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EPIDEMIOLOGICAL PROFILE AND RISK FACTORS ASSOCIATED WITH AUTISM SPECTRUM DISORDER IN CHILDREN ATTENDING A TERTIARY CARE CENTER IN NORTHERN INDIA: A CASE-CONTROL STUDY

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ABSTRACT

Background: Autism Spectrum Disorder (ASD) is a multifactorial neurodevelopmental disorder, with both genetic and environmental influences. In developing countries, limited data exist on the role of potentially modifiable perinatal and environmental factors in the etiology of ASD, underscoring the need for focused assessments and management in this area.

Objective: To identify epidemiological and risk factors associated with ASD in children, comparing them to controls at a tertiary care center in Northern India.

Methods: This retrospective case-control study was conducted over 18 months at a tertiary care center. Seventy-five children aged 2–12 years were enrolled, including 50 with ASD (Group A), diagnosed per DSM-V criteria, and 25 age-matched healthy controls (Group B). Detailed demographic, perinatal, postnatal, and environmental data were collected. Statistical analysis was performed using chi-square and t-tests, with $p<0.05$ considered significant.

Results: Significant associations with ASD were found for high socioeconomic status ($p=0.007$), nuclear family structure ($p=0.007$), history of abortion ($p=0.004$), maternal systemic illness ($p=0.024$), and maternal drug intake during pregnancy ($p=0.031$). Delayed crying at birth was more frequent in the ASD group (14%; $p=0.049$). Early screen exposure (<1 year) and prolonged screen time (>3 hours/day) were highly associated with ASD ($p<0.001$). Although not all were statistically significant, higher rates of inadequate sleep, non-exclusive breastfeeding, and vegetarian diet were observed in children with ASD.

Conclusion: The study highlights significant modifiable risk factors, particularly early screen exposure and maternal health issues linked to ASD. Targeted early interventions may reduce risk and improve outcomes.

Keywords: Autism Spectrum Disorder, perinatal, screen time, maternal health, socioeconomic status

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorders characterized by persistent deficits in social communication and interaction, along with restricted, repetitive patterns of behavior, interests, or activities (Hodges et al., 2020). Globally, the prevalence of Autism Spectrum Disorder (ASD) is on the rise. According to CDC reports (2020), approximately 1 in 36 children in the United States are diagnosed with ASD, affecting individuals across all racial, ethnic, and socioeconomic groups (Chakrabarti, 2023). In India, the estimated prevalence is 1.12 (0.74–1.68) per 100 children aged 2–9 years, translating to roughly 1 in every 68 children being affected (Panda, 2019).While genetic and neurobiological mechanisms play a central role in the pathogenesis of ASD, environmental, perinatal, and postnatal factors have also been implicated, especially in regions with limited access to early diagnostic and interventional services (Panda, 2019). In India, research on ASD has significantly increased in recent years, yet most studies have focused on behavioral therapies and symptomatology rather than examining etiological factors (Yuan et al., 2024). Furthermore, existing studies are concentrated in urban centers, while data from tertiary care settings in semi-urban or rural areas remain sparse.

Given India's socioeconomic and cultural diversity, identifying contextual risk factors is essential for designing appropriate screening and preventive strategies. The role of modifiable environmental exposures, maternal health status, and early life experiences has gained attention as potential contributors to ASD, especially in low- and middle-income countries (Qin et al., 2024). This study was therefore done to explore the epidemiological and risk factors of children with ASD attending a tertiary care hospital in Northern India, with a focus on identifying significant prenatal, perinatal, and postnatal risk factors. We also aimed to assess the impact of screen exposure patterns, breastfeeding practices, sleep pattern and dietary habitsin children at risk of ASD.

METHOD

Participants

This was a hospital-based, observational case-control study conducted at the Child Psychology Clinic, Department of Pediatrics, in collaboration with the Department of Kaumarbhritya/Balroga, of a tertiary care center, over a period of 18 months. The study included 75 children aged between 2 to 12 years, with 50 children clinically diagnosed with Autism Spectrum Disorder constituting the case group (Group A), and 25 age-matched neurotypical children as controls (Group B). The diagnosis of ASD is made by a pediatrician and a trained child psychologist, based on the DSM-5 diagnostic criteria.

Measures

1. Personal data sheet- was used to measure the basic demographic details of children with ASD
2. Indian Scale for Assessment of Autism (ISAA): was used to assess Autism Spectrum Disorder (ASD) and to determine the severity of symptoms in the children included in the study. The ISAA consists of 40 items, which are grouped into six domains namely, Social Relationship and Reciprocity, Emotional Responsiveness, Speech–Language and Communication, Behavior Patterns, Sensory Aspects, and Cognitive Component. Each item is rated on a five-point scale ranging from 1 to 5, based on the intensity, frequency, and duration of the behavior. The total ISAA score ranges from 40 to 200, with lower scores indicating no or minimal autistic symptoms and higher scores were reflecting more severe manifestations of Autism Disorder. According to the recommended guidelines, scores between 70 and 107 indicate mild autism, scores between 108 and 153 indicate moderate autism, and scores of 153 and above indicate severe autism.
3. Risk-Factor Questionnaire for ASD: was developed by researcher based on available literature to systematically gather information on a wide range of factors that may contribute to the risk of Autism Spectrum Disorder. The questionnaire included items related to potential prenatal, perinatal, postnatal, family/genetic, and environmental risk factors. Prenatal risk factors assessed in the questionnaire included maternal systemic illness, hyperemesis, infections, drug intake, and any history of abortion or bleeding during pregnancy. Perinatal factors documented were gestational age, mode and place of delivery, the presence of meconium-stained amniotic fluid (MSAF), prolonged labour, delayed crying at birth, and birth weight. Postnatal information collected included NICU admission, immunization status, screen exposure (with details on onset and duration), dietary pattern (vegetarian or mixed), breastfeeding practices, and adequacy of sleep.

Procedure

Participants were recruited through purposive sampling based on predefined inclusion criteria aligned with the study objectives. Written informed consent was obtained from their parents or legal guardians. After consent, the Indian Scale for Assessment of Autism (ISAA) was administered to assess the presence and severity of autism-related symptoms. A detailed developmental and clinical history was then collected using a semi-structured proforma developed for the study. This proforma included comprehensive sociodemographic information and details of relevant prenatal, perinatal, and postnatal events.

Ethical Approval

The ethical review committee of the Institute of Medical sciences, Banaras Hindu University, Varanasi, had approved the study.

Data Analysis

The data collected were compiled and analyzed using SPSS software version 26.0. Descriptive statistics were applied for demographic variables. Categorical variables were compared using chi-square test, and continuous variables using independent sample t-test. A p-value <0.05 was considered statistically significant.

RESULTS

The study included 75 children, with 50 in the ASD group (Group A) and 25 in the control group (Group B). The mean age of children in Group A was 4.68 ± 1.2 years, with a male predominance. In Group B, the mean age was 4.52 ± 1.1 years, with a similar gender ratio. There was no significant difference between the groups with respect to parental age or place of residence. Socioeconomic status was found to be significantly associated with ASD, with 28% of children in Group A belonging to the high socioeconomic strata, compared to 4% in the control group (p=0.007). A nuclear family structure was more common in ASD cases (48%) compared to controls (16%), and this difference was statistically significant (p=0.007) as shown in table 1.

Table 1: Demographic and Socioeconomic Characteristics of Study Participants

Characteristic	Group A (ASD) n=50	Group B (Controls) n=25	p-value
Mean Age (years ± SD)	4.8 ± 1.3	4.7 ± 1.2	0.68[a]
Male Gender, n(%)	39(78)	14(56)	0.02[b]
Nuclear Family, n(%)	24(48)	4(16)	0.007[b]
Higher Socioeconomic Status, n(%)	14(28)	1(4)	0.007[c]
Maternal Age >30 yrs, n(%)	15(30)	7(28)	0.78[b]
Paternal Age >35 yrs, n(%)	26(52)	14(56)	0.74[b]
Uarban Residence, n(%)	19(38)	11(44)	0.617[b]
Marital Status (Married), n(%)	49(98)	25(100)	0.477[b]
Any psychiatric disorder in family, n(%)	5(10)	0	0.102[c]

[a]Independent sample t-test, [b]Pearson Chi square test, [c]Fisher's exact test, SD- Standard Deviation, ASD- Autism Spectrum Disorder

Among prenatal factors, 18% of mothers of ASD children reported systemic illness during pregnancy, whereas none in the control group (p=0.024). History of maternal drug use during pregnancy was present in 24% of cases but 4% in controls (p=0.031). Additionally, a significant association was found between maternal hyperemesis (72% in cases vs. 40% in controls, p=0.007) and history of abortion (30% vs. 0%, p=0.004). Perinatal complications also showed important associations. A history of delayed crying at birth was significantly higher in ASD children (14%) compared to 0% in controls (p=0.049). Although a history of MSAF was present in 10% of ASD children, the difference was not statistically significant. Similarly, prolonged labor and mode of delivery did not show significant associations. Postnatal findings revealed that 26% of ASD children had a history of hospitalization after birth, compared to 28% of controls as shown in table 2.

Table 2: Comparison of Prenatal and Perinatal Risk Factors

Risk Factor	Group A (ASD) n=50	Group B (Controls) n=25	p-value
History of Abortion, n(%)	15(30)	0	0.004[b]
Maternal Systemic Illness, n(%)	9(18)	0	0.024[b]
Maternal Hyperemesis, n(%)	36(72)	10(40)	0.007[a]
Maternal Drug Use in Pregnancy, n(%)	12(24)	1(4)	0.031[b]
Maternal Bleeding, n(%)	10(20)	1(4)	0.065[b]
Intrauterine Infection, n(%)	4(8)	2(8)	1.000[b]
Delayed Crying at Birth, n(%)	7(14)	0	0.049[b]
Meconium Stained Amniotic Fluid, n(%)	5(10)	1(4)	0.367 [b]
Prolonged Labor, n(%)	4(8)	0	0.146[b]
Birth Weight ≥2.5 kg, n(%)	41(82)	23(92)	0.249[a]
NICU Admission After Birth, n(%)	13(26)	7(28)	0.854[a]

[a]Pearson Chi square test, [b]Fisher's exact test, ASD- Autism Spectrum Disorder

Full immunization was noted in 96% of ASD children versus 100% in controls. Exclusive breastfeeding was reported in 86% of ASD children, higher than previously published studies, but not significantly different from controls. Inadequate sleep was reported in 38% of children with ASD, which was higher than controls (20%) but not statistically significant. Environmental exposures, especially screen time, showed strong associations. A total of 64% of ASD children had screen exposure before the age of 1 year, while only 16% were exposed after 1 year. Prolonged screen time (>3 hours/day) was seen in 50% of ASD children, significantly higher than controls (p<0.001). The majority of ASD children (90%) were on a vegetarian diet as shown in table 3.

Table 3: Comparison of Environmental and Behavioral Risk Factors

Risk Factor	Group A (ASD) n=50	Group B (Controls) n=25	p-value
Screen Exposure Before Age 1, n(%)	32(64)	4(16)	0.001[b]
Screen Time >3 hrs/day, n(%)	25(50)	1(4)	0.001[b]
Exclusive Breastfeeding, n(%)	43(86)	21(84)	0.817[a]
Fully Immunized, n(%)	47(96)	25(100)	0.211[a]
Vegetarian Diet, n(%)	45(90)	17(68)	0.018[a]
Inadequate Sleep, n(%)	19(38)	5(20)	0.115[a]
Packaged Food Consumption, n(%)	5(10)	8(32)	0.018[a]

[a]Pearson Chi square test, [b]Fisher's exact test, ASD- Autism Spectrum Disorder

DISCUSSION AND CONCLUSION

This study highlights a broad spectrum of significant and potentially modifiable risk factors associated with Autism Spectrum Disorder in children from a tertiary care setting in Northern India. The findings highlight the importance of integrating perinatal, environmental, and socioeconomic variables into ASD risk assessment models, particularly in resource-limited settings. Maternal systemic illness, history of abortion, and use of medications during pregnancy were significantly associated with ASD (Jenabi et al., 2022; Lyall et al., 2014). Delayed crying at birth is a surrogate for perinatal asphyxia and was significantly more common in ASD children, supporting prior evidence of hypoxia as a contributing factor in ASD pathogenesis (Sato et al., 2022). The study draws attention to the profound influence of environmental factors, particularly screen exposure. Early onset and prolonged screen use were strongly associated with ASD, aligning with global concerns about Intensive Early Screen Exposure (IESE) (Fezer et al., 2017). Excessive screen use may interfere with attention development, social reciprocity, and language acquisition, which are core domains affected in ASD (Chen et al., 2020). Our study also supports the hypothesis that early screen use may disrupt maternal-child interaction, which is essential for socio-emotional development in early childhood (Dong et al., 2021). The association of a vegetarian diet with ASD in this population is an interesting finding, possibly reflecting nutritional deficits such as vitamin B12 or omega-3 fatty acid deficiency (Al- Beltagi, 2024; Swider-Cios et al., 2023). Although causality cannot be inferred, this result warrants further nutritional and biochemical exploration in future studies. The strength of our study is inclusion of a control group. However, certain limitations include small sample size, and the hospital-based nature of the study may limit generalizability. Recall bias from parental interviews and lack of longitudinal follow-up may have affected the accuracy of reported exposures.

In conclusion, the study identifies several important sociodemographic, maternal, perinatal, and environmental risk factors associated with ASD. These findings support the need for heightened awareness and early screening, particularly in high-risk populations. Public health efforts should focus on maternal care during pregnancy, reduce unnecessary medication exposure, discourage early screen exposure, and promote optimal early childhood nutrition and interaction. Future multicenter prospective studies with larger sample sizes and biochemical correlations will further validate these observations and guide early intervention strategies for ASD in the Indian context.

REFERENCES

1. Al-Beltagi, M. (2024). Nutritional management and autism spectrum disorder: A systematic review. World Journal of Clinical Pediatrics, 13(4), 99649.
2. Chakrabarti, B. (2023). Autism in India: Time for a national programme. Indian Journal of Medical Research, 157(4), 227–229.
3. Chen, J.-Y., Strodl, E., Huang, L.-H., Chen, Y.-J., Yang, G.-Y., & Chen, W.-Q. (2020). Early electronic screen exposureand autistic-like behaviors among preschoolers: The mediating role of caregiver–child interaction, sleep duration and outdoor activities. Children, 7(11), 200.
4. Dong, H. Y., Feng, J. Y., Wang, B., Shan, L., &Jia, F. Y. (2021). Screen time and autism: Current situation and risk factors for screen time among pre-school children with ASD. Frontiers in Psychiatry, 12, 675902.
5. Fezer, G. F., Matos, M. B., Nau, A. L., Zeigelboim, B. S., Marques, J. M., & Liberalesso, P. B. (2017). Características perinatais de crianças com transtorno do espectroautista. RevistaPaulista de Pediatria, 35(2), 130–135.
6. Hodges, H., Fealko, C., &Soares, N. (2020). Autism spectrum disorder: Definition, epidemiology, causes, and clinical evaluation. Translational Pediatrics, 9(Suppl 1), S55–S65.
7. Jenabi, E., Ayubi, E., Bashirian, S., Seyedi, M., &Rezaei, M. (2022). Association between previous abortion history and risk of autism spectrum disorders among offspring: A meta-analysis. Clinical and Experimental Pediatrics, 66(2), 70–75.
8. Lyall, K., Schmidt, R. J., & Hertz-Picciotto, I. (2014). Maternal lifestyle and environmental risk factors for spectrum disorders. International Journal of Epidemiology, 43(2), 443–464.
9. Panda, P. (2019). Current consensus on clinical features, pathogenesis, diagnosis and management of autism spectrum disorder in children: A brief review. International Journal of Pediatric Research, 6, 144–149.
10. Qin, L., Wang, H., Ning, W., Cui, M., & Wang, Q. (2024). New advances in the   diagnosis   and   treatment   of autism spectrum disorders. European Journal of Medical Research, 29(1), 322.
11. Sato, A., Kotajima-Murakami, H., Tanaka, M., Katoh, Y., & Ikeda, K. (2022). Influence of prenatal drug exposure, maternal inflammation, and parental aging on the development of autism spectrum disorder. Frontiers in Psychiatry, 13, 821455.
12. Swider-Cios, E., Vermeij, A., &Sitskoorn, M. M. (2023). Young children and screen-based media: The impact on cognitive and socioemotional development and the importance of parental mediation. Cognitive Development, 66, 101319.
13. Yuan, J. J., Zhao, Y. N., Lan, X. Y., Zhang, Y., & Zhang, R. (2024). Prenatal, perinatal and parental risk factors for autism spectrum disorder in China: A case-control study. BMC Psychiatry, 24(1), 219.