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A STUDY ON ASSOCIATION BETWEEN NUTRITIONAL STATUS AND PULMONARY FUNCTION TESTS IN RURAL TRIBAL AND NON-TRIBAL STUDENTS OF TRIPURA

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ABSTRACT

Background: Tribal communities in India are considered as underprivileged. Anthropometric parameters and physiological variables are considered to be the independent variables upon which the dependent variable the nutritional status was based. Respiratory disorders are major group of illness affecting children especially in India and are the important causes of childhood morbidity and mortality. **Methodology**: A cross-sectional study was conducted from April to October 2020 in Tripura to assess the relationship between nutritional status and pulmonary functions in tribal and non-tribal school children. Data were collected randomly from 8 high schools and 9 higher secondary schools were selected at random. Altogether 256 Tripuri children and 256 Bengali children aged 8-15 years were included in the study. Socio-economic status and different anthropometric measures and indices were applied for evaluating the nutritional status of the subjects and association between socio-economic status, nutritional status and physiological health status were determined. **Results**: The present study however showed that most of the respondents were from low and middle income group. Higher degree of stunting was found in Tripuri boys compared to Bengali boys. 52.13 % of Tripuri boys and 64.65 % of Bengali boys were underweight. Malnourished children showed lower values in height ($P<0.001$) and weight ($P<0.001$) in both tribal and non tribal counterparts. FVC, FEV_1 and PEFR showed significantly ($P<0.001$) lower values when compared between malnourished and normal children in both tribal and non tribal communities. **Conclusions**: The study revealed a lack of adequate nutritional knowledge among the parents as a result the vital period of growth was greatly affected by poor nutrition. The study confirms that undernutrition along with muscle wasting diminished skeletal growth is a reason for reduced lung functions.

KEYWORDS: Nutritional Status, anthropometric measures, lung functions, Tribal childen and Bengali children

INTRODUCTION

Tripura situated in the remotest north-eastern part of India, contains majority of Bengalee and about 35% tribal populations of different races like Deb Barmas, Tripuris, Reangs, Chakmas, Jamatias, Uchai, Mog, Darlongs etc. Tribal populations are particularly vulnerable to undernutrition, because of their geographical isolation, socio-economic disadvantage and inadequate health facilities.

The present study was undertaken to reveal some basic facts regarding the above mentioned unexplored pre-adolescent and adolescent groups of Tripura. Here children of 8-15 years age group were chosen because this is a significant period of growth and maturation. The growth pattern, anthropometric variables and Physiological status of the children of various sections of Indian population have been assessed but information about the tribal population in this regard is scanty.

It has been estimated this approximately 70.00% of the world's undernourished children live in Asia, giving that region the highest concentration of worldwide childhood undernutrition. Moreover, India shows the highest occurrence of childhood undernutrition in the worlds and it has been estimated that more than half of Indian children are undernourished.

Tribal communities in India are considered as underprivileged. Several research studies on various tribal populations living in different parts of India have found them to be socially and economically disadvantaged.[1] Also the study conducted by Bose and Chakraborty suggests that there is an urgent need to evaluate the nutritional status of tribes in India.[2,3] On this background, the present study was carried out to determine the nutritional and physiological status of Tripuri children residing at rural areas of Tripura. In the present study socio-economic status, anthropometric

parameters and physiological variables are considered to be the independent variables upon which the dependent variable the nutritional status was based.

Anthropometric dimensions may influence physical efficiency. Measurements of height and weight provide important clues about health and nutritional well- being. Mid upper arm circumference and triceps skin fold measures are important indicators of nutritional status.

Respiratory disorders are major group of illness affecting children especially in India and are the important causes of childhood morbidity and mortality. So, assessment of pulmonary function test in children is very important. The PEFR is one among the lung function test which is helpful in evaluating obstructive lung diseases especially bronchial asthma.[4] Beside this the study also includes the measurements of FVC, FEV_1 and FEV_1 % of all school students for early detection of occurrence of COPD (Chronic Obstructive Pulmonary Disease).

In the present investigation one tribal populations, viz., 'Tripuri' and a non-tribal 'Bengali' population is taken into consideration for the study.

The main objectives of the study are to assess the socio-economic and nutritional status of pre-adolescent and adolescent boys of the selected tribal and non-tribal populations and also to evaluate the association between socio-economic status, nutritional status and physiological health status and to compare the different parameters with their non-tribal counterpart

MATERIALS AND METHODS

The study was conducted in South, Gomati, West and North district of Tripura, a north-eastern state of India. Proper care was taken so that the two tribal communities are available along with their Bengali counterpart. After the selection of schools, the investigator contacted the school authorities to get the permission to carry out the research work on enrolled students in the schools in the age range of 8-15 years. A total of 537 school children were initially approached for the necessary inclusion in the present study. Those subjects whose dates of birth were either not available in the school records or were not in the age group of 8–15 years were excluded. Of these 537 children, 13 were too old and birth records of 10 were not available, 2 children were excluded due to physical deformities. So the final study sample was 512 students. Special care was taken so that community wise each category (age) had at least of 30 subjects (minimum statistical criterion ≥30 subject per age category).

To achieve the purpose of the study 8 high schools and 9 higher secondary schools were selected at random. Altogether 256 Tripuri children and 256 Bengali children aged 8-15 years were included in the study. The study was performed in accordance with the Helsinki Declaration.

Permission was sought from school authority prior study. The requirements for the study were explained to all the subjects in the presence of their teachers and all the subjects voluntarily agreed to undergo the prescribed tests.

The socioeconomic status of the participant was evaluated by modified Kuppuswamy's scale.[5] The socioeconomic status of the participant was determined by the scores suggested in this scale.

Different anthropometric measures and indices were applied for evaluating the nutritional status of the subjects. These include height, weight, Mid-upper arm circumference (MUAC) and tricep skin folds. The height of the subjects was measured to the nearest 0.5cm without shoes using a Martin's type anthropometer with head in Frankfort plane.[6]

Weight was recorded with minimum clothing to the nearest 0.1 kg using digital electronic weighing machine. The subject stands on the centre of the scales without support and with the weight distributed evenly on both feet.[6]

The nutritional status of the sample was ascertained with the help of indicators such as Gomez classification (% reference weight for age), Water low classification (height for age) and WHO classification (BMI for age) and results were calculated.[7]

The body mass index (BMI) of the subject will be determined by dividing the weight (kg) by the squared value of height (meter). Thinness has been assessed using the indicator BMI- for- age according to the z-score of WHO. [7]

Mid upper arm circumference (MUAC) was recorded with the help of flexible non-stretchable steel measuring tape to the nearest 0.1 cm, using the standard procedure of Lee and Nieman. [6]
The skinfold measurement was taken parallel to the long axis of the arm over the triceps muscle in the middle of the arm at the level of the upper arm circumference in line with the olecranon process. The jaws of the caliper was applied to the fold at the marked level and the reading was obtained after two seconds.[8]

Peak Expiratory Flow Rate (PEFR) was measured with Mini Wright's Peak Flow meter using standard procedure and was repeated thrice.[9]

Forced Vital Capacity (FVC) , Forced Expiratory Volume during first second (FEV_1) and FEV_1 expressed as per cent of FVC (FEV_1%) were measured according to American Thoracic Society (ATS) guidelines by using an expirograph (Helios 401, RMS, India).[10]

The data were statistically analysed using the statistical package for social science (SPSS, version 23). A p-value

less than 0.05 were considered to be statistically significant. The descriptive statistical analysis of the data obtained was depicted in terms of mean and standard deviation (SD). One way analysis of varianace (ANOVA) using the Scheffe procedure was used to assess age difference in different anthropometrical, physiological variables. Bivariate correlation test was performed age wise to show significant influence of different anthropometrical and nutritional status on physiological variables.

RESULTS AND DISCUSSIONS

The participants mostly belonged to lower class strata (Upper middle: 3.63% Tripuri and 3.31% Bengali; lower middle : 8.97% Tripuri and 8.58% Bengali and upper lower or lower: 87.4% Tripuri and 88.11% Bengali) of the society, as indicated by modified Kuppuswamy's scale. Therefore, tribal communities need much importance in terms of healthcare opportunities, information and resources. The present study however showed that most of the respondents were from low and middle income group.

Tribal community showed slightly better socio-economic status than their non-tribal counterparts. This might be due to fact that Bengali community rely mostly on agriculture and some of them working as daily labourers and hawkers. Only a little percentage of this community had small business or employed in Government service. The people of the tribal community, on the other hand, were engaged in small business, or employed as Government services and some of them were working as tappers in rubber plantation fields, in addition to their engagement in agricultural work. Beside these tribal population were also engaged themselves in Jhum cultivation. Women of this community were used to bring the fuel wood from forests and sell in the local markets. They also earned money by selling vegetables grown from Jhum cultivation.

Various anthropometric parameters viz. Height, Weight, Mid-upper arm circumference (MUAC), and triceps skin fold has been measured in both tribal and non-tribal students as shown in Table-1 and 2.

Table 1: Age-wise distribution of Mean±SD values of Anthropometric variables of Tripuri children.

Age (in years)	Height (cm) Mean ± SD	Weight (kg) Mean ± SD	MUAC (cm) Mean ± SD	Triceps Skin Fold (cm) Mean ± SD
8	121.15±4.91	22.96±2.09	16.35±0.98	3.96±1.12
9	128.27±6.85	25.02±3.68	16.97±1.45	5.15±3.23
10	137.17±9.09	29.24±4.01	17.81±1.19	4.41±1.34
11	137.99±6.61	30.91±4.09	18.16±1.26	5.09±1.29
12	145.08±6.70	36.93±6.76	20.57±2.64	5.77±2.41
13	153.72±7.59	45.84±8.83	22.77±2.66	5.86±2.08
14	155.67±4.96	46.91±4.87	23.37±2.06	5.12±1.20
15	157.86±5.05	47.04±4.67	23.01±1.66	4.78±1.28

Table 2: Age-wise distribution of Mean±SD values of Anthropometric variables of Bengali children.

Age (in years)	Height (cm) Mean ± SD	Weight (kg) Mean ± SD	MUAC (cm) Mean ± SD	Triceps Skin Fold (cm) Mean ± SD
8	125.44±5.05	22.19±1.69	16.14±0.94	6.25±2.32
9	129.64±6.06	25.72±3.07	17.01±1.62	8.22±2.62
10	133.31±6.13	26.61±3.17	17.46±2.16	5.11±1.58
11	136.66±9.78	27.56±4.70	17.97±1.67	4.78±1.64
12	145.81±9.83	34.48±7.03	19.15±2.61	4.89±2.36
13	152.15±9.27	35.83±6.03	19.62±1.65	5.53±3.15
14	156.69±8.49	44.4±6.31	21.42±2.33	5.79±2.57
15	161.62±1.89	46.12±3.63	22.48±2.26	7.4±3.69

Height and weight of the students were compared with the ICMR standards, the study reveals that with increase in age both the tribal and non-tribal boys showed lower values of their mean height and weight in comparison to ICMR standard values of 8-15 years age groups. The extent of undernutrition in children was analyzed on the basis of cut offs values of height for age classification, weight for age classification and BMI-for-age, as proposed by WHO as shown in Table 3,4 and 5.

Table 3: Prevalence of overall stunting in Tripuri and Bengali boys (figures in the parenthesis indicate percentage).

Communities	Nutritional Status				
8-15 years	Above normal (≤+2 Z-score)	Normal (≤ -2 to +2 Z-score)	Moderate (-2 to -3 Z-score)	Severe (< -3 Z-score)	Total Stunting
Tripuri boys (N= 256)	0(0.0)	82 (32.03)	167 (65.23)	7 (2.73)	174 (67.97)
Bengali boys (N= 256)	0(0.0)	97 (37.89)	142 (55.47)	17 (6.64)	(159) 62.11

Table 4: Prevalence of overall underweight in Tripuri and Bengali children (8-10 years) (figures in the parenthesis indicate percentage).

Communities	Nutritional Status				
8-10 years	Above normal (≤+2 Z-score)	Normal (≤ -2 to +2 Z-score)	Moderate (-2 to -3 Z-score)	Severe (< -3 Z-score)	Total Underweight
Tripuri boys (N=94)	0(0.0)	45 (47.87)	48 (51.06)	01 (1.06)	49 (52.13)
Bengali boys(N= 99)	0(0.0)	35 (35.35)	54 (54.54)	10 (10.10)	64 (64.65)

Table 5: Classification of grades of malnutrition (thinness) according to BMI for age of Tripuri and Bengali boys.

Types of malnutrition	N	Over weight	Normal	Grade I (mild)	Grade-II (moderate)	Grade-III (severe)	Total malnourished
Tripuri Boys							
BMI (kg/m^2)	256	03 (1.17)	119 (46.48)	86 (33.59)	48 (18.75)	NIL	134 (52.34)
Bengali Boys							
BMI (kg/m^2)	256	04 (1.56)	95 (37.11)	114 (44.53)	43 (16.80)	NIL	157 (61.33)

Higher degree of stunting was found in Tripuri boys compared to Bengali boys as shown in the Table-3. Weight for age (WFA) classification determines the status of undernutriton in children 8-10 years of age and beyond this age errors are encountered due to adolescent spurt. According to WFA, as shown in Table 4, 52.13 percent of Tripuri boys and 64.65 percent of Bengali boys were underweight. The study showed that 1.06 percent Tripuri boys and 10.10 percent Bengali boys were found to be severely underweight. The proportion of mild to moderately underweight non tribal boys was more than the tribal boys. Similar trends of results were obtained by Das et al.[11]

BMI shows a good correlation with fatness and poor correlation with stature. It is a simple index of weight-for- height that is commonly used to classify underweight, overweight and obesity. UNICEF reported that India harbours one third of the stunted, wasted and malnourished children of the world.[12] The recent study of Cole et al. has stated that undernutrition could be better assessed as thinness (low body mass index for age) than as wasting (low weight for height).[13] Thinness has been assessed using the indicator BMI- for- age (Table 5) it was observed that the degree of total malnutrition was higher among Bengali students followed by Tripuri students respectively. About 61.33 percent of Bengali boys were malnourished. Among Tripuri boys it was 52.34 percent were malnourished. (Table 5). The prevalence of thinness observed in the present study was almost similar with the findings of IIPS.[14]

More than half of the undernourished children in our study appeared to be stunted, underweight and thin. A strong overlap in risk factors, such as a poor socio-economic status, low (parental) cultural status, income source, poor feeding practices and both quality and quantity of food for these types of undernutrition, was thought to explain this coincidence of these types of undernutrition. Although some studies claimed the overlap of risk factors between different types of undernutrition was rather minimal, different types of undernutrition often co-existed and lead to a compounded risk of morbidity and mortality.[15] Both the diet survey method and anthropometric measurements were used to assess the nutritional status of Tripuri and Bengali community. Dietary surveys and anthropometric measurements were therefore one of the essential components of nutritional assessment.[16]

Table 6: Intergroup Comparison in Age, Weight and Height among Three Groups Studied in Tripuri boys [n = 256].

Variables	Normal Group-I (N=119)	Grade-I (Mild) Group-II (N=86)	Grade-II (Moderate) Group-III (N=54)	F-Test	Bonferroni 't' Test [Intergroup Comparison]
Age (in years)	9.83±1.92	10.92±2.13	11.24±1.98	9.17 P=0.001	I vs II - 'S' I vs III - 'S' II vs III - 'NS'
Height (cm)	136.89±11.56	133.74±16.88	132.54±13.14	32.51 P=0.001	I vs II - 'NS' I vs III - 'S' II vs III - 'NS'
Weight (kg)	30.61±6.12	28.29±5.80	25.79±5.23	44.45 P=0.001	I vs II - 'NS' I vs III - 'S' II vs III – 'S'

S' = Significant; 'NS' = Non-significant

Table 7: Intergroup Comparison in Age, Weight and Height among Three Groups Studied in Bengali boys [n = 256].

Variables	Normal Group-I (N=119)	Grade-I (Mild) Group-II (N=86)	Grade-II (Moderate) Group-III (N=54)	F-Test	Bonferroni 't' Test [Intergroup Comparison]
Age (in years)	10.36±1.87	10.97±2.44	11.46±1.14	10.2 P=0.001	I vs II - 'NS' I vs III - 'S' II vs III - 'NS'
Height (cm)	135.83±12.33	133.81±13.25	131.85±13.56	36.51 P=0.001	I vs II - 'NS' I vs III - 'S' II vs III - 'NS'
Weight (kg)	29.98±6.60	27.90±6.22	25.58±6.47	50.21 P=0.001	I vs II - 'NS' I vs III - 'S' II vs III – 'NS'

S' = Significant; 'NS' = Non-significant

The tables 6and 7 showed the intergroup comparison of age and anthropometric measurement among three groups categorized as normal, grade-I and Grade-II based on BMI. There exists significant difference in terms of age, height and weight among the boys of three categories viz., normal, grade-I and Grade-II malnutrition groups in both tribal and non-tribal communities. When comparison was made between groups of malnourished children with normal children, malnourished children showed lower values in height (P<0.001) and weight (P<0.001) in both tribal and non tribal counterparts.

Table 8: Intergroup Comparison in FVC, FEV1, FEV1/FVC (%) and PEFR among Three Groups Studied in Tripuri boys [n = 256].

Variables	Normal Group-I (N=119)	Grade-I (Mild) Group-II (N=86)	Grade-II (Moderate) Group-III (N=54)	F-Test	Bonferroni 't' Test [Intergroup Comparison]
FVC (litre)	1.56±0.51	1.42±0.41	1.25±0.37	24.75 P=0.001	I vs II - 'S' I vs III - 'S' II vs III – 'S'
FEV_1 (litre)	1.41±0.31	1.31±0.35	1.20±0.35	23.26 P=0.001	I vs II - 'S' I vs III - 'S' II vs III - 'S'
FEV_1/FVC (%)	93.38±14.10	94.25±17.23	95.79±17.11	2.19 P=0.17	NS
PEFR (litre/Sec)	3.17±1.21	2.71±1.28	2.20±1.26	8.16 P=0.05	I vs II - 'NS' I vs III - 'S' II vs III – 'NS'

Table 9: Intergroup Comparison in FVC, FEV1, FEV1/FVC(%) and PEFR among Three Groups Studied in Bengali boys [n = 256].

Variables	Normal Group-I (N=119)	Grade-I (Mild) Group-II (N=86)	Grade-II (Moderate) Group-III (N=54)	F-Test	Bonferroni 't' Test [Intergroup Comparison]
FVC (litre)	1.47±0.48	1.34±0.44	1.21±0.37	25.65 P=0.001	I vs II - 'S' I vs III - 'S' II vs III – 'S'
FEV_1 (litre)	1.36±0.39	1.27±0.37	1.19±0.33	22.24 P=0.001	I vs II - 'S' I vs III - 'S' II vs III - 'S'
FEV_1/FVC (%)	94.17±13.70	94.88±15.78	95.46±16.97	2.34 P=0.31	NS
PEFR (litre/Sec)	3.88±1.30	3.11±1.34	2.42±1.21	8.21 P=0.05	I vs II - 'NS' I vs III - 'S' II vs III – 'NS'

This study was mainly undertaken to determine the pulmonary function tests of school going malnourished children and demonstrated that anthropometric, measurement, lung volumes and flow rates were significantly lower in malnourished children than normal healthy children. Malnutrition is a leading cause of impaired muscle contractility affecting both its strength and endurance.

Faridii et al., studied the pulmonary function test in malnourished children and reported that there was decrease in FVC, FEV1 in undernourished children as compared to normal healthy children.[17] Another recent observation by Nair et al., in Indian undernourished children stated that respiratory function would be affected in the presence of malnutrition & reported reduced FVC, FEV0.5 , FEV1, PEFR, MVV in malnourished children.[18] They pointed out that PEFR & FEV1 decreased proportionately as a result of poor endurance & strength of respiratory muscles.

Our observation suggests that different degree of malnutrition have its effect on pulmonary function test. The reduction in lung volume and flow rates may be due to wasting of ventilatory muscle. Malnutrition also results in reduction in expiratory efforts, this may be due to atrophy of muscles of diaphragm in malnourished children. Along with the diaphragm the ventilatory muscles are also suspected of wasting. As stated above by Nair et al., the reduction in the vital capacities & MVV can be explained on the basis of decreased muscle strength & poor muscle endurance. The study also reported that the ratios between timed volume and vital capacities were in normal or above normal limit which indicates no airflow limitation was produced by poor nutritional status.

FVC, FEV_1 and PEFR showed significantly ($P<0.001$) lower values when compared between malnourished and normal children in both tribal and non tribal communities.

No significant difference was noticed in FEV1/FVC % between normal and different types of malnourished children.

CONCLUSION

The study reveals that most of the studied tribal and non-tribal children belonged to lower socio-economic condition. Most of parents among tribal groups are daily labourer and some had their rubber plantation, some are forest dwellers engaged in search of fire woods. So, tribal population appeared to be in slightly better socio-economic condition compared to Bengali counterpart.

Parents of Bengali children are mostly cultivators, very few are engaged in Government services and some had their own small business, they are mostly hawkers.

From the study it was concluded that the both tribal and non-tribal population suffers from under nutrition as they might be consuming inadequate diet as stated by ICMR. More over poverty greatly influenced the purchasing capacity of foods items. Most of the parents of tribal children are illiterate, so there is lack of proper nutritional knowledge among the parents. Most children both in tribal and non-tribal community was found to consume two meals a day, one of which was the mid-meal provided in school under Governmental mid-day meal scheme. Thus the vital period of growth was greatly affected by poor nutrition.

The reduction in lung volumes and flow rates in malnourished children is probably due to ventilatory muscle wasting. However, undernutrition along with muscle wasting diminished skeletal growth is a reason for reduced lung functions.

The present study showed the existence of ethnic variation in terms of pulmonary function and flow rates.

Further the study showed correlation between nutritional status with lung function test values in both tribal and non-tribal boys.

The study would certainly provide reference data on pulmonary function variables for rural tribal and non-tribal school students in Tripura.

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