

## Biomedical Communication

# Relationship Between Nutritional Status and Academic Performance of Primary School Children in Rural Bankura Region of West Bengal, India

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### ABSTRACT

The period of school age is an active phase for both the physical growth and mental development. Hence, proper nutrition during this period is very important as it lays the foundation of life time health, strength and intellectual capacity. However, malnutrition, especially undernutrition during primary school age is one of the important causes of poor school enrolment, high absence from school, unsatisfactory educational performance and early dropout. So, to ascertain the relationship between nutritional status and academic performance of the primary school children, this study was performed in rural Bankura district of West Bengal in India. A total of 269 primary school children aged 6-10 years were selected as participants of this study and a structured schedule was used for data collection. Nutritional status of the children was evaluated from three indices of undernutrition – underweight, stunting and wasting. For the estimation of overall magnitude of undernutrition, Composite Index of Anthropometric Failure (CIAF) was used. Moreover, academic performance of the primary school children was evaluated using seven-point grading system. Statistical analysis was performed using  $\chi^2$  test and one way ANOVA. In this study, the prevalence of underweight, stunting and wasting was 27.88%, 17.10% and 15.24% respectively. The overall prevalence of undernutrition was 39.03% as determined by CIAF. Conclusively, it was observed that there was positive association of academic grades with underweight ( $P<0.001$ ), stunting ( $P<0.05$ ), wasting ( $P<0.001$ ), and CIAF ( $P<0.001$ ). Moreover, the academic grades were positively associated with BMI (boys  $P<0.05$ ; girls  $P<0.001$  and sex combined  $P<0.001$ ). This study elicits high prevalence of undernutrition among rural primary school going children and also shows positive relationship between nutritional status and academic performance of the children. These findings will not only help to design efficient measures to abate the burden of childhood undernutrition but also serve as a guideline for the development of better future generation.

**KEY WORDS:** ACADEMIC PERFORMANCE, CHILDREN, STUNTING, UNDERNUTRITION, WASTING.

### INTRODUCTION

The children between the age of 6 and 10 years are termed as primary school children. The period of primary school age is nutritionally significant because this is the prime period to build up body stores of nutrients for the utilization during rapid growth of adolescence. Moreover, proper nutrition during primary school age is important as this period lays the foundation of life time health, strength and intellectual capacity (Chadha and Mathur 2015; Chandramohan et al., 2015; Sharma

et al., 2017). The period of school age is the active phase of physical growth as well as mental development of the children. In this period, nutrients play a critical role in the development of the brain (Dey and Nath 2017; Karavida et al., 2019). Overall, children's quality of growth and development, status of health and the quality of life are indicated by their nutritional status (Eze et al., 2017; Marwat et al. 2019; Sathiadas et al., 2021). The nutritional imbalance at school age period can result in critical health problems throughout the life of children (Srivastava et al., 2012)

Long-term undernutrition during the childhood is associated with delayed development in cognition and

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grave health impairments at the later part of life that affects the quality of life in adulthood (Srivastava et al., 2012). Improved nutrition is linked with optimal brain function and nutritional deficiencies can significantly affect brain development (Nyaradi et al., 2013). It was evident from previous studies undernutrition during primary school age is an important cause of poor school enrolment, higher absence from school, unsatisfactory educational performance and early dropout (Subhprada 2015). In addition to these factors, recent findings have established poor nutritional status of school children as one major reason of their poor academic performance (Agarwal et al., 2018; Khan et al., 2020).

The children, especially of rural areas, are at risk of undernutrition because of inadequate diet, improper care, repeated infection and uneven food distribution in the family (De and Chattopadhyay 2019). In spite of economic growth, malnutrition especially undernutrition is a major health-related issue of developing countries till today (Mohseni et al., 2019). For the development of better future generation and development of the nation, an understanding of the impact of nutritional status on academic performance of primary school children is immense important. But there is no sufficient information related to it. So, to find out the relationship

between nutritional status and academic performance of primary school children, the present study was performed in different villages of Bankura district of West Bengal in India.

## MATERIAL AND METHODS

A community based cross-sectional study was carried out among the primary school children aged between 6 and 10 years residing at rural Bankura district of West Bengal. A total of 269 children were selected from six villages by multistage random sampling. To carry out the survey, written permission was taken from District School Authority (Primary Education) and Local Bodies (Gram Panchayats). Informed consent was also taken from the parents/guardians of the children. Data was collected using a structured schedule. Nutritional status of the children was assessed using different indices based on two anthropometric parameters weight and height. Weight was measured by digital weighing machine and height was measured by anthropometer. Body mass index (BMI) was calculated as dividing weight (kg) by height<sup>2</sup> (meters). Date of birth of the children was recorded from birth certificate issued by the Department of Health and Family Welfare.

Table 1. Age and sex wise distribution of the children

Age group (years)	Boys		Girls		Total	
	Number	%	Number	%	Number	%
6	17	11.72	11	8.87	28	10.41
7	38	26.21	31	25.00	69	25.65
8	35	24.14	31	25.00	66	24.54
9	30	20.69	30	24.19	60	22.30
10	25	17.24	21	16.94	46	17.10
Total	145	100.00	124	100.00	269	100.00

Three types of Z scores – weight-for-age Z-score (WAZ), height-for-age Z-score (HAZ) and weight-for-height Z-score (WHZ) – were calculated from reference values of National Centre for Health Statistics (NCHS). Using these three Z-scores, three indices of undernutrition – underweight (WAZ < - 2SD), stunting (HAZ < - 2SD) and wasting (WHZ < - 2SD) were defined. For estimation of overall magnitude of undernutrition Composite Index of Anthropometric Failure (CIAF) was used (Nandy et al., 2005; Khanra et al., 2019). Academic performance of the children was evaluated from their 'academic grades' which were computed by the school authorities from overall percentage of marks obtained in three summative examinations.

A seven point grading system A+ (90-100%), A(80-89%), B+ (70-79%), B (60-69%), C+ (45-59%), C (25-44%) and D (< 25%), was used in schools for academic grading. As no examination was held for the children of class one, a questionnaire containing ten questions on basic knowledge was used and same grading system

was followed to evaluate academic performance. In the present investigation, the SPSS for Windows statistical software package (Version 16.0) was used to perform data processing and analysis. To find out the association among different groups,  $\chi^2$  test was carried out. One way ANOVA was done for group comparison. The p value of <0.05 was considered statistically significant.

## RESULTS AND DISCUSSION

The present study was performed on 269 primary school children, out of which 145 (53.9%) were boys and 124 (46.1%) were girls. Age and sex wise distribution of the children is presented in table 1. The three anthropometric parameters (weight, height and BMI) of the children were expressed as mean and SD, and these are presented in table 2. Mean (with SD) weight, height and BMI of boys were 20.93±3.96 kg, 121.10±8.18 cm and 14.16±1.40 kg/m<sup>2</sup> respectively; whereas those of girls were 21.28±4.46 kg, 121.90±7.67 cm and 14.17±1.64 kg/m<sup>2</sup> respectively. In sex combined, mean (with SD) weight, height and

BMI were  $21.09 \pm 4.19$  kg,  $121.47 \pm 7.95$  cm and  $14.17 \pm 1.51$  kg/m<sup>2</sup> respectively. It was observed that the mean weight, height and BMI of girls were higher than boys. The possible reason behind higher weight in girls than boys may be of lower level of activity in girls than boys. In similar studies the mean weight and height of girls were found higher than boys (Dey and Nath 2017; Firdos et al. 2018; Yankanchi et al., 2018).

In present study, the nutritional status of the participants was judged from three indices of undernutrition

– underweight, stunting and wasting. The overall prevalence of undernutrition was determined by CIAF. Prevalence of different forms of undernutrition is presented in table 3. In this study, the prevalence of underweight, stunting and wasting was 27.88%, 17.10% and 15.24% respectively. In boys, the prevalence of these indices was 30.34%, 19.31% and 14.48%; whereas that of girls was 25.00%, 14.52% and 16.13% respectively. The overall prevalence of undernutrition was 39.03% as determined by CIAF.

Table 2. Anthropometric parameters of the children

Anthropometric parameters	Boys (N=145) Mean $\pm$ SD	Girls (N=124) Mean $\pm$ SD	Sex combined (N=269) Mean $\pm$ SD
Weight (kg)	20.93 $\pm$ 3.96	21.28 $\pm$ 4.46	21.09 $\pm$ 4.19
Height (cm)	121.10 $\pm$ 8.18	121.90 $\pm$ 7.67	121.47 $\pm$ 7.95
BMI (kg/m <sup>2</sup> )	14.16 $\pm$ 1.40	14.17 $\pm$ 1.64	14.17 $\pm$ 1.51

Table 3. Prevalence of undernutrition among children

Nutrition status	Boys		Girls		Total	
	N	%	N	%	N	%
Underweight	44	30.34	31	25.00	75	27.88
Stunting	28	19.31	18	14.52	46	17.10
Wasting	21	14.48	20	16.13	41	15.24
CIAF	61	42.07	44	35.48	105	39.03

Table 4. Relationship of academic achievement and nutritional status

Academic Grade	N	Underweight N (%)	Stunting N (%)	Wasting N (%)	CIAF N (%)
A+	42	2 (4.76)	2 (4.76)	1 (2.38)	3 (7.14)
A	60	8 (13.33)	5 (8.33)	6 (10.0)	17 (28.33)
B+	77	26 (33.76)	16 (20.78)	7 (9.09)	34 (44.15)
B	45	20 (44.44)	10 (22.22)	9 (20.00)	22 (48.89)
C+	22	8 (36.36)	5 (22.73)	7 (31.81)	14 (63.63)
C	23	11 (47.82)	8 (34.78)	11 (47.82)	15 (65.21)
$\chi^2$ test		$\chi^2=30.283$ P<0.001	$\chi^2=14.895$ P<0.05	$\chi^2=33.280$ P<0.001	$\chi^2=35.744$ P<0.001

This prevalence is similar to another study performed in the state of West Bengal in which the overall prevalence of undernutrition was found 38.1% (Mondal et al., 2015). In sex wise consideration, the prevalence of undernutrition in boys (42.47%) was found higher than girls (35.48%). In a similar study the undernutrition was found more common in boys than girls. Some recent studies also revealed high prevalence of undernutrition in different district of West Bengal (Sharma et al. 2017; Khanra et al., 2019; Pramanik 2020).

Academic performance of the primary school children was evaluated using seven-point (A+, A, B+, B, C+, C and D) grading system. In the present study only 15.61% children obtained the grade A+. Grade A was obtained by 22.30% children. Grade B+, B, C+ and C were obtained by 28.62%, 16.73%, 8.18% and 8.56% children respectively where nobody obtained grade D. To ascertain the relationship between nutritional status and academic performance of the children,  $\chi^2$  test was carried out and this relationship is presented in table 4.

Table 5. Association of academic achievement and BMI

Academic Grade	BMI					
	Boys		Girls		Sex combined	
	N	Mean±SD	N	Mean±SD	N	Mean±SD
A+	17	14.90±1.49	25	15.36±1.45	42	15.17±1.47
A	33	14.63±1.24	27	14.60±1.87	60	14.61±1.54
B+	46	13.91±0.96	31	14.14±1.43	77	14.00±1.17
B	19	13.58±1.31	26	13.41±1.00	45	13.48±1.13
C+	14	14.06±1.45	8	13.26±1.38	22	13.77±1.45
C	16	13.93±2.17	7	12.38±1.01	23	13.45±2.01
ANOVA	F=2.927; P<0.05		F=8.067; P<0.001		F=9.328; P<0.001	

It was observed that there was positive association of different academic grades with underweight ( $P<0.001$ ), stunting ( $P<0.05$ ), wasting ( $P<0.001$ ) and CIAF ( $P<0.001$ ). As CIAF is the indicator of overall state of undernutrition, it was clear that there was a positive association of nutritional status and academic performance. A similar study conducted at rural areas of Karnataka established a positive association between different indices of nutritional status and academic performance of students, apart from establishing a high incidence of malnutrition among school children (Rashmi et al., 2015). Similar findings were also observed in other studies conducted at different areas (Verma et al. 2019; Ayalew et al. 2020).

As BMI is another indicator of nutritional status, we tried to find out relationship between academic performance and BMI. For this purpose, ANOVA was performed and this relationship is presented in table 5. From this study it was clearly observed that the academic grades were positively associated with sex wise and sex combined BMI of the children (boys  $P<0.05$ ; girls  $P<0.001$  and sex combined  $P<0.001$ ). This finding also established positive association of nutritional status and academic performance. Similar result was obtained from a cross sectional study conducted at urban Meerut, Uttar Pradesh (Agarwal et al. 2018). Significant relationship between nutritional status and academic achievement of the children were observed in the studies conducted at Indonesia and Soudi Arabia (Rahmatillah and Mulyono 2019; Khan et al., 2020).

From previous researches, it was established that the children who are well-nourished are commonly more prepared in learning, more interested in attending school and able in taking advantage of educational opportunities (Naik et al., 2015). So, nutritional status acts as an important determinant of the academic performance of the children. Poor nutrition status adversely affects the cognitive development of children (Opoola et al., 2016; Dey and Nath 2017). Poor academic performances as a consequence of undernutrition can cause debarring a child from a promising future (Agarwal et al. 2018). Abatement of undernutrition can help to improve children's cognitive achievement which in turn potentially improves their grade progression. A

child with good nutrition will focus better and thereby perform better academically (Acharya et al. 2019; Okafor et al. 2020).

## CONCLUSION

This study elicits high prevalence of undernutrition among rural primary school children and it also shows positive relationship between nutritional status and academic performance of the children. The findings of this study indicate the cause of poor academic performance of the rural primary school children. So, this study will not only help to design efficient measures to abate the burden of childhood undernutrition but also serve as a guideline for the development of better future generation.

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