [14, 18]. We speculated that parents who co-viewed screen media with their children were more likely to choose appropriate programs, teach, supervise, and monitor what and how they watched media content with the child, and could navigate their children to do other non-screen activities with the parents. Additionally, there appeared to be bidirectional relationships between increased screen media use and negative parenting documented in previous studies [7, 14, 20, 21]. This assumption might explain why children who had difficulty stopping media use when requested by their parents were associated with a longer duration of hospitalized media use in our study. Those who had difficulty stopping media

use when requested were more likely to have a poor relationship with their parents and tended to elicit more negative parenting thereby increasing children's screen media use. Educating parents to implement positive discipline over screen media use and co-view with verbal interaction during screen time with their children may minimize screen media overuse in hospitalized children.

There were limitations in this study that could have influenced our results. First, a single responder survey could lead to recall bias in which parents tended to underestimate the amount of screen media exposure and overestimate their discipline and rules over the child's screen media use as they might give more socially desired responses. However, the method of asking questions regarding duration of screen media use based on 3-time frames was likely to result in higher estimates than other methods used in the previous studies. The reasons for asking parents to provide 3 estimates of time intervals from awaking in the morning until 12 p.m., 12 to 6 p.m., and 6 p.m. to sleep onset at night were to help parents orientate to specified time frames of the day rather than recalling a single digit of 24-h duration of media exposure. A single daily estimate was likely underreported based on our pilot study and clinical perspectives. Moreover, approximately 35% of parents were likely to either overestimate or underestimate their child's use of smartphones and tablets compared with an objective method of mobile device sampling [26]. Accurate measurement of household screen media use with various platforms is extremely challenging and this might also be the case for such measurement in the hospital. Future studies should include a comprehensive assessment of screen media use through various approaches [27]. Parents who reported having a higher number of positive discipline techniques also reported that their child used media less in the hospital. A third variable could be at the root of such an association. For instance, parents who had negative attitudes toward media use would likely report more rules about media use and lower levels of screen media use among their children. Therefore, findings on associations between longer duration of hospitalized media use and lower numbers of caregiver's discipline techniques over the child's screen media use should be cautiously interpreted. Second, information on the availability of personal electronic media devices was not collected in this study. Children with a personal smartphone might be much more exposed to screen media use. Future studies should take these potential confounders into consideration. Third, cumulating data on screen time from children with very different conditions might be misleading. Given the smaller sample size for each medical condition, additional statistical analyses were not possible. However, we attempted to ascertain information of participants during their children's clinically stable conditions. Fourth, this study was conducted during the COVID-19 pandemic which was at the very start globally including

Thailand. The first wave of COVID-19 pandemic in Thailand occurred at a boxing stadium and nightlife establishments [28]. After preventive interventions were implemented, the outbreak subsided by May 2020 [29, 30] and there were almost no transmitted infections in the country until December 2020 [31]. As a result, hospital settings during the study period were likely similar to those that occurred prior to the COVID-19 era [28–30]. However, our findings could not be generalizable to other settings and contexts. Fifth, in this study it was not possible to investigate the causal relationships between hospitalized screen media use and various associated factors due to the cross-sectional nature of this study. Nonetheless, our study had strengths including in-depth details of screen media exposure data. Furthermore, the variable regarding positive discipline and rules over the child's screen media use were based on expert panels in developmental and behavioral pediatrics which took the AAP recommendation into consideration of the Thai cultural context. Last, our overall findings could fill the gaps of previous knowledge on hospitalized screen media use where reasons for increased screen media use, inclusion of positive discipline and rules over the child's screen media use were investigated [4, 11–13].

In summary, hospitalized children spent 6 h/day on screen media and this was higher than recommended by the AAP. Using more than one device, difficulty stopping media use, having lower numbers of positive discipline techniques and rules over media use, less media co-viewing with verbal interaction about the screen between children and their caregivers, and specific reasons for hospitalized media use, including helping the child to relax and having no alternative activities to do during hospitalization, had associations with longer screen media use in hospitalized children. Fostering positive discipline over media use, media co-viewing with verbal interaction during screen time, and providing other non-screen activities during hospitalization may lessen undesirable effects of excessive hospitalized screen media use.

**Supplementary information** The online version contains supplementary material available at <https://doi.org/10.1007/s00431-022-04435-6>.

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**Authors' contributions** OC had substantial contributions to conception and design, acquisition of data, preliminary analysis, and interpretation of data, drafted the article, and finally approved the version to be published. WC had substantial contributions to conception and design, analysis, and interpretation of data; drafted the article and revised it critically for important intellectual content; and finally approved the version to be published.



**Availability of data and material** The data of this study are available from the corresponding author upon reasonable request.

## Declarations

**Ethics approval** This study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand (IRB NO. 846/62).

**Consent to participate** Participants' caregivers provided written informed consent and participants aged at least 7 years provided assent.

**Consent for publication** Not applicable.

**Conflict of interest** The authors declare no competing interests.

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