RESEARCH ARTICLE

The Relationship between Electronic Screen Exposure and Risk of Autistic-Like Symptom Among Typically Developing Toddlers

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Abstract:

This study was conducted to investigate the relationship between electronic screen exposure and risk of autistic-like symptoms in typically developing toddlers. M-CHAT-R and a demographic questionnaire were used in this cross-sectional study involving 120 parents with typically developing toddlers. Daily duration of electronic screen media viewing and presence of parent-child interaction during exposure to electronic screen media, were significantly related to risk of autistic-like symptoms among typically developing toddlers, with ($p = 0.033$) and ($p = 0.0012$) respectively. The present study revealed a relationship between electronic screen exposure and risk of autistic-like symptoms in typically developing toddlers. Future efforts should emphasize on increased awareness on the potential harm electronic screen exposure and measures to reduce high prevalence of ASD among this group. This vital to maintain their health status and avoid harmful consequences on their overall development.

Keywords: Autism spectrum disorder, ASD risk, electronic screen exposure, screen time

1. INTRODUCTION

The use of electronic screen media among children is on the rise due to the rapid-growing nature of today's technological advancements and inventive gadget creations. Many parents resort to exposing their children to television, handphones, or tablets at a very young age, as a form of companion, often to keep the child entertained and occupied while they perform their chores. The likelihood of screen media usage for children was attributed to its portability, screen size, decreasing cost, multiple applications and interactive ability [1,2]. Recent research has found that children nowadays are exposed to screens far more than what is recommended by the American Academy of Paediatrics in 2016, in which children younger than 18 months are entirely not recommended to be given screen exposure whereas children above the age of 2 are limited to only 1 hour per day [3].

Early childhood is an especially critical phase for healthy brain development. Tierney & Nelson [4] strongly suggests that changes during this period are essential as they lay the groundwork for future growth. It is further explained that the development of the child's brain is heavily dependent on environmental experience which entails either deprivation or enrichment [4]. The deprivation of parent-child interaction and sensory overload originating from the screen-based media occurs when the child is left to their own devices while their parents attend to other matters at hand.

Recent studies have linked excessive screen time in early years with social isolation and environmental overload which leads to autistic-like symptoms [5,6,7,8]. According to Heffler et al. [9] early television or video exposure to television at 12 months old was correlated substantially with more ASD-like symptoms at 2 years of age. This can be supported by a case-study done by Numata‐Uematsu et al. [10] in 2018, it was found a child's excessive screen time was associated with autistic symptoms (i.e., eye contact difficulties, hyperactivity and language delay).

Although the exact aetiology for autism spectrum disorder (ASD) remains unclear in most cases, technological advancements and population-based studies have provided new insight on the framework of ASD risk factors and the possible role environment has on the development of ASD [11]. Heffler et al. [9] suggested two factors that may be associated with ASD risk, namely experiential factors and socio-economic factors. Experiential factors relating to screen media may include onset age of child's first exposure to screens, duration of screen-time and presence of parent-child interaction during exposure to electronic screen media (ESM) whereas socio-economic factors include parent's household income and highest level of education.

Many previous studies have reviewed the relationship of screen time with different parameters such as sleep outcomes [12], physical activity [13], depression or anxiety [14], and mental well-being [15]. However, the information pertaining to the relationship between electronic screen exposure and risk of autistic-like symptoms among typically developing children is limited and inconclusive. Therefore, there is a need for this study to be conducted in order to develop prevention strategies and health promotion interventions to control the emergence of autistic-like symptoms in this population. Using cross-sectional data, we examined the patterns of screen exposure according to socio-demographic

characteristics as well as the extent of the relationship between early screen exposure and later risk of ASD and ASD-like symptoms as measure by the Modified Checklist for Autism, Revised (M-CHAT-R) [16].

2. METHODOLOGY

2.1. Data Source and Study Sample

Parents were recruited from day-care centres, playschools, public health centres, hospitals, and shopping complexes. Individual day-care centres and preschool directors were contacted to solicit their assistance with in-person participant recruitment by announcing and posting the Google form link through email or parent-teacher WhatsApp groups. Recruitment was also done by approaching parents in shopping complexes, hospitals, and public health centres to have them complete the questionnaire through the Google form link. An online approach was also adopted whereby parents were recruited from Telegram groups consisting of community members, parenting Facebook groups, and parenting forums.

Malaysian parent who are literate in the English language, with toddlers aged 16-30 months (as per the requirements for M-CHAT-R) who uses screen-based media (ESM) were included. The exclusion criteria include toddlers diagnosed with any form of physical, cognitive or psychological developmental delay. Toddlers with pending diagnostic observation of these conditions as well as parent or carer who do not live with child were also excluded from the study.

2.2. Research Instruments

A demographic questionnaire was given to the parents which includes the child experiential information relating to screen exposure as well as the parent's socio-economic information. Experiential information was recorded by parents through questions assessing onset age of first exposure to ESM ("At what age did you first expose your child to ESM?" [less than 1 year old or less than 2 years old]), duration of viewing per day ("How long does your child receive screen-time per day?" [less than 1 hour; 1-2 hours; more than 2 hours; or more than 3 hours]) and parent-child interaction during exposure ("Is there anyone present and interacting (e.g. asking questions, providing verbal and physical prompts, singing along) with the child throughout the whole duration that he/she is given screen-time?" [yes or no]). Household income was recorded on 7-point scale as less than RM1000, RM1000-RM2000, RM2000-RM3000, RM3000-4000, RM4000-RM5000, RM5000-RM10000 or more than RM10000. Parent educational level was recorded on a 5-point scale as High school certificate, Diploma, Bachelor's Degree, Master's Degree or PhD.

The M-CHAT-R, a 20-item, parent-report screening tool was used to assess risk for ASD for toddlers. Parent or carer were instructed to score a Yes or a No for all the 20 questions with respect to how their child usually behaves [16]. These questions include measures of joint attention behaviours, social relatedness and communication which are discriminating variables between ASD and other neurological cases [17]. M-CHAT-T's current recommended algorithm classifies toddlers into 3 risk ranges; high, medium and low risk. [16].

2.2. Data Analysis

All the data obtained were analysed using Statistical Package for Social Science (SPSS) version 25. All variables related to characteristics of the study population were categorical. Normality testing was conducted by using Shapiro-Wilk. The patterns of electronic screen media (ESM) usage, socio-demographic data and prevalence of ASD risk among toddlers were documented using descriptive statistic. Fisher's exact tests and mean score calculation was used to identify the relationship between electronic screen exposure and risk of autistic-like symptoms among typically developing toddlers. Both independent and dependent variable significance level was set at $p<0.05$.

3. RESULT AND DISCUSSION

3.1. Participant Characteristics

The survey was answered by 120 parents with typically developing toddlers, of whom 68% were male and 52% female. More than fifty per cent of participants have a bachelor's degree (n = 87; 72.5%), and 39% of them earns a monthly household income of RM5000-RM10,000. Furthermore, majority of the toddlers was first exposed to ESM at ages less than 1 years old (n = 63; 52.5%), had parent-child interaction during exposure to ESM (n = 107; 89.2%) and spends approximately 1-2 hours (n = 43; 35.8%) viewing ESM per day (Table 1).

Table 1: Frequency of participants' demographic data

Parameters	Total, n (%)
Child's gender	
Male	68 (56.7)
Female	52 (43.3)
Socio-demographic Factors	
Parent's education level	
High school certificate	2 (1.7)
Diploma	18 (15.0)
Bachelor's Degree	87 (72.5)
Table 1 continued	
Master's Degree	12 (10.0)
PhD	1 (0.8)
Household income	
<RM1000	3 (2.5)
RM1000-RM2000	6 (5.0)
RM2000-RM3000	12 (10.0)
RM3000-RM4000	17 (14.2)
RM4000-RM5000	15 (12.5)
RM5000-RM10,000	39 (32.5)

>RM10,000	28 (23.3)
Experiential Factors	
Time of child's first exposure to ESM	
< 1 year old	63 (52.5)
< 2 years old	57 (47.5)
Duration of ESM viewing per day	
< 1 hour	34 (28.3)
1 – 2 hours	43 (35.8)
> 2 hours	32 (26.7)
> 3 hours	11 (9.2)
Parent-child interaction during exposure to ESM	
Yes	107 (89.2)
No	13 (10.8)

3.2. Demographic Factors

Results for the frequency of electronic screen exposure according to parent demographic characteristics is indicated in Table 2 and 3. In the current study, parent's level of education and household income were investigated as possible predictors of electronic screen exposure patterns. It was found that parents with a higher household income were more likely to expose their child at ages less than a year old. But similarly, parents from the higher monthly income subgroups (RM5000-RM10,000 and more than RM10,000), exposed their children to ESM at ages less than 2 years old. For screen-time duration, the current study reported a somewhat similar pattern in which, all for duration subgroups were dominated by parents with incomes on the higher end of the spectrum. Furthermore, a "Yes" on parent-child interaction was reported consistently with the overall pattern.

In current literature, mixed associations were reported between family socio-economic factors and media use. This reflects consistency with a recent study that reported positive association, indicating that children from high-income families were using ESMs for longer than those from low-income families [18]. In longitudinal analyses conducted by Yang-Huang et al. [19], significant association ($p = 0.01$) was reported between net household income and child's television watching. Although the percentage of children watching television for more than 1 hour daily increased linearly between low- and high-income household, high-income household has a higher percentage of increase (58.9%) compared to low-income families (57.7). However, these claims can be contended by several studies that indicated that no association was found between screen media usage and family income [20, 21], as well as a negative association [22]. A plausible reason for this finding would be due to the parents simply not having the means to purchase these gadgets. In contrast, a more affluent household may possess a greater ownership and access to touch screen devices as a result from their financial means [23].

Another factor associated with children screen time is parent's level of education. In this current study, a higher level of educated correlated with all experiential subgroups, including time of first exposure, duration of viewing and parent-child interaction. Current research has found unsimilar results in which lower education received by parents were linked with more excessive usage of screen media. This could be due to the representativeness of the data set, having less diversity in terms of parent demographic characteristics. Despite this, it is important to note that methodological differences between current study and the studies conducted could contribute to the difference in results. Yang-Huang et al. [19] found a much higher increase in percentage in children of low-educated mothers (60.8%) when it comes to increases in hourly viewing for children as they age from 2 to 9 compared to high-educated mothers (56.7%). In placing more emphasis, several studies that adopted an integrative approach to education and income revealed that parents of lower socioeconomic status allow their children to watch screen media for longer periods of time [24,25]. A group interview involving Hispanic families conducted by Beck et al. [26] found caregivers to have inadequate knowledge concerning the potential risks of excessive screen time, but rebutted that they would be more mindful about the amount of time their child receives screen time, if they were given the knowledge and being made aware of the effects. Parents can be given a sense of empowerment by equipping them with knowledge and awareness about the adverse effects of excessive screen time towards language delay in young children [27].

3.3. Experiential Exposures

The majority of the participants received a low risk score when the duration of screen-time was less than an hour (n = 29; 24.2%, 1 – 2 hours (n = 37; 30.8%), more than 2 hours (n = 28; 23.3%). A high-risk score was obtained by a child spending more than 3 hours (n = 1; 0.8%) and 1-2 hours (n = 1; 0.8%). Furthermore, more than fifty per cent of the toddlers (n = 90; 75%) who received parent—child interaction during the exposure also scored a low risk score. Inversely, a high and moderate risk score was obtained when no interaction was present, both with (n = 2; 1.7%) respectively.

The mean score from the total score of 20 was calculated for each variable. The average score for toddlers who received their first exposure at ages less than 1 years old and 2 years old is 1.75 and 1.20, respectively. Although minimal, the 0.55 difference in score indicates a toddler

Table 2: Frequency of electronic screen exposure according to household income

Electronic screen exposure	Total population n (%)	Household income						
		<RM1000 n (%)	RM1000 -RM2000 n (%)	RM2000 -RM3000 n (%)	RM3000 -RM4000 n (%)	RM4000 -RM5000 n (%)	RM5000 -RM10,000 n (%)	>RM10,000 n (%)
Time of first exposure to ESM								
< 1 year old	63 (52.5)	2 (1.7)	2 (1.7)	2 (1.7)	**14 (11.7)**	9 (7.5)	**23 (19.2)**	11 (9.2)
< 2 years old	57 (47.5)	1 (0.8)	4 (3.3)	10 (8.3)	3 (2.5)	6 (5.0)	**16 (13.3)**	**17 (14.2)**
Duration of ESM viewing per day								
< 1 hour	34 (28.3)	2 (1.7)	3 (2.5)	4 (3.3)	2 (1.7)	5 (4.2)	**7 (5.8)**	**11 (9.2)**
1 – 2 hours	43 (35.8)	0 (0.0)	1 (0.8)	3 (2.5)	8 (6.7)	4 (3.3)	**17 (14.2)**	**10 (8.3)**
> 2 hours	32 (26.7)	0 (0.0)	1 (0.8)	4 (3.3)	5 (4.2)	6 (5.0)	**13 (10.8)**	3 (2.5)
> 3 hours	11 (9.2)	1 (0.8)	1 (0.8)	1 (0.8)	2 (1.7)	0 (0.0)	2 (1.7)	**4 (3.3)**
Parent-child interaction during exposure to ESM								
Yes	107 (89.2)	2 (1.7)	5 (4.2)	12 (10.0)	**16 (13.3)**	13 (10.8)	**32 (26.7)**	**27 (12.5)**
No	13 (10.8)	1 (0.8)	1 (0.8)	0 (0.0)	1 (0.8)	2 (1.7)	**7 (5.8)**	1 (0.8)

Bold value indicates significant value

	Level of education					
Electronic screen exposure	**Total population n (%)**	**High school certificate n (%)**	**Diploma n (%)**	**Bachelor's degree n (%)**	**Master's degree n (%)**	**PhD n (%)**
Time of first exposure to ESM						
< 1 year old	63 (52.5)	1 (0.8)	9 (7.5)	**47 (39.2)**	6 (5.0)	0 (0.0)
< 2 years old	57 (47.5)	1 (0.8)	9 (7.5)	**40 (33.3)**	6 (5.0)	1 (0.8)
Duration of ESM viewing per day						
< 1 hour	34 (28.3)	1 (0.8)	7 (5.8)	**21 (17.5)**	5 (4.2)	0 (0.0)
1 – 2 hours	43 (35.8)	1 (0.8)	5 (4.2)	**35 (29.2)**	2 (1.7)	0 (0.0)
> 2 hours	32 (26.7)	0 (0.0)	5 (4.2)	**22 (18.3)**	5 (4.2)	0 (0.0)
> 3 hours	11 (9.2)	0 (0.0)	1 (0.8)	**9 (7.5)**	0 (0.0)	1 (0.8)
Parent-child interaction during exposure to ESM						
Yes	107 (89.2)	2 (1.7)	**13 (10.8)**	**79 (65.8)**	12 (10.0)	1 (0.8)
No	13 (10.8)	0 (0.0)	5 (4.2)	**8 (6.1)**	0 (0.0)	0 (0.0)

Bold value indicates significant value

Table 3: Frequency of electronic screen exposure according to level of education

with an early exposure to electronic screens have a slightly higher degree of risk for ASD. Furthermore, toddlers watching screens for more than 3 hours obtained a distinctly higher mean score of 3.00 compared to the other duration clusters; < 1 hour (1.56), 1-2 hours (1.42) and >2 hours (0.97) which indicates that the longer duration holds more weight as contributing risk factor of ASD. Moreover, similar results were yielded for parent-child interaction during exposure in which, an absence of interaction reveals a higher average score of 3.08 on the M-CHAT-R.

The fisher's exact tests indicate that there is significant relationship between daily duration of ESM viewing and presence of parent-child interaction during exposure to ESM with autistic-like symptoms among typically developing toddlers, with ($p = 0.033$) and ($p = 0.0012$) respectively. For time of first exposure to ESM, the results demonstrated a p-value of more than 0.05 (0.432), implying that there is no significant relationship between the age in which the child was first exposed to screen media with and autistic-like symptoms among typically developing toddlers in Malaysia. The summary of the inferential statistics results is presented in Table 4.

Table 4: Relationship between ESM and risk of autistic-like symptoms among typically developing toddlers.

Electronic screen exposure	Present with ASD risk				
	Low n (%)	Moderate n (%)	High n (%)	Mean score	p-value
Time of first exposure to ESM					
< 1 year old	50 (41.7)	11 (9.2)	2 (1.7)	**1.75**	0.432
< 2 years old	49 (40.8)	8 (6.7)	0 (0.0)	1.20	
Duration of ESM viewing per day					
< 1 hour	29 (24.2)	5 (4.2)	0 (0.0)	1.56	**0.033**
1 – 2 hours	37 (30.8)	5 (4.2)	1 (0.8)	1.42	
> 2 hours	28 (23.3)	4 (3.3)	0 (0.0)	0.97	
> 3 hours	**5 (4.2)**	**5 (4.2)**	**1 (0.8)**	**3.00**	
Parent-child interaction during exposure to ESM					
Yes	90 (75.0)	17 (14.2)	0 (0.0)	1.30	**0.012**
No	**9 (7.5)**	**2 (1.7)**	**2 (1.7)**	**3.08**	

Bold indicate significant value

Studies have revealed that the age in which the child was first exposed to screens plays a significant role towards the child's development. This is because environmental experiences affect critical brain development in early childhood [28]. Christakis et al. [29] explained due to its overstimulating effect, television exposure during a child's critical synaptic development in their earlier years would give way for subsequent attentional issues.

The amount of time invested in these screen-based media indefinitely also affects the child's development. Studies found that children who spent viewing < 3 hours per day experienced language delay and short attention span, whereas children who spent viewing more than 3 hours per day had an additional symptom, hyperactivity [30]. The material that the child is exposed to can also pose as a risk factor. The production of most infant shows which portray unusually rapid and abrupt changes in images and scenes could have an undesirable effect on a child's cognitive, social, and emotional development even it being educational [29, 31] In a separate study, Lillard et al. [32] argued that viewing contents that portray a "fantastical or physically impossible events could be detrimental specifically for subsequent executive function performance". In adding more emphasis, it was addressed that fast-paced scene changes and a heightened level of sensory stimulation in entertainment and violent content could intercept with attentional capabilities.

Cespedes et al. [33] found that an increased duration of media exposure was inversely proportional to duration of sleep, in which they acquire fewer minutes of sleep per night. More alarmingly, even infants exposed to screen media in the evening hours show significantly shorter night-time sleep duration than those with no evening screen exposure [34]. This association is explained through the mechanism of arousing content and suppression of endogenous melatonin by blue light emitted from screens [35,36]. The first few years of an infant's life highly revolve around sleep. These precious hours are prime time for brain development, when neural connections form and sensory memories are encoded. But when sleep disruption occurs, as occurs more often among children with autism, brain development may be affected. It was also revealed that sleep difficulties were more prevalent among infants that was later diagnosed with ASD [37].

Screen media usage places these children at high risk for developmental delays because not only does it take away from their playtime, it also reduces the amount and quality of parent-child interaction [38]. When a child is engaged in screen-media viewing, a lack of parent-child interaction makes the activity worse because not only is the child mindlessly watching and barely understanding, they are also deprived of crucial social interaction and bonding with their parents. Ultimately, language development is impeded, affecting further social communication because parents spend a lesser time interacting and talking to their child. Furthermore, attachment issues may also arise when the child gets to engrossed in the gadgets. After countless hours being one with the electronics, taking it away or depriving them of it may lead to undesirable behaviours. For example, when parents resort to using these gadgets as pacifiers when the child is cranky or a filler when the child is bored, every

waking hour is possibly supplied with screen-time. This eventually may lead to the toddlers developing social-emotional delays because they are unable to regulate their emotions without having to rely on gadgets as a reward.

CONCLUSION

Screen media can welcome more harm than good when used improperly**.** The risk for developing ASD among typically developing toddlers who are exposed to excessive screen media is warranted. It is realistic to predict that children who spends longer hours exposed to screen time and doing so without the presence of an adult to facilitate the learning process are at higher risk to develop ASD. Hence, the role of the parent is crucial in outlining the proper usage of ESM for these children. Further recommendations for future research would be to include a large sample size and to emphasize the analysis regarding the nature of electronic screen exposure, specifically the content, context and type of viewing material and its relationship to ASD risk.

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