

## Early electronic screen exposure and autistic-like symptoms

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### Summary

Prevalence autism spectrum disorders (ASD) has been on rise, but many studies suggests over-diagnosed. Currently, children have more access to electronic media on the daily basis than those of previous generation. Some studies suggest that increases screen time is associated with melanopsin-expressing neurons and decreasing gamma-aminobutyric acid (GABA) neurotransmitter, and thus results aberrant behavior, decreased cognitive, and language development. Early exposure of electronic media in early life (< 2 years old) gives an impact on language, but it still inconclusive. We made a study aiming at revealing the impact of early exposure of electronic screen on language development and autistic-like behavior. Results showed that children who spent viewing  $\leq 3$  hours per day had language delay and short attention span, while children who spent viewing  $\geq 3$  hours per day had language delay, short attention span, and hyperactivity. While, we found that more than a half of children (66.6%) had no parents-child interaction during the exposure, speech delayed and short attention had been reported in all cases, and hyperactivity was found in 66.6% children.

**Keywords:** Screen exposure, speech delay, short attention span, hyperactivity

Prevalence of using electronic screen media was high among children below 3 years, and tends to increase within a decade. Some studies suggest that increased screen time in young children is associated to negative health outcomes such as decreased cognitive ability, impaired language development, mood, and autistic-like behavior including hyperactivity, short attention span, and irritability (1,2). Currently, children worldwide spend more time with electronic screen media compare to children which previously more socially engage. The first exposure have been found in much younger age and, more overly, parents actively persuade them to use electronic screen media as a companion to entertain and

to keep them occupied, therefore, the parent can freely working on their own. Surprisingly, almost all parents proudly reported that their child aged below 2 years has been able and enjoy electronic media in regular basis.

Early exposure to screen can cause neurochemical and anatomical brain changes. Reduced melatonin concentration has been found significantly in a group of individual who were exposed to screen (3). Neurotransmitter deficiency like dopamin, acetylcholine, gamma aminobutyric acid (GABA), and 5-hydroxytryptamine (5-HT) was observed in study on internet-addicted urban left-behind children which may cause a spectrum of aberrant behavior phenotype (4). Takeuchi *et al.* (5) found that there is a positive effects of screen exposure on regional grey matter volume and white matter volume in the brain that may correlates with verbal competence, aggression, and cognitive abilities.

The disruption of those biological daily light-dark rhythms from environment can increase depression-like behavior and cognitive function through melanopsin-expressing neurons (6). Light input is detected by

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**Table 1. Exposure history of electronic screen media among all cases who were not meet autism criteria**

Case	Age (month)	Sex	Chief Complain	Behavioral Phenotype	IQ Score	Time of first exposure	Time spent viewing/day	Parent-child interaction
1	60	Male	Speech delay	short attention span, hyperactivity	108	< 1 years old	≥ 5 hours	No
2	78	Female	Speech delay	short attention span	100	< 2 years old	≤ 3 hours	No
3	55	Female	Non-verbal	short attention span, hyperactivity	83	< 1 years old	≥ 5 hours	Yes
4	56	Male	Speech delay	short attention span, hyperactivity	70	< 2 years old	3-5 hours	Yes
5	51	Female	Speech delay	short attention span	75	< 2 years old	3-5 hours	No
6	44	Male	Speech delay	short attention span, hyperactivity	72	< 2 years old	3-5 hours	Yes
7	68	Male	Speech delay	short attention span, hyperactivity	70	< 2 years old	3-5 hours	No
8	70	Male	Speech delay	short attention span, hyperactivity	83	< 2 years old	3-5 hours	No
9	57	Male	Speech delay	short attention span	82	< 2 years old	≤ 3 hours	No

and signaled to relevant brain regions through retinal ganglion cells (RGCs). The majority of RGCs signal light to thalamic nuclei and visual cortex for image visual function, the minority, called intrinsically photosensitive retinal ganglion cells (ipRGCs) for non-image visual function expresses the photopigment melanopsin. Melanopsin expression ipRGCs distribute to multiple brain regions including suprachiasmatic nucleus (SCN), ventrolateral preoptic area (VLPO), and limbic regions in order to regulate circadian rhythms, sleep, cognitive function, and mood (7).

Brain and behavioral studies indicate a very complex set of interacting brain systems in the initial acquisition of language. Attention and social interaction will activate brain mechanisms that raise up a sense of relationship between the self and other, and social understanding systems that connect the perception and action (8). Media screen exposure is electronic screen media as a source of information and entertainment for children that can contribute to children's language development, however, learning at an early age including language extremely depends mainly on the influence of the context of linguistic directly from social interactions.

In Indonesia, young children are commonly found bounding with various electronic screen media in both higher socio-economic level and lower socio-economic level society. This phenomenon can easily be seen in public places such as restaurant, shopping mall, playing ground, and school.

We made an autism risk factor study in special school for autism children in Probolinggo, East-Java, Indonesia in 2016. Diagnostic and Statistical Manual of Mental Disorders (DSM)-5 had been administered by experienced Pediatricians to diagnosed Autism Spectrum Disorders (ASD). Children who met criteria of ASD, had an IQ under 70, and had syndromic intellectual disabilities (ID) were excluded, only Children who had autistic-like behavior were included. Intellectual Quotient (IQ) was measured in 2016 using Wechsler. Parents of children who had scored above 70 who signed the consent form was administered structured interview of electronic screen media exposure questionnaires to access time of first exposure, spent time viewing, and parent-child interaction. Chief complaint was obtained during

interview and confirmed by experienced pediatricians. Risk factors of language delayed *i.e* family history of language delayed, low birth weight, neurological disorders, ear problems, severe toxic exposure, chronic medical illness, severe infectious diseases were obtained using questionnaire. Ethical Clearance was obtained from Komite Etik Penelitian Kesehatan (KEPK), Faculty of Medicine Diponegoro University/dr. Kariadi Hospital, Semarang, Central-java.

Nine children who met criteria with autistic-like behavior were included (6 males, 3 females; aged 44-78 months). All children had speech delay as a chief complain, and among those one case was non-verbal. The time of first exposure was very early, all had exposure before 2 years old, more overly, two cases had been exposed before the age of first. Parents reported having interaction with children during the exposure only in three cases, while the majority of cases (66.6%) there was no interaction during the exposure. Aberrant behavioral phenotypes were observed including short attention span was found in all cases and hyperactivity in the majority of cases (66.6%). Children who spent viewing ≤ 3 hours per day had language delay and short attention span, while children who spent viewing ≥ 3 hours per day had language delay, short attention span, and hyperactivity (Table 1).

In all cases, the first exposure was started before 2 years old and the intention of exposure was very high in the majority of cases (≥ 3 hours/day). Chonchaiya et al. found that children who started watching television before 12 months and watched more than 2 hours a day were six times more likely to have language delays (2). Electronic screen stimulation in early stage leads dysregulation and disorganization of various biological systems. Escalation of stimulation especially in early stage, will also influence other function, and language is the function that mostly affected (9). Recently, Fisher introduce a new term of electronic screen syndrome (ESS), an unrecognized disorders associated with exposure of electronic media and mental health symptoms *i.e*. mood, anxiety, cognition, behavior, and social interaction due to hyperarousal. (Unpublished data, Martin H Fisher, Electronic Screen Syndrome: An unrecognized disorder)

This study found that more than a half of children (66.6%) had no parents-child interaction during the exposure, speech delayed and short attention had been reported in all cases, and hyperactivity was found in 66.6% children. Previous studies shown negative associations between times spent viewing TV and the range of cognitive outcomes in young children including attention, intelligence and future educational attainment. A longitudinal study in 2004 found that the more TV watched by infants (aged 1-3), the more likely they were to have attention problems (9). In addition, poor quality of interactions with parents combine with screen excessive use may have negative effects on children's health and development, parent-child interactions was found had positive impact on language development especially word learning and retention (10). Studies in rodent revealed the behavioral changes occurred because ipRGCs project to the brain regions involved in mood. Bedrosian TA and Nelson RJ summarizing the effect of aberrant light and mood disorders through ipRGC projections to brain regions involved in emotions (1), and also an effective sources for suppressing nocturnal melatonin that can lead sleep disruption (3).

**Study Limitation:** An important limitation is the lack of a control group that would help us evaluate the effect of screen exposure and whether autistic-like behavior is indeed increased in children due to excessive screen exposure.

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