ISSN- 0301-1216
Indian J. Prev. Soc. Med. Vol. 56, No.4, 2025

Extent, Spectrum and Interlinkages of Anthropometric indices and Physical Development Delay among Rural Children (0-3 years): A Community based study from North India

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ABSTRACT

Introduction: Optimum nutritional wellbeing and physical development of young children are major concern particularly in rural areas. **Objective:** To assess nutritional status and physical development of subjects and its associates. **Methods:** This community based cross sectional study was conducted on 155 rural children (0-3 years) selected through multistage sampling procedure. Anthropometric indices and attainment of physical developmental of 155 children were assessed following standard techniques. **Results:** In all 56.1% were undernourished. Grade 3rd and 4thPEM prevailed in 4.5% and 2.5% subjects, respectively, on nutritional scale using weight for age as parameter and IAP classification; Out of 149 subjects 15.4% had delayed physical development. There existed significant association between age and physical development of the children ($p<0.05$). **Conclusion:** The nutritional status of children is not up to the mark. Nearly 3 out of 20 subjects had delayed physical development. No consistent pattern was observed between nutritional status and physical development.

Key words: Anthropometric indices, Physical development, Rural areas, Under nutrition, Under five children.

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Citation: Yadav Manpriti, Keshari P. Extent, Spectrum and Interlinkages of Anthropometric indices and Physical Development Delay among Rural Children (0-3 years): A Community based study from North India. Indian J Prev Soc Med, 2025; 56 (4): **458-463.**
DOI: https://doi.org/10.5281/zenodo.18045273

Sequence of Article: **Submission:** 14.08.2025 **Accepted:** 10.09.2025 **Published:** 31.12.2025

Prior Publication: *Nil****; Source of Funding:*** *Nil****; Conflict of Interest:*** *None****, Article # 858/1328***

Introduction

Nutritional wellbeing of the children is considered one of the major indicators of developed human resource. Growth and development is a continuum phenomenon. It serves as indirect measurement of the quality of life. Foundation of physical and mental health in adult life is laid down during childhood and optimum nutrition is of prime importance in the attainment of normal growth and development [1]. The first 1000 days of life (from conception to 2 years after birth) is a unique time period for every child in terms of the foundation of optimum health, growth, and neuro-development across the lifespan. During this time various skills like cognitive, language, motor, social and vision are acquired by the children. Despite the breakthrough progress in young child survival over the past few decades, worldwide children between 0-3 years of age are at risk of malnutrition particularly under nutrition and developmental milestone delay as per their age.

Malnutrition is a state of under or over nutrition, evidenced by a deficiency or an excess of essential nutrients. It restrains the structural and functional capacity of brain of growing children, resulting in developmental deficits [2-3]. Developmental delays refer when a child does not achieve developmental milestones in comparison to peers of the same age range. The delay can be in a single domain (Isolated developmental delay) or more than one domain (Global developmental delay). In Indian context when delay occur in one area it called “Focal Delay” while in more than one area is called as Global developmental delay.

Globally 165 million children are stunted and approximately 52.9 million children reportedly have identifiable developmental delay. Worldwide 1.5% -19.8% of children are afflicted with developmental delays. In India approximately 10% of the children have developmental delays [4]. Across the world, including India a wide variation in the prevalence of under-weight (39-75%), stunting (15.4-74%) and wasting (10.6-42.3%) among children have been reported by the researchers [5-6]. The measures

adopted for the assessment of nutritional status of the children could be the reason for variations in the different forms of malnutrition.

Assessments of nutritional status of growing children ensure their developmental potential including physical and psychological wellbeing and not merely survival. This information also supports in achieving the Sustainable Developmental Goals (SDGs). SDG target 3.2 focuses to end preventable deaths of newborns and children under five years of age.

Although information on the extent of malnutrition in children is available, there is paucity of information on developmental delays in children (0-3 years) and their interlinkages. This issue has not been explored in the rural areas of Pratapgarh District. With this background present study was undertaken in the rural children of Pratapgarh District with the aim to examine extent of malnutrition adopting different anthropometric indices, physical developmental delays and linkage between nutritional indices and physical development.

Methodology

Study design and participants: This community based cross sectional study was conducted in villages of Kunda tahsil of Pratapgarh district, India. The total population of Pratapgarh is 32.09 lakhs. The male and female population of this district is 50.05% and 49.95%, respectively. Sex ratio is 998 per 1000. This District constituted 216,865 (14.13%) children of 0-6 age group with the sex ratio of children 917 per 1000; male child 236,478 (14.72%) and female child 216,869 (13.53%)[7]. The reference population for this study was rural children (0-3 years) with their parents residing in Pratapgarh.

Sample size and selection of subjects: Taking prevalence of underweight as 41% in rural (0-5 years) children (NFHS-5)[8], design effect 1.5, permissible level of error 10% (absolute) and non-response rate of 10% the sample size worked out to be 155. Subjects were selected by multistage sampling procedure. Thus, they are representative sample of the reference population. Community Development Blocks, villages, families and subjects were the different stages of sampling procedure.

Inclusion and exclusion criteria: Only those rural children (0-3 years), whose parents were willing to participate and gave their consent to provide necessary information and permitting assessment of nutritional status and physical development of reference child were included in study. Subjects residing <6 month in the study area and/ or having serious physical and mental illness/ abnormalities were excluded.

Ethical Approval: Before commencement of the study ethical approval was obtained by the Institutional Ethics Review Board, University of Allahabad, Prayagraj. Written informed consent was obtained from mothers of the study subjects.

Tools of the study: Predesigned and pretested proforma was used as primary tool for this study which included following sections: **[A]** Socio-economic and demographic information **[B]** Anthropometric indices related information (weight, height, head, chest and mid arm circumferences, skin fold thickness and fat fold triceps) **[C]** Developmental status of child. Weighing machine, infantometer, stadiometer, measuring tape, shakir tape, skin fold caliper tools were used to measure weight, length/height, head and chest circumferences, mid arm circumference, skin fold thickness and fat fold triceps of study subjects, respectively. For assessment of physical development of subjects, a check list was used which took taking into consideration attainment of developmental milestone at different age points.[9]

Techniques of the study: Following techniques were employed in the study-

[A] Information pertaining to socio demographic and economic characteristics was recorded by interviewing parents of subjects using predesigned and pretested proforma. Age of the children was assessed on the basis of available evidence (i.e. birth certificate, horoscope and calendar of local events) or by referring to festival dates. Socio economic status was assessed using modified B. G. Prasad classification [10].

[B] Assessment of nutritional status of subjects was done on the basis of anthropometric measurements. Weight, length/height, mid arm, head and chest circumference, skin fold thickness and fat fold triceps of the subjects were measured following standard techniques[11]. Nutritional status of the subjects was assessed on the basis of weight for age using Indian Academy of

Paediatrics (IAP) classification[12]. Chronic malnutrition was assessed using height for age as parameter. 50th percentile values for weight and height according to age and gender of the child provided by World Health Organization were taken as reference standard [13].

[C] Physical development of subjects was assessed by interviewing mothers for attainment of developmental mile stones of their children at different age points with the help of a checklist [9]. Direct observation was also done for some of the milestones by the researcher.

Statistical analysis: Data were entered in personal computer and analyzed with the help of statistical software SPSS version 22. All the categorical variables were presented as percentage. For inferential purpose chi square test was used and p value <0.05 was considered as significant.

Results

Socio demographic profile of subjects: Out of 155 subjects, 70 (45.2%) and 85 (54.8%) subjects were male and female, respectively. In all, 32.9%, 34.8% and 32.3% subjects were from the age group 0-12, 13-24 and 25-36 months, respectively. Of 155 subjects, 148 (95.5%) and 7 (4.5%) were Hindu and Muslim, respectively. As much as 16.1%, 60.7% and 23.2% subjects were from SC/ST, OBC and others caste categories, respectively. Of 155 subjects 45.2% and 54.8% were from nuclear and joint family, respectively. Family size in 56.8% and 43.2% subjects were 3-6 and >6, respectively. In case of 5.8% and 25.8% subjects' social class was I and II, respectively. Sixty (43.9%) subjects belonging to social class IVth and Vth where in socio-economically disadvantaged position (Table-1).

Table- 1: Socio demographic profile of subjects

Particulars		No.	%
Age Group (months)	0-12	51	32.9
	13- 24	54	34.8
	25-36	50	32.3
Gender	Male	70	45.2
	Female	85	54.8
Religion	Hindu	148	95.5
	Muslim	7	4.5
Caste	SC/ST	25	16.1
	OBC	94	60.7
	Others	36	23.2
Type of Family	Nuclear	70	45.2
	Joint	85	54.8
Size of Family	3-6	88	56.8
	> 6	67	43.2
Social Class as per modified B. G. Prasad classification	I	9	5.8
	II	40	25.8
	III	38	24.5
	IV	44	28.4
	V	24	15.5

Nutritional well being on the basis of various anthropometric indices and Physical Development of the subjects: In all 43.9% subjects were categorized as normal on the nutritional scale using weight for age as parameter and IAP classification. As much as 31.6% and 17.4 subjects were in grade 1st and grade 2nd PEM, respectively. Grade 3rd and 4th PEM prevailed in 4.5% and 2.5% subjects, respectively. In all 29.0% subjects were categorized as normal on the nutritional scale using height for age. As much as 49.0%, 17.4% and 4.5% subjects were with mild, moderate and severe chronic malnutrition, respectively. On the basis of Mid Upper Arm Circumference (MUAC), 63.9% subjects had normal nutritional status. As much as 18.7% and 17.4% had mild and severe under nutrition on the basis of MUAC. In case of 56.8% subjects their head circumference was < 50th percentile, it indicates under nourishment. On the basis of Chest Circumference (CC), 44.5% subjects had normal nutritional status. Based on skin fold thickness 24.5% subjects were undernourished (< 50th percentile). Out of 150 subjects 49.0% were undernourished on the basis of their fat fold triceps **(Table-2).**

Table-2: Nutritional Wellbeing of the subjects on the basis of various anthropometric indices (N=155)

Particular		No.	%
Weight for age (IAP classification)	Normal (>80)	68	43.9
	Grade 1 (70-80)	49	31.6
	Grade 2 (60-70)	27	17.4
	Grade 3 (50-60)	7	4.5
	Grade 4 (<50)	4	2.5
Height for age (cm)	Normal (>95)	45	29.0
	Mild (87.5-95)	76	49.0
	Moderate (80-87.5)	27	17.4
	Severe (<80)	7	4.5
Mid Arm Circumference	Normal (>13.5)	99	63.9
	Mild (12.5-13.5)	29	18.7
	Severe (<12.5)	27	17.4
Head circumference	>50th percentile	67	43.2
	<50th percentile	68	56.8
Chest Circumference	>50th percentile	69	44.5
	<50th percentile	81	52.2
	Not applicable	5	3.2
Skin fold thickness	>50th percentile	112	72.2
	<50th percentile	38	24.5
	Not applicable	5	3.2
Skin fold triceps	>50th percentile	74	47.7
	<50th percentile	76	49.0
	Not applicable	5	3.2

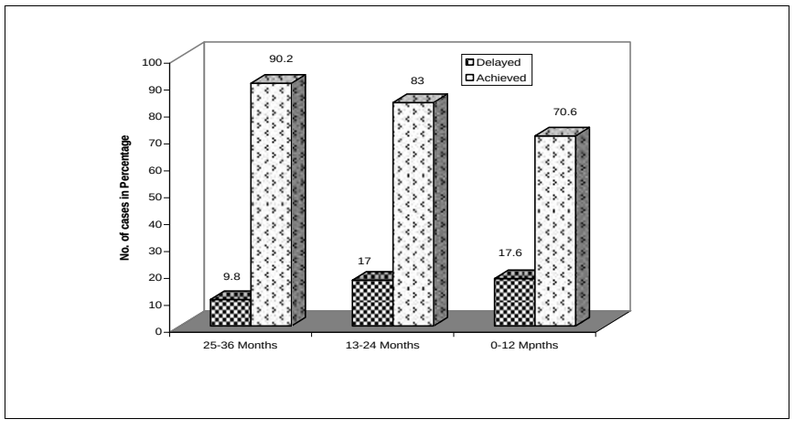
Physical development was assessed in 149 subjects; out of this 23 (15.4%) had delayed physical development **(Table-3).**

Table-3: Status of Physical Development of subjects

Status of Physical Development	No	%
Achieved	126	81.3
Delayed	23	14.8
Not applicable	6	3.8
Total	**155**	**100.0**

Association between age and physical development: There existed significant (χ^2=14.8; df=4, p=0.005) association between age and physical development of subjects. In case of 51 subjects from 0–12-month physical development milestone was assessed in 45 subjects. As much as 17.6%, 17.0% and 9.8% subjects from age 0-12, 13-24 and 25-36 months had delayed physical development of milestones **(Figure-1).**

Fig.-1: Interlinkage between age and Physical of Subject (N=149)



As much as 13.5% and 21.1% subjects with nutritional status normal+ grade 1 and grade 2+3+4 protein energy malnutrition had physical developmental delay, respectively. In all 20.5%, 12.5% and 15.2% normal, mild and moderate + severe stunted subjects had developmental delay, respectively. As much as 14.3% normal, 10.3% mild, 15.9% moderate and 21.1% severely wasted subjects had developmental delay. There existed no significant ($p>0.05$) difference between nutritional status and in the achievement of physical development milestone of subjects (Table-4).

Table-4: Physical Development Vis a Vis Nutritional Indices (N= 149)

Nutritional parameter		Physical development status						Test of Significance
		Achieved		Delayed		Total		
		No.	%	No.	%	No.	%	
Weight for Age (Under weight)	Normal (>80%) + Grade 1 (70-80%)	96	86.5	15	13.5	111	100.0	χ^2= 1.23; df = 1 p = 0.27
	Grade 2 (60-70%) + Grade 3+4 (<60%)	30	78.9	8	21.1	38	100.0	
Height for Age (Stunting)	Normal (>95%)	35	79.5	9	20.5	44	100.0	χ^2=1.32; df =2 p = 0.51
	Mild (87.5-95%)	63	87.5	9	12.5	72	100.0	
	Moderate +Severe (<80%)	28	84.8	5	15.2	33	100.0	
Weight for Height (Wasting)	Normal (>90%)	24	85.7	4	14.3	28	100.0	χ^2=1.7; df =3 p = 0.62
	Mild (80-90%)	35	89.7	4	10.3	39	100.0	
	Moderate (70-80%)	37	84.1	7	15.9	44	100.0	
	Severe (<70%)	30	78.9	8	21.1	38	100.0	

Discussion

This study was carried out on 155 subjects. Nearly one third of them were from age groups 0-12, 13-24 and 25-36 months. Nine out of 20 subjects were male. Nineteen out of 20 subjects were Hindu. There was preponderance of subjects belonging to Other Backward Caste (6 out 10). Nearly one out of six subjects were from others caste category. Eleven out of 20 subjects were from joint family and rest were from nuclear family on the basis of Modified BG Prasad classification nearly 9 out of 20 subjects were in socio-economically disadvantaged position.

Nutritional status of the subjects was far from being satisfactory. Nearly 9 out of 20 subjects were normal by weight for age as per IAP classification. In all 7 out of 10 subjects were stunted by height for age. Nearly 13 out of 20 subjects were normal on the basis of Mid Arm Circumference. In case of 9 out of 20 subjects, Head Circumference was $\geq 50^{th}$ percentile of the reference standard. On the basis of Chest Circumference nearly half of the subjects had normal nutritional status. On the basis of skin fold thickness 1 out of 4 subjects were undernourished. On the basis of fat fold triceps half of the subjects were under nourished. Underweight, stunting and wasting are commonly used indices in the nutritional anthropometry of under five children. Taking them into account nutritional adversities have been reported by several workers [6, 14-21]. Findings of these studies as well as present study pinpoint that nutritional status of under five children are not up to the mark. The observed difference in the extent of under nutrition may be due to differences in the setting of the study, prevailing socio-cultural context and socioeconomic development.

Out of 149 subjects whose physical development was assessed, nearly 3 out of 20 subjects had delayed physical development. Several workers [14,22-24] from India have identified developmental delays. Developmental delays have been also reported in several studies conducted outside India [25-28]. Considerable variations exist in the extent of developmental delays. This may be accounted by spectrum of delays explored, settings of study and variations in the socio-cultural context. In this study age emerged as significant associate of physical development of subjects. With increasing grade of under-nutrition, there was decline in the in the proportion of subjects achieving physical milestones. However, this trend was not statistically significant. In contrast to this finding a study from Ethiopia reported stunting and underweight children had a three- and two-fold increased risk of developmental delay[28]. Study conducted in Nigerian children weight for age had significant association with hearing and language and interactive domain [29]. Further a community based cross sectional study from North West Ethiopia identifies stunting as predictor of child developmental delay[30]. This study brings out no consistent pattern in nutritional parameters and physical development of children (0-3 years) residing in rural area. This is likely to be due to underlying mechanisms of undernutrition and physical development. Undernutrition is primarily a consequence of nutrient inadequacy whereas physical development is linked

to stimulus child receives from caregivers. Parent based stimulation is a key input for optimum growth and development of young children. Kicking at objects, rolling over, use of chairs or pushcarts as well as praise and encourage for the child attempting to walk independently may be rewarding for physical development. Further emphasis should be given on focused attention during critical period of growth and development. There are need and scope for undertaking multi centric study of prospective nature to sharpen action points for up scaling growth and development of children.

Conclusion

Nutritional status of the children was far from being satisfactory. Nine out of 20 subjects were normal by weight for age as per IAP classification. Nearly 3 out of 20 subjects had delayed physical development. Age emerged as significant associate of physical development delay in children. The findings of the study emphasize on a multi centric study of prospective nature which is likely to provide key areas of intervention for up scaling growth and development of children in general and during critical period in particular.

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