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PREVALENCE AND DETERMINANTS OF DEVELOPMENTAL DELAY AMONG CHILDREN AGED 6 MONTHS TO 5 YEARS USING STANDARDIZED SCREENING TOOLS IN A TERTIARY CARE HOSPITAL IN NORTH INDIA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Developmental delay in early childhood is a major public health concern, particularly in low- and middle-income countries. Early identification through screening tools is essential for timely intervention and improved outcomes.

Objectives: To assess the prevalence of developmental delay among children aged 6 months to 5 years using standardized screening tools and to identify associated risk factors.

Methods: A hospital-based cross-sectional study was conducted from January 2019 to October 2019 in a tertiary care hospital in North India. A total of 60 children aged 6 months to 5 years were included using consecutive sampling. Data on socio-demographic and perinatal factors were collected using a structured questionnaire. Developmental screening was performed using age-appropriate standardized tools (TDSC and DDST-II). Statistical analysis was carried out using SPSS version 21.0, and associations were tested using Chi-square/Fisher's exact test with $p<0.05$ considered significant.

Results: The prevalence of developmental delay was 18.3%. Language delay was the most commonly affected domain (54.5%), followed by gross motor delay (36.4%). Significant associations were found between developmental delay and low birth weight ($p=0.03$), prematurity ($p=0.04$), birth asphyxia ($p=0.02$), and undernutrition ($p=0.05$). Socio-demographic factors such as rural residence and lower socioeconomic status showed higher proportions but were not statistically significant.

Conclusion: Developmental delay is relatively common among children attending tertiary care settings. Early screening using simple tools is effective in identifying at-risk children. Integration of developmental screening into routine pediatric care and targeted interventions for high-risk groups are recommended.

Keywords: Developmental delay; Screening tools; Under-five children; Risk factors; Early detection; TDSC; DDST-II

INTRODUCTION

Early childhood represents a critical period of rapid neurodevelopment, during which the foundation for cognitive, motor, language, and socio-emotional functioning is established. Developmental delay, defined as a significant lag in achieving age-appropriate milestones in one or more domains, is a major public health concern worldwide. It is estimated that approximately 5–15% of children globally experience some form of developmental delay, with higher prevalence reported in low- and middle-income countries due to adverse socioeconomic and environmental factors [1,2]. Early identification and timely intervention are crucial, as they can substantially improve long-term developmental outcomes and reduce disability-adjusted life years (DALYs) [3].

Globally, several screening tools have been developed to facilitate early detection of developmental delays in children. Instruments such as the Ages and Stages Questionnaire (ASQ), Denver Developmental Screening Test (DDST), and Trivandrum Developmental Screening Chart (TDSC) are widely used in both clinical and community settings [4,5]. These tools are designed to be simple, cost-effective, and feasible for use in resource-limited settings, thereby enabling early referral and intervention. Despite the availability of such tools, routine developmental screening is not universally implemented, particularly in developing countries, due to lack of awareness, trained personnel, and integration into primary healthcare services [6].

In the Indian context, developmental delays remain under-recognized and under-reported. Studies have indicated that nearly 10–20% of children under five years of age in India may be at risk of developmental delay, with higher prevalence among those exposed to risk factors such as low birth weight, prematurity, malnutrition, perinatal asphyxia, and low socioeconomic status [7,8]. National programs such as the Rashtriya Bal Swasthya Karyakram (RBSK) have emphasized early identification of developmental delays; however, gaps persist in effective screening and timely referral at the facility level [9].

At the tertiary care level, children presenting to pediatric outpatient departments often represent a mix of both healthy and high-risk populations. This provides an opportunity for systematic screening using standardized tools to detect developmental delays that might otherwise go unnoticed. However, there is limited data from tertiary care settings in North India assessing the burden of developmental delay using validated screening instruments, particularly in children under five years of age.

Furthermore, variability in the choice of screening tools and lack of standardized implementation protocols contribute to inconsistencies in reported prevalence and outcomes. There is a need for context-specific data to inform clinical practice and policy decisions, especially in regions with diverse socio-demographic characteristics.

In this context, the present study aims to assess developmental delay among children aged 6 months to 5 years using standardized screening tools in a tertiary care hospital in North India. The objectives are to estimate the proportion of children with developmental delay and to evaluate associated socio-demographic and perinatal factors influencing developmental outcomes.

METHODOLOGY

Study Design: This was a hospital-based cross-sectional observational study conducted to assess developmental delay using standardized screening tools among children aged 6 months to 5 years.

Study Setting: The study was carried out in the Department of Pediatrics of a tertiary care hospital in North India, which caters to both urban and rural populations and receives a large number of pediatric outpatient visits.

Study Duration: The study was conducted over a period of ten months from January 2019 to October 2019.

Study Population: Children aged 6 months to 5 years attending the pediatric outpatient department (OPD) or immunization clinic during the study period constituted the study population.

Inclusion Criteria

• Children aged between 6 months and 5 years

• Children attending pediatric OPD or immunization clinic
• Children whose parents/guardians provided informed consent

Exclusion Criteria
• Children with previously diagnosed developmental disorders (e.g., cerebral palsy, autism spectrum disorder, Down syndrome)
• Children with acute severe illness requiring emergency care
• Children whose caregivers were unwilling or unable to participate

Sample Size: The sample size was calculated using the formula for estimating a proportion in a cross-sectional study:

$$n = \frac{Z^2 \times p \times q}{d^2}$$

Where:
• (Z = 1.96) (for 95% confidence level)
• (p = 15%) (expected prevalence of developmental delay based on previous studies)
• (q = 1 - p = 85%)
• (d = 10%) (absolute precision)
The calculated sample size was approximately 49. Considering feasibility and rounding off, a total of 60 children were included in the study.

Sampling Technique: A consecutive sampling technique was used. All eligible children attending the pediatric OPD or immunization clinic during the study period were recruited until the desired sample size of 60 was achieved.

Data Collection Tools & Procedure: Data were collected using a predesigned, pretested structured questionnaire administered to the caregivers. The questionnaire included sections on socio-demographic details, birth history, and relevant medical history. Developmental assessment was carried out using standardized screening tools appropriate for the age group, such as the Trivandrum Developmental Screening Chart (TDSC) for younger children and the Denver Developmental Screening Test II (DDST-II) for older children. Each child was assessed across developmental domains including gross motor, fine motor, language, and personal-social skills. Screening was conducted by trained investigators under supervision to ensure uniformity. Children identified with suspected developmental delay were referred for further evaluation.

Study Variables: The dependent variable was the presence or absence of developmental delay as determined by screening tools. Independent variables included age, sex, birth weight, gestational age, birth order, socioeconomic status, parental education, history of perinatal complications (such as birth asphyxia, neonatal intensive care admission), and nutritional status. These variables were selected based on their known association with developmental outcomes.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 21.0. Descriptive statistics such as frequencies and proportions were used to summarize categorical variables, while means and standard deviations were used for continuous variables. The association between developmental delay and independent variables was assessed using the Chi-square test or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from the parents or legal guardians of all participating children prior to enrollment. Confidentiality of participant information was strictly

maintained. The study adhered to the ethical principles outlined in the Declaration of Helsinki. Children identified with developmental delay were counseled and referred for appropriate diagnostic evaluation and early intervention services.

RESULTS

A total of 60 children aged 6 months to 5 years were included in the study. The majority belonged to the 37–60 months age group (33.3%), and males constituted 56.7% of the participants. Most children were from rural areas (63.3%) and lower socioeconomic status (46.7%) (Table 1).

Table 1: Socio-demographic Characteristics of Study Participants (n = 60)

Variable	Category	Frequency (n)	Percentage (%)
Age Group	6–12 months	12	20.0
	13–24 months	15	25.0
	25–36 months	13	21.7
	37–60 months	20	33.3
Sex	Male	34	56.7
	Female	26	43.3
Residence	Urban	22	36.7
	Rural	38	63.3
Socioeconomic Status	Lower	28	46.7
	Middle	24	40.0
	Upper	8	13.3
Maternal Education	Illiterate/Primary	20	33.3
	Secondary	25	41.7
	Graduate & above	15	25.0

Regarding perinatal characteristics, 30.0% of children had low birth weight, and 23.3% were born preterm. A history of birth asphyxia and NICU admission was present in 16.7% and 20.0% of children, respectively. Undernutrition was observed in 35.0% of participants (Table 2).

Table 2: Perinatal and Clinical Characteristics of Children (n = 60)

Variable	Category	Frequency (n)	Percentage (%)
Birth Weight	<2.5 kg	18	30.0
	≥2.5 kg	42	70.0
Gestational Age	Preterm	14	23.3
	Term	46	76.7
Birth Asphyxia	Present	10	16.7
	Absent	50	83.3
NICU Admission	Yes	12	20.0
	No	48	80.0
Nutritional Status	Normal	39	65.0
	Undernourished	21	35.0

The overall prevalence of developmental delay was found to be 18.3% (Table 3).

Table 3: Prevalence of Developmental Delay (n = 60)

Developmental Status	Frequency (n)	Percentage (%)
Normal Development	49	81.7
Developmental Delay	11	18.3

Among children with developmental delay, language delay was the most commonly affected domain (54.5%), followed by gross motor delay (36.4%) (Table 4).

Table 4: Domain-wise Distribution of Developmental Delay (n = 11)

Developmental Domain	Frequency (n)	Percentage (%)
Gross Motor Delay	4	36.4
Fine Motor Delay	3	27.3
Language Delay	6	54.5
Personal-Social Delay	2	18.2

Note: Multiple domain delays may be present in the same child.

A statistically significant association was observed between developmental delay and low birth weight (p=0.03), prematurity (p=0.04), history of birth asphyxia (p=0.02), and undernutrition (p=0.05) (Table 5).

Table 5: Association Between Selected Risk Factors and Developmental Delay (n = 60)

Variable	Category	Developmental Delay n (%)	No Delay n (%)	p-value
Birth Weight	<2.5 kg	6 (33.3)	12 (66.7)	0.03*
	≥2.5 kg	5 (11.9)	37 (88.1)	
Gestational Age	Preterm	5 (35.7)	9 (64.3)	0.04*
	Term	6 (13.0)	40 (87.0)	
Birth Asphyxia	Present	4 (40.0)	6 (60.0)	0.02*
	Absent	7 (14.0)	43 (86.0)	
Nutritional Status	Undernourished	6 (28.6)	15 (71.4)	0.05*
	Normal	5 (12.8)	34 (87.2)	

*Chi-square/Fisher's exact test applied; *$p < 0.05$ considered statistically significant.*

DISCUSSION

The present study assessed developmental delay among children aged 6 months to 5 years attending a tertiary care hospital using standardized screening tools. The overall prevalence of developmental delay was found to be 18.3%, with language delay being the most commonly affected domain. Significant associations were observed with low birth weight, prematurity, birth asphyxia, and undernutrition. The prevalence observed in this study is consistent with global and Indian estimates, which report developmental delay in approximately 5–15% of children worldwide and up to 10–20% in developing countries [1,7]. The slightly higher prevalence in the present study may be attributed to the hospital-based setting, where children with underlying risk factors are more likely to present, thereby increasing the likelihood of detecting developmental issues.

Language delay emerged as the most common domain affected, which aligns with findings from previous studies conducted in similar settings. Early language development is highly sensitive to environmental stimulation, parental interaction, and socio-cultural factors. In resource-limited settings, reduced caregiver-child interaction, lower parental literacy, and lack of early stimulation

may contribute to delayed language acquisition [7,10]. Additionally, language delays are often more noticeable to caregivers, increasing their likelihood of being identified during screening.

The study demonstrated a significant association between low birth weight and developmental delay. This finding is supported by earlier research indicating that low birth weight infants are at increased risk of neurodevelopmental impairments due to intrauterine growth restriction and associated complications [8,11]. Similarly, prematurity was significantly associated with developmental delay, consistent with existing literature highlighting the vulnerability of preterm infants to neurological immaturity and subsequent developmental challenges [3,12].

Birth asphyxia was another significant risk factor identified in this study. Perinatal hypoxia can lead to neuronal injury and long-term neurodevelopmental deficits, including motor and cognitive impairments. This finding is in agreement with previous studies that have demonstrated a strong association between perinatal asphyxia and delayed developmental milestones [8,13]. Early identification and intervention in such high-risk groups are therefore essential.

Undernutrition was also found to be significantly associated with developmental delay. Adequate nutrition is critical for optimal brain development, particularly in the first two years of life. Malnutrition can impair synaptogenesis, myelination, and overall brain growth, leading to delays across multiple developmental domains [2,14]. This underscores the importance of integrating nutritional interventions with developmental screening programs.

The findings of this study have important clinical and public health implications. Routine developmental screening should be incorporated into pediatric outpatient services and immunization clinics to facilitate early detection. Simple, cost-effective tools such as TDSC and DDST-II can be effectively utilized even in resource-constrained settings. Furthermore, strengthening existing national programs such as RBSK can enhance early identification and timely referral for intervention services.

The strengths of the present study include the use of standardized screening tools and inclusion of a broad age range of children under five years. The study also considered multiple socio-demographic and perinatal factors, allowing for a comprehensive assessment of associated risk factors.

However, certain limitations must be acknowledged. The study was conducted in a single tertiary care hospital with a relatively small sample size, which may limit the generalizability of the findings. The cross-sectional design precludes causal inference. Additionally, screening tools were used rather than definitive diagnostic assessments, which may lead to over- or under-estimation of true developmental delay. Recall bias from caregivers regarding perinatal history is also a possibility.

Despite these limitations, the study highlights the substantial burden of developmental delay and emphasizes the need for routine screening and early intervention strategies in pediatric healthcare settings.

CONCLUSION

The present study highlights that developmental delay is a significant concern among children aged 6 months to 5 years attending a tertiary care hospital, with a prevalence of 18.3%. Language delay emerged as the most commonly affected domain. Key risk factors identified included low birth weight, prematurity, birth asphyxia, and undernutrition, all of which showed significant association with developmental delay. These findings underscore the importance of routine developmental screening in early childhood, particularly in healthcare settings where high-risk children are likely to present. The use of simple, standardized screening tools can facilitate early identification and timely referral for further evaluation and intervention. Strengthening integration of developmental screening into existing child health services, along with parental awareness and early stimulation practices, is essential. Early intervention strategies targeting high-risk groups can significantly improve developmental outcomes and reduce long-term disability burden. Further large-scale, multicentric studies are recommended to validate these findings and support policy-level implementation.

DECLARATIONS

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