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INTRA-FAMILY DIFFERENCES IN NUTRITIONAL STATUS BETWEEN PRE-SCHOOL AND SCHOOL AGE CHILDREN

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ABSTRACT Currently under- and over-nutrition are public health problems in Indian children. A community-based study in 3249 children was undertaken to assess the magnitude of intra-family differences in nutritional status between pre-school and school age children from urban low middle income families. Length/height and weight were measured; nutritional status was computed using WHO Anthro and Anthro Plus software. One-fourth of children were stunted, 1/5th underweight, 1/10th wasted and less than 5% were overweight. Prevalence of stunting, underweight and wasting was higher in children whose elder siblings were stunted, underweight or wasted. However, majority of the younger siblings of under-nourished elder siblings were normally nourished; majority of the elder siblings of under-nourished younger sibling were normally nourished. In view of this, it is essential to screen all children, identify those who are under- or over-nourished using BMI-for-age and provide appropriate interventions.

KEYWORDS : Pre-school children, primary school children, adolescents, under-nutrition, over-nutrition, intra-family differences in nutritional status.

INTRODUCTION

Surveys carried out by the National Nutrition Monitoring Bureau (NNMB) in the 1970s had shown that dietary intake of Indian children were lower as compared to the requirements and prevalence of under-nutrition across all age groups especially in 0-4 year children was high[1]. In the 1970 poverty and food insecurity were major factors responsible for under-nutrition. Families below poverty line (BPL) were identified and provided with employment to improve purchasing power. Subsidised food grains were provided to the BPL families through Public Distribution System. India initiated two supplementary feeding programmes: Integrated Child Development Services (ICDS) for pre-school children and Mid-Day Meal (MDM) programme for school children to bridge the gap between energy intake and energy requirement and reduce the prevalence of under-nutrition in children. Improvement in access to health care prevented deterioration in nutritional status in children due to prolonged or repeated infections. Over time there has been a slow but steady decline in the under-nutrition rates in pre-school and school age children and a small rise in over-nutrition[1-12].

NNMB surveys from mid-1990s[2,3] have reported that there were intra-family differences in the dietary intake between children of different age groups and adults from the same family. NFHS 3[13] and research studies[14,15] have shown that there were differences in nutritional status between children and adult women in the same family. There are no publications reporting the differences if any in nutritional status of the pre-school, primary school children and adolescents from the same family. A community-based study was taken up to document the magnitude of the intra-family differences in nutritional status between pre-school and school age children from urban low middle income group. Currently ICDS and MDM provide food supplements to families Below Poverty Line. If there are substantial differences in nutritional status between children from the same families, the focus of the public health interventions has to shift to screening all children, identifying those who are under- and over-nourished and initiating appropriate interventions based on their nutritional status.

MATERIAL AND METHODS

The study was conducted in ICDS blocks in South Delhi. A household census was done in these blocks and families with one or more 0-5 year children and one or more child in the 0-18 year age groups were identified. The details about the study were explained to these families and the Hindi version of Study Information Sheet was provided to them. The families were revisited one week later; consent was obtained from parents who were willing to allow their children in the 0-18 year age group to participate in the study. Details of the study was explained to the children in the 7-18 year age group and their assent to participate in the study was also obtained.

Socio-demographic details of the families were obtained in a pre-tested and pre-coded proforma. Majority of the 0-4 year children were at home and anthropometric assessment could be carried out during the first or second home visit. Majority of the children in the 5-18 years of age were not at home during the usual home visit; despite repeat home visits at such times when they were likely to be at home, not all school age children could be measured.

Length was measured using an infantometer in infants and children who could not stand erect. Height was measured using stature meter in children who could stand erect. Infantometers and stature meters had accuracy of 0.1 cm. Personnel measuring anthropometric parameters were trained in undertaking measurements especially length measurements in infants and height measurements in young children in community settings. Only those who were accurate in taking measurement in infants and young children, took length/height measurements in pre-school children. Weight was measured using a digital balance (with accuracy of 100g) in all children. Balances were checked every day for accuracy by weighing standard weights and repeatedly weighing two persons five times in the balance. Only those balances which were accurate (balances showing ±100g difference in weight as compared to standard weights and weight of the same person) were used for measurement of weight in the community. Nutritional status of the 0-4 year children (2137) was assessed using WHO MGRS; nutritional status of the 5-9 year (736) and 10-18 year (376) children were assessed WHO AnthroPlus. Nutritional status of children was classified on the basis of z scores: for length/height-for-age (stunted, normal or tall), weight-for-age (underweight, normal or overweight) and BMI-for-age (wasted, normal or over weight).

This observational study was approved by the Institutional Ethics Committee. Permission to conduct the study was obtained from the Deptt of Woman and Child Development National Capital Territory, Delhi.

Sample Size

There were no data on the differences in under-nutrition rates between 0-4, 5-9 and 10-18 year children from the same family. So, the study was initiated and the data from the first year was used to compute sample size. Data from the first year showed that the difference in stunting rates between 5-9 years and other age groups was about 10%. Assuming the difference in stunting rates of 10%, margin of error of 5%, confidence level at 95% and design effect of 2 the sample size required was 1000 pairs of children.

Data entry, data cleaning and analysis

Data were entered and cleaned in Microsoft Excel 2013. Nutritional status of children was assessed using the WHO Anthro (0-4 years) and

WHO AnthroPlus (5-18) software and the prevalence of under- and over-nutrition rates were computed in different age groups.

Statistical analysis was carried out using MS Excel and SPSS 27. Means and standard deviations were calculated for continuous variables; for categorical variables percent prevalence was computed. Student t test was used to assess the statistical significance of the observed inter-group differences in the continuous variables; Chi square test was used to assess the statistical significance of observed inter-group variations in categorical variables.

RESULTS AND DISCUSSION

Socio-demographic profile

Analysis of data on socio-demographic profile of the study families showed that majority were nuclear families (65.6%) with five or less members. Majority of fathers (77.2%) and mothers (56.6%) had secondary school education. Majority of the fathers (55.6%) were semi-skilled workers; 21.6% worked in white collar jobs. Over 97% of mothers were home makers.

Over 95% of households lived in brick-and-mortar buildings; 38.5% owned their houses; the rest were mostly migrant labourers who lived as tenants in one or two room tenements. Over 95% had access to piped water supply at home or in the near vicinity and access to flush toilets either in their own home or shared with other households. For cooking almost all used Liquefied Petroleum Gas (LPG) and stainless-steel utensils. Over 98% owned colour TV, which was their main source of entertainment. These families stated that they:

- were food secure;
- had adequate earning to meet the essential requirements of shelter, household possessions, education of children and primary health care, but
- because of urban housing constraints, they lived in one or two room tenements in over-crowded unhygienic localities.

Nutritional profile of 0-18 year children

Table 1 Nutrition profile of the children (cross-sectional)

Age group	Number	Age (mths)	Wt (kg)	Height (cm)	BMI	WAZ	HAZ	BAZ
0-4 year	2137	24.4±17.52	9.9±3.61	78.8±15.49	15.4±1.99	-1.1±1.14	-1.4±1.48	-0.4±1.34
5-9 year	735	86.9±16.37	21.0±5.51	117.6±10.62	15.0±2.23	-1.0±1.29	-0.9±1.39	-0.6±1.35
10-18 year	377	158.2±27.43	39.1±10.54	146.4±12.14	17.9±3.17	NA	-1.2±1.31	-0.5±1.29
T test p value 0-4 yr & 5-9 yr: HAZ S 1.84E-14; WAZ 0.002; BAZ S 6.32E-05;								
T Test p value 0-4 yr & 10-18 yr: HAZ S 0.01; BAZ S 0.03								
T test p value 5-9 yr & 10-18 yr: HAZ S 0.001 BAZ NS 0.4								

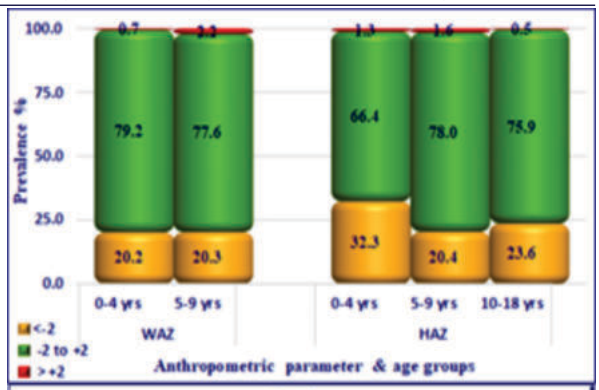
A total of 3249 children were enrolled for the study. The mean age, weight, height and BMI as well as z scores of the three anthropometric parameters in 0-18 year children is given in Table 1. There was a progressive increase in mean height and weight in the three age groups. Mean BMI was similar in the 0-4 and 5-9 year groups but was substantially higher in the 10-18 year age group. This increase in BMI-with-age is due to the increase in muscle and fat mass in children as they become older. Similar trends in BMI with age have been reported in AHS CAB and DLHS 4[9-10].

Indian children are small statured; their median height-for-age and weight-for-age are near -2SD of WHO standards for height- and weight-for-age. However median BMI-for-age of Indian children is around -1SD of WHO standards for BMI-for-age[16,17]. This difference between indicators used for assessment of nutritional status in children is reflected in the mean z scores for height, weight and BMI.

In all the age groups the mean HAZ, WAZ and BAZ were all in the negative range. The negative mean z scores for height (range -1.4 to -0.9) and weight (-1.1. to -1.0) were higher as compared to the negative mean z scores for the BAZ (range -0.6 to -0.4). WAZ were available only for the 0-4 year and 5-9 year age groups. The differences in the:

- mean HAZ, WAZ and BAZ between 0-4 and 5-9 year children,
- mean HAZ, and BAZ between 0-4 and 10-18 year children and
- mean HAZ between 5-9 and 10-18 year children

were statistically significant.



P value				
<-2 & others 0-4 vs 5-9 yrs	NS 0.95	WAZ	>+2 & others 0-4 vs 5-9 yrs	S 4.65E-04
	S 1.01E-09	HAZ		NS 0.46
<-2 & others 0-4 vs 10-18 yrs	S 7.78E-04	HAZ	>+2 & others 0-4 vs 10-18 yrs	NS 0.22
<-2 & others 5-9 vs 10-18 yrs	NS 0.31	HAZ	>+2 & others 5-9 vs 10-18	NS 0.11

Fig. 1 Nutritional Status of Pre-school and School Age Children (cross-sectional)

Comparison of the nutritional status of the three age groups as assessed by HAZ (stunting <-2SD, normal -2SD to +2SD and tall >+2SD), WAZ (underweight <-2SD, normal -2SD to +2SD and overweight >+2SD) is shown in Fig. -1.

Prevalence of stunting was highest in the 0-4 year children, lower in 10-18 year age group and lowest in the 5-9 year age group. The differences in stunting rates between 0-4 and 5-9 year group and 0-4 and 10-18 year group were statistically significant but the difference between 5-9 and 10-18 year was not statistically significant. The difference in underweight rates between 0-4 and 5-9 year children was not statistically significant (Fig. -1). It is possible that the faltering in linear growth during the periods of rapid linear growth (under-five children and adolescents) was responsible for the observed differences in stunting rates between the three age groups.

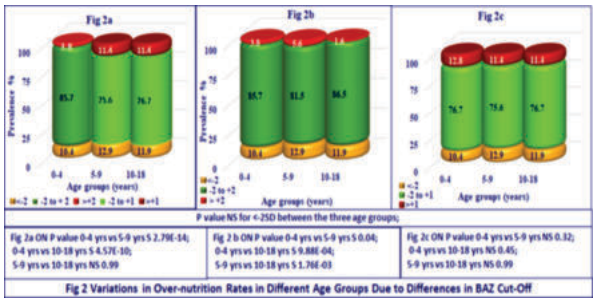


Fig 2 Variations in Over-nutrition Rates in Different Age Groups Due to Differences in BAZ Cut-Off

In the dual nutrition burden era BMI-for-age is the most appropriate indicator for assessing nutritional status of children especially in countries like India with high stunting rates in children. WHO Anthro and WHO AnthroPlus classify wasting in children as BAZ <-2 SD. The differences in the wasting rate between the three age groups were small and not significant (Fig. 2a, b and c). Prevalence of under-nutrition (stunting, underweight and wasting) in Indian children are among the highest in the world.

The WHO Anthro classifies 0-4 year children as over-nourished if BAZ was >+2; WHO AnthroPlus has classified 5-18 year children as over-nourished if BAZ was >+1. The WHO AnthroPlus manual states that this modification was done because BMI-for-age for +1 SD for 19 years, coincided with the cut-off of BMI of 25 kg/m^2 in adults (overweight adults), +2 SD coincided with the adults' cut-off of BMI of 30 kg/m^2 (obese adults) and +3 SD cut-off corresponded to an adult BMI of above 35 kg/m^2 (severely obese adults)[18].

Data from the present study were analysed using the WHO dual cut off (BMI for age +2 for 0-5 and + 1 for 5-18), as well as uniform BMI for age +1 cut off and uniform BMI for age +2 cut off for 0-18 and the

results are shown in Fig 2. If the WHO dual BMI for age cut off classifications were used (Fig. 2a), there were substantial and statistically significant differences in over-nutrition rates as assessed by BAZ between 0-4 and 5-9 year as well as 0-4 and 10-18 year age groups. However, the differences in over-nutrition between 5-9 and 10-18 year age group was small and statistically not significant (Fig. -2a). If uniform norms of BMI for age either +1 or +2 were used for defining over-nutrition across the 0-18 year there were no differences in the prevalence of over-nutrition in children.

NNMB survey[4] and CNNS[11] used the WHO dual BMI cut off; both these surveys reported a higher over-nutrition rate in the 5-18 year age group. AHS[10] and DLHS4[9] surveys which used BMI for age of +2 for defining over-nutrition in the 0-18 age group did not report any difference in the prevalence of over-nutrition in the 0-18 year age group. Data from the present study indicate that the differences in the reported prevalence of over-nutrition between 0-5 and 5-18 year children is due to the differences in the norms used for defining over-nutrition. It might not be appropriate to use different cut-offs for defining over-nutrition in 0-4 and 5-18 year age groups. If the dual classification is used a 59 month child with a BMI for age of + 1.2 will be classified as normally nourished; but two months later, the same child without any change in BMI for age will be classified as over-nourished. If uniform criteria are used for defining over-nutrition in pre-school and school age children, the prevalence of over-nutrition in 0-18 year children are similar. Therefore, in India, interventions to halt the rise in over-nutrition have to begin right from infancy and early childhood and continue thereafter during the school age children. Currently prevalence of over-nutrition in children is low. If all the children are screened at least twice a year, under- and over- nourished children are identified, and appropriate intervention provided and improvement monitored, it will be possible to accelerate the pace of reduction in under-nutrition and halt the rise in over-nutrition in children.

Intra-family differences in nutritional status of children

Intra-family differences in nutritional status were assessed by comparing nutritional status of pairs of children of different age groups from the same family:

- elder (E) and younger (Y) 0-4 year children (933 pairs),
- 5-9 year children and, 0-4 year children, (931 pairs)
- 10-18 year children, and 0-4 year children (472 pairs) and
- 10-18 year children and 5-9 year children (195 pairs).

If the elder of the 0-4 year sibling was underweight, stunted or wasted, the prevalence of underweight, stunting and wasting rates were higher in the younger 0-4 year siblings, (Fig. -3). These differences were statistically significant for stunting, underweight and wasting (Fig. 3).

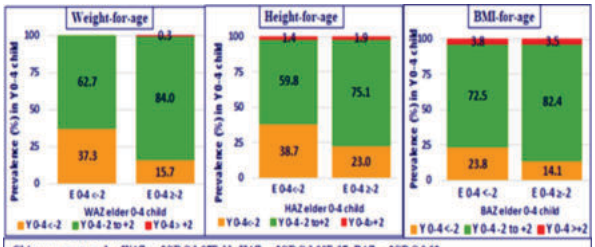


Fig. 3 Comparison of Nutritional Status of Elder and Younger 0-4 yr Siblings

If the 5-9 year child was stunted, underweight or wasted, the prevalence of underweight, stunting and wasting was higher in the 0-4 year sibling (Fig. 4). These differences were statistically significant for WAZ and HAZ.

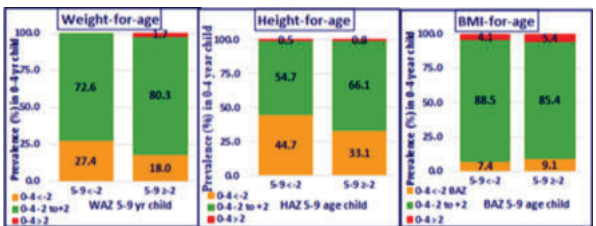


Fig. 4 Comparison of Nutritional Status of 5-9 year and 0-4 year Siblings

The differences in stunting and wasting rates between 10-18 and 0-4 year children were small and not statistically significant. (Fig. 5). If the 10-18 year old child was stunted or wasted, the stunting and wasting rates in 5-9 year group were higher (Fig. 6). These differences were statistically significant for HAZ but not for BAZ (Fig. 6).

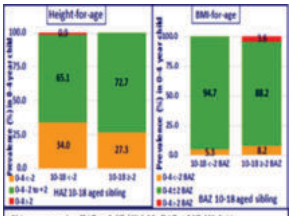


Fig. 5 Comparison of Nutritional Status of 10-18 year and 0-4 year Siblings

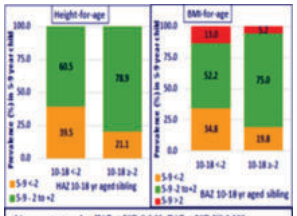


Fig. 6 Comparison of Nutritional Status of 10-18 year and 5-9 year Siblings

Comparison of the prevalence of under-nutrition between children from the same family showed some interesting findings. Irrespective of the parameter (stunting, underweight or wasting) or the age group (0-4, 5-9 or 10-18 year), if the elder sibling was stunted, underweight or wasted, the prevalence of stunting, underweight and wasting in the younger sibling was higher (Figs. 3-6). This is because the siblings share some of the major factors responsible for under-nutrition in children such as small parental stature, low parental weight, low dietary intake and poor environmental sanitation (Figs. 3-6).

CONCLUSION

In India prevalence of under-nutrition in children continued to be high in 0-18 year age group. Risk of under-nutrition in younger child is higher if the elder child is under-nourished; but majority of the younger siblings of under-nourished elder siblings were normally nourished and majority of the elder siblings of under-nourished younger sibling were normally nourished. Prevalence of over-nutrition in children is quite low. Over-nutrition rates in Indian children are low. If uniform norms are used to define over-nutrition across 0-18 years there were no differences in over-nutrition rates between different age groups.

In India both under-nutrition and over-nutrition in childhood are associated with increased risk of over-nutrition in adult life and non-communicable diseases[19]. SDG[20] have set targets for reduction in wasting (<5%) and halting the rise in over-nutrition to be achieved by 2030. In view of the substantial intra-family differences in nutritional status between children, it is imperative to screen all children and detect under-nourished and over-nourished children. Effective management of wasting with food supplements and health care can accelerate the pace of reduction in under-nutrition. Increasing physical activity and preventing habitual consumption of energy dense foods can help in halting the rise and perhaps later in reversing over-nutrition in children and adolescents.

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