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Cross-sectional study on prevalence of autism among toddlers, preschool and school-going children (1–12 years) attending pediatrics OPD at tertiary care hospital at Karur

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ABSTRACT

Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder marked by difficulties in social communication and restricted and/or repetitive behaviors. In India, ASD represents a significant health burden and early identification is crucial for improving outcomes. **Aims and Objectives:** This study aimed to determine the prevalence of ASD in toddlers, preschoolers, and school-aged children (1–12 years). **Materials and Methods:** A cross-sectional study was conducted with 245 children aged 1–12 years attending the pediatric outpatient department (OPD) at a tertiary care hospital in Karur. Screening for ASD was performed using the MCHAT and ISAA scoring. **Results:** Of 245 patients, 53.5% were under 3 years of age, and 58.8% were male. The prevalence of autism was 6.1%, with higher rates observed among children over 3 years of age, and autism was more prevalent in males (8.3%) than females (3%). Significant associations were found for factors such as socioeconomic status, parental age, and screen time. Autism prevalence was higher in the upper socioeconomic classes, older mothers (21.9%), older fathers (12%), and children with a history of social or language delays. In addition, children using mobile phones or watching TV for >1 h daily had a higher prevalence of autism (P<0.0001). No significant associations were found between birth weight, neonatal factors, or breastfeeding status. **Conclusion:** This study highlights the key factors associated with autism, such as parental age, developmental delays, and excessive screen time. These findings emphasize the need for early identification and intervention, particularly for children with developmental delays and those from families with a history of autism.

Key words: Autism spectrum disorder; Prevalence; Children; Risk factors; Parental age; Family history; Screen time

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INTRODUCTION

Autism spectrum disorder (ASD) is a complex neurodevelopmental condition characterized by difficulties in social communication and the presence of restrictive and repetitive behaviours.[1] Autism seems to originate from early brain development and affects nearly all areas of a child's functioning. Key characteristics of ASD include difficulties with reciprocal social interactions, challenges in communication, and repetitive or stereotyped behaviors, interests, and activities.[2] According to recent estimates from the Centers for Disease Control and Prevention (CDC) in the USA, approximately 1 in 36 children are diagnosed with ASD (CDC, 2023).[3]

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India, with a population of approximately 1.3 billion, has nearly one-third of its population under the age of 15. It is estimated that over 2 million people in India may be affected by ASD.[4] However, most studies on ASD are based on hospital data and do not provide accurate prevalence estimates for the general population.[5,6] Few studies have addressed the prevalence of ASD in community settings, and the lack of uniformly applied, validated, and translated diagnostic tools complicates accurate prevalence estimations. In addition, data on the prevalence of ASD in India, particularly among children seeking pediatric outpatient care, remain limited. There is often a delay in diagnosing ASD at a young age, leading to under-recognition of the disorder.[7]

Over the past decade, advancements in research have improved the potential for early diagnosis of ASD. Efforts in deep phenotyping, particularly in high-risk infants such as younger siblings of children with ASD, have enhanced early detection capabilities. Biomarkers may also help assess risk even before behavioral symptoms become apparent.[8,9] Despite these advances, the average age for a clinical diagnosis remains at 4–5 years, with little evidence of a decrease.[8,10] Factors such as cognitive and language development, ethnicity, socioeconomic status, and waiting lists affect diagnosis timing. High-quality, comprehensive assessments are recommended, but the high demand for these services can lead to longer waiting times.[11,12] Thus, early detection and intervention are critical, as they can significantly improve the quality of life of affected children and their families.

Aims and objectives

This study was conducted to estimate the prevalence of ASD among children aged 1–12 years attending a pediatric outpatient department (OPD) at a tertiary care hospital in Karur. In addition, it aims to identify the risk factors associated with ASD in this population, thereby contributing to the understanding of autism in the Indian context and highlighting the importance of early diagnosis and intervention.

MATERIALS AND METHODS

This cross-sectional study was designed to estimate the prevalence of ASD among 245 children aged 1–12 years who attended a pediatric OPD at a tertiary care hospital in Karur for 6 months.

Inclusion criteria

All children aged 1–12 years attending the pediatric OPD during the study period were included in the study Figure 1.

Exclusion criteria

Children with hearing impairments or global developmental delays were excluded from this study. These conditions could confound the diagnosis of ASD or affect the study results by presenting overlapping symptoms or developmental challenges.

Ethics statement

This study was approved by the institutional review board of the Tertiary Care Hospital, Karur. The study adhered to the ethical guidelines for research involving human subjects outlined in the Declaration of Helsinki. Informed consent was obtained from the parents or guardians of all the participating children. Confidentiality was stringently maintained, with all data anonymized to protect participants' privacy.

The sample size was calculated based on data from the study "Neurodevelopmental disorders in children aged 2–9 years: Population-based burden estimates across five regions in India,"[13] with Z alpha @ 95% level, "prevalence of neurodevelopmental disorders 2±<6-year-olds ranged from 2.9% to 18.7% and in the 6±9-year-old children, from 6.5% to 18.5%," and an absolute precision of 5%.

Parameter analyzed

The study analyzed the prevalence of ASD among children aged 1–12 years and investigated associated risk factors, including parental age, family history, screen time (TV and mobile usage in children), and developmental delays.

Statistical analysis

Descriptive statistics were used to summarize continuous data, with means, standard deviations, and categorical data as percentages. Inferential statistics were performed using Statistical Package for the Social Sciences 16.0 to generate reports and analyze trends in the data.

RESULTS

Of the 245 patients, 131 (53.5%) were under 3 years of age and 114 (46.5%) were older than 3 years. The study included 144 male patients (58.8%) and 101 female patients (41.2%). Among 245 patients, 15 (6.1%) were diagnosed with autism and 230 (93.9%) were not. Ten patients (4.1%) were classified as wasted according to weight-for-height status, while 235 (95.9%) had normal weight-for-height status.

The socioeconomic status distribution showed that 49 patients (20%) were in the lower class, 29 (11.8%) in the upper-lower class, 138 (56.3%) in the lower-middle class, 19 (7.8%) in the upper-middle class, and 10 (4.1%) in the upper class. 51 patients (20.8%) had a history of

consanguinity and 194 (79.2%) did not. Thirty-two mothers (13.1%) were older than 30 years, whereas 213 (86.9%) were younger than 30 years. One hundred fathers (40.8%) were older than 30 years and 145 fathers (59.2%) were younger than 30 years. Nine patients (3.7%) had comorbidities during pregnancy and 236 (96.3%) did not have comorbidities during pregnancy. Six patients (2.4%) were exposed to chronic drug intake during pregnancy, while 239 (97.6%) were not exposed to chronic drug intake during pregnancy. About 53 (21.6%) reported mobile usage for >1 h, 143 (58.4%) reported mobile usage for <1 h, and 49 (20%) reported no mobile usage (Table 1).

Gestation status indicated that five patients (2%) were preterm and 240 (98%) were term. Thirty-two patients (13.1%) were classified as having low birth weight (LBW) and 213 (86.9%) had normal birth weight. 24 patients (9.8%) had a neonatal intensive care unit (NICU) stay, while 221 (90.2%) did not have a NICU stay. One patient (0.4%) experienced neonatal seizures and 244 (99.6%) did not experience neonatal seizures. One patient (0.4%) experienced neonatal hypoglycemia, whereas 244 (99.6%) did not. One patient (0.4%) had neonatal sepsis and 244 (99.6%) did not have neonatal sepsis.

None of the 245 patients (100%) had neonatal jaundice. All 245 patients (100%) were exclusively breastfed. Seven patients (2.9%) had delayed complementary feeding and 238 (97.1%) did not have delayed complementary feeding. Seven patients (2.9%) were bottle-fed, whereas 238 (97.1%) were not. 45 patients (18.4%) were administered cow's milk before 1 year and 200 (81.6%) were not administered cow's milk before 1 year. All 245 patients (100%) were immunized up to age (Table 2).

Four patients (1.6%) had a gross motor delay, while 241 (98.4%) did not have a gross motor delay. Three patients (1.2%) had a fine motor delay, and most patients

Table 1: Demographics, clinical characteristics and parental factors related to autism among children

Characteristics	No of patients	Percentage
Age (years)		
<3	131	53.5
>3	114	46.5
Sex		
Male	144	58.8
Female	101	41.2
Autism		
Yes	15	6.1
No	230	93.9
W/H		
Wasted	10	4.1
Normal	235	95.9
Socioeconomic status		
Lower	49	20
Upper lower	29	11.8
Lower middle	138	56.3
Upper middle	19	7.8
Upper	10	4.1
Consanguinity		
Yes	51	20.8
No	194	79.2
Mothers age in years		
>30	32	13.1
<30	213	86.9
Fathers age in years		
>30	100	40.8
<30	145	59.2
Comorbidities in pregnancy		
Yes	9	3.7
No	236	96.3
Chronic drug intake during pregnancy		
Yes	6	2.4
No	239	97.6
Mobile usage		
>1 h	53	21.6
<1 h	143	58.4
No usage	49	20

Table 2: Neonatal factors related to autism among children

Characteristics	No of patients	Percentage
Gestation		
Preterm	5	2
Term	240	98
Weight		
LBW	32	13.1
Normal	213	86.9
NICU stay		
Yes	24	9.8
No	221	90.2
Neonatal seizures		
Yes	1	0.4
No	244	99.6
Neonatal hypoglycemia		
Yes	1	0.4
No	244	99.6
Neonatal sepsis		
Yes	1	0.4
No	244	99.6
Neonatal jaundice		
No	245	100
Exclusive breastfeeding		
Yes	245	100
Delayed complementary feeding		
Yes	7	2.9
No	238	97.1
Bottle feeding		
Yes	7	2.9
No	238	97.1
Early cow's milk administration before 1 year		
Yes	45	18.4
No	200	81.6
Immunized up to age		
Yes	245	100

LBW: Low birth weight, NICU: Neonatal intensive care unit

accounting for 242 (98.8%) patients did not have a fine motor delay. Thirty-six patients (14.7%) experienced social delays and 209 (85.3%) did not experience social delays. Twenty-nine patients (11.8%) had language delays and 216 (88.2%) did not have language delays. A total of 202 patients (82.4%) were from nuclear families, whereas 43 (17.6%) were from joint families. Four patients (1.6%) had a history of autism in their siblings and 241 (98.4%) had no history of autism. A total of 194 patients (79.2%) used mobile phones, while 51 (20.8%) did not use mobile phones. 53 patients (21.6%) used mobile phones for >1 h, 143 (58.4%) used them for <1 h and 49 (20%) did not use mobile phones. Fifty-three patients (21.6%) watched TV for >1 h and 192 (78.4%) watched TV for <1 h.

MCHAT risk levels showed that three patients (42.9%) were classified as high-risk on the MCHAT, while four (57.1%) were classified as moderate-risk on the MCHAT. Two patients (25%) had severe autism, 4 (50%) had moderate autism, and 2 (25%) had mild autism based on ISAA score (Table 3).

Table 3: Developmental factors, family type, screen time, MCHAT risk levels, and ISAA scores related to autism among children

	No of patients	Percentage
Gross motor delay		
Yes	4	1.6
No	241	98.4
Fine motor delay		
Yes	3	1.2
No	242	98.8
Social delay		
Yes	36	14.7
No	209	85.3
Language delay		
Yes	29	11.8
No	216	88.2
Joint family		
Nuclear family	202	82.4
Joint family	43	17.6
H/o autism in siblings		
Yes	4	1.6
No	241	98.4
Mobile phone usage		
Yes	194	79.2
No	51	20.8
Mobile usage		
>1 h	53	21.6
<1 h	143	58.4
No usage	49	20
TV watching time		
>1 h	53	21.6
<1 h	192	78.4
MCHAT		
High risk	3	42.9
Moderate risk	4	57.1
ISAA score		
Severe autism	2	25
Moderate autism	4	50
Mild autism	2	25

The prevalence of autism was 5.3% among those under 3 years of age and 7% among those older than 3 years of age, with a P=0.586. The prevalence of autism was 8.3% in males and 3% in females, with a non-significant P=0.085. The prevalence of autism was 6.4% in patients with normal weight-for-height and 0.0% in wasted patients, with a non-significant P=0.41. Autism prevalence was significantly higher in the upper-middle and upper socioeconomic status groups (26.3% and 40%, respectively) compared to lower socioeconomic statuses, with a P<0.0001.

The prevalence of autism was 7.8% in patients with a history of consanguinity and 5.7% in those without consanguinity (P=0.565). Autism prevalence was significantly higher in children whose mothers were older than 30 years (21.9%) than in those whose mothers were younger (3.8%), with a P<0.0001. Autism prevalence was higher in children whose fathers were older than 30 years (12%) than in those whose fathers were younger (2.1%), with a P=0.001. No autism cases were associated with comorbidities during pregnancy (P=0.435). No autism cases were associated with chronic drug intake during pregnancy (P=0.527) (Table 4).

Table 4: Association of autism with age, sex, weight-for-height status, socioeconomic status, consanguinity, and parental factors

Characteristics	Autism		P-value
	No (%)	Yes (%)	
Age (years)			
<3	124 (94.7)	7 (5.3)	0.586
>3	106 (93)	8 (7)	
Sex			
Male	132 (91.7)	12 (8.3)	0.085
Female	98 (97)	3 (3)	
W/H			
Wasted	10 (100)	0	0.41
Normal	220 (93.6)	15 (6.4)	
Socioeconomic status			
Lower	48 (98)	1 (2)	<0.0001
Upper lower	28 (96.6)	1 (3.4)	
Lower middle	134 (97.1)	4 (2.9)	
Upper middle	14 (73.7)	5 (26.3)	
Upper	6 (60)	4 (40)	
Consanguinity			
Yes	47 (92.2)	4 (7.8)	0.565
No	183 (94.3)	11 (5.7)	
Mothers age in years			
>30	25 (78.1)	7 (21.9)	<0.0001
<30	205 (96.2)	8 (3.8)	
Fathers age in years			
>30	88 (88)	12 (12)	0.001
<30	142 (97.9)	3 (2.1)	
Comorbidities in pregnancy			
Yes	9 (100)	0	0.435
No	221 (93.6)	15 (6.4)	
Chronic drug intake during pregnancy			
Yes	6 (100)	0	0.527
No	224 (93.7)	15 (6.3)	

The prevalence of autism was 6.3% in term babies and 0.0% in preterm babies, with a P=0.564. The prevalence of autism was 3.1% among babies with LBW and 6.6% among normal-weight babies (P=0.448). The prevalence of autism was 4.2% in patients with a NICU stay and 6.3% in those without (P=0.674). Neonatal seizures were significantly associated with autism, with 6.7% of those with autism having a history of neonatal seizures, compared to 0% without autism (P<0.0001). The prevalence of autism was 0.0% among those with neonatal hypoglycemia and 6.1% among those without, with a P=0.798. The prevalence of autism was 0.0% among those with neonatal sepsis and 6.1% among those without sepsis, with a P=0.798. No autism was found to be associated with neonatal jaundice.

The prevalence of autism was 6.1% among the exclusively breastfed children. No autism cases were associated with delayed complementary feeding (P=0.493). No autism cases were associated with bottle feeding (P=0.493). The prevalence of autism was 0.0% among children administered cow's milk before 1 year and 7.5% among those who were not administered cow's milk before 1 year (P=0.058). All patients with autism were immunized up to age. The prevalence of autism was 0.0% in children with gross motor delay and 6.2% in those without gross motor delay (P=0.607). Autism prevalence was 33.3% among children with fine motor delay and 5.8% among those without fine motor delay, with a P=0.048. Autism prevalence was significantly higher in children with social delays (41.7%) than in those without social delays (0.0%) (P<0.0001).

The prevalence of autism was 51.7% among children with language delays and 0.0% among those without language delays (P<0.0001). The prevalence of autism was higher in joint families (100%) than in nuclear families (7.4%), with a P=0.065. The prevalence of autism was 75% among those with a history of autism in siblings and 5% among those without a history of autism in siblings, with a P<0.0001. Autism prevalence was significantly higher in children who used mobile phones (7.7%) than in those who did not use mobile phones (0.0%) (P=0.040). Autism prevalence was higher in children using mobile phones for >1 h (18.9%) than in those using mobile phones for <1 h (3.5%), with a P<0.0001. Autism prevalence was higher in children who watched TV for >1 h (18.9%) than in those watching <1 h (2.6%), with a P<0.0001 (Table 5).

Table 5: Association of autism with developmental factors, family type, and screen time

Characteristics	Autism		P-value
	No (%)	Yes (%)	
Gestation			
Preterm	5 (100)	0	0.564
Term	225 (93.8)	15 (6.3)	
Weight			
LBW	31 (96.9)	1 (3.1)	0.448
Normal	199 (93.4)	14 (6.6)	
NICU stay			
Yes	23 (95.8)	1 (4.2)	0.674
No	207 (93.7)	14 (6.3)	
Neonatal seizures			
Yes	0	1 (100)	<0.0001
No	230 (94.3)	14 (5.7)	
Neonatal hypoglycemia			
Yes	1 (100)	0	0.798
No	229 (93.9)	15 (6.1)	
Neonatal sepsis			
Yes	1 (100)	0	0.798
No	229 (93.9)	15 (6.1)	
Neonatal jaundice			
No	230 (93.9)	15 (6.1)	N/A
Exclusive breastfeeding			
Yes	230 (93.9)	15 (6.1)	N/A
Delayed complementary feeding			
Yes	7 (100)	0	0.493
No	223 (93.7)	15 (6.3)	
Bottle feeding			
Yes	7 (100)	0	0.493
No	223 (93.7)	15 (6.3)	
Early cow's milk administration before 1 year			
Yes	45 (100)	0	0.058
No	185 (92.5)	15 (7.5)	
Immunized up to age			
Yes	230 (93.9)	15 (6.1)	N/A
Gross motor delay			
Yes	4 (100)	0	0.607
No	226 (93.8)	15 (6.2)	
Fine motor delay			
Yes	2 (66.7)	1 (33.3)	0.048
No	228 (94.2)	14 (5.8)	
Social delay			
Yes	21 (58.3)	15 (41.7)	<0.0001
No	209 (100)	0	
Language delay			
Yes	14 (48.3)	15 (51.7)	<0.0001
No	216 (100)	0	
Joint family/nuclear family			
Nuclear family	187 (92.6)	15 (7.4)	0.065
Joint family	43 (100)	0	
H/o autism in siblings			
Yes	1 (25)	3 (75)	<0.0001
No	229 (95)	12 (5)	
Mobile phone usage			
Yes	179 (92.3)	15 (7.7)	0.04
No	51 (100)	0	
Mobile usage			
>1 h	43 (81.1)	10 (18.9)	<0.0001
<1 h	138 (96.5)	5 (3.5)	
No usage	49 (100)	0	
TV watching time			
>1 h	43 (81.1)	10 (18.9)	<0.0001
<1 h	187 (97.4)	5 (2.6)	

DISCUSSION

Autism involves social and communication challenges, along with repetitive behaviors, and can be diagnosed within 18–24 months. Despite global progress in autism research

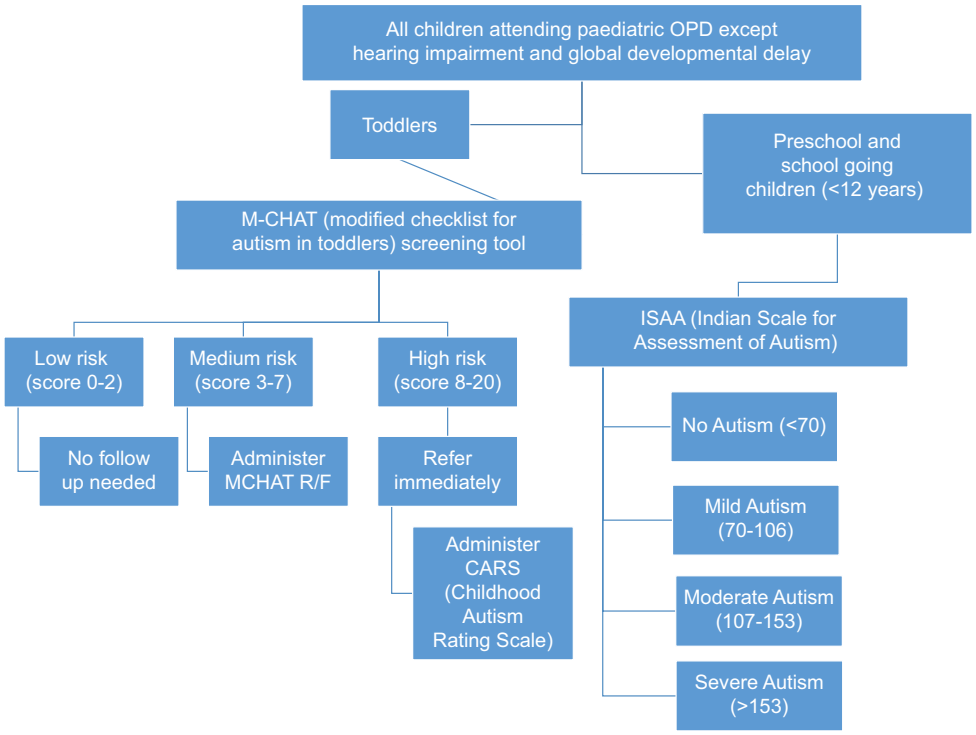

Figure 1: Case selection and assessment using M-CHAT and ISAA

and policies, access to diagnostic and intervention services varies across regions. This study found an autism prevalence rate of 6.1%, consistent with global estimates of 1 in 100 children.[14] Mittal et al., reported a 1% incidence of severe ASD,[15] which aligns with our findings, although prevalence varied by age, being slightly higher in children over 3 years (7%) than in younger children (5.3%). This suggests that diagnoses increase with age due to greater awareness and improved diagnostic tools in clinical settings, such as OPD. Autism was more prevalent in males (8.3%) than females (3%), which is consistent with the existing literature. Higher rates of autism were observed in children from upper-middle and upper socioeconomic backgrounds (26.3% and 40%, respectively), likely due to better access to diagnostic services. This highlights the need for equitable access to diagnostic services for children of lower socioeconomic backgrounds.

Parental age was identified as a significant risk factor for autism, with children born to mothers older than 30 years and fathers older than 35 years showing a significantly higher autism prevalence (21.9% and 12%, respectively). This association, supported by other studies such as those by Srivastava et al., and Arora et al., suggests that advanced parental age may contribute to the risk of neurodevelopmental disorders.[13,15-18] Our study also found that developmental delays, particularly in social and language skills, were strongly associated with autism, with social delays present in 41.7% of children with autism and language delays in 51.7%. These findings emphasize the need for early developmental screening as delays in these areas may serve as early indicators of ASD.

Maenner et al., reported a 23.0/1,000 prevalence of ASD among 8-year-olds, with a male-to-female ratio of 4.2.[3] May et al., observed that, in 2016, the parent-reported ASD prevalence among 12-year-olds from the Longitudinal Study of Australian Children's Birth cohort was 4.4%, compared to 2.6% in the Kinder cohort.[16] ASD assessment is a continuous process starting early in life and extending throughout the lifespan.[8]

Children with mothers aged >30 years had a significantly higher autism prevalence than those with younger mothers ($P<0.0001$), and children with older fathers also showed a higher prevalence ($P=0.001$). Therefore, the association with parental age was more pronounced. The prevalence of autism was significantly higher among children with neonatal seizures, but no significant associations were found with consanguinity, comorbidities, chronic drug intake during pregnancy, or gestation.

Arora et al., identified risk factors such as non-institutional delivery, perinatal asphyxia, neonatal illness, stunting, LBW, and older maternal age.[13] Strasser et al., found intellectual disability, sex, and age as risk factors for ASD.[17] Srivastava et al., highlighted advanced paternal age, preterm birth, neonatal jaundice, birth asphyxia, late breastfeeding initiation, neonatal seizures, and consanguinity as ASD risk factors.[18] In addition, our findings indicated a higher autism prevalence in children with fine motor delays ($P=0.048$). Social and

language delays showed stronger associations, with a prevalence of 41.7% among children with social delays and 51.7% among those with language delays (P<0.0001).

Mohd Nordin et al., reported gross (6.7%) and fine motor skill (38.5%) delays in children with ASD, especially in older age groups.[19] Choi et al., noted slower fine motor growth between 6 and 24 months in high-risk infants who later developed ASD.[20] LeBarton and Landa associated early motor skill delays with language delays.[21] A higher autism prevalence was found in children from joint families compared to nuclear families (P=0.065), aligning with Fayyaz et al.,'s findings.[22]

A family history of autism was strongly correlated with a higher autism prevalence. Children using mobile phones or watching TV for >1 h daily had a higher autism prevalence than those with <1 h of usage (P<0.0001), suggesting a potential association between excessive screen time and autism risk. Hermawati et al., observed language delays and short attention span in children watching screens ≤3 h daily, with hyperactivity also present in those watching ≥3 h.[23] Kushima et al., and Alrahili et al., found a significant association between longer screen time and ASD.[24,25] Careful use of research and diagnostic tools, a two-level screening process, and strengths-based assessments are recommended for accurate developmental monitoring.[26]

Limitations of the study

While the sample size was substantial, the study's cross-sectional design prevents the establishment of causal relationships between the identified risk factors and autism. In addition, the findings may not be generalizable to all populations, particularly those not attending pediatric OPD services at tertiary care hospitals.

CONCLUSION

This study identified several key factors linked to the prevalence of autism in children aged 1–12 years attending a pediatric OPD, including parental age, developmental delays, and possibly excessive screen time. These findings highlight the importance of early identification and intervention, particularly in children with developmental delays or a family history of autism. Future research should further investigate these associations, considering both genetic and environmental influences, to improve early diagnosis and intervention strategies in the clinical setting.

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