EVALUATING THE ASSOCIATION BETWEEN EARLY CHILDHOOD SCREEN EXPOSURE AND AUTISM SPECTRUM DISORDER (ASD): DISENTANGLING CORRELATION AND CAUSATION

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ABSTRACT

There has been an upsurge in Autism Spectrum Disorder (ASD) and the proportional rise in early exposure to screens has resulted in developmental concerns. The research question of the present study is whether there is a relationship between the early screen exposure and ASD characteristics, which would help in separating correlation and causation. Being a new mom who knows little about the dangers of exposure to different screens at such an early stage of their development, the reasons behind the choice of research are a necessity to understand how the exposure to screens influences the neurodevelopment of young children. Data were gathered with 160 parents of children between 2 and 6 years of age through the use of a quantitative and cross-sectional design using a stratified sampling question. Findings indicated that there was a strong positive relationship between increased screen exposure and high ASD-like behavior; causation, however, is not conclusively possible. It seeks to educate the parents and caregivers on the consequences of limiting exposure to screen time at early stages of their life thus reducing the development risk of the brain.

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is characterized by the impairment of social communication as well as repetitive or narrowed behaviors. The improvements in the distribution of digital devices have seen significant increases in the exposure to the screen during early years in infants and toddlers. Regardless of the prevalence, most parents even those who are new like myself- do not know the possible risks on

development by allowing excessive screen time in the crucial stages of brain development. Some previous studies have reported the correlation of the early screen exposure, the lack of social interaction, the language delay and ASD-like symptoms but the directional causality is inconsistent. The proposed study will address the gaps in existing literature, as it will differentiate between correlation and causation and analyzing the factors associated with it, which can be categorized as demographic and family-related factors. The implications of the findings are to direct parents, teachers and medical care providers to make evidence-based decisions concerning early childhood visualization on screens.

LITERATURE REVIEW

Heffler et al. (2020) confirmed that there is a high correlation between screen exposure at an early age and ASD-like symptoms, which implies that screen media can deprive children of a chance to learn socially and in the environment. Madigan (2019) also concluded that more screen time predicted communication and cognitive developmental delays. Chonchaiya (2008) pointed out that children who were exposed to screens at a very young age showed retards in the language acquisition process because they met less caregivers. Nonetheless, Kirkorian (2009) discussed that an ASD marker at an early age may prompt parents to spend more time on screens, which is usually a two-way process. Neurobiological proof of how screen exposure is associated with changes in brain activation and a decrease in white matter integrity was presented by Zivan (2022) and John (2023), but these results are still correlational. The results of these studies are however, mostly correlational with causation yet to be determined. However, other scholars claim that the signs of ASD in early years can result in more screen time, and this turns the causality of these concepts back. A cohort study by Sugiyama et al. (2021) with more

than 84000 children in Japan found out that more time spent on screen at the age of 1 increased the probability of an ASD diagnosis at the age of 3, especially in the boys. The paper was more convincing since it controlled confounding factors including age, education, and family income of parents. A separate study by Chen (2022) discovered that a screen time of more than two hours per day was associated with a delay in joint attention as a fundamental deficit in ASD. Their results gave evidence that toddlers with over 2 hours of screen time daily demonstrated remarkably low scores of social interaction on standardized instruments. There is some support that screen-based stimuli can be used to replace real-world social interaction, as such that may inhibit the acquisition of joint attention, an important early milestone which is frequently disturbed in ASD. Other studies however caution regarding the interpretation of such associations as causal.

Radesky. et al. (2020) highlighted the two-way quality of the relationship in which an early behavioral sign of ASD (including social withdrawal or difficulties in communication) might culminate into caregivers providing more or the soothing effect of screen-based activities. Simply, screen time might be a symptom, but not a cause of early ASD. Oh et al (2023) systematically searched 18 studies about screen time and ASD symptoms and found that high screen time was associated with communication deficits and reduced cognitive scores, but there was no clarity about the causal mechanisms because they were based on retrospective parental reporting and there were no neurological data.

The growing popularity of screen-based media among the young children has raised great concerns on the effects of media on the development of the brain. This literature review discusses the recent research results on the impact of early screen exposure on the brain structure, functional development and

developmental outcomes of the exposure, especially those published within the past five years. It sets out to connect the evidence provided in the research on brain integrity, regulation of attention, and neurodevelopmental conditions like Autism Spectrum Disorder (ASD), and differentiates between correlation and causation.

The article of John et al. (2023) is named the Association between Screen Based Media Use and Brain White Matter Integrity in Preschool Aged Children. The researchers used sophisticated methods of neuroimaging, such as Diffusion Tensor Imaging (DTI), in order to determine how screen exposure would affect the structure of the white matter. The results showed that there was a decline in the white matter integrity of major areas of the brain especially those related to language and executive functions with screen time. Although these were correlational results, this implied a possibility of a relationship between the excessive screen time and the poor brain development especially among children at the preschool age.

Zivan et al. (2022) were concerned with screen exposure and modified brain activity based on the regulation of attention in preschool children. The research was conducted using EEG measurements and proved that the children with a greater number of screen exposure exhibited different patterns of brain activation when it comes to the tasks that require attention and focus. The study hypothesized that overuse of screens might disrupt neural processes that facilitate attention control which is an essential process in early childhood. Although the research focused on correlational results, there was a clue that there might be a causal relationship between screen time and attention deficit.

The latest research that uses CT scan has provided important clues on the brain structural adaptations with early screen exposure. Smith et al. (2020) conducted a study to determine the correlation between cortical thickness and the screen time of children aged between 3 and 6 years through CT imaging. The findings showed that more screen time was related to the thinning in the areas of the cortex that dealt with processing visual information and other higher order processing and thinking that included reasoning and problem-solving. Differently, Li et al. (2021) reported that there were changes in grey matter volume in children who played over the recommended screen time. Such changes in the structure of the brain were observed to be associated with language and cognitive delays.

Although the evidence of the association between early screen exposure and brain changes is growing, the issue of difference between correlation and causality is a critical debate in the area. Some of the studies underscore the fact that although there are positive correlations between screen time and developmental delays, it can also be the other way round. ASD is a developmental issue in early development as the hypothesis put forward by Radesky et al. (2020) might suggest, and so these children can be converted into larger screen time consumers and this can lead to increasingly more screen time. Besides, there is an allusion in such studies as that of Chen et al. (2022) that screen exposure may replace the necessary real-life social interactions and not allow the development of joint attention, one of the most significant limitations of ASD. These arguments suggest that two-way relationships are possible, with the possibility of screen exposure being the cause and are only a pointer of developmental delay.

The evidence shows that structural and functional changes in the brain are evidenced that have been demonstrated to have been linked to early screen exposure. Studies of neuroimaging, such as in John S. (2023) and Zivan et al. (2022) indicate that the effect is on the brain regions that deal with attention and cognitive processes following the use of

screens. Nevertheless, these studies present excellent correlational data, although the causality processes are not clear. To fully unravel the bewildered interactions of screen exposure and brain development it needs to be conducted longitudinally with more sophisticated instruments and methods especially in its role in pathogenic neurodevelopment disorders such as ASD. Thus, it seems that there is a high correlation between unnecessary exposure to screens early and ASD-like tendencies, but the causation has not been established strictly. This underscores the necessity of longitudinal neuroimaging research and measures of standardization of neuroimaging to discuss brain-behavior associations during early development. Unanimously, literature, therefore, points to good correlations but lacks causal validation, hence making it necessary to conduct additional research.

METHODOLOGY

This was a quantitative and cross-sectional study that integrated the use of stratified sampling to represent all the classes of samples in terms of socioeconomic status and family structure. A sample size of 160 parents of children aged 26 years of Islamabad and Rawalpindi was used. Structured questionnaires that measured screen exposure, demographics, and ASD traits were used to collect the data with the help of the Modified Checklist of Autism in Toddlers (M-CHAT). Measures of screen exposure were on a ratio scale, M-CHAT scores were measured on an interval scale and demographic characteristics measured with nominal and ordinal scales. Data analysis, Pearson correlation and t-tests with Cohen d effect sizes were conducted using SPSS ethical approval was obtained, informed consent was gathered and the improved data were analyzed using SPSS (Masih, Khattak & Khan, 2025). The data were correlated using Pearson correlation to determine the relationship between screen time and M-CHAT scores. Prone variables against parental education, income and child gender were adjusted using multiple regressions. The institutional review board gave the ethical approval. The involvement was voluntary and anonymous. The informed consent was provided by parents and the process of the study was carried out in a confidential manner..

RESULTS

Characteristics of Sample (N = 160)

Variables	Categories	f	%	M/Median	SD/Range
Age				5.00	1.41
Gender	Boys	86	54		
	Girls	74	46		
Screen time	>1hr	52	32		
	1-2hrs	29	18		
	3-4hrs	35	22		
	<4hrs	44	28		
Socio-economic Status	Low	12	9		
	Middle	15	41		
	High	66	49		
Family System	Joint	78	49		
	Nuclear	82	51		

Family history of autism	Yes	64	40		
	No	96	60		
Parent's Marital Status	Living together	105	66		
	Single Parent/ Separated	55	34		
Mother's Employment Status	Working	72	45		
	Non-working	88	55		

Explanation

A total of 160 children were used in the study with an average age of about 5 years (SD = 1.41). The boys were slightly over fifty percent (54%) and girls comprised forty-six percent of the sample. On the amount of time children spend on the screen, 32 percent of them were spending over 1 hour daily, 18 percent of children had over 1-2 hours, 22 percent of children had over 3-4 hours, 28 percent of children had over 4 hours of screen time. There was a substantial skewing in the socio-economic status to the middle (41) and high (49) classes with the 9 percent of the population having Low socio-economic status.

Nearly fifty percent of respondents were in joint family (49%), and 51 percent in the nuclear family. In 40% of the sample, it was in a family history of autism. The majority of the parents lived together (66-percent), but 34-percent separated or single parents. Forty five percent of mothers were working and 55 percent were non-working. Hence, the following table is a summary of the demographic distribution. It demonstrates that the sample is equal in terms of gender and family systems. Mother employment and family history are recognized as risk factors of ASD.

Table 2
Pearson Product Correlation (r) Between Study Variables (N = 160)

	Variables	1	2	3
1	Age	1	.05	.03
2	Autism Spectrum Disorder	.05	1	.64**
3	Screen Exposure	.03	.64**	1

Explanation

Pearson product-moment correlation was performed to address age and symptoms of autism spectrum disorder (ASD) as well as screen exposure. No significant correlation was found between age and screen exposure and the symptoms of ASD. Nevertheless, the symptoms of ASD were positively related and significantly, to the screen exposure (r =.64, p <.01), whereby the more the screen time was, the more were the ASD characteristics/traits. Correlation matrix indicates a positive correlation of a strong (r =.64) between the screen exposure and ASD traits, i.e., high exposure is correlated with more ASD related traits or symptoms

Table 3
Mean Differences between Study Variables on the Basis of Gender (N = 160)

Variables	Boys (N =86)		Girls (N = 74)		*t*	*p*	*Cohen's d*
	M	*SD*	*M*	*SD*			
Autism Spectrum Disorder	29.37	4.23	29.84	4.94	-.64	.02	-0.10
Screen Exposure	39.44	11.74	42.57	11.51	-1.69	.76	-0.27

Explanation

According to the analysis of independent samples t-tests, there were no significant gender differences in screen exposure and ASD symptoms. There were similar scores of boys and girls in the two variables (p >.05). The minor difference is gender. The d values generated by Cohen represent extremely minor effects caused by ASD (d ≈ -0.10) and screen exposure (d ≈ -0.27), which means that gender does not have a considerable impact on them.

Table 4
Mean Differences between Study Variables on the Basis of Family System (N = 160)

Variables	Joint (N =78)		Nuclear (N = 82)		*t*	*p*	*Cohen's d*
	M	*SD*	*M*	*SD*			
Autism Spectrum Disorder	28.73	4.06	30.40	4.88	-2.34	.03	-0.37
Screen Exposure	37.83	10.43	43.79	12.16	-3.31	.07	-0.52

Explanation

There was a significant score difference between nuclear family children and joint family children where the score of nuclear family children was much greater on ASD symptoms (t = -2.34, p <.05). Within a similar vein, children in nuclear families indicated high screen time in comparison with joint families (t = -3.31, p <.01). The influences of the differences in family systems are intermediate scale: ASD (d = -0.37) and screen exposure (d = -0.52). Children in nuclear families possess more ASD traits and a higher level of screen exposure.

Table 5
Mean Differences between Study Variables on the Basis of Family History of Autism (N = 160)

Variables	Yes (N =64)		No (N = 96)		*t*	*p*	*Cohen's d*
	M	*SD*	*M*	*SD*			
Autism Spectrum Disorder	31.97	4.71	28.00	3.71	5.93	.00	0.96
Screen Exposure	47.50	11.03	36.48	9.97	6.56	.21	1.06

Explanation

The scores of ASD symptom (M = 31.97, SD = 4.71) in those children who had a family history of ASD were significantly higher when comparing them to the control group (M = 28.00, SD = 3.71), t (158) = 5.93, p = 0.001. In the same way, in children with autism in family history (M = 47.50, SD = 11.03), the most prevalent was screen exposure (when compared to children without such history, M = 36.48, SD = 9.97), t (158) = 6.56, p =.001.: The effect size of family history is large: ASD (d 0.96) and screen exposure (d 1.06). This means that the family history of ASD traits and screen exposure practices are effective determinants.

Table 6
Mean Differences between Study Variables on the Basis of Marital Status (N = 160)

Variables	Yes (N =105)		No (N = 55)		*t*	*p*	*Cohen's d*
	M	*SD*	*M*	*SD*			
Autism Spectrum Disorder	28.37	4.21	31.91	4.34	-4.99	.42	-0.83
Screen Exposure	39.14	10.73	44.22	12.82	-2.65	.14	-0.44

Explanation

Separated and single parents had significantly higher scores on ASD symptoms (M = 31.91, SD = 4.34) than parents living together (M = 28.37, SD = 4.21), t(158) = -4.99, p <.001. The screening exposure was also significantly greater in children of separated parent (M = 44.22, SD = 12.82) compared to children of intact families (M = 39.14, SD = 10.73), t(158) = -2.65, p <.01. The differences based on marital status also exhibit large effects: ASD (d = -0.M3) and moderate effect of the exposure to the screens (d = -0.M4). Children who have separated parents reveal more ASD characteristics..

Table 7
Mean Differences between Study Variables on the Basis of Mother's Employment Status (N = 160)

Variables	Yes (N =64)		No (N = 96)		*t*	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Autism Spectrum Disorder	32.79	4.57	26.97	2.37	10.37	.00	1.70
Screen Exposure	46.69	11.38	36.14	9.69	6.33	.01	1.01

Explanation

ASD symptom scores (M = 32.79, SD = 4.57) among children of working mothers were significantly higher than those of children of non-working mothers (M = 26.97, SD = 2.37), t(158) = 10.37, p <.001. Likewise, children are more exposed to screens than children of non-working mothers (M = 46.69, SD =

11.38), t(158) = 6.33 p <.001). The effect sizes among maternal employment conditions are very large: ASD (d =.70) and screen exposure (d =.01). Children in working mothers exhibit a much greater screen time and ASD-like behavior.

DISCUSSION

The current research has ascertained that there is a strong and positive relationship between screen exposure and the ASD-like symptoms in early childhood and this means that children exposed to screen at a higher level have more pronounced ASD-related traits. This is in line with recent longitudinal and cohort designs that have shown that early and excessive screen exposure is associated with retarded social communication, lack of parent-child interaction, and developmental vulnerabilities that mimic autistic-like traits (Madigan et al., 2019; Kamal et al., 2025). The lack of meaningful relationships between age and either screen exposure or ASD symptoms also provides evidence that these trends cannot be explained by developmental differences alone, and it is consistent with the findings that indicate the relatively low levels of age-driven variability in the early childhood media habits (Madigan et al., 2021). Nevertheless, it is not clear whether this relationship is directional or not. Children with early signs of ASD are also likely to voluntarily seek predictable screen settings of low demand (Martins, 2020; Heffler et al., 2020). The connection can, therefore, be bidirectional or transactional, which makes it important that longitudinal studies be done to shed light on causal patterns.

The effect of gender in this research scenario was not significant on the symptom of ASD-like or screen exposure and the boys and girls revealed identical state in both variables and the effect size observed was also insignificant in terms of practical implications. This reflects modern findings that gender disparity in early childhood screen time is usually minuscule because of common household set-ups and other comparable media habits of parents (Li et al., 2020). Even though ASD is more frequently diagnosed when affected by boys, dimensional trajectories of autism have been found to be often equally prevalent and expressed across genders during early childhood (Wood-Downie et al., 2021; Lai et al., 2015). Such results indicate that gender does not play a significant part in early differences in screen use or ASD-like behaviors.

Nuclear families showed a higher rating of ASD-like-symptom and higher screen exposure than the ones in joint families with moderate effect sizes pointing to differences. There are better social interactions, mutual caregiving, and enhanced communication opportunities in joint family systems, which are linked to protection elements relating to improved socio-emotional development (Wang, 2023). Screens could be a more integral part of nuclear families as they have fewer support changes to care and encounter increased expectations concerning parenting (Browne et al., 2020; Nobre et al., 2021). Such processes can decrease the opportunity to play and social learn, which can increase ASD-like characteristics. The results found are significant in the application of family context towards the formation of early screen behaviors and developmental outcomes.

Children who had a history of autism in their family showed significantly higher scores in ASD-like symptoms and also their exposure to the screens which are very large and the effect sizes are very large showing strong influences. The traits linked to ASD are highly inheritable and subclinical autistic traits will tend to cluster among families even in children not diagnosed with this disorder (Tick et al., 2016; Tsompanidis et al., 2024; Zhang et al., 2025). The high screen exposure of these children can be predetermined by

early attentional or sensory profiles related to the family risk of ASD, so the screen environments might become more attractive (Heffler et al., 2020; Martins, 2020). Digital media can also be more useful to parents who need to control and support the behavior of children with ASD (Kattein et al., 2023; Browne et al., 2020). These results highlight the importance of the fact that family history can determine an ASD characteristic, as well as the screen behavior.

Children of divorced or single parents had much higher ASD-like traits and screen time exposure than their two parent families. To a certain extent, family disruption and household instability have become interconnected with increased socio-emotional problems in early childhood (Black et al., 2021; Kayode et al., 2022). Single parents are also more exposed to stress and less time to direct interaction, which causes the use of more of the screen media (Vanderloo et al., 2022; Browne et al., 2020). Such trends can decrease the possibility of social learning and increase ASD-like traits (Madigan et al., 2019). The results highlight the necessity of the special attention to single-parent families.

Effects were large and symptomatic of ASD and screen exposure were much high among children of working mothers. Mother employment does not cause the development of the ASD-like phenomena, but the lack of direct parent-child communication, high work-family stress, and the uncertainty in the quality of childcare can determine the developmental outcomes (Chung et al., 2022; Nomaguchi and Milkie, 2020). Single mothers and fathers frequently say that they have turned to digital media use more as a convenient child care measure (McArthur et al., 2020; Browne et al., 2020). These dynamics reflect the necessity of favorable workplace policy and media advice over working families.

Conclusions and Limitations

The findings of the study are that although screen exposure is closely associated with ASD-like characteristics with a high level of validation, causation cannot be established accurately. The shortcomings with the study are the absence of neuroimaging (e.g., MRI or CT) data, self-report measures, and small sample on a regional basis. The next generation research ought to employ the use of longitudinal designs and biological evaluations in an attempt to determine the changes in the brain following the use of screens.

Recommendations and Future directions

It should be remembered that early exposure to screens and excessive emphasis on interactive environments, which make early screen exposure less vital to cognitive and social growth, should be avoided by parents. Pediatricians and policymakers ought to come up with methods of safe screen use during early childhood.

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