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NUTRITIONAL STATUS OF SCHOOL GOING CHILDREN (6-9 YEARS) IN RURAL AREA OF BHOPAL DISTRICT (MADHYA PRADESH), INDIA

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ABSTRACT

The nutritional status of 200 school going children (6-9 years) in Bhopal district was studied. Personal interviews consisting, food frequency questions and 24 hour dietary recall of children were used. Amount of nutrients obtained per day from food consumed was calculated and compared with RDA for Indian children (ICMR, 2009). Anthropometric measurements including weight and height were used to identify the physical condition of children. Water low's, Gomez's classification and CDC cut-off for BMI-for-age determined the extent of mal-nutrition in children and were compared with IAP standards**.** The height, weight and BMI of all respondents were significantly ($p \leq 0.05$) lower than the reference value. As per Water low's and Gomez's classification, only 12% of the children were normal. 55% of the children were wasted and 47% severely malnourished. Food consumption patterns indicated that except fat, diet consumed lacked all major and minor nutrients required for growth of children. Nutritional inadequacies, poverty, lack of infrastructure and poor education of mother resulted in severe mal-nutrition in school going children. This condition needs careful consideration. Steps like nutritional interventions, mid-day meal schemes and women education programs organized along with governmental and non-governmental groups can help in improving this condition.

Key words: Anthropometric assessment; malnutrition; nutritional status; dietary intake.

INTRODUCTION

Nutrition plays a vital role in growth and development of children. Inadequate nutrition may lead to malnutrition, growth retardation, reduced work capacity and poor mental and social development (Awasthi and Kumar, 1999; Manna *et al*., 2011). These conditions if encountered during childhood can lead to a life of poor productivity and endless sufferings. Among all age groups, the school age period is nutritionally significant because this is the prime time to build up body stores of nutrients in preparation for rapid growth of adolescence (Sati *et al*., 2012). Apart from that, the population of school-going children contributes to future man-power which can improve the socio-economic condition of developing countries. Thus, their mental and physical well-being is of utmost concern which can be achieved by adequate nutrition.

Developing countries like India, account for about 40 percent undernourished children in the World which is mainly due to the dietary inadequacy in relation to their needs (Mitra *et al*., 2007). India has diverse agro-climatic regions, ethnic multiplicities, socio-cultural practices, life styles and eating habits which vary not only between states but also within districts (Vashisth *et al*., 2005). Thus, there is a need for assessment of nutritional status in various parts of our country to obtain a clear picture of status of mal-nutrition in various regions. This will help in identifying the cause of this problem in each region and the solutions to combat it through locally available resources.

One such state with poor nutritional condition of children is Madhya Pradesh. The Central state of Madhya Pradesh (MP) is the second largest state in India with respect to area. The state of MP along with 6 more Indian states ranks at the bottom of the Child Development Index developed in 2009 by Indicus Analytics for UNICEF India (Hungama survey report 2011). Severe malnutrition has claimed the lives of around 125 children less than six years of age in MP since May 2008. As per National Family Health Survey (NFHS) data (2005-06) , 40% children below 5 years are stunted, 33% wasted and 60% underweight in MP.. The condition of school going children is no better. The government of India has established programs like 'Anganwadi' (Courtyard shelter) schemes under Integrated Child Development Services (1978) which aims to provide basic health care and nutrition to children. However, inadequate data on the nutritional requirements of children of a particular region limits the success of these attempts. Therefore, it is imperative that the dietary pattern of school going children are thoroughly assessed which can help in imbibing simple changes in their daily diets, thus improving their nutritional status. In the present study 200 school-going children (6-9 years) from three villages (Bagroda, Hath Mughalia and Dhamarra) in Bhopal district of MP were

selected and their nutritional status and extent of malnutrition was analyzed. The steps involved collection of general information, food and nutrient intake (24 hour dietary recall) and anthropometric assessments and finally identifying the lacunas in their diet and eating habits.

MATERIALS AND METHODS

SAMPLING, DATA COLLECTION AND ANALYSIS

Households from Bagroda, Hath Mughalia and Dhamarra Village who had children between 6 to 9 years were chosen for detailed dietary assessment. Data collection was done through questionnaire method. The questionnaire developed in German software NutriSurvey, 2007 was modified to suit Indian conditions and information on socio-economic status, including member information, income, educational, livelihood status including income earned from land and livestock and expenditure of the household was gathered. After the base information was collected, nutritional survey was carried out by the 24 hour dietary recall method. In this procedure the respondents (along with their mothers) were asked to list all the foods and beverages consumed during the previous day. All children surveyed ate lunch in the anganwadis under the mid-day meal scheme which was included in the dietary recall questionnaire. Anthropometric measurements covering weight, height, head and chest circumference for each child was recorded separately. All the absolute and circumferential measurements were recorded to nearest 0.1 cm and weight to nearest 0.1 kg. Data collection was done in liaison with the Krishi Vigyan Kendras (KVK) (district level Farm Science Centre), local Government school and anganwadis. The nutritional data collected were analyzed using NutriSurvey, 2007 software which gave individual nutrient breakup of each food consumed by respondents in past 24 hours. The values obtained were compared with Recommended Dietary Allowance (RDA) values for Indians (ICMR, 2009). Anthropometric data collected were used to calculate Body Mass Index, BMI (Kg/m^2), Weight for Height (WFH), Height for Age (HFA) and Weight for Age (WFA). The weight and height of children of each age group was compared with the reference data (ICMR, 2009) and Z-score was calculated. The malnutrition status of children was analyzed using CDC percentile cut-offs for BMI for age as proposed by Himez and Dietz 1994 (Table 1), Water low's classification (Waterlow, 1972) and Gomez's classification (Gomez *et al.*, 1955) (table 2). The CDC (Centre for Disease Control Prevention, USA) cut-off percentiles were matched through both CDC (2000) and IAP (Khadilkar *et al.*, 2007) (Indian Academy of Pediatrics) growth charts.

Water low's classification of malnutrition was calculated as:

$$\% \text{ Weight for Height} = \frac{\text{Weight of respondent}}{\text{Weight of normal child of same age}} * 100$$

$$\% \text{ Height for Age} = \frac{\text{Height of respondent}}{\text{Height of normal child of same age}} * 100$$

Gomez's classification of malnutrition was calculated as

$$\% \text{ Reference weight for age} = \frac{\text{Weight of respondent}}{\text{Weight of normal child of same age}} * 100$$

The statistical significance ($p \leq 0.05$) was determined using Two-way ANOVA with replicates in Microsoft Excel for Windows, 2010.

Table 1- CDC percentile cut-offs for BMI-for- age

Cut-off	Condition
< 5^{th} percentile	Under-weight
5^{th} to <85^{th} percentile	Normal
85^{th} <95^{th} percentile	Risk of over-weight
>95^{th} percentile	Over-weight

Table 2-Water low's and Gomez's classification of malnutrition in children

Condition	Water Low's classification		Gomez's classification
	Weight for height (wasting)	Height for age (Stunting)	% Reference weight for age
Normal	>90	>95	90-110
Mild	80-90	90-95	75-89
Moderate	70-80	85-90	60-74
Severe	<70	<85	<60

RESULTS

Various nutritional anthropometric indices and nutrient consumption pattern were examined to determine the nutritional status of school going children in Bhopal district of Madhya Pradesh.

SOCIO-ECONOMIC STATUS

Among the households surveyed, 95% of the families were Hindus and remaining belonged to Muslim community. 56% of the families had 3 to 4 children and 28% had 5 to 6 children. About 11% of the population analyzed had annual income below Rs 20,000 ($1 = Rs 63) which classifies them as 'Below Poverty Line' families. 9% of the population had annual income up to 1 lakh and the major population (24%) earned up to 80-90,000 per annum. On analyzing the educational qualification of mothers whose children were surveyed it was found that 58% of the mothers were illiterate, 16% studied till primary school and only 2% completed high school. Also, it was found that among the women analyzed, maximum i.e. 32% had their first child between 17-19 years, followed by 19% women who had between 19-21 years and only 5% had between 23-25 years.

GROWTH PARAMETERS

The height and weight obtained for 6-9 years boys and girls were compared with ICMR reference data, 2009. The average value for height and weight and z-score obtained for the corresponding parameter has been presented in Table 3. The height and weight obtained for each age group was found to be significantly ($p \leq 0.05$) less than the reference value. The z-score, which indicates the deviation of

an individual from reference population, was maximum for height and weight of 8 year old boys followed by height of 7 years old girls. Figure 1 compares the BMI of boys and girls of 6-9 age groups with that of reference values. The BMI of all age groups were found to be significantly less ($p \leq 0.05$) than reference BMI values except for BMI for girls of 6 years.

Table 3- Height and weight statistics of school going children of Bhopal district

	Height (cm)				Weight (Kg)			
Age (years)	**Boys**	**z-score (between)**	**Girls**	**z-score**	**Boys**	**z-score**	**Girls**	**z-score**
6[a]	108.31 ± 6.2	-0.9 to 1.8	104.2 ± 4.6	-0.9 to 0.8	15.4 ± 1.79	-1.3 to 1.0	16 ± 1.8	-0.5 to 1.4
Reference[b]	118.5		117.5		20.4		20.0	
7[c]	112.47 ± 6.3	-1.4 to 2.1	114.5 ± 10.3	-2.6 to 2.7	17.12 ± 2.1	-1.7 to 1.1	17.2 ± 1.9	-1.3 to 1.7
Reference[d]	124.3		123.6		22.7		22.3	
8[e]	117.78 ± 7.5	-3.1 to 1.3	126.8 ± 12	-0.2 to 4.3	18.75 ± 3.9	-3.4 to 1.0	21.9 ± 2.8	-0.9 to 2.0
Reference[f]	130.1		129.2		25.2		25.0	
9[g]	124 ± 4.56	-0.6 to 1.2	126.3 ± 11.6	-1.1 to 3.4	22.35 ± 3.9	-1.88 to 1.5	20 ± 3.7	-2.1 to 0.7
Reference[h]	134.6		135.0		28		27.6	

Reference values from ICMR (2009). Values with different superscript are statistically different ($p \leq 0.05$).

MALNUTRITION INDICATORS

The extent of malnutrition in children was analyzed on the basis of BMI-for-age cut offs as proposed by CDC, Water low's classification and Gomez's classification. Table 4 shows the percentage of children falling under various categories of mal-nutrition using standards from IAP and CDC growth charts. From the results obtained it can be seen that 56% of 6 year old boys were underweight whereas all 6 years old girls were under the normal category as per both IAP and CDC standards. On the contrary, only 17% of 9-year old boys were underweight and 56% of the 9-year old girls were underweight as per both the standards. Variation in results obtained for IAP and CDC standards was reflected in results of 7 and 8 year old children. As per IAP, 35 and 24% of boys and girls respectively were underweight whereas when computed through CDC charts, more than half of the population of 7 years old boys and girls were underweight. For this age group as per IAP standard 5% of the children were even under the 'risk of overweight' i.e. having BMI between 85^{th}-95^{th} percentiles.

Water low's classification uses "Weight for Height (WFH)" and "Height for Age (HFA)" to analyze the extent of malnutrition in children. On the basis of WFH only 12 % of the population (table 5) fell under normal category whereas more than half of the children analyzed were severely malnourished. On the other hand as per HFA under Water low's classification more than 50% of the children analyzed were normal and only 6% were severely malnourished. Gomez's classification determines the status of malnutrition in children on the basis of "Weight for Age". According to the WFA data obtained (Table 5) 47% of the children in the age group of 6-9 year were moderately malnourished and only 12 % can be regarded as normal with respect to their anthropometric data, one-fourth i.e. 25% of the children analyzed were suffering from mild malnutrition.

Table 4- Percentage of children suffering from various degrees of malnutrition as per IPA and CDC standards

Cut-off	**< 5th percentile (underweight)**				**5^{th} to $<85^{th}$ percentile (Normal)**				**85^{th} $<95^{th}$ percentile (risk of overweight)**				**$>95^{th}$ percentile (overweight)**			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
Age (years)	IAP*	CDC**	IAP	CDC	IAP	CDC	IAP	CDC	IAP	CDC	IAP	CDC	IAP	CDC	IAP	CDC
6	55.56	55.56	0.0	0.0	44.44	44.44	100	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	35.00	55.00	24.00	56.00	60.00	40.00	72.00	44.00	5.0	5.0	4.00	0.0	0.0	0.0	0.0	0.0
8	33.33	61.11	22.22	33.33	66.67	38.89	77.78	66.67	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0
9	16.67	16.67	55.56	55.56	83.33	83.33	44.44	44.44	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0

*values obtained from growth charts compiled by Indian Academy of Pediatrics (IAP), 2007

** values obtained from growth curves compiled by Centre for disease control and prevention(CDC), USA, 2000

Table 5- Percentage of malnutrition in children according to Water low's and Gomez's classification

Nutritional status	Children (6-9 years) n=200 (%)		
	Weight for Height	Height for Age	Weight for Age
Normal	12.00	53.00	12.00
Mild	15.00	21.00	25.00
Moderate	18.00	20.00	47.00
Severe	55.00	06.00	16.00

FOOD CONSUMPTION PATTERN

24-hour dietary recall method was used to record the nutrient intake in children of Bhopal district. The nutrient intake per day calculated from various foods consumed by children has been presented in table 6. Among the various nutrients analyzed, except for fat consumed per day all other nutrients were significantly less ($p \leq 0.05$) than the RDA for 6-9 years of age group. The food consumed by children could fulfill only 51.7 % of energy required with respect to RDA. About 35% of this energy was obtained by the consumption of cereals (mainly wheat and rice) which were followed by oils and fats which contributed to 30% of the total energy obtained from diet consumed by children (Figure 2). On the other hand, the amount of carbohydrate required was not even 50% fulfilled of the foods consumed by children. The amount of protein consumed by children was found to be 21.6 % less than the RDA as per ICMR, 2009 standards. Among the micronutrients studied such as calcium (mg/d), phosphorus (mg/d), iron (mg/d), etc. were significantly lower ($p \leq 0.05$) than the RDA. Calcium and iron which are required for the development and growth of body was fulfilled only 21 and 34% respectively. The food frequency questionnaire (Table 7) elicited the consumption pattern in terms of the different food groups. It was seen that cereals, milk in the form of tea, sugar and fat were consumed on everyday basis. Protein rich foods like pulses and lentils were consumed everyday by 22% of the respondents whereas fish and meat were consumed by only 8% of the respondents. Pulses were maximally consumed only once a week, despite most farmers growing soybean, pigeon pea and chickpea.

Table 6-Daily nutrient consumption compared with RDA

Nutrient	Average Nutrient intake	RDA (ICMR, 2010)	% fulfillment of nutrient
Energy (Kcal)	873.43 ± 65.67	1690	51.68
Protein (g)	23.1 ± 6.05	29.5	78.39
Moisture (g)	510.2 ± 52.90	1800	28.34
Fat (g)	35.17 ± 2.32	30	117.22
Carbohydrate (g)	112.13 ± 16.43	265	42.31
Dietary fibre (g)	12.17 ± 4.74	25	48.67
Carotene (mg)	3.23 ± 1.62	6.8	47.55
Calcium (mg)	127.17 ± 20.4	600	21.19
Phosphorus (mg)	493.9 ± 44.79	600	82.32
Iron (mg)	5.47 ± 0.65	16	34.17
Zinc (mg)	4.67 ± 0.83	5.2	89.74

Table 7- Food frequency consumption pattern

Food groups	Every day (%)	Once a week (%)	Once a fortnight (%)	Once a month (%)
Cereals	100	-	-	-
Pulses and lentils	22	76	2	-
Green leafy vegetables	4	83	2	-
Other vegetables	100	-	-	-
Root and tubers	15	61	-	-
Fruits	0	74	20	4
Milk and Milk Products	100	-	-	-
Fish and meat products	8	13	15	-
Sugar and jiggery	100	-	-	-
Fats and Oils	100	-	-	-
Fried snacks/sweet Snacks	27	61	23	-

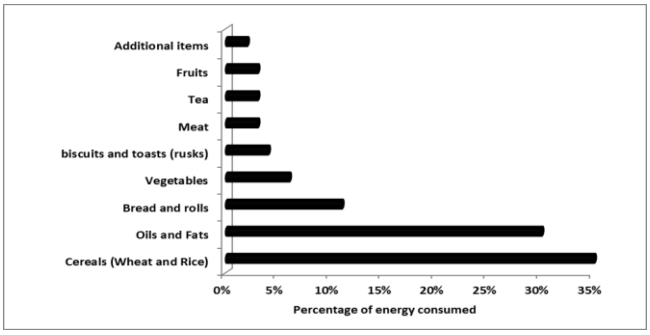

Figure 2- Percentage of energy obtained by various food groups consumed by children of Bhopal district

DISCUSSION

A country's development is reflected by the health condition of its population. The status of health in a group is influenced by factors such as education, poverty, nutritional intake and proper utilization of available resources. Of these, nutrition is of paramount importance, improper nutrition can give rise to the phantom of mal-nutrition which can cripple any society. Malnutrition in children is the consequence of a range of factors that are often related to poor food quality, insufficient food intake and severe and repeated infectious diseases, or frequently some combinations of the three. These conditions, in turn, are closely linked to the overall standard of living and whether a population can meet its basic needs, such as access to food, housing and health care (WHO, 1997). Dietary surveys and anthropometric measurements are therefore one of the essential components of nutritional assessment (Kulsum *et al.*, 2008)

The present study was undertaken to evaluate the nutritional status of school going children of Bhopal district. From the results obtained it was observed that the children analyzed weighed significantly ($p \leq 0.05$) less than their reference counter parts. This difference is mainly attributed to the nutritional inadequacies observed. Carbohydrates are the main source of energy, since the amount of carbohydrates

consumed couldn't match to even 50% of the RDA of Indian children of same age; the energy fulfillment was automatically lowered. From Figure 2 it was observed that wheat and rice contributed to 35% energy consumed and was consumed everyday by whole population analyzed, these cereals are also good source of carbohydrates, and their inadequacy indicates that the quality and quantity of carbohydrates consumed are not up to the standard. Both these things are linked to the poverty prevailing in Bhopal district. About 11% of the children belonged to BPL families and only 9% of the families had annual income greater than 1 lakh.

Protein deficiency in children was not as severe as energy or carbohydrate deficiency but still prevailed to a considerable extent. Protein is an important nutrient required during the growth years of life. Its deficiency can have severe health effects on the physical and mental growth of children. Apart from that in the absence of insufficient energy from carbohydrates and fats, body metabolizes protein to fulfill its energy requirements which can result in wasting and physical impairment. The population studied did not have access to a protein rich diet. Pulses and meat which are regarded as good protein sources were consumed once in a week which might have contributed to decrease in weight and short stature of children. Despite the fact that most families has farming as their major occupation and pulses like soybean and pigeon pea are grown, the protein deficiency reflects the lack of nutritional awareness among people of Bhopal district

The high amount of fat observed in the diet of children is mainly attributed to the cooking traditions followed in Bhopal district whereby the amount of fat used in cooking is higher than required. Mostly soybean oil was used for cooking. Among the minerals, consumption of calcium was extremely lower than the RDA, the main reason for this being absence of calcium rich foods in diet. The best source of calcium is milk and milk products but the children of Bhopal district reported consumption of dairy products once in a fortnight apart from a small amount (5-10ml) consumed in tea every day. Children need relatively more calcium than adults to meet the requirements of growing bone. Calcium is also required for absorption of vitamin D, thus, deficiency of calcium can have adverse effect on absorption of vitamin D in body.

The iron requirement by children was only fulfilled by 34%. Iron deficiency can lead to cognitive deficits and reduced intellectual performance among school children (Sachdev, 1997; Rammohan *et al.*, 2012). The kind of diet being consumed has a lot of influence on iron absorption. Cereal based diets permit low absorption of iron as compared to diets rich in meat and fish (Gopal *et al*., 1999). Since the diet consumed by children in Bhopal district are low in meat and fish could have resulted in iron deficiency.

Nutritional inadequacy was also reflected through the anthropometric assessment. Weight for Height, Height for Age, BMI-for-age, wasting and stunting with low BMI are regarded as important objective indicators of attained size and physical growth in children and help in identifying the status of mal-nutrition in children through various classifications (Ramahandra and Gopalan, 2009).

Body Mass Index (BMI) reflects a shorter-term nutritional/health status, which at low levels is referred to as "wasting" and is associated with elevated risks of mortality and morbidity (Fogel, 1994; Schultz, 2005). All cases studied had a lower BMI than reference except for 6 year old girls (Figure 1). To compare the BMI's of children two standard populations were used viz IAP standards which are a representative of Indian population and CDC standards which represents population of US children of same age group. Variation in IAP and CDC standards among 7-8 years old children suggests a lower standard BMI value for Indian population. From the results obtained it was found that children in 6-9 years of age group were primarily underweight. Apart from insufficient caloric intake, childhood underweight is also related to improper infrastructure for storage and distribution of food in developing nations (Onis *et al*., 2004; Henninger, 2008). Underweight in children results in various detrimental effects like decreased academic achievement, low immunity, social problems, challenging behavior etc. (Chang *et al*., 2002). Thus, prevalence of underweight condition among school children in Bhopal district needs to be considered.

Gomez's classification evaluates Weight for Age (WFA) in children and determines the extent of short term mal-nutrition. The results obtained suggested that only 12% of the children were normal and almost half of the population was moderately malnourished. WFA also reflects underweight condition in an indirect way and it's the beginning of long term mal-nutrition condition like wasting and stunting.

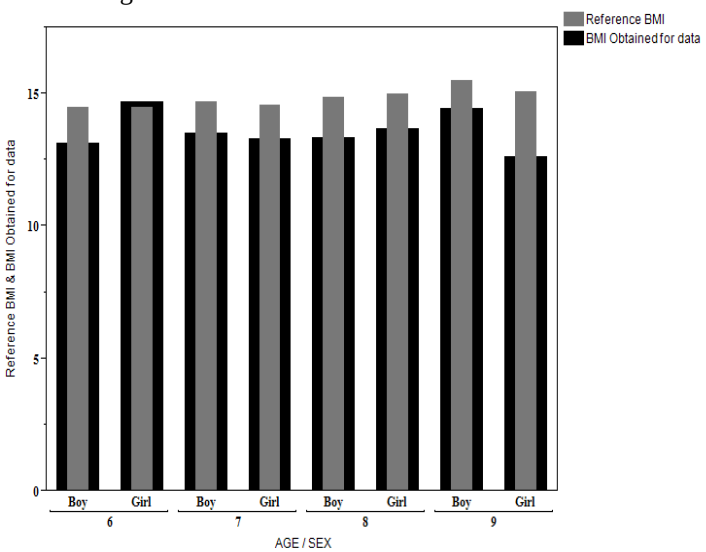

Figure 1- Comparison of BMI of children of 6-9 years with reference value (ICMR, 2009; BMI: Body Mass Index

Assessment of Height for Age (HFA) and Weight for Height (WFH) also known as Water low's classification is used to determine long-term malnutrition that effects a child's growth that eventually results in short stature

(stunting) and wasting respectively (Agrahar-Murugkar, 2005). From the results obtained for WFH it was found that more than half of the population showed severe signs of wasting whereas this severe effect was not yet reflected on the stature of the children as more than half had normal stature. About 6% of the children were severely stunted showing that malnutrition in children if not controlled at this stage can drastically increase in future. WFA, HFA and WFH are inter linked and it has been observed that an underweight child i.e. low in WFA may be adequate in WFH but low in HFA (short but not thin), or adequate in HFA but low in WFH (thin but not short), or low in both (short and thin), as is very common. All these conditions reflect physical abnormalities in children and is a related to poor nutritional intake. Thus, in order to prevent this plague to spread further it is essential that steps should be taken towards dietary intervention in this district.

Literacy and schooling levels, especially of mothers, are known to affect the style and goals of child care. An educated mother would not only have a sound idea of the nutritional requirement of her child but would also influence her child's performance in school. In our study, 58% of the mothers were illiterate and only 2% had completed basic schooling, this could have been a factor of poor health conditions of children of Bhopal district. Another contributing factor can be the traditions of our society, whereby early marriage of girls are preferred which results in child birth at a young age of mother. An early pregnancy can result in poor physical growth of both child and mother and 32% mother's in our study had their first child in the age of 17-19 years.

From the picture that emerged from this study it can be concluded that the extent of malnutrition in Bhopal district among children in the age group of 6-9 years needs careful consideration. All the macro and micro nutrients analyzed was found to be lower than the RDA and its consequences were reflected through anthropometric assessment. Childhood is an age of development and growth and dietary habits imbibed in this age are carried through other stages of life too. Thus, improper nutrition would result in poor quality of life.

Similar condition of mal-nutrition was reported by other researchers too in India (Vashisth *et al.,* 2005; Maitra *et al.*, 2012; Mehrotra *et al*., 2012). For the development of our country it is essential that this vicious cycle of malnutrition, poverty and disease be broken and this is possible through specific health and nutritional interventions. Schools in collaboration with Anganwadis or NGO's can provide a practical platform to deliver an integrated package of interventions, such as nutritious meals or snacks, micro-nutrient supplements or on-site fortification, infection control, health promotion and life skills education to improve the health and nutrition of schoolchildren (Best et al. 2010). Apart from that programs for women education should be encouraged. Thus, in order to improve the quality of life from childhood it is essential that immediate actions should be taken in this direction.

CONCLUSION

Anthropometric assessment and nutritional status analysis indicates that the children (6-9 years) of Bhopal district are suffering from severe mal-nutrition. Extent of mal-nutrition has been reflected through wasting and under-weight in children. Stunting, which is also an indication of mal-nutrition hasn't reached the same extent but if not controlled at this point can increase drastically in future. The major factors identified for this problem is illiteracy of mother, poverty, nutritional inadequacy and poor infrastructure. In order to deal with this issue steps like nutritional interventions, mid-day meal schemes, micro-nutrient supplementation and women education programs organized by schools in collaboration with anganwadis, NGOs and private organization can give fruitful results.

REFERENCES

- 2000 CDC Growth charts for the United States: Methods and Development. National Centre for Health Statistics. Vital Health Stat 2002; 11(246). www.cdc.gov.
- Agrahar-Murugkar, D. Nutritional status of Khasi school girls in Meghalaya. Nutrition. 2005; 21: 425-431.
- Awasthi, N., Kumar, A. P. Nutritional status of hill primary school children. Ind J. Nutr Dietetics. 1999; 36: 453-459.
- Best, C., Neufingerl, N., Van Geel, L., Briel, T.V.D., Osendarp, S. The nutritional status of school going children: Why should we care? Food Nutr Bulletin. 2010*;* 31: 400-417.
- Chang, S.M., Walker, S.P., Grantham-McGregor, S.C., Powell, A. Early childhood stunting and later behavior and school achievement. J. Child Psychol Psychiatry. 2002; 43: 775-783.
- Fogel, R.W. Economic growth, population theory and physiology. Am Ecol. Rev. 1994; 84 (3):369-395.
- Gomez, F., Galvan, R.R. Cravioto, J., Frenk. S. Malnutrition in infancy and childhood, with special reference to kwashiorkor. Advances in Pediatr.1955;7: 131-169.
- Gopalan, C., Shastari, R.B.V., Balasubramanian. S.C. Nutritive value of Indian foods, Hyderabad: National Institute of Nutrition. 1999.
- Henninger, W. R.. Differences in the development of under-weight and over-weight children and their parents' perception of their socio-emotional development. 2008Iowa state university, digital repository.
- Himes, J.H., Deitz. W.H. Guidelines for overweight in adolescent preventive services: recommendations form an expert committee. *Am. J. Clinical Nutr.* 1994; 59:307-316.

- Hungama survey report-2011, www.hungamaforchange.org
- ICMR, 2009. Nutrient Requirements and Recommended Dietary Allowances for Indians. A Report of the Expert Group of the Indian Council of Medical Research. ICMR, New Delhi.
- Khadilkar, V.V., Khadilkar, A.V. Choudhary, P., Agarwal, K.N., Ugra, D., Shah, N.K. IAP growth monitoring guidelines for children from birth to 18 years. Indian Pediatrician. 2007;44: 187-197.
- Kulsum, A., Lakshmi, J.A.,. Prakash. J. Food intake and energy protein adequacy of children from an urban slum in Mysore, India-a Qualitative analysis. Malaysian J. Nutr. 2008; 14(2): 163-172.
- Maitra, P., Rammohan, A., Ray, R., Robitaille. M.C. Food consumption patterns and malnourished Indian children: Is there a link? Food Policy. 2013; 38: 70-81.
- Manna, P.K., De, D., Bera, T.K., Chatterjee, K., Ghosh. D.. Anthropometric assessment of physical growth and nutritional status among school children of North Bengal. Anthropologist. 2011; 13(4): 299-305.
- Mehrotra, M., Arora S., Nagar. V. Nutritional health status of primary school children- A study in Bareilly district. Indus. Edu Rev. 48(1): 18-29.
- Mitra, M., Kumar, P.V., Chakrabarty, S., Bharati, P. Nutritional status of Kamar tribal children in Chhatisgarh. Ind. J. Pediatrics. 2007;74: 381-384.
- National Family Health Survey-3 (2007) NFHS (2005-2006) report: Fact sheet for Madhya Pradesh.
- Onis, M., Blossner, M., Borghi, E., Frongillo, E.A., Morris, R. Estimates of global prevalence of childhood underweight in 1990 and 2015. J. Ame Med. Assoc. 2004; 291: 2600-2606.
- Ramachandran, P., Gopalan, H.S. Under-nutrition and risk of infections in preschool children. Ind. J Med Res. 2012; 130: 579-583.
- Rammohan, A., Awofeso, N., Robitaille, M.C. Addressing female Iron-deficiency anemia in India: Is vegetarianism the major obstacle? ISRN 2012, doi:10.5402/2012/765476. 2012.
- Sachdev, H.P.S. Nutritional status of children and women in India: Recent trends. NFI Bulletin. 1997; 18(3): 1-5.
- Sati, V., Dahiya. S. Nutritional assessment of rural school going children (7-9 years) of Hisar district, Haryana. Open Access Scientific Reports. 2012; 1(7): 2-4.
- Schultz, T.P. Productive benefits of Health: Evidence from Low Income countries. Centre Discussion Paper: Economic Growth Centre, Yale University 2005; 1-30.
- Vashisht, R.N., Krishnan, K., Devial, S. Physical growth and nutritional status of Garhwali girls. Ind J. Pediatrician. 2005; 72: 573-578.
- Waterlow, J.C. Classification and definition of protein-calorie, malnutrition. British Med J. 1972; 3: 566-569.
- WHO (1997). WHO global database on child growth and malnutrition. NUT/97.4. World health Organization, Geneva.