Correlation Between Sociodemographic Factors and Neurodevelopmental Disorders Among Children Born by Assisted Reproductive Technology

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Abstract

Introduction: *Children's psychological well-being is influenced by a complex interplay of factors, including socio-demographic variables. Understanding these relationships is critical for developing targeted interventions to improve children's mental health. This study aimed to assess the relationship between socio-demographic variables and children's psychological well-being using the Strengths & Difficulties Questionnaire (SDQ) score categories.*

Methods: *This retrospective longitudinal study was conducted at the Fertility Center of Combined Military Hospital, Dhaka, Bangladesh, with a sample of 47 parents and their children, who completed a socio-demographic questionnaire and the SDQ. Data were analyzed to examine correlations between socio-demographic variables and SDQ score categories, including emotional problems, conduct problems, hyperactivity, peer problems, prosocial behavior, and total difficulty score.*

Result: *The study included 47 participants, primarily parents aged 30-39 (53.19%). Most parents had education up to HSC level (68.09%) and belonged to the middle socio-economic class (72.34%). SDQ scores revealed a considerable proportion of children with average scores in various categories, though some exhibited very high or low scores in prosocial behavior, peer relationship problems, and conduct problems. Bivariate correlation analysis found significant correlations (p<0.05) between various socio-demographic variables and SDQ score categories, highlighting the complex relationship between demographic factors and children's mental health.*

Conclusion: *This study contributes to the understanding of the impact of socio-demographic factors on children's mental health, highlighting the need for targeted interventions addressing specific problem areas. The findings emphasize the importance of a comprehensive approach to understanding and addressing children's psychological well-being by considering the interconnected nature of mental health domains and focusing on enhancing protective factors such as prosocial behavior and supportive relationships.*

Keywords: *Neurodevelopmental, Impairment, Disorder, SDQ*

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I. INTRODUCTION

Neurodevelopmental disorders (NDDs) encompass a wide range of conditions characterized by impairments in cognitive, emotional, and behavioral functioning that originate during childhood development.(1) Autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and intellectual disability (ID) are some of the most common NDDs affecting millions of children worldwide.(2,3) The etiology of NDDs is complex, involving a combination of genetic, environmental, and sociodemographic factors.(4) Assisted

reproductive technology (ART) refers to a group of medical interventions utilized to facilitate conception in infertile couples. In vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI) are the most commonly employed ART techniques.(5) While these techniques have resulted in the successful birth of millions of children worldwide, there is mounting evidence suggesting that children conceived through ART may be at an increased risk of developing NDDs.(6–8)The difficulties faced by individuals with NDDs are multifaceted and can persist throughout their lives, affecting not only the individuals themselves but also their families, caregivers, and society at large. These challenges may include difficulties with communication, social interactions, emotional regulation, learning, and adaptive skills, as well as increased healthcare and educational needs.(3) Moreover, the economic burden of NDDs is substantial, with increased direct and indirect costs for healthcare, education, and support services, as well as lost productivity for affected individuals and their caregivers.(9,10) Given the high prevalence and far-reaching implications of NDDs, it is essential to investigate factors that may contribute to their development and inform effective prevention and intervention strategies.Several hypotheses have been proposed to explain the potential link between ART and NDDs. Some researchers argue that the increased risk may be attributed to the underlying infertility of the parents, rather than the ART procedures themselves.(11,12) Alternatively, others suggest that certain ART techniques, such as ICSI, may increase the likelihood of genetic abnormalities and epigenetic alterations, which in turn contribute to the development of NDDs.(13,14) Further research is needed to elucidate the specific mechanisms underlying the association between ART and NDDs, as well as the role of sociodemographic factors in this relationship.Bangladesh, a densely populated South Asian country, has witnessed a significant increase in the demand for ART services in recent years, driven by rapid urbanization and sociocultural factors.(15,16) Despite this, there is a scarcity of research investigating the correlation between sociodemographic factors and NDDs among children conceived through ART in the Bangladeshi context. Understanding these associations is crucial for developing targeted prevention and intervention strategies to address NDDs in this vulnerable population.This study aims to examine the correlation between sociodemographic factors, such as maternal age, education, and socioeconomic status, and the prevalence of NDDs among children born through ART in Bangladesh. Previous studies conducted in other countries have reported that advanced maternal age, lower maternal education, and lower socioeconomic status are associated with an increased risk of NDDs in children.(17–19) However, the extent to which these findings are generalizable to the Bangladeshi population remains unclear. As such, the present study seeks to investigate the correlation between sociodemographic factors and the prevalence of neurodevelopmental disorders among children born through assisted reproductive technology in Bangladesh. By examining the unique sociodemographic context of Bangladesh and addressing the current gap in the literature, this research will provide valuable insights that may inform targeted interventions and public health policies aimed at reducing the burden of NDDs in this population.

II. METHODS

This retrospective longitudinal study was conducted at the Fertility Center of Combined Military Hospital, Dhaka, Bangladesh. The study period was 5 years, from September 2017 to September 2022. Children born between this period who fulfilledthe criteria were included in the study. The study population included all children born by ART at the center during the study period, and participants were selected using purposive convenient consecutive sampling. Inclusion criteria for the study were mothers whose children were over the age of 2 years, born by ART in CMH Dhaka since the fertility center was established, and who provided consent to participate. Exclusion criteria included mothers who were not interested in participating in the study.Data collection was carried out by the researcher through face-to-face interviews with the participants, using semi-structured questionnaires designed by the investigator, after obtaining informed consent. The questionnaires included items to assess socio-demographic characteristics and the Strengths & Difficulties Questionnaire (SDQ) to determine the psychosocial competencies of the children. Children identified as having difficulties by the SDQ were further evaluated for neurodevelopmental disorders using the DSM-5 by a psychiatrist. Data were collected in collaboration with the Department of Psychiatry and the Department of Gynecology and Obstetrics (Infertility Centre of CMH Dhaka).Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 23.0. Quantitative data were expressed as means and standard deviations, while qualitative data were expressed as frequencies and percentages. Comparisons were made using the Chi-Square ($\chi2$) test and unpaired t-test where necessary, and risk factors were determined using odd ratios. A probability (p) value of < 0.05 (p<0.05) was considered statistically significant, and p<0.001 was considered highly significant, while $p > 0.05$ was considered non-significant. Results were presented in text, tables, graphs, and figures.

III. RESULTS

Table 1: Distribution of participants by baseline characteristics (n=47)

Variables	Frequency	Percentage
Parents Age		
20-29	7	14.89%
30-39	25	53.19%
40-49	15	31.91%
Mean ± SD	36.47 ± 6.49	
Parental Educational Status		
Up to HSC	32	68.09%
Degree and above	15	31.91%
Socio-Economic Status		
Lower class	10	21.28%
Middle class	34	72.34%
Upper Class	4	8.51%
Type of habitat		
Rural	22	46.81%
Urban	25	53.19%
Family History of Psychiatric Illness		
Yes	6	12.77%
No	41	87.23%
Clinical History of Physical Illness		
Yes	4	8.51%
No	43	91.49%
Children's gender		
Male	22	46.81%
Female	25	53.19%

The study included 47 participants, with the majority of parents (53.19%) aged between 30-39 years old. The mean age of the parents was 36.47 ± 6.49 years. In terms of parental educational status, 68.09% of the parents had an educational background up to the Higher Secondary Certificate (HSC) level, while 31.91% had a degree or higher. The socio-economic status of the participants revealed that the majority belonged to the middle class (72.34%), while 21.28% were classified as lower class, and 8.51% as upper class. The type of habitat was evenly distributed, with 46.81% of the participants living in rural areas and 53.19% in urban areas.Regarding the family history of psychiatric illness, only 12.77% of the participants reported having a history, while 87.23% did not. A small percentage (8.51%) of the participants had a clinical history of physical illness, while the majority (91.49%) did not. Finally, the children's gender was almost equally distributed, with 46.81% being male and 53.19% being female.

Table 2: Distribution of participants by categorized Strengths & Difficulties Questionnaire score (n=47)

Variables	Frequency	Percentage
Prosocial Behavior Category		
Close to Average	23	48.94%
Slightly Raised/Lowered	8	17.02%
Moderately High/Low	7	14.89%
Very High/Low	9	19.15%
Mean Score	2.04 ± 1.20	
Peer Relationships Problems Category		
Close to Average	15	31.91%
Slightly Raised/Lowered	7	14.89%
Moderately High/Low	10	21.28%
Very High/Low	15	31.91%
Mean Score	2.53 ± 1.25	
Hyperactivity Category		

Close to Average	32	68.09%
Slightly Raised/Lowered	5	10.64%
Moderately High/Low	4	8.51%
Very High/Low	6	12.77%
Mean Score	1.66 ± 1.09	
Conduct Problems Category		
Close to Average	26	55.32%
Slightly Raised/Lowered	8	17.02%
Moderately High/Low	3	6.38%
Very High/Low	10	21.28%
Mean Score	1.94 ± 1.22	
Emotional Symptoms Category		
Close to Average	24	51.06%
Slightly Raised/Lowered	17	36.17%
Moderately High/Low	3	6.38%
Very High/Low	3	6.38%
Mean Score	1.68 ± 0.86	
Total Difficulty Score		
Close to Average	19	40.43%
Slightly Raised/Lowered	12	25.53%
Moderately High/Low	5	10.64%
Very High/Low	11	23.40%
Mean Score	2.17 ± 1.20	

For prosocial behavior, 48.94% of the children scored close to average, 17.02% scored slightly raised/lowered, 14.89% scored moderately high/low, and 19.15% scored very high/low. The mean score in this category was 2.04 ± 1.20.

In the peer relationship problems category, 31.91% scored close to average, 14.89% scored slightly raised/lowered, 21.28% scored moderately high/low, and 31.91% scored very high/low. The mean score for this category was 2.53 ± 1.25.

Regarding hyperactivity, 68.09% of children scored close to average, 10.64% scored slightly raised/lowered, 8.51% scored moderately high/low, and 12.77% scored very high/low. The mean score for hyperactivity was 1.66 ± 1.09.

For conduct problems, 55.32% of the children scored close to average, 17.02% scored slightly raised/lowered, 6.38% scored moderately high/low, and 21.28% scored very high/low. The mean score in this category was 1.94 ± 1.22.

In the emotional symptoms category, 51.06% of children scored close to average, 36.17% scored slightly raised/lowered, 6.38% scored moderately high/low, and 6.38% scored very high/low. The mean score for emotional symptoms was 1.68 ± 0.86.

Finally, the total difficulty score revealed that 40.43% of the children scored close to average, 25.53% scored slightly raised/lowered, 10.64% scored moderately high/low, and 23.40% scored very high/low. The mean total difficulty score was 2.17 ± 1.20.

Table 3: Bivariate Correlation between socio-demographic variables and SDQ score categories (n=47)

		Parents A	Socio-econ	Type of I	Family histo	Clinical H	Children's S	Emotional F	Conduct Pr	Hyperactivity C	Peer Proble	Prosocial c	Total Diff
Parents Age	Pearson Corr	1	0.209	0.181	-0.039	.401*	-.419*	0.122	0.212	-0.196	0.144	-0.161	0.129
	Sig. (2-tailed		0.251	0.338	0.831	**0.023**	**0.014**	0.491	0.229	0.266	0.415	0.363	0.469
Socio-economi	Pearson Corr	0.209	1	-0.154	0.053	0.113	-.419**	-0.229	-0.185	-0.256	-0.309	0.083	-0.283
	Sig. (2-tailed	0.251		0.364	0.747	0.499	**0.008**	0.161	0.260	0.116	0.055	0.615	0.081
Type of Habita	Pearson Corr	0.181	-0.154	1	.429**	-0.067	-0.088	0.195	-0.041	-0.153	0.062	-0.026	0.063
	Sig. (2-tailed	0.338	0.364		**0.008**	0.696	0.604	0.247	0.812	0.366	0.714	0.879	0.713
Family history	Pearson Corr	-0.039	0.053	.429**	1	-0.100	0.127	0.161	0.157	0.215	0.293	-0.009	0.289
	Sig. (2-tailed	0.831	0.747	**0.008**		0.549	0.441	0.329	0.340	0.189	0.070	0.958	0.074
Clinical History	Pearson Corr	.401*	0.113	-0.067	-0.100	1	0.146	0.205	0.221	-0.121	0.054	0.159	0.110
	Sig. (2-tailed	**0.023**	0.499	0.696	0.549		0.383	0.217	0.183	0.468	0.747	0.342	0.510
Children's Sex	Pearson Corr	-.419*	-.419**	-0.088	0.127	0.146	1	0.049	0.127	.376**	.335*	0.034	0.242
	Sig. (2-tailed	**0.014**	**0.008**	0.604	0.441	0.383		0.744	0.396	**0.009**	**0.021**	0.822	0.102
Emotional Prob	Pearson Corr	0.122	-0.229	0.195	0.161	0.205	0.049	1	.289*	0.275	-0.041	0.203	.430**
	Sig. (2-tailed	0.491	0.161	0.247	0.329	0.217	0.744		**0.048**	0.061	0.785	0.171	**0.003**
Conduct Proble	Pearson Corr	0.212	-0.185	-0.041	0.157	0.221	0.127	.289*	1	.506**	0.236	0.239	.775**
	Sig. (2-tailed	0.229	0.260	0.812	0.340	0.183	0.396	0.048		**<0.001**	0.110	0.105	**<0.001**
Hyperactivity	Pearson Corr	-0.196	-0.256	-0.153	0.215	-0.121	.376**	0.275	.506**	1	0.264	.395**	.692**
	Sig. (2-tailed	0.266	0.116	0.366	0.189	0.468	**0.009**	0.061	**<0.001**		0.073	**0.006**	**<0.001**
Peer Problems	Pearson Corr	0.144	-0.309	0.062	0.293	0.054	.335*	-0.041	0.236	0.264	1	0.145	.474**
	Sig. (2-tailed	0.415	0.055	0.714	0.070	0.747	**0.021**	0.785	0.110	0.073		0.332	**0.001**
Proscoial Categ	Pearson Corr	-0.161	0.083	-0.026	-0.009	0.159	0.034	0.203	0.239	.395**	0.145	1	0.282
	Sig. (2-tailed	0.363	0.615	0.879	0.958	0.342	0.822	0.171	0.105	**0.006**	0.332		0.055
Total Difficulty	Pearson Corr	0.129	-0.283	0.063	0.289	0.110	0.242	.430**	.775**	.692**	.474**	0.282	1
	Sig. (2-tailed	0.469	0.081	0.713	0.074	0.510	0.102	**0.003**	**<0.001**	**<0.001**	**0.001**	0.055	

Table 3 presents the bivariate correlation analysis between socio-demographic variables and Strengths & Difficulties Questionnaire (SDQ) score categories for the 47 participants. There was a significant positive correlation between parental age and clinical history of physical illness (r = 0.401, p = 0.023) and a significant negative correlation between parental age and children's sex (r = -0.419, p = 0.014). Socio-economic status showed a significant negative correlation with children's sex (r = -0.419, p = 0.008). Type of habitat had a significant positive correlation with family history of psychiatric illness (r = 0.429, p = 0.008).Children's sex showed significant positive correlations with hyperactivity (r = 0.376, p = 0.009) and peer problems categories (r = 0.335, p = 0.021). Emotional problems category had a significant positive correlation with conduct problems (r = 0.289, p = 0.048) and total difficulty score (r = 0.430, p = 0.003). Conduct problems category demonstrated strong positive correlations with hyperactivity (r = 0.506, p < 0.001) and total difficulty score (r = 0.775, p < 0.001). Hyperactivity category was positively correlated with prosocial category (r = 0.395, p = 0.006) and total difficulty score (r = 0.692, p < 0.001). Lastly, peer problems category was positively correlated with the total difficulty score (r = 0.474, p = 0.001).

IV. DISCUSSION

The current study aimed to assess the relationship between socio-demographic variables and children's psychological well-being, as measured by the Strengths & Difficulties Questionnaire (SDQ) score categories. Our findings contribute to the existing body of knowledge by providing additional insights into the potential impact of demographic factors on children's mental health.The majority of participants in this study were parents aged 30-39 (53.19%), with up to HSC education (68.09%) and belonging to the middle socio-economic class (72.34%). This is consistent with the global trend of increasing age of parents at the time of childbirth, which has been associated with various factors such as higher education levels and career aspirations.(20,21)

The SDQ score categories included prosocial behavior, peer relationship problems, hyperactivity, conduct problems, and emotional symptoms. The results showed that a substantial proportion of the children fell within the close to average range for prosocial behavior (48.94%), conduct problems (55.32%), and emotional symptoms (51.06%). However, it is noteworthy that a considerable percentage of participants exhibited very high or low scores for prosocial behavior (19.15%), peer relationship problems (31.91%), and conduct problems (21.28%). These findings emphasize the variability in children's psychological well-being and the need for targeted interventions addressing specific problem areas to improve overall mental health.In our study, there was a significant positive correlation between parental age and clinical history of physical illness, and a significant negative correlation between parental age and children's sex. The relationship between parental age and children's mental health has been widely explored in the literature, with some studies suggesting that older parents may have a positive influence on their children's psychological well-being due to increased emotional maturity and financial stability.(22) However, other studies have shown mixed results, indicating that the relationship between parental

age and children's mental health is complex and likely influenced by various factors.(23) Regarding socio-economic status, our study found a significant negative correlation with children's sex. A previous study by Kaiser (2017) reported that children from lower socio-economic backgrounds are at a higher risk of developing emotional and behavioral problems.(24) This suggests that socio-economic status may play a crucial role in children's mental health, potentially due to the availability of resources and access to quality healthcare and education.We found a significant positive correlation between type of habitat and family history of psychiatric illness. This is in line with previous research which has shown that urban environments can be associated with higher rates of psychiatric disorders, potentially due to factors such as increased stress, social isolation, and exposure to environmental toxins.(25) However, it is important to consider that rural environments may also have unique challenges that could impact children's mental health, such as limited access to mental health services and social support networks(26,27) The children's sex showed significant positive correlations with hyperactivity and peer problems categories. This is consistent with prior research that has found that boys are more likely to exhibit externalizing behaviors such as hyperactivity and aggression, while girls are more likely to demonstrate internalizing behaviors like anxiety and depression.(28) However, it is essential to acknowledge that gender differences in mental health outcomes may be influenced by various factors, such as cultural expectations, parenting practices, and biological predispositions.(29)Our findings revealed significant correlations between different Strengths and Difficulties Questionnaire (SDQ) score categories, emphasizing the intricate relationships between various aspects of children's psychological well-being. These associations suggest that children experiencing difficulties in one domain may be more likely to face challenges in other areas, underscoring the complexity of factors that contribute to children's mental health.For instance, the observed positive correlation between emotional problems and conduct problems indicates that children struggling with emotional issues may also be more likely to exhibit behavioral difficulties. This relationship can be attributed to various factors, such as the influence of negative emotions on decision-making, impulsivity, and social interactions, which can result in conduct problems. Similarly, the significant correlation between hyperactivity and peer problems suggests that children with high levels of hyperactivity may have difficulties in social situations, potentially due to challenges in self-regulation, attention, and understanding social cues.Moreover, the association between prosocial behavior and total difficulty score implies that children with higher levels of prosocial behavior may have lower overall difficulties. Prosocial behavior, which involves actions that benefit others, such as helping, sharing, and cooperating, can have a protective effect on children's mental health by fostering positive relationships with peers, enhancing self-esteem, and promoting resilience in the face of adversity.The interplay of factors influencing children's mental health highlights the importance of a comprehensive approach to understanding and addressing children's psychological well-being. Recognizing the interconnected nature of children's mental health domains can guide the development of multifaceted interventions that target multiple aspects of psychological well-being simultaneously. This approach can include addressing emotional, behavioral, and social components of mental health, as well as focusing on enhancing protective factors, such as prosocial behavior and supportive relationships.

V.   Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

VI.   CONCLUSION

In conclusion, this study provides valuable insights into the associations between socio-demographic factors and children's mental health outcomes. However, it is important to recognize the limitations of a cross-sectional design and the need for further longitudinal research to establish causal relationships. Future studies should also consider investigating additional factors that may influence children's mental health, such as parenting styles, family functioning, and exposure to adverse childhood experiences. Ultimately, understanding the complex interplay of factors that contribute to children's mental health will facilitate the development of targeted interventions and policies to promote the psychological well-being of children across diverse socio-demographic backgrounds.

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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