Autism spectrum disorders and electronic screen devices exposure in Al-Nasiriya city 2019-2020.

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Abstract

Autism Spectrum Disorders (ASD) characterized by persistent impairment in social communication and interaction, and restricted repetitive patterns of behaviors, interests and activities. Many studies in different countries suggest that increased screen time exposure in young children is associated with negative health outcome such as: Impaired language development, mood and autistic like behavior.

A cross sectional case control study was done in Al-Nasiriya city, south of Iraq, during a period of 2 years from 1st of January 2019 to the end of December 2020. The study included 107 child diagnosed with ASD in Al-Nasiriya Autism center, their mean age was 5.3 years, and 263 child included as a control group, their mean age was 5.6 years. Specially designed structured questionnaire was used to collect the information. The data was collected by direct face-to-face interview. Patients were followed up for a period of 6-12 months.

The study showed that there was a significant relationship between age of starting electronic screen exposure and ASD in which more than 81% of ASD patients started electronic screen exposure at ≤ 2years of age (27.1% at age <1 year and 54.2% at age 1-2 years) compared to 62.8% of control group (P value=0.001). Most ASD patients (75.7%) watched screen devices for more than 4 hours/day (P value=0.001). TV watching has a significant relation with ASD, and mixed electronic devices watching was dominant in both groups (P value=0.001).

Watching and listening to children songs was significantly associated with ASD, P value=0.001. There was a significant association between ASD and increased level of education of both parents. The study showed that there was a significant improvement in about 2/3 of patients after eliminating or reducing screen exposure. Early and prolonged exposure to screen devices is an important trigger for ASD. Education of society about the risk of early and prolonged exposure of children to electronic screen devices is recommended and screen device exposure for children below 2 years of age should be discouraged.

Introduction

Autism spectrum disorders, can be defined as an early neuro-developmental disorder characterized by persistent impairment in social communication and interaction, and restricted repetitive patterns of behaviors, interests and activities [1,2]. Year after year the prevalence of ASD increased dramatically worldwide, according to t CDC (Center for Disease Control and prevention) the prevalence of ASD among children aged 8 years in multiple USA communities have increased from about 1 in 150 during 2000-2002 to 1 in 54 during 2016 [3].

There is a 4:1 male predominance, but the intellectual disabilities were seen in girls more than boys [4]. The exact cause of autism, although still unknown, but is almost certainly a complex interaction between genetic, environmental, and epigenetic factors with more than 1000 associated genes implicated, and there is a high rate of heritability and genetic loading [5,6]. An epigenetic model is considered as one of the explanations for the etiology; individuals with genetic receptivity may be more sensitive to environmental factors that can affect early brain development [4].

Screen media exposure plays a growing role in the child`s life [7]. Word wide increased availability of household media expose children to 3–6 hours of daily screen viewing, which is the longest single daily activity, excluding sleeping [8]. This finding indicates that many children aged less than 2 years spend about 1/3 of their waking hours watching an electronic screen [9]. Many studies in different countries suggest that increased screen time exposure in young children is associated with negative health outcome such as: Impaired language development, mood and autistic like behavior including hyperactivity, short attention span and irritability [10-14]. In addition, excessive screen exposure leads to poor child

interactions with his parents. This in turn has a negative effect on child development, as parent-child interactions have a positive impact on language development, especially word learning and retention [15].

It is possible that intensive routine screen exposure during critical stages of CNS development can alter gene expression, leading to structural, synaptic and functional changes in the developing brain, particularly in children with predisposing neuro-genetic profiles [16]. Some neuro-chemical and anatomical changes in the growing brain can be caused by early electronic screen exposure. Neurotransmitters deficiency such as dopamine, acetylcholine, GABA, and 5-Hydrotryptamine (5-HT) was reported in internet addicted urban abandoned children, which may cause a spectrum of aberrant behaviors [17]. The grey and white matters volumes in the developing brain can be affected by the prolonged electronic screen exposure, that may be associated with verbal competence, aggressiveness and can affect cognitive abilities [18]. Significantly reduced levels of melatonin have been found in a group of individuals who were exposed to electronic screen [19]. Social interactions will stimulate brain mechanism that heightens a sense of relationship between the self and the other. At an early age learning including language mainly depends on the influence of the context of linguistic directly from social interaction [20]. The American academy of pediatrics discourage screen media exposure at ages below 18-24 months and for children aged more than 24 months the screen exposure is limited to one hour or less per day of high quality programming with attendance of parents to help understand what they are seeing [21].

Aim of the Study

To evaluate the relationship of electronic screen exposure in children with ASD.

Method

Cross sectional case control study done in Al-Nasiriya city, capital of Thi-Qar governorate, south of Iraq over a period of 2 years, from the 1st of January 2019 to the 31st of December 2020. The study included 107 patients with ASD and 263 children as a control with normal development matched by age (2-8 years of age). The enrolled 107 children diagnosed with autistic spectrum disorder by a team of doctors composed of two pediatricians and one psychiatrist in Al-Nasiriya autism center according to DMS-5 diagnostic criteria for autism spectrum disorder [22].

The control group was collected from two kindergartens and from those children who seeks medical care at the outpatient clinic in Bint-Alhuda teaching hospital in Al-Nasiriyah city for complaints other than developmental ones. Specially designed structured questionnaire used to collect the information was used. It included socio-demographic factors: Sex, age, residence, family size, child sequence in the family, and level of the parent's education. Screen exposure information included age when they started watching screen devices, daily duration of screen exposure, type of device, type of program that had been mainly viewed, and reasons for excessive screen exposure for both case and control groups were collected.

Data was collected by direct face-to-face interview, filling all the questionnaire information. Patients were followed for a period of 6-12 months after stopping screen media exposure to assess if there is an improvement. Children with Down syndrome, cerebral palsy, mental retardation, hearing problems, were excluded from the study. Written assent was obtained from all families of patients enrolled in the study. The study was approved by the ethical scientific committee of medical college/university of Thi-Qar, and Thi-Qar health directorate.

Screen time defined as the time that had been spent with any screen device, including smart phones, tablets, television, video games, and computers [23]. The total daily screen exposure was calculated by summation the duration of each exposure for the same child during over a period of 24 hours. Daily screen exposure duration then divided into 3 groups (<2 hours, 2-4 hours, and ≥ 4 hours).

The electronic devices included in the study Television (TV) screens, smart mobile phone, tablets, and mixed use (more than one device). The type of viewed programs was divided to cartoons, children songs, games and mixed exposure. Parent education was classified as (illiterate, read and write and primary school, intermediate and high school, college and above).

The data had been expressed in form of numbers and percentage and analyzed using SPSS (version 25). ANOVA test, t-test had been used to associate the quantitative variables. Pearson chi-square test and fisher exact test were used to associate qualitative variables. Logistic regression analysis was used for independent variables to see the real effect on outcome. For all analyses, P value of <0.05 provide statistical significance.

Results

There was male predominance. Male to female ratio was 4.6:1 (P value of 0.0001). Urban address was seen in majority of both case and control groups (Table 1).

Variant	Sample type		Total	X^2
	Case	Control		P value
Gender				
Male	88	157	245	17.284

	82.20%	59.70%	66.20%	
Female	19	106	125	0.0001
	17.80%	40.30%	33.80%	
Address				
Urban	84	232	316	5.751
	78.50%	88.20%	85.40%	
Rural	23	31	54	0.008
	21.50%	11.80%	14.60%	
Socioeconomic status of the family				
Poor	16	34	50	2.885
	15%	12.90%	13.50%	
Moderate	52	153	205	
	48.60%	58.2	55.40%	0.265
Good	39	76	115	
	36.40%	28.90%	31.10%	
Total	107	263	370	
	100%	100%	100%	

Table 1. Socio-demographic features of the sample.

There were no significant differences in age and family size between both groups. We found that ASD children start viewing screens 5 months earlier than the control group. The mean age of diagnosis of ASD was 3.67 years. P-value=0.0001 (Table 2).

Variants	Sample type	N	Mean	Std. deviation	Anova	P value
Age (Yr.)	Case	107	5.3845	2.41403	-0.940	0.348
	Control	263	5.6544	2.54044		
Age at start viewing of electronic devices(in months)	Case	107	34.8	0.694	-5.240	0.0001
	Control	263	39.6	0.612		
Family size	Case	107	5.77	1.945	0.382	0.703
	Control	263	5.69	1.715		
Child sequence	Case	107	2.7	1.695	1.757	0.08
	Control	263	2.38	1.521		
Hours of watching electronic devices/day	Case	107	3.7	0.605	7.588	0.0001
	Control	263	3.05	0.78		
Age of diagnosis of ASD	Case	107	3.67	0.491	88.464	

Table 2. Other variables.

There was a significant association between ASD and increased level of education of parents (Table 3).

Education level	Mother education		Total	X^2	Father education	Total	X^2	
	Case	control	P value	Case	Control	P value		
No formal education	5	10	15	11.562	2	2	4	5.922
	4.70%	3.80%	4.10%		1.90%	0.80%	1.10%	
Literate and primary school	35	136	171		21	74	95	
	32.70%	51.70%	46.20%		19.60%	28.10%	25.70%	
Intermediate and secondary school	26	51	77	0.009	30	85	115	0.034
	24.30%	19.40%	20.80%		28%	32.30%	31.10%ᵃ	
College and above	41	66	107		54	102	156	
	38.30%	25.10%	28.90%		50.50%	38.8	42.2%2	
Total	107	263	370		107	263	370	
	100%	100%	100%		100%	100%	100%	

Table 3. Parent's education level.

Early electronic screen exposure was associated with ASD. P-value=0.001 (Table 4).

Age of watching devices	Variable	Type of participant		Total	X^2
		Case	Control		P
<1 year	Count	29	22	51	28.522
	% within age of watching devices	56.90%	43.10%	100%	
	% within type of participant	27.10%	8.40%	13.80%	
1-2 years	Count	58	143	201	
	% within age of watching devices	28.90%	71.10%	100%	
	% within type of participant	54.20%	54.40%	54.30%	0.001
>2 years	Count	20	98	118	
	% within age of watching devices	16.90%	83.10%	100%	
	% within type of participant	18.70%	37.30%	31.90%	
Total	Count	107	263	370	
	% within type of participant	100%	100%	100%	

Table 4. Age of starting electronic screen devices exposure.

Most ASD cases watching electronic devices more than 4 hours per day. Pearson Chi-Square=57.492ᵃ, P value=0.001 (Figure 1).
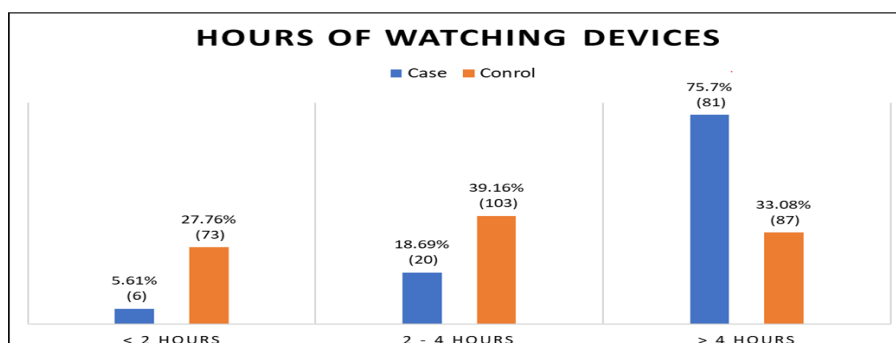

Figure 1. Hours of watching electronic devices.

Watching television had a significant relationship with ASD, while mixed screen exposure was common in both groups (Figure 2).
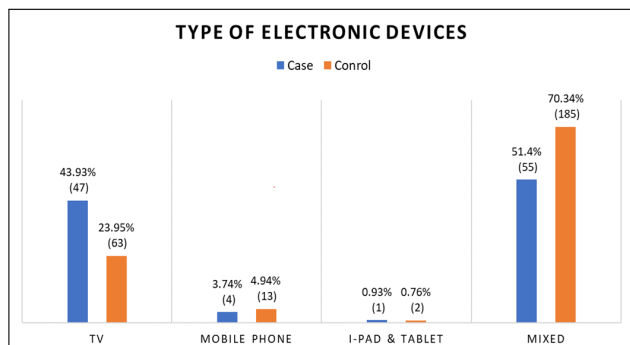

Figure 2. Type of electronic devices. Fisher's exact test=14.367, P value=0.001.

Watching children songs was significantly associated with ASD, and mixed electronic programs watching were the common in both groups (Figure 3).
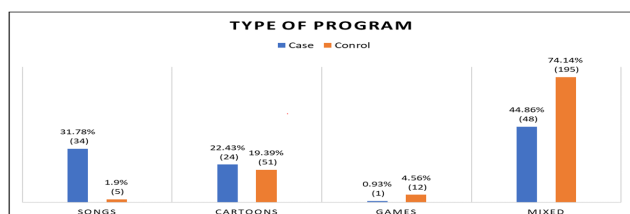

Figure 3. Type of program that had been watched in the main. Pearson chi-square=77.526a, P value=0.001.

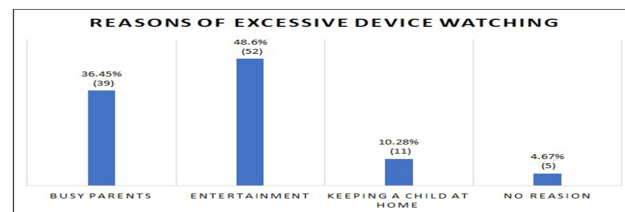Children entertainment and busy parents were the main reasons to

Figure 4. Reasons of excessive device watching.

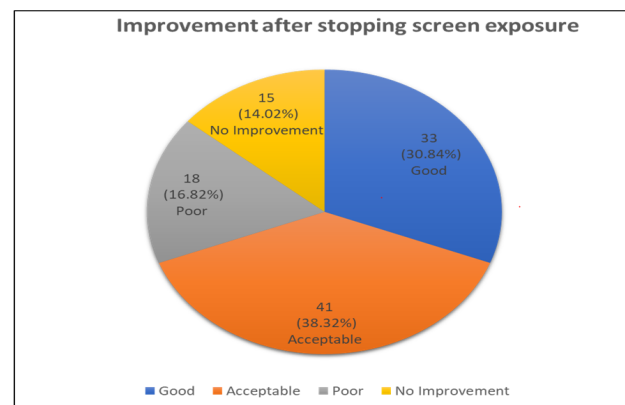Improvement was seen in about two thirds of patient after discontinuation of electronic screen exposure (Figure 5).

Figure 5. Improvement after discontinuing electronic screen exposure.

Autistic children from families with good socio-economic state had better improvement after stopping electronic screen exposure, P value=0.019 (Table 5).

early and long screen exposure, followed by ˈ keeping the child safe at homeˈ (Figure 4).

		Improvement after stop watching Devices				Total	X²
		Good	Acceptable	Poor	No Improvement		P value
Gender of participant							
	Male	24	36	16	12	88	2.293
		27.30%	40.90%	18.20%	13.60%	100.00%	
	Female	9	5	2	3	19	0.301
		47.30%	26.30%	10.50%	15.90%	100.00%	
Address							
	Urban	27	28	17	12	84	4.626
		32.20%	33.30%	20.20%	14.30%	100.00%	
	Rural	6	13	1	3	23	0.345
		26.10%	56.50%	4.40%	13%	100.00%	
Socioeconomic status							
	Poor	1	7	5	3	16	11.642

		6.20%	43.80%	31.30%	18.70%	100.00%	
	Moderate	14	24	7	7	52	
		28.90%	46.10%	11.50%	13.50%	100.00%	0.019
	Good	18	10	6	5	39	
		46.20%	25.60%	15.40%	12.80%	100.00%	
Total	No.	33	41	18	15	107	
	%	31%	38%	17%	14%	100.00%	

Table 5. Improvement after stopping screen device exposure and socio-demographic factors.

Good improvement after discontinuing screen media exposure seen in those using TV and those using electronic devices for viewing children songs, P value=0.011 and 0.009 respectively (Table 6).

	Improvement after stop watching devices					X^2
	Good	**Acceptable**	**Poor**	**No Improvement**	**Total**	**P value**
Type of Device						
TV	20	13	5	9	47	17.33
	42.60%	27.70%	10.60%	19.10%	100.00%	
Mobile phone	0	1	1	2	4	
	0.00%	25.00%	25.00%	50.00%	100.00%	
I- pad	1	0	0	0	1	0.011
	100.00%	0.00%	0.00%	0.00%	100.00%	
Mixed	12	27	12	4	55	
	21.80%	49.10%	21.80%	7.30%	100.00%	
Type of program						
Songs	16	9	4	5	34	19.245
	47%	26.50%	11.80%	14.70%	100.00%	
Cartoons	6	7	4	7	24	
	25.00%	29.20%	16.70%	29.20%	100.00%	
Games	0	0	1	0	1	0.009
	0.00%	0.00%	100.00%	0.00%	100.00%	
Mixed	11	25	9	3	48	
	22.90%	52.10%	18.70%	6.30%	100.00%	
Total	33	41	18	15	107	
	31%	38%	17%	14%	100.00%	

Table 6. Improvement after stopping screen media exposure and type of device and type of program.

Independent variables when analyzed by logistic regression for estimation of co- founders by multi-variants analysis showed that age of start watching electronic devices, viewing hours, and program type were really associated with autistic spectrum disorder (Table 7).

Variables in the Equation								
Step 1ª			B	S.E.	Wald	df	Sig	Exp (B)
		Watching age			5.554	3	0.135	
		Watching age	-1.133	0.491	5.321	1	0.021	0.322
		Device type	1.722	1.774	0.942	1	0.332	5.594
		Program type	-2.489	0.627	15.76	1	0	0.083
		Watching hours	1.647	0.345	22.839	1	0	5.191
		Mother education	0.89	0.894	0.99	1	0.32	2.434
		Father education	0.142	0.376	0.142	1	0.707	1.152
		Constant	0.625	0.415	2.27	1	0.132	1.868

Table 7. Logistic regression.

Discussion

When we searched online about similar studies that expected to deal with this important subject, we found that our study was the first study of its kind carried out in Iraq to investigate if that early and prolonged exposure of children to electronic screen devices is an important trigger for autistic spectrum disorder. Male to female ratio was 4.6:1 (P value of 0.0001), and it is slightly higher than that had been reported in USA by CDC in 2016, in which male to female ratio was 4.3:1. CDC reported a range from 3.4:1 to 4.7:1 according to the site difference in USA [3].

Most cases and controls were recruited from urban areas; this may be due to fact that both groups sample were collected in Al-Nasiriya city which is the capital of Thi-Qar governorate. Our study showed no significant difference in family size and socioeconomic state between ASD and the control groups, which is similar to results of Cahid study [24].

We found that ASD children started viewing screen 5 months earlier than controls, this finding correlated with study by Chonchaiya et al. in Thailand; they revealed that ASD children began watching television around six months earlier than typically developing peers [25]. In an analysis of National Longitudinal Study of Youth data in USA, Zimmerman and Christakis found that there was a negative association between average screen viewing before the age of 3 years and cognitive outcomes at 6 years [26].

The study revealed that the mean age of diagnosis of ASD was 3.67 year (44 months), earlier than the CDC finding of median age of diagnosis in USA was 51 months [2]. There is no screening or surveillance programs in Iraq, unlike in the USA in which the CDC established the Autism and Developmental Disabilities Monitoring (ADDM) network, for reporting ASD prevalence in multiple communities in even-numbered years since 2000, and it may reflect community practices and differences for identifying ASD, changes in the data available to the surveillance system, or other unknown factors [3]. The median age of ASD diagnosis will increase if the community begins assessing ASD at an older age children. ASD screening is recommended by the American academy of pediatrics for all children at age 18-24 months [4]. ASD often goes undiagnosed until four years of age, while early emerging autistic-like behaviors such as eye fixations decline and avoidant responses to touch can be observed as early as 18–24 months [27,28]. In Canada, National Autism Surveillance System (NASS) data indicated that 28% of children with ASD were diagnosed after 8 years of age [29].

A significant association between ASD and increased level of education of the parents was noted (50.5% and 38.3% of ASD children fathers and mothers respectively had college and above education), compared with control group (P value was 0.009 for mother education and 0.03 for father education). This result correlate with Karla et al. study in California which found the majority of areas of autism clustering were characterized by high parental education, in which the relative risks were more than 4 times for college graduate versus non-high school graduate parents [30].

More than 81% ASD patients started electronic screen exposure ≤ 2 years (27.1% <1 year and 54.2% at age 1-2 years) compared to 62.8% of control group who started electronic screen exposure ≤ 2 years. When we compare between the case and control groups according to the age of starting screen devices exposure we notice that among those starting to watch below 1 year 56.9% of them had ASD, and with increased age the risk is less as we see that only 16.9% of those starting screen device watching at age more than 2 years had ASD. This result close to Mahmood study in which 80.9% of the children diagnosed with ASD had been exposed to screen devices for long hours during the first 2 years of their life [31]. Cahid et al. study showed that 56.7% and 96.7% of ASD children start viewing screen devices <1 year and <2 years respectively [24].

Several studies showed that exposure to certain screen activities during critical stages of neural development may alter gene expression, leading to structural, synaptic and functional changes in the developing brain [16-19]. Most of the ASD cases were watching electronic devices >4 hours (75.7%), compared with 33.1% among the control group, with significant P-value of 0.001. Tomopoulos et al. study done in New York revealed that duration of media exposure at age of 6 months was associated with lower cognitive development [7].

Watching television had a significant relation with ASD and it was seen in (43.9%) of cases compared with control group (24%), and P-value was 0.001. Cahid et al. study revealed that TV-viewing habits has a significant association with ASD, in which 28.1% of ASD children were viewing TV>2 hrs/day and 56.3% of them viewed TV>4 hrs/day [24]. Chonchaiya et al. study indicated that children with ASD interacted less with others while watching TV (79.6%) than control group (13.1%), while Hermawati et al. study found that 66.6% of children had no interaction with parents during the screen exposure, short attention span and speech delay were reported in all of them [25,13]. Today, TV is one of the most approachable forms of media and 8 out of 10 households in the world possess more than one TV device at home [32].

Children song watching was significantly associated with ASD (31.8%), compared to 1.9% of control group, and mixed electronic devices watching was common in both groups. Zimmerman et al. study showed that among 8-16 months there were significant associations between videos/DVD exposure and Communicative Development Inventory (CDI) scores, and explained that it contain little dialogue, short scenes, disconnected rapid images, and a variety of visually salient but linguistically indescribable events [33].

Three potential explanations for media-associated adverse effects on every young children's development. First, a number of studies have shown decreased parent-child interactions in children with increased media, including reduced audible language, conversation, and engagement with the child. Second, exposure to media in very young children has been shown to interfere with their playing activities. Third, specific characteristics of media exposure such as rapid scene changes have been hypothesized to have direct, adverse effects on the developing brain [7].

Child entertainment and busy parents were the main reasons to early and long electronic screen exposure, followed by keeping child safe at home. Hamel study revealed that there is a correlation between parental attitudes towards screens and the amount of screen exposure children receive. It has been reported by parents that the TV is viewed as a peacemaker in the household, and safe activity for their children while they are busy getting ready for the day, doing household chores, or preparing dinner.

In Mahmood study the main reasons cited by the parents were to keep the child occupied, avoid having them cry or move around too much, keeping them entertained and safe, or simply because the mother or caregiver was preoccupied [31]. Improvement was seen in about 2/3 of patients after screen exposure. Several case reports indicated that young autistic-like children with excessive electronic screen use were re-assessed as non-autistic after a couple months of elimination of screen media [35,36]. Better improvement was seen in those with good socioeconomic state 46.2% (P value=0.019). Good improvement after elimination of screen media exposure seen in those using TV (42.6%) and those using electronic devices for viewing children songs (47%) with significant P value (0.011 and 0.009 respectively).

Independent variables when analyzed by logistic regression for estimation of co-founders by multi-variants analysis show that age of start electronic screen exposure, watching hours, and program type were really associated with autistic spectrum disorder.

Conclusion

- Early and prolonged exposure to screen devices is an important trigger for ASD.
- Screen devices have negative effects on the developing brains of children, especially when they were exposed at an early age (below 2 years) and for long periods at a time (more than 2 hours).
- Early TV screen exposure and child songs watching had a significant risk for the development of ASD.

Recommendations

- Educate the society about the risk of early and prolonged exposure of children to screen devices.
- Discourage screen devices watching for children below 2 years, and encourage more interactive activities such as talking and playing that will promote proper brain development.
- For children aged more than 2 years, limit the total time of child watching screen devices to not more than 1 to 2 hours/day.
- Limit the number of televisions in the household, remove television from children bedrooms, and discourage buying smart phones, tablets or I-pad for children.
- Watching screen devices should be attended by the parents or an adult person to choose suitable programs and to explain to the children what they are watching.
- Discourage watching channels that show programs and songs which are loud, fast-paced, and have several attention-grabbing features such as quick changing scenes, rapid zooms, and flashes of colors.
- More researches are requiring on the effects of electronic screen devices on various aspects of children development, in the Middle East region in general and in Iraq in particular.

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