Content available at: https://www.ipinnovative.com/open-access-journals

IP Journal of Paediatrics and Nursing Science

Journal homepage: https://www.jpns.in/

Original Research Article

Intrafamily differences in nutritional status of preschool children

Honey Kumari[1], **K Kalaivani**[1], **Prema Ramachandran**[1,*]

[1]*Nutrition Foundation of India, New Delhi, India*

ARTICLE INFO

Article history:
Received 14-09-2023
Accepted 16-10-2023
Available online 21-10-2023

Keywords:
Preschool children
Intrafamily differences
Nutritional status
Stunting
Underweight
Wasting
Growth monitoring

ABSTRACT

Background: Studies on intra-family differences in nutritional status in under-five siblings reported that prevalence of stunting, underweight, and wasting were higher in the elder sibling. A mixed longitudinal study was taken up to document changes in anthropometric indicators with increasing age in pre-school children and to assess whether the observed differences in nutritional status between the two under-five siblings were due to changes in anthropometric indices with increasing age.

Materials and Methods: The study was undertaken in three groups of children from urban low middle-income families: Group A (cross-sectional data), Group B (paired data of the siblings, one in the 0-23 months and the other, in the 24-59 month age group), and Group C (first measurement in the 0-23 month age and the second measurement in the 24-59 month age in the same child). Changes in anthropometric indices and nutritional status in relation to age were computed in all three groups and compared.

Results: There was an increase in stunting and underweight, and a decrease in wasting rates with increasing age in Groups A, B, and C. The trend and magnitude of change in nutritional status were similar in Groups A, B and C.

Conclusion: Intra-family differences in the nutritional status of under-five siblings were due to the changes in nutritional status with increase in age. Interventions focussed on growth monitoring, early detection and effective management of growth faltering may reduce the deterioration in nutritional status with increasing age in children.

1. Introduction

India is currently facing a dual nutrition burden.[1,2] National surveys show that the prevalence of under-nutrition in pre-school children continued to be high but over-nutrition was low.[3–7] Among adults there has been some reduction in under-nutrition and a sustained increase in over-nutrition because of the steep reduction in physical activity without commensurate reduction in energy intake.[2] National Family Health Survey 3[8,9] and research studies[10,11] have shown that in India, there were substantial differences in nutritional status between mothers and their under-five children. Even in families that were food secure and women were normally nourished or over-nourished, the prevalence of under-nutrition in pre-school children was high, suggesting that household food insecurity and low energy intake were not the major factors responsible for under-nutrition in pre-school children.[10–12] Over time there had been changes in factors associated with under-nutrition in pre-school children. Low birthweight was and continues to be a major factor associated with low trajectory of growth and under-nutrition in pre-school children.[2] NNMB surveys had shown that in about a third of the families surveyed in the 1990s adults had adequate energy intake but energy intake in under-five children was inadequate, suggesting

* *Corresponding author*.
E-mail address: premaramachandran@gmail.com (P. Ramachandran).

https://doi.org/10.18231/j.ijpns.2023.016

that poor child feeding practices may be an important determinant of under-nutrition in pre-school children.[6,9–12] Infections were an important factor responsible for under-nutrition earlier, but recent studies show that with improved access to health services infections were not associated with persistent deterioration in the nutritional status of children.[13]

Research studies in urban food-secure families showed that in families with two under-five children, prevalence of stunting, underweight and wasting were higher in children whose elder siblings were stunted, underweight or wasted.[12] This could be because the siblings from the same family shared the factors responsible for under-nutrition. These studies also showed that, prevalence of stunting, underweight and wasting were higher in the elder sibling as compared to the younger siblings.[12] National surveys have shown that in under-five children there was an increase in the prevalence of stunting and underweight and decrease in the prevalence of wasting with increase in age.[3–6] These data suggest that differences in nutritional status between younger and older under-five siblings might be due to changes in nutritional status with increasing age. A mixed longitudinal study was taken up in food secure, urban, low middle income families to document changes in anthropometric indicators of nutritional status in relation to age in pre-school children, differences in nutritional status between two under-five siblings and assess whether the observed differences in nutritional status between elder and younger siblings in 0-59 months of age were due to changes in anthropometric indices with increasing age. If the observed changes in under-nutrition rates between younger and older preschool siblings were due to changes in anthropometric indices with increasing age, it is possible that interventions with a focus on growth monitoring for early detection of growth faltering and assessment and management of factors associated with faltering growth may halt the deterioration in nutritional status of pre-school children with increasing age.

2. Materials and Methods

The study was conducted in selected ICDS blocks in South Delhi where our institution has been working during the past decade and has built up a good rapport with the people and the ICDS personnel. Initially, a household census was done and families with under-five children were identified. The details of the study were explained to these families and the Hindi version of the study information sheet was provided to them. The families were revisited one week later; written consent was obtained from parents who were willing to allow their children in the 0-59-month age group to participate in the mixed longitudinal study. Socio-demographic details of the families were obtained in a pre-tested and pre-coded proforma.

All the under-five children in households in the area and both the under-five children in the families with two under-five children were enrolled in the study. In this mixed longitudinal study, height and weight measurements were obtained in three groups of children from urban low-middle-income families: Group A (cross-sectional data), Group B (paired data of the siblings one in the 0-23 months and the other in 24-59 month age group), and Group C (first measurement when the child was in the 0-23 month age group and the second measurement when the child was in the 24-59 month age group). Length was measured using an infantometer (accuracy 0.1cm) in infants and children who could not stand erect. Height was measured using stature meter (accuracy 0.1cm) in children who could stand erect. Weight was measured using a digital balance (accuracy 100 g) in all children. Personnel measuring anthropometric parameters were trained in undertaking measurements, especially length measurements in infants and height measurements in young children. 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.

2.1. Data entry, data cleaning and analysis were calculated

Data were entered and managed in Microsoft Excel 2019. The nutritional status of 0-59-month-old children was assessed using the WHO Anthro software. Statistical analysis was carried out using MS Excel and SPSS 27. Means and standard deviations for length/height, weight and BMI and z scores for these three parameters in 12 monthly age groups were computed. Anova T test was carried out to compare the mean anthropometric parameters in different age groups in Groups A, B and C, and ANOVA Chi square test to compare the prevalence of stunting, underweight and wasting in Group A, B and C. Data on mean length/height, weight and BMI in relation to age in children were compared with the WHO child growth standards. Chi square test was done to assess differences in nutritional status between children in 0-23 months and 24-59 months in Groups A, B and C.

3. Results

A total number of 3414 families with 6540 children (Group A cross-sectional data) were enrolled for the study. In 1030 families there were two under-five children: the younger one in the 0-23 months age group and the elder one in 24-59 month age group (Group B 1030 pairs of children). Of these 1030 younger siblings, anthropometric measurements were available in 534 children both at 0-23 months and at 24-59 months of age (Group C longitudinal component).

3.1. Sociodemographic profile

Analysis of data on the socio-demographic profile of families showed that the majority were nuclear families (58.5%). Nearly three-fourths (74.1%) of the fathers and over half of the mothers (56.3%) had secondary school education. The majority of the fathers were semi-skilled workers (60.2%); $1/5^{th}$ worked in white-collar jobs. The majority of women were homemakers (93.6%). Over 80% (81.1%) of households lived in brick-and-mortar buildings; 45.7% owned their houses; the rest were mostly migrant laborers who lived as tenants in one or two-room tenements. Piped water supply was available at home in 77.8% of households; for most of the others in the near vicinity; they had access to flush toilets either in their own home or shared with other households. Almost all used Liquefied Petroleum Gas (LPG) and stainless-steel utensils for cooking; 96.8% of households owned a colour TV, which was their main source of entertainment. The families stated that their monthly income was sufficient to ensure food security and take care of their essential requirements for education and health care; because of the urban housing constraints, they had to live in unhygienic environment in small tenements.

3.2. Changes in anthropometric parameters in relation to age

Mean length/height, weight and BMI in Group A B and C in relation to age is given in Figure 1 A, B and C. There was a progressive increase in the height and weight of the children with increasing age in Groups A, B and C. Mean BMI for age showed an increase in 0 to 23 months and a decline with increasing age between 24 to 59 months. The small differences in the mean height, weight and BMI for age between Group A, B and C were not statistically significant in any age group.

The mean z scores for height, weight and BMI for age in Group A, B and C is given in Figure 2 2A, B and C. The mean z score for height was -0.7 at 0-11 months; there was a steep fall in mean z score for height between 0-11 and 12-23 months and thereafter the mean z scores for height for age plateaued. The mean z score for weight for age was around -1.0 in the 0 to 11 months, showed a slow reduction between 12 to 47 months and thereafter it plateaued. The mean z score for BMI was around -0.5 in the 0 to 11 months of age; BMI z score improved to near zero at 12-23 months and thereafter showed small progressive decline till 48-59 months of age. The small differences in the mean z scores for height, weight and BMI for age between Group A, B and C were not statistically significant in any age group.

Prevalence of stunting, underweight and wasting in Groups A, B and C is given in Figure 3, 4 and 5. There was a steep increase in prevalence of stunting between 0-11 months and 12-23 months; stunting rates plateaued between 24 and 47 months and there was a small fall in 48-59 months. The underweight rate showed a gradual increase with increasing age till 47 months and then plateaued. Wasting rate showed a steep fall between 0-11 months and 12-23 months and thereafter plateaued till 47 months; there was a small rise in wasting at 48-59 months. The changes in wasting rates with age were due to steep changes in height for age and relatively smaller changes in weight for age and should not be interpreted as an improvement in nutritional status.

3.3. Growth of pre-school children

Data of mean height, weight and BMI for age of these study children were plotted against the WHO growth standards for height, weight and BMI for age (Figures 6, 7 and 8). There was a progressive increase in the mean height with increasing age of the girls in the study (Figure 6) The mean values for height for age in the girls in the study was similar to the mean of the WHO Multi-Centre Growth Reference Standards (MGRS) in the first three months; thereafter the mean height for age of the study children were lower as compared the mean of the WHO MGRS. The gap between the study children and the WHO standards widened between 6 and 23 months; after 24 months the mean height of the study children was along the -2 SD of the WHO MGRS. The linear growth trend with age in boys from the study groups were similar.

There was a progressive increase in weight with increasing age in girls in the study (Figure 7). The mean values for weight for age in the girls in the study were similar to the mean of the WHO MGRS in the first month; thereafter the mean weight for age of the study children were lower as compared to the mean of the WHO MGRS. The gap between the mean weight in the study children and the mean of the WHO standards widened between 3-36 months; in the 36-59 months of age, the mean weight of the study children was between the -1SD and -2 SD of the WHO MGRS. The weight gain pattern in boys from the study groups was similar to the weight gain with age pattern of the girls in the study.

There was a progressive increase in mean BMI for age with increasing age in 0-11 months; the mean BMI for age in study girls plateaued between 12 and 35 months and then showed a further reduction between 36-59 months of age groups (Figure 8). The mean values for BMI for age in the girls in the study were lower than the mean of the WHO MGRS in the 0-11month; between 12 and 35 months mean BMI for age of the study children was comparable to the mean of the WHO MGRS. The gap between the mean BMI in study children and the WHO standards widened in the 36-59 months and the mean BMI for age in the study children was between the mean and -1SD the WHO MGRS. The changes in BMI for age in boys from the study groups were similar to the changes in BMI for age pattern of the girls in the study.

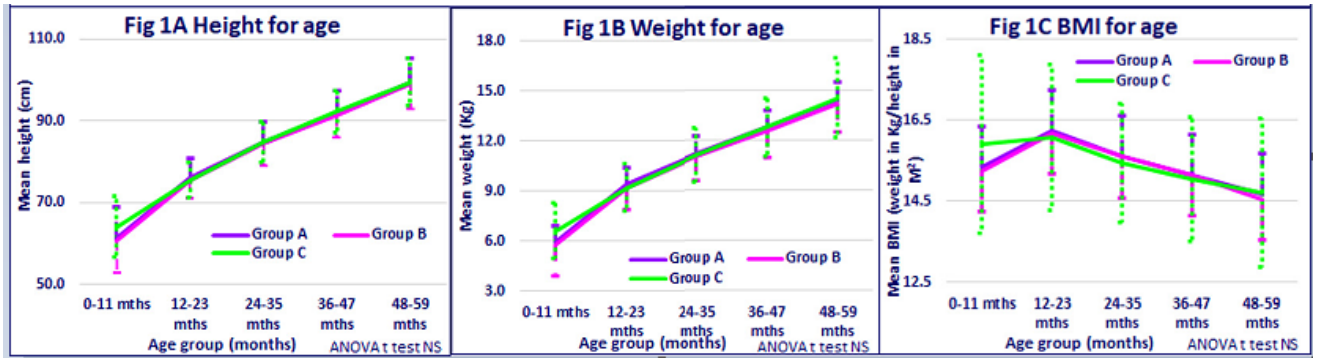

Fig. 1: Height weight and BMI for age in pre-school children

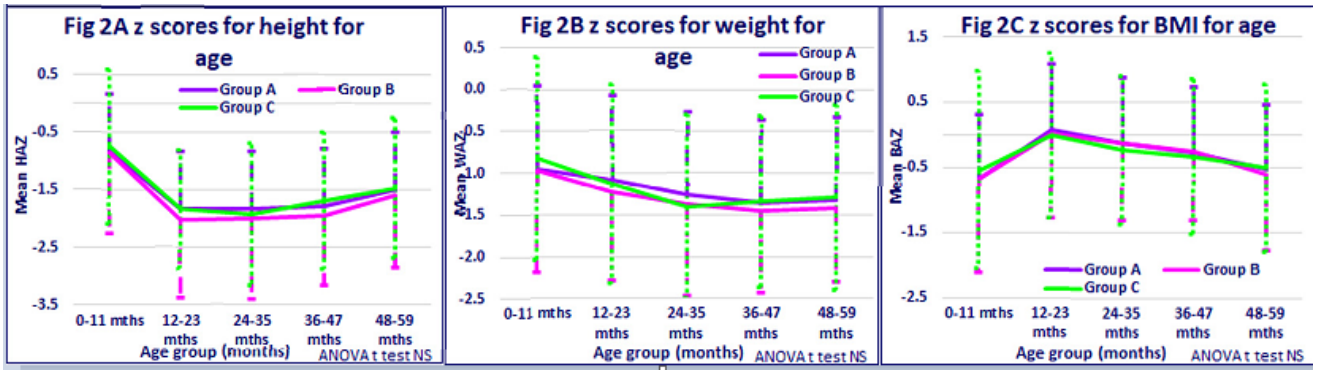

Fig. 2: Z scores for height, weight and BMI for age in pre-school children

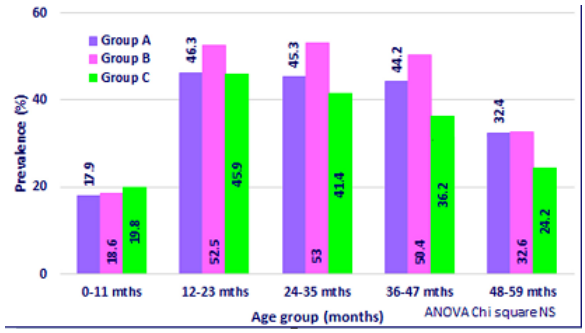

Fig. 3: Prevalence of stunting in 0-5 year children

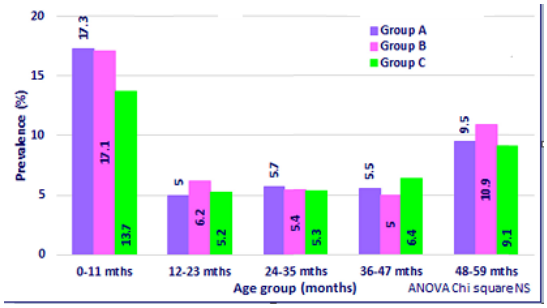

Fig. 5: Prevalence of wasting in 0-5 year children

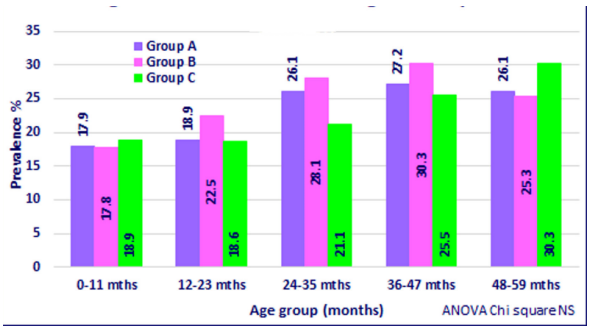

Fig. 4: Prevalence of underweight in 0-5 year

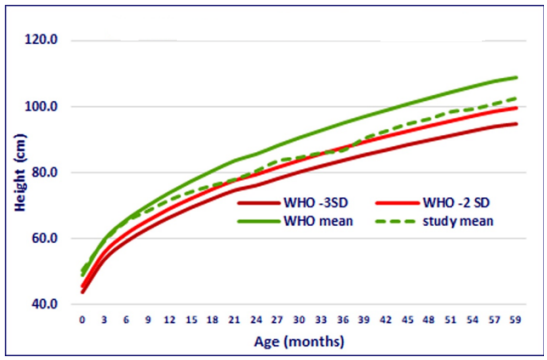

Fig. 6: Linear growth in girls 0-59 months

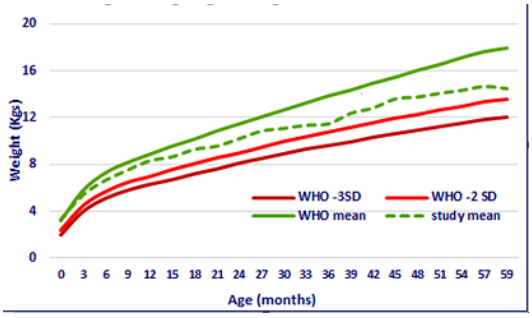

Fig. 7: Weight gain in girls 0-59 months

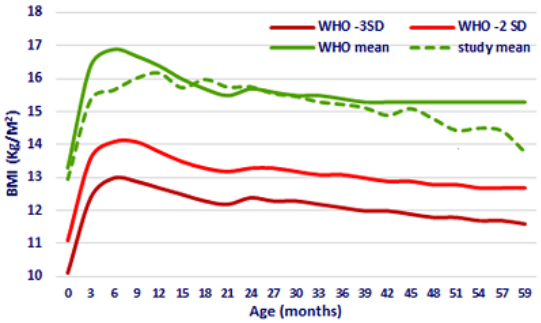

Fig. 8: BMI for age in girls 0-59 months

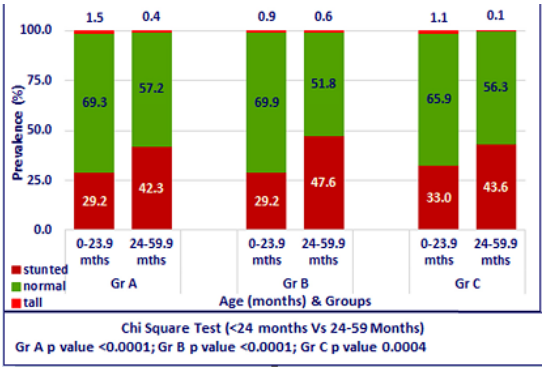

Fig. 9: Nutritional status in children (HAZ)

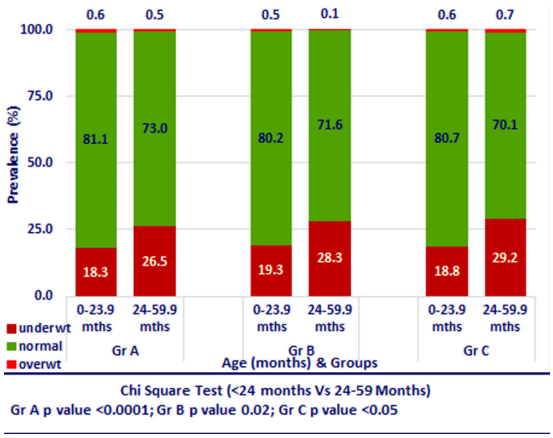

Fig. 10: Nutritional status in children (WAZ)

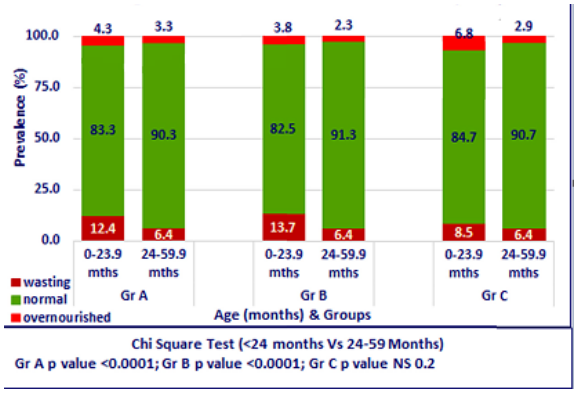

Fig. 11: Nutritonal status in chidren (BAZ)

3.4. Nutritional status of pre-school children

Nutritional status of children assessed by height for age z scores in the 0-23 month and 24-59 month age groups, in Group A, B, and C are shown in Figure 9. Prevalence of stunting in the 24-59 month age group was higher as compared to 0-23 month age group in Group A, B and C. These differences in stunting rates between the two age groups were statistically significant in Groups A, B, and C.

Nutritional status of children assessed by weight for age z scores in 0-23 month and 24-59 month age groups, in Group A, B and C are shown in Figure 10. The prevalence of underweight in the 24-59 month age group was higher as compared to 0-23 month age group in Group A, B and C. These differences in underweight rates between the two age groups were statistically significant in Groups A, B, and C.

Nutritional status of children as assessed by BMI for age z scores in the 0-23 month and 24-59 month age groups, in Group A, B and C are shown in Figure 11. Prevalence of wasting in the 0-23 month age group was higher as compared to 24-59 month age group in Group A, B and C. These differences in wasting rates between the two age groups were statistically significant in Groups A, and B, but not Group C.

4. Discussion

Five decades ago, the majority of Indian families were poor, and food insecure; low dietary intake was the major factor responsible for under-nutrition in all age and sex groups. Interventions to alleviate poverty, improve food security, and nutritional status aimed at identifying families living below the poverty line and providing them with goods and services to improve dietary intake and nutritional status of members of the family.[2] Over time there has been substantial improvement in household food security. Under the National Food Security Act two-thirds of Indian citizens are entitled to getting subsidised food grains. Integrated Child Development Services (ICDS) and Mid-Day Meal Programmes (MDM) provide food supplements to bridge

the gap between energy requirement and energy intake. Access to health services for the management of infection is now universal.[2] It is a matter of concern that despite all these multisectoral interventions, the pace of reduction in child under-nutrition is slow.

During the last three decades, there had been a steep reduction in physical activity in adults; the concurrent reduction in energy intake was relatively small.[2] As a result, there had been a reduction in the prevalence of under-nutrition and an increase in the prevalence of over-nutrition in adults. National Family Health Survey 3 was the first national survey to report substantial differences in nutritional status between the mother and her under-five children.[9] The differences in nutritional status between the parents and pre-school children were because over $3/4^{th}$ of women were normally nourished or over-nourished while over a third of the under-five children were under-nourished. These findings have been confirmed by all national[3–6] surveys and many research studies.[10–12] As there are substantial intra-family differences in nutritional status between adults and children, it might be appropriate to use a dual approach for nutrition interventions. Programmes aimed at improving household food security may continue to focus on families as the unit of intervention. Programmes aimed at improving the nutritional status of individuals, may have to focus on anthropometric screening of individual members (children and adults) for early detection of under- or over-nutrition, appropriate management and monitoring improvement. The focus on screening and management of nutritional problems in individual children may accelerate the pace of reduction in under-nutrition and halt the rise in over-nutrition in under-five children and enable the country to achieve SDG targets by 2030.

Earlier studies on intra-family differences in nutritional status had reported that the prevalence of under-nutrition was higher in younger children whose elder siblings were stunted, underweight or wasted.[10–12] Data from the present study also showed a similar finding. The higher prevalence of under-nutrition in both under five siblings could be because of the shared sub-optimal feeding and health care-seeking practices in the family.

The earlier research studies[10–12] and all the national surveys[3–6] had showed that in pre-school children, there was an increase in stunting and underweight, and a decrease in wasting rates with increasing age in pre-school children. These changes may be responsible for the reported differences in nutritional status between younger and elder under-five siblings. The present mixed longitudinal study was taken up to document changes in anthropometric indicators of nutritional status with increase in age in pre-school children and to assess whether these changes could be responsible for the observed differences in nutritional status between the younger and older under-five siblings. Analysis of data from the present study showed that there was a progressive deterioration in nutritional status as assessed by an increase in the prevalence of stunting and underweight in all three groups (Figures 3 and 4). Indian children are short-statured and because of this have lower weight for age. WHO had recommended that in countries with short-statured children, BMI for age may be the preferred indicator for assessing the current nutritional status of children. In the study children, the prevalence of wasting showed a steep fall between 0-11 months and 12-23 months and plateaued thereafter. The reduction in wasting rates in relation to age was due to steep changes in height for age and relatively smaller changes in weight for age. This reduction in wasting rates with increasing age in pre-school children should not be interpreted as an improvement in nutritional status. The changes in nutritional status (stunting, underweight and wasting) with increase in age were similar in children from Group A, B and C (Figures 3, 4 and 5). These data indicate that the observed differences in nutritional status in under-five siblings were attributable to the changes in height and weight for age over time. Screening of children for early detection and effective management of under-nutrition may accelerate the pace of reduction in under-nutrition in pre-school children.

Five decades ago, under-nutrition in children was mainly attributable to low birth weight, poor infant and young child feeding practices, food insecurity, inadequate intake of adult food in the habitual family practice of three meal/day, and adverse nutrition consequences of untreated infections. Interventions were initiated to:

1. Improve antenatal care to improve birthweight,
2. Improve household food security by providing food grains at subsidised cost to the families below poverty line,
3. Bridge the gap between energy requirement and intake by providing food supplements under the ICDS programmes, and
4. Improve access to health care for treatment of infections.

Due to these interventions, there had been substantial reduction in under-nutrition in children but the pace of reduction is slow.

Data from the present study showed that the gap between mean height for age and weight for age of study children and the WHO MGRS were small at birth and widened with increasing age (Figures 6 and 7). This in turn resulted in an increase in stunting and underweight. The reasons for the widening of the gap in anthropometric indictors between study children and WHO standards have to be ascertained so that appropriate corrective interventions could be initiated.

Even now a third of Indian neonates are born with birthweight below 2.5 kg.[14] Birthweight is a major determinant of growth during infancy and early childhood. Low birth weight infants have a lower trajectory for growth

and this may be partly responsible for the fact that about a third of under-five children are stunted and underweight. Data from the studies in the community indicate that the families are food secure.[11,13,14] Nutrition and health education and monitoring during the research studies has ensured that:

1. Breast feeding is universal; over 80% of infants were exclusively breast-fed in the first six months,[15]
2. Mothers initiate complementary feeds by 7^{th} month and provide three to four feeds per day but these food secure families do have a problem in providing adequate food to the young child within the constraints of the family's three meal pattern,[15]
3. Prevalence of morbidity was high because of poor environmental hygiene and overcrowding, but because of utilization of health services for treatment of infection there was no deterioration in nutritional status of children due to infections.[13]

Regular weighing of children, and plotting of growth in WHO child growth chart is not widely followed.[16] There are inadequacies in content, quality and continued coverage of children under the food supplementation component of the ICDS programme. Prevalence of infections continue to be high due to poor environmental hygiene and overcrowding but deterioration in nutritional status due to infection is prevented to a large extent due to access to heath care.[13]

Nutrition and health education regarding appropriate feeding and caring for children is essential. Screening all under-five children to detect those with under-nutrition, providing the family appropriate nutritional and health education and ensuring that under-nourished children get continued supply of food supplements, and monitoring improvement in nutritional status can result in substantial reduction in under-nutrition in children. In view of the progressive increase in under-nutrition rate as assessed by weight for age, it is important to focus on growth monitoring using the WHO child growth chart for early detection and effective management of growth faltering, so that the deterioration in nutritional status of pre-school children with increasing age can be reduced or halted.

5. Summary and Conclusions

A mixed longitudinal study was taken up in three groups of children from urban low middle income families: Group A (cross-sectional data), Group B (paired data of the siblings one in the 0-23 months and the other in 24-59 month age group), and Group C (first measurement in the 0-23 month age group and the second measurement in the 24-59 month age in the same child). Data analysis from the study showed that there was an increase in stunting and underweight, and a decrease in wasting rates with increasing age in Groups A, B and C. The trend and magnitude of change in nutritional status were similar in Groups A, B and C. These data from the study indicate that differences in nutritional status of under-five siblings were due to the changes in nutritional status of children with an increase in age.

Interventions focussed on growth monitoring, early detection and effective management of growth faltering may reduce the deterioration in nutritional status with increasing age in children. Screening all under-five children for under-nutrition and providing appropriate management can accelerate the pace of reduction in under-nutrition.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Double burden of malnutrition. Case study from India; 2006. Available from: https://ftp.fao.org/docrep/fao/009/a0442e/a0442e01.pdf.
2. Ramachandran P, Kalaivani K. Nutrition Transition in India: Challenges in Achieving Global Targets. *Proc Indian Natn Sci Acad*. 2018;84(4):821–33.
3. 3.IIPS 'National Family Health Survey-1 . Available from: http://rchiips.org/nfhs/pub_nfhs-1.shtml;.
4. IIPS 'National Family Health Survey 2. Available from: http://rchiips.org/nfhs/pub_nfhs-2.shtml,.
5. IIPS 'National Family Health Survey 3 . Available from: http/rchiips.org/nfhs/pub_nfhs-3.shtml.
6. IIPS 'National Family Health Survey 4 ; 2023. Available from: http:/rchiips.org/NFHS/factsheet_NFHS-4.shtml.
7. IIPS 'National Family Health Survey 5. Available from: https://rchiips.org/nfhs/factsheet_NFHS-5.shtml.
8. NNMB: All the Technical Reports of the NNMB . Available from: http//nnmbindia.org/downloads.html.
9. IIPS Nutrition in India NFHS 3; 2011. Available from: http://rchiips.org/nfhs/nutrition_report_for_website_18sep09.pdf..
10. Kumari H, Kalaivani K, Ramachandran P. Intra-family differences in nutritional status between pre-school children and women. *Int J Community Med Public Health*. 2020;7:2580–7.
11. Kumari H, Kalaivani K, Ramachandran P. Nutritional Status of Parents and their Pre-School Children. *J Nutrition Diet*. 2020;58(4):489–500.
12. Kumari H, Kalaivani K, Ramachandran P. Food Consumption and Nutritional Status of Urban Low Middle-Income Families. *Indian J Nut Diet*. 2020;59(3):357–68.
13. Ramachandran P, Kalaivani K, Lakshmi RV, Kalaivani M, Pandey RM, Subapriya MS. Nutrition morbidity interactions in pre-school children. *Indian J Med Res*. 2023;157(5):460–9.
14. Pramanik A, Ramachandran P, Kalaivani K. Maternal nutrition and birth weight . *Indian J Nutr Diet*. 2022;59(2):187–96.
15. Prabhakar K, Kalaivani K, Kowsalya S, Ramachandran P. Use of mother child protection card for improving infant feeding practices. *Indian J Nutr Diet*. 2019;56(4):351–64.
16. Prabhakar K, Kowsalya S, Kalaivani K, Ramachandran P. Growth Monitoring in Under-Three Children Using the Mother Child Protection Card Indian. *J Nutr Diet*. 2020;57(4):368–86.

Author biography

Honey Kumari, Research Scholar

K Kalaivani, Deputy Director https://orcid.org/0000-0002-9582-4488

Prema Ramachandran, Director https://orcid.org/0000-0003-1974-8281

Cite this article: Kumari H, Kalaivani K, Ramachandran P. Intrafamily differences in nutritional status of preschool children. *IP J Paediatr Nurs Sci* 2023;6(3):86-93.