

## Relationship between Nutritional Status and Academic Achievements: A Study among Rural School Children in South India

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#### Abstract

*Introduction:* Malnutrition is a serious global issue. Each year nearly 25 million low birth babies are born. Recent reports show that, among under five children in developing countries, 206 million are stunted (low height for age), 50 million are wasted (low weight for height) and 167 million are underweight (low weight for age). Further, under-nutrition accounts for 3 million deaths among children and threatens the futures of hundreds of millions more. Studies indicate that nutrition affects the cognitive development, and in turn affects the academic performance. This study was conducted to assess the prevalence of under nutrition and association between under nutrition and academic performance among rural school students. *Materials & Methods:* A total of 400 students were enrolled in the study, studying in 5th, 6th, and 7th standards from the selected schools. Height and weight were measured and indicators of nutrition such as Height for age, Weight for Age and BMI for age were determined for each student for both girls and boys separately using IAP growth centile charts. Academic performance was assessed by taking average scores of mathematics and science. Chi square test and multiple regression analysis were used to test the association. *Results:* 400 students participated in this study. Out of these, 210 (52.4%) were boys and 190 (47.6%) were girls. Out of these, 30.8% of the students were from lower socio-economic status while 29% were from middle class. A total of 80 (20%) students were found stunted while 114 (28.5%) children were found to be under weight. Further, 96 (24%) students were under nourished (BMI for age <3rd centile for age). On multiple regression analysis after adjusting confounders, a significant positive co-relation was observed between under nutrition and poor academic performance ( $p < 0.05$ ). *Conclusion:* The study brought out a positive co-relation between under-nutrition and poor academic performance.

**Keywords:** Under-Nutrition; Co-relation; Academic Performance; Rural.

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#### Introduction

Nutrition is a fundamental pillar of human life, health, and development across the entire lifespan. From the earliest stages of foetal development, at birth, through infancy, childhood, adolescence, and into adulthood and old age, proper food and good nutrition are essential for survival, physical growth,

mental development, performance and productivity, health, and well-being [1].

However, every year, under-nutrition accounts for deaths of 3 million children and threatens the futures of hundreds of millions more, adversely affecting the healthy development of their bodies and their brains, and ability to learn [2]. Under-nutrition not only affects the health and well-being of children but also prevents them from reaching their full potential. According to UNICEF, 2016; 25 million babies born were low birth weight, 52 million children under 5 years of age were wasted, 17 million were severely wasted and 155 million were stunted, while 41 million were overweight or obese. Around 45% of deaths

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among children under 5 years of age were linked to under-nutrition. Unfortunately, most of these deaths occur in low- and middle-income countries [3].

Studies indicate that even mild malnutrition experienced by children during critical periods of growth can impair their cognitive behaviour and school performance. Children who consume insufficient or imbalanced quantities of nutrients are more likely to struggle in an academic settings [4]. They are at an educational disadvantage which compounds through the years of childhood and adolescence and can conceivably cause children to have lower levels of aspiration, accomplishment, and even intelligence. Traditionally, family status variables such as socioeconomic status and parents' level of education have been regarded as predictors of children's academic achievement [5].

The objective of this research work was to study the association between the nutritional status, school performance of these adolescent rural school children, their cognitive potential and their demographic profile.

## Material and Methods

### Study Population

Among the 5 schools located in the rural area of Panemangalore, in Dakshin Kannada district of Karnataka (India) which is also the rural field practice area of AJIMS & RC Mangalore, 3 schools were randomly selected. All the three schools are governments schools and charge no tuition fee. The sample size as calculated by taking prevalence of (p) 20% [3] and allowable error (d) of 20% by using formula  $N = \frac{4pq}{d^2}$  ( $q = 1 - p$ ) was taken as 400. Probability proportionate to size (PPS) was used to decide the number of children studying in 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> standard to be included from each schools. The students were enrolled after obtaining the permission from the school authorities and their parents .

### Study Design

Present study is a descriptive, cross-sectional survey conducted using a pre-tested semi-structured validated questionnaire to elicit the information on socio- demographic profile and nutritional status of the study subjects. Height and weight of individual student was recorded and Body Mass Index was calculated. Nutrition status was determined as per IAP growth centiles (BMI for age) for boys and girls separately [6].

### Educational Achievements

Academic performance was assessed by taking average of Mathematics and Science percentage scores, <65% - second class, 65-100% - first class. Data was analysed using SPSS 21.0 trial version, further Chi square test and Odds ratio were used to test statistical significance ( $p < 0.05$ ).

### Statistical Analysis

*Chi-squared test*, and the logistic regression analysis were used to investigate the relationship between the prevalence of malnutrition and the socio-demographic factors and school achievement. Differences were considered statistically significant at  $p < 0.05$ .

## Results

A total of 400 students were enrolled in this study, belonging to 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> standards. Out of these 22% were in the age group of 10 -11 years, 23.8% were in the age group of 11-12 years, 28.5% were in the age group of 12-13 years while 25.7% were aged more than 13 years. The number of male students in the study population was 210 (52.4%) while 190 (47.6%) were girls. Out of these, 30.8% of the students were from lower socio-economic status, followed by 29% from middle class, while remaining 4.5% belonged to upper class families (Modified BG Prasad SES classification updated to Jan 2018). The literacy status (primary level and above) of the mothers of the students was 81.5% while 92% of the fathers were literates (Table 1).

It was observed that 114 (28.5%) students were under weight while 262 (65.5%) of them had normal weight for their age (IAP growth centile charts). Further, 312 (78%) students had normal "height for age" while 80 (20%) students were found to be stunted. In our study, 96 (24%) students were found to be under nourished, i.e., Body Mass Index (BMI) for age < 3<sup>rd</sup> centile (IAP growth centile charts for age and gender); while 288 (72%) had normal BMI. However, 4% of the students were overweight (adult equivalent 23 Kg/ m<sup>2</sup> (Figure 1).

In our study, 130 (33%) of the students had poor scores in their academics, as determined by their average percentage scores in Mathematics and Science while rest of them i.e. 270 (67%) students had performed well (aggregate scores  $\geq 65\%$ ) (Figure 2).

In this study, we have observed that 65% of the under nourished students were poor in academics,

whereas only 22.9% of the students with normal BMI had aggregate scores less than 65%. This observation was found to be statistically significant ( $p < 0.01$ ). Similarly underweight (54.3%) and stunting (70%) were also associated with poor academic performance and the observations were found to be statistically significant (Table 2).

On multiple regression analysis, it was observed

that students who performed poorly in school had 6 times more odds of being under-nourished as compared to those who had performed well academically. Students with clinical pallor and the students whose mother was illiterate also had higher odds of poor performance in school (Adjusted OR 2.6 & 2.2 respectively;  $p < 0.05$ ). These observations were found to be statistically significant. However, socio-

**Table 1:** Socio- demographic profile of school children (n=400)

	Parameters	Number of students	Percentage	
<b>Age in completed years</b>	10	88	22.0	
	11	95	23.8	
	12	114	28.5	
	13	103	25.7	
<b>Gender</b>	Male	210	52.4	
	Female	190	47.6	
<b>Socio- economic status*</b>	Class I	18	4.5	
	Class II	70	17.6	
	Class III	116	29.0	
	Class IV	73	18.1	
	Class V	123	30.8	
<b>Parental education</b>	Mother	Illiterate	75	18.7
		Literate	325	81.3
	Father	Illiterate	32	8.0
		Literate	368	92.0

\*As per modified B G Prasad's classification Jan- 2018

**Table 2:** Association between nutrition status and academic performance among the students (n= 400)

Nutrition status	Academic Performance			Chi square value	P value*	
	Good (%)	Poor (%)	Total (%)			
BMI for age	Normal	237 (77.1)	67 (22.9)	304 (100)	63.18	<0.01
	Under nutrition	33 (34.3)	63 (65.6)	96 (100)		
Weight for age	Normal	218 (76.2)	68 (23.7)	286 (100)	34.81	<0.05
	Underweight	52 (45.6)	62 (54.3)	114 (100)		
Height for age	Normal	246 (76.8)	74 (23.1)	320 (100)	64.10	<0.01
	Stunted	24 (30)	56 (70)	80 (100)		

\*p <0.05 is considered statistically significant

**Table 3:** Multiple regression analysis to test the association between under nutrition and academic performance (n= 400)

Parameters	Adjusted odd's ratio (95 % CI)	p value*	
Nutrition Status (BMI for age)	Normal	1	<0.001
	Under nourished	6.782 (3.668- 12.540)	
Anaemia (pallor)	Absent	1	<0.01
	Present	2.660 (1.422- 4.975)	
Mother's education status	Literate	1	<0.05
	Illiterate	2.292 (1.737- 3.266)	
Social class	Upper	1	0.481
	Lower	1.880 (0.554- 1.396)	

\*p <0.05 is considered statistically significant

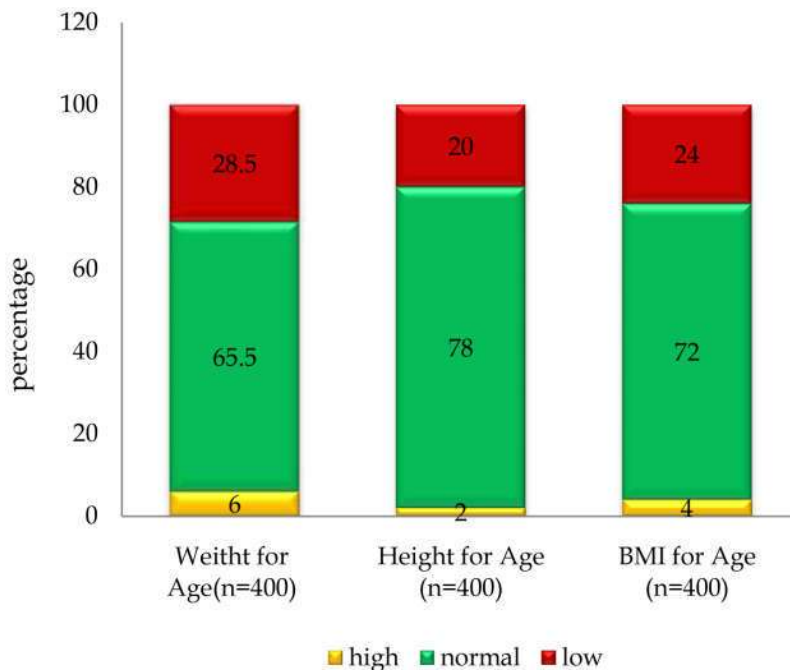


Fig. 1: Nutritional status of the students

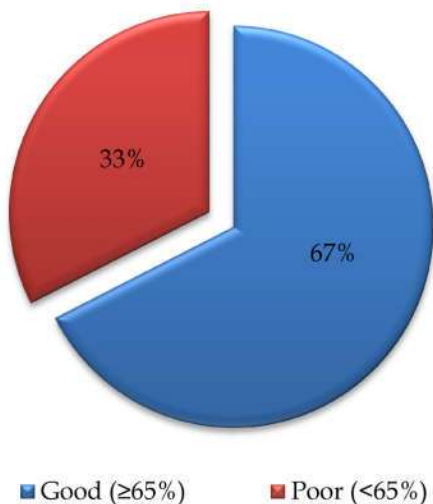


Fig. 2: Academic performance of the students (n=400)

economic status did not reveal any significant association with poor academic performance (p=0.481) Table 3.

### Discussion

Malnutrition is generally defined as a chronic condition which is a consequence of over- or under-consumption of any or several essential macro- or micronutrients relative to the individual's

physiological and pathological requirements. A number of studies in Latin America, Africa and the U.S reported that on intelligence tests, children with a history of malnutrition attained lower scores than children of similar social and economic status who were properly nourished (Fanzo 2012) [7]. Protein energy malnutrition, iron deficiency, anaemia, Vitamin A deficiency, these poverty related conditions decrease resistance to disease in general. Malnutrition therefore causes illness, brain damage, delayed physical growth, delayed development of motor skills and delayed intellectual development [8].

This study was an institution based, cross sectional, observational, non interventional research, conducted at Panemangalore, which is the Rural Field Practice area of AJIMS & RC Mangalore, located in Dakshina Kannada District of Karnataka. The objectives of the study were to assess the prevalence of under nutrition among the selected students and to determine, if there is any association between under-nutrition and poor academic performance. The study population comprised of 400 students, studying in, 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> standards. The male students were 210 (52.4%) while the girls were 190 (47.6%). The mean age of students under study was 12.74 years with a range from 11 years to 15 years.

In present study, the gender ratio among the school children enrolled was 904:1000 which is much lower than that of rural average for Dakshina Kannada district as per NFHS- 4 (1056:1000) [9]. This

difference observed could be due to preference of parents to enrol girls in government schools which provides free education. In this study majority of the students belonged to lower and middle income families, and the reason could be perceived better quality of education in private schools rather than in government schools and willingness of the parents to spend on children's education even with financial constraints. Similar findings were reported by Rashmi MR et al. (2015) [10] in rural parts of Bangalore (Karnataka ) where males students were 54% and females students were 46% and Ghosh S et al. (2013) [11] who reported a gender ratio of 58% male students to 42% female students, in North Tripura.

In present study the prevalence of under nutrition was found to be 28.5% among the study participants. However, Rashmi MR et al. (2015) [10] in their study reported that 27% of the children had pallor, 20% had under nutrition, 7% had stunting, 34% had thinness while 1% were found to be obese. In another study in Allahabad, (U.P.) Neha Bansal et al. (2017) [12] found an overall prevalence of overweight, obesity and underweight as 19.3%, 8.0% and 4.5%, respectively among school children. The occurrence of overweight and obesity was higher among boys (20.8% and 10.5% ) than girls (17.1% and 4.3% ) whereas underweight was found higher among girls (5.7%) compared to boys (3.5%).

In this study it is also observed that, there exist a positive relationship between indicators suggestive of poor nutrition and poor academic performance. Similar findings were observed by Rashmi et al (2015) [10] who reported Positive relationship between weight for age scores and English as well as Maths; Height for age scores with English. Ghosh et al. (2013) [11] in their study also found a negative correlation of BMI with academic achievement. However, El Hioui M et al. (2016) [13] in their study in Morocco, found the test scores positive correlated with Z-scores of height-for-age ( $P < 0.005$ ) but not with weight-for age ( $P > 0.05$ ). In another study in Zimbabwe, Kudzai Chinyoka (2014) [7] concluded that malnutrition affected physical growth, cognitive development and it consequently impacts on academic performance, health and survival of learners. Similar findings have been confirmed by many researchers among school children [14-17].

In this study, on multiple regression analysis even after adjusting for confounding factors such as mother's education status, social class and anaemia, students with under nutrition had 6 times higher odds of performing poor in school, this points towards

possibility that chronic under nutrition affects the ongoing development of higher cognitive processes during childhood and adolescence which will have adverse impact on scholastic performance. However, El Hioui M et al. (2016) [13] in their study after linear regression analysis concluded the effect of nutritional status on the academic performance of the student as "not confirmed, as a causal effect by multiple regression analysis."

#### *Limitations*

The measurements of height and weight are subject to inter observer variability and errors in the calibration of instruments. The results were adjusted for confounding factors like parental education, socio-economic status, anaemia and gender. Other factors such as hereditary factors, congenital cognitive impairment, mental illness, chronic physical illnesses and social issues (problem family etc) could not be adjusted in this study.

#### **Conclusion**

This study brings out a positive co-relation between malnutrition and academic performance among the rural students under study ( $p=0.01$ ). It also provides an insight into persistent problem of under nutrition in the rural areas despite multiple ongoing state nutritional supplementary programmes. The results of the present study also warrants further research in order to confirm the association between malnutrition and school performance. A longitudinal study, would probably bring out a closer monitoring of children's academic performance and nutritional status, including identification of other related factors, such as genetic factors and home environment providing cognitive stimulation which impact school performance.

#### *Recommendations*

Based on the above results, the study makes the following recommendations:-

1. All stakeholders should work towards the cause of minimising the root causes of mal-nutrition, especially in rural areas .
2. Backyard gardening at home as well schools, to augment supply of fresh green leafy vegetables should be encouraged.
3. Academic progress of under-nourished students must be closely monitored and additional classes may be arranged if performance is not found satisfactory.

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