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Original Research Article

Nutritional status of Indian pre-school children and WHO nutrition targets for 2025

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ABSTRACT

Background: India has been food secure and has been implementing food supplementation programmes for decades but prevalence of under-nutrition in pre-school children is high. Data from two large scale surveys were analysed to document current nutritional status of pre-school children and assess whether India will be able to achieve the WHO targets by 2025.

Methods: District level household survey 4 and annual health survey (2013-2015) undertook height and weight measurements in pre-school children (DLHS4 74717 and AHS 139157 children). Mean weight, height and BMI-for-age were computed for girls and boys in 0-5 years and compared with WHO MGRS growth standards. Prevalence of stunting, under-weight, wasting, over-nutrition and combined stunting and wasting were computed in each survey in relation to age.

Results: The mean height and weight-for-age in boys and girls during 6-60 months was around the -2SD and mean BMI-for-age was between the mean and -1SD of the WHO standards. Frequency distribution of Z scores for all three indices in Indian children were to the left of the WHO standards. In under-five children stunting rates were highest, wasting rates lower and over-nutrition rates the lowest. Prevalence of stunting increased and wasting decreased with increasing age of the children. Prevalence of under-nutrition was higher in children surveyed in AHS.

Conclusions: It might not be possible to achieve rapid reduction in low birthweight or stunting. It might be possible to achieve the targets for sustained reduction in wasting in some states. Early detection and management of over-nutrition in children can prevent the rise in over-nutrition.

Keywords: Growth of Indian children, Stunting, Underweight, Wasting, Pre-school children**,** WHO nutrition goals

INTRODUCTION

Nutritional status of pre-school children has been recognized as an important indicator of nutrition and health status of populations. In the last century, stunting and underweight rates computed using WHO/NCHS standards were used to assess prevalence of under-nutrition.[1-3] In the last two decades when the dual nutrition burden has emerged as a global problem, the WHO MGRS standards for BMI were used to grade both under and over nutrition in children especially in countries with high stunting rates.[4-7] Wasting in under-five children (low BMI-for-age) has been used by FAO/WFP to assess acute food insecurity in population groups affected by natural or manmade catastrophes.[8] In India wasting rates are high but this is not due to food insecurity.[9] Wasting and stunting share common risk factors but wasting rates in India are half that of stunting rates.[10] Stunting rates increased between 3-24 months of age; during this period there was progressive reduction in wasting rates.[10] Global studies confirm that the relationship between stunting and wasting are complex.[11-19] Prevalence of over-nutrition in children is low in India.

The WHO has set global nutrition targets for reduction in low birthweight, stunting, wasting and halting rise in over-nutrition in children to be achieved by 2025.[20-22] India is a signatory to these and the SDG2 targets. The present study undertook an analysis of data from two large scale surveys carried out in India in 2012-14 with the objective of: comparing the growth of Indian children with the WHO MGRS growth standards, assessing the prevalence of stunting, underweight and wasting in relation to age and assessing differences between the two surveys, in the frequency distribution of z scores for height, weight and BMI and prevalence of stunting, underweight, and wasting. These analyses may provide leads towards evolving and implementing age and region-specific policy, strategy and programmes to accelerate the reduction in stunting and wasting and halting rise in over-nutrition in Indian pre-school children.

METHODS

District level household survey (DLHS4) and clinical anthropometric and biochemical component of annual health survey (AHS-CAB) were carried out in 2012-14. The sampling frame for the surveys had been prepared by International Institute of Population Sciences (IIPS), Mumbai and Office of Registrar General of India (RGI), New Delhi. Height and weight measurements were taken in 0-5 year children from selected households. All anthropometric equipment for the survey were centrally procured and tested for accuracy before being sent to the survey agencies. Prior to initiation of the survey all the para-professionals recruited by various agencies for undertaking the survey in different states were trained in taking length/height and weight measurement in children; only those who had attained the required accuracy at the end of the training, undertook length and height measurements in children. As an internal quality assurance measure, duplicate measurements were carried out in randomly selected 10% of the children.

Raw data from the AHS and AHS CAB was obtained from the Ministry of Health and Family Welfare and that of DLHS4 were obtained from IIPS. Data were cleaned and analysed using SPSS 26. The mean, 2.3 centile, and 97.7 centile for length/height-for-age, weight-for-age, and BMI-for-age were computed for Indian boys and girls and compared with the WHO standards for 0 to 60 months. Z scores were computed for all children (AHS CAB and DLHS4) using WHO Anthro software. Frequency distribution of z scores for height, weight and BMI and prevalence of stunting, underweight, wasting and over-nutrition were calculated. Changes in relation to age in prevalence of stunting, underweight, wasting and combined stunting and wasting in AHS CAB and DLHS4 surveys were computed. Prevalence of over-nutrition as assessed by BMI-for-age were computed in the two surveys.

RESULTS

The number of under-five children in the surveyed families and those in whom height and weight were measured is indicated in (Table 1). Almost all children in the selected households were measured.

In Indian children (boys and girls) mean length/height was between -1SD and -2SD in the 1-12 months and at -2D of the WHO growth standards in 18 and 60 months. The 2.3 centile of length of Indian children was near -5SD of the WHO growth chart in 0-6 months, between -5SD and -6SD in 6-30 months, at -6SD in 30-36 months and at -5 SD at 60 months. The 0.1 centile of the Indian children was near -7 SD of the WHO growth standards. The 97.7 centile of the Indian children were between ±2SD and ±3 SD in 0-36 months and thereafter around ±2SD of the WHO standards (Figure 1). The mean weight of Indian children was just below the mean weight of WHO standards at 1 month; in the 6-60 month mean weight of Indian children remained just above the -2 SD of the WHO standards. The 2.3 centile of weight of Indian children was either just above or just below -5SD of the WHO standards in 1-60 months. The 0.1 centile of the weight of Indian children was near -7 SD of the WHO growth standards. The 97.7 centile of Indian girls were just above +2SD of WHO standards at 1 month, just below +2 SD in 6-36 months and thereafter around ±1SD (Figure 2).

The mean BMI of Indian children in 1-12 months was just below WHO mean; at 18 months it was at the WHO mean, in the 18-42 months just below WHO mean and subsequently well below the mean of WHO standards. The 2.3 centile of BMI of Indian children was near -5SD in 1-6 months, around -4SD of the WHO growth standards in the 6-60 months.

Table 1: Number of children in surveyed households and those with height and weight measurements.

Parameters					
DLHS 4					
Age (years)	**Measured**	**Not present**	**Refused**	**Other reasons**	**Total**
0-4	74,398	98	91	130	74,717
AHS CAB					
0-4	1,30,606	7535	858	158	1,39,157
Total	2,05,004	7633	949	288	2,13,874

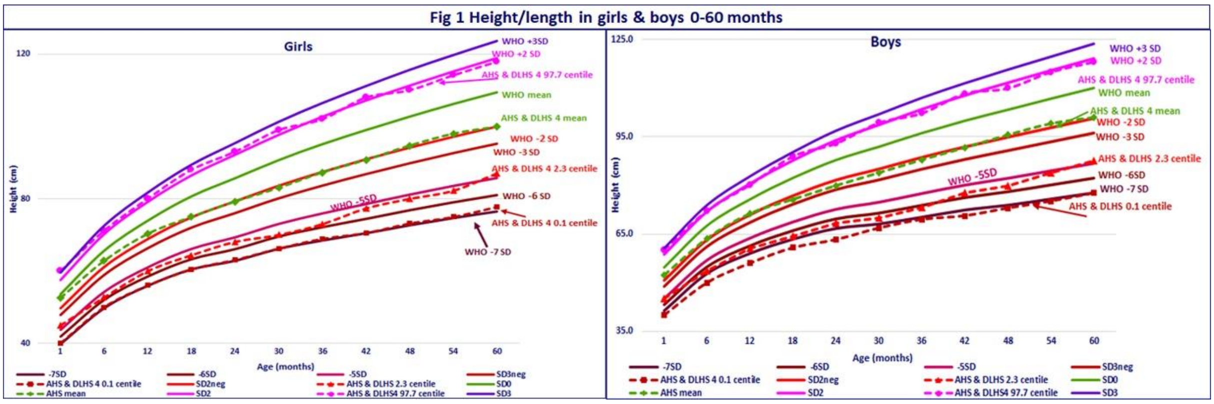

Figure 1: Height/length in girls and boys 0-60 months.

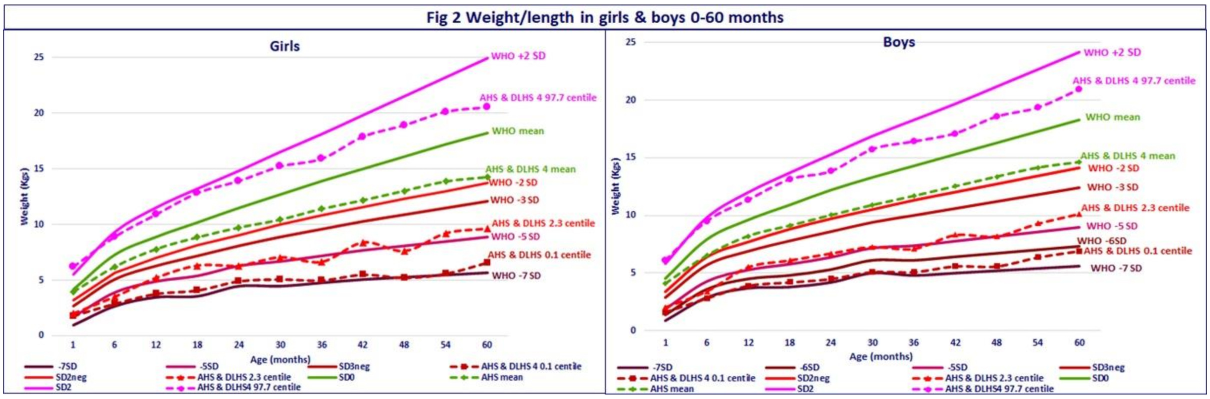

Figure 2: Weight in girls and boys 0-60 months.

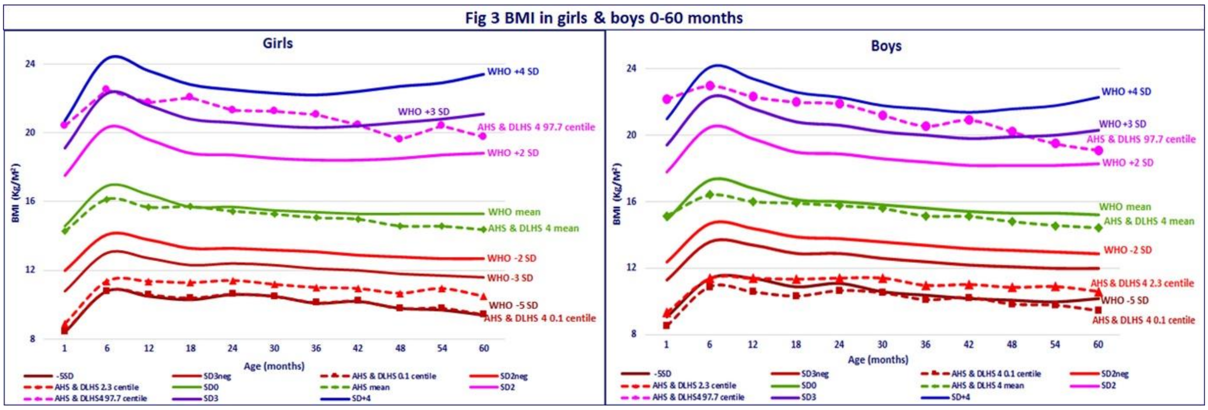

Figure 3: BMI in girls and boys 0-60 months.

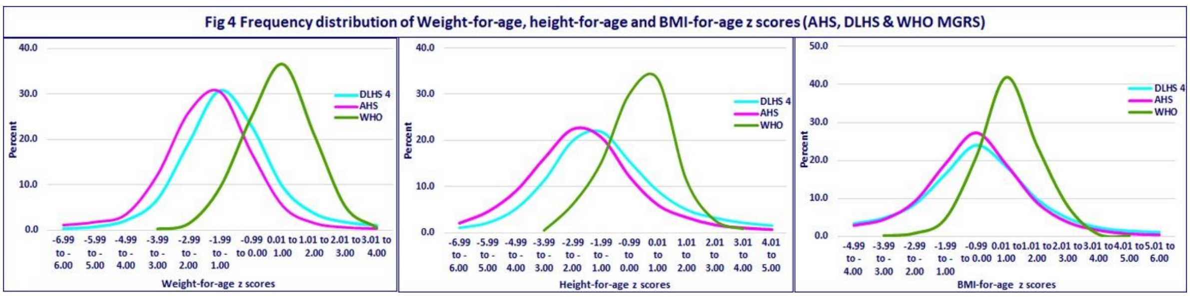

Figure 4: Frequency distribution of height-for-age, weight-for-age and BMI-for-age z scores (AHS, DLHS4 and WHO MGRS).

Table 2: Mean HAZ, WAZ and BAZ in relation to age.

Age (months)	HAZ	WAZ	BAZ
0.00 to 2.99	0.5±5.95 (3840)	-0.01±5.26 (3840)	-0.3±6.26 (3840)
3.00 to 5.99	-1.2±4.28 (8197)	-1.3±3.28 (8197)	-0.7± 4.29 (8197)
6.00 to 8.99	-1.1±3.95 (9403)	-1.4±2.61 (9403)	-0.8±3.82 (9403)
9.00 to 11.99	-1.4±3.91 (8797)	-1.4±2.52 (8797)	-0.6±4.16 (8797)
12.00 to 17.99	-1.6±3.16 (18336)	-1.4±1.99 (18336)	-0.5±3.43 (18336)
18.00 to 23.99	-2.2±2.91 (16857)	-1.6±1.84 (16857)	-0.2±3.35 (16857)
24.00 to 35.99	-2.2±2.62 (39683)	-1.8±1.63 (39683)	-0.4±2.96 (39683)
36.00 to 47.99	-2.0±2.37 (42841)	-1.7±1.52 (42841)	-0.5±2.66 (42841)
48.00 to 60.00	-1.8±2.02 (41820)	-1.7±1.37 (41820)	-0.7±2.42 (41820)
0.00 to 60.00	-1.8±2.92 (189774)	-1.6±1.97 (189774)	-0.5±3.16 (189774)

The 0.1 centile of the Indian girls was near -5 SD of WHO growth standards. The 97.7 centile of Indian children was at +4SD at 1 month, at +3 SD in the 6-12 months between +3 and +4 SD in the 12-42 months and just below +3 SD in the 48-60 months (Figure 3).

The mean HAZ, WAZ and BAZ calculated in relation to age of children (both boys and girls) is given in (Table 2). Comparison of the mean values of these three parameters with the WHO mean values across 0-60 months showed that the deviation from the WHO values were lowest in the first three months. Between 3 and 6 months the magnitude of the deviation increased substantially for all the three parameters. Between 12-24 months there was a progressive increase in deviation in HAZ from WHO mean values; the increase in deviation in WAZ was smaller and deviation decreased in BAZ. The deviation from WHO mean was reduced in 24 months and 59 months in HAZ; the reduction was lower in WAZ; there was an increase in the deviation in BAZ during this period. Frequency distribution of z scores for height-, weight and BMI-for-age of the Indian children in comparison with WHO Z scores shown in (Figure 4). In Indian children the distribution of z scores for all the three parameters were over a broader range and to the left of the distribution of the WHO Z scores. The distribution of the z scores for height and weight in AHS CAB was to the left of the DLHS4. The difference in distribution of z scores for BMI-for-age between the two surveys was minimal (Figure 4).

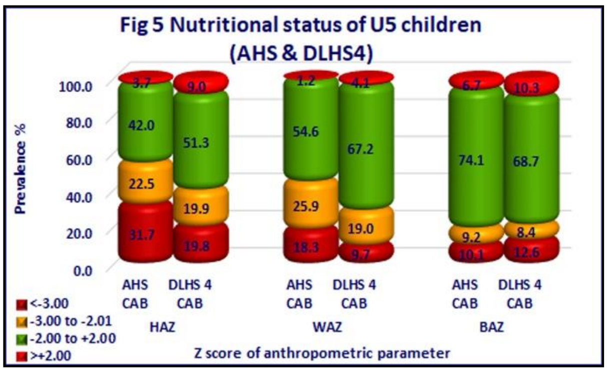

Figure 5: Nutritional status of U5 children (AHS and DLHS4).

In under-five children stunting rates were higher than under-weight rates and wasting rates were the lowest. Prevalence of stunting (moderate and severe) and underweight (moderate and severe) were higher in children surveyed in AHS CAB as compared to those in DLHS4. But the prevalence of wasting was higher in DLHS4 as compared to AHS CAB, perhaps because of lower stunting rates. There were tall children (3.7% in AHS CAB and 9.1% in DLHS4); prevalence of overweight was low (1.2% in AHS CAB and 4.2% in DLHS4). However, 6.7% of children in AHS CAB and 10.4 % of children in DLHS4 were over-nourished (BMI z score >+2) (Figure 5).

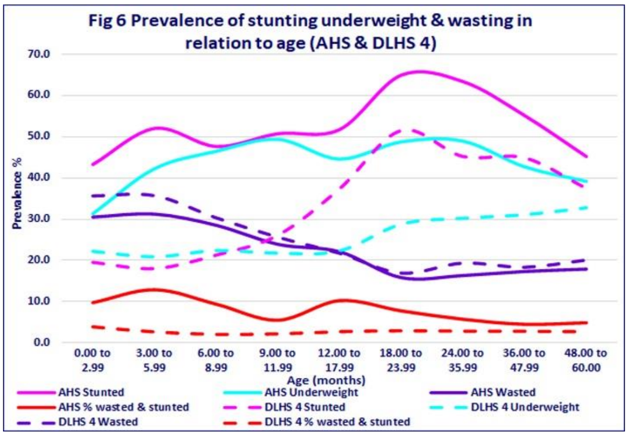

Figure 6: Prevalence of stunting, underweight and wasting in relation to age (AHS and DLHS4).

In both the surveys prevalence of stunting and underweight were low in the first three months, increased with age till 24 months and subsequently declined (Figure 6). Stunting and underweight rates were higher in AHS CAB children as compared to the DLHS4 children but the trends in relation to age were similar. Prevalence of wasting was highest in the first three months (30.4% in AHS CAB and 35.7% in DLHS4). The higher wasting rates in DLHS4 was because of the lower stunting rates. There was a progressive fall in wasting between 6 months and 24 months in AHS CAB as well as DLHS4; between 24 and 60 months wasting rates plateaued and subsequently remained below 20% both in AHS CAB and in DLSH4 (Figure 6). Prevalence of stunting with wasting was less than 5% in DLHS4 in all age groups. In AHS CAB children prevalence of stunting with wasting was around 10% in the first 18 months because of the high stunting rates; between 18-48 months there was a decline in prevalence of this group because of the decline in stunting rates. Between 48 and 60 months the prevalence of stunting with wasting in both the surveys were below 5% (Figure 6).

DISCUSSION

Analysis of the data from AHS CAB and DLHS4 surveys showed that: in the first month the mean length, weight and BMI was lower as compared to WHO standards and stunting, underweight and wasting rates were high, there were no changes in these parameters in the first three months, between 6-59 months mean height and weight in Indian boys and girls were around the -2SD and mean BMI-for-age was between the mean and -1SD of the WHO standards, frequency distribution of Z scores for all three indices were to the left of the WHO standards and spanned a wider range, in under-five children stunting rates were highest, underweight and wasting rates were lower and over-nutrition (BAZ>+ 2) rates were the lowest, prevalence of stunting increased and wasting decreased with increasing age of the children, prevalence of stunting and underweight were higher in AHS CAB as compared to DLHS4 children but prevalence of wasting was higher in DLHS4. About a third of the Indian children are born with low birthweight, about one fourth have low length and a third low BMI.[23,24] The poor intrauterine growth is perhaps partly due to small parental stature and partly due to low pre-pregnancy weight, low pregnancy weight gain, anaemia and other obstetric problems.[24] In the last five decades reduction in low birthweight rates have been very slow. These mature but small Indian infants survive when given essential new born care.[25,26] Despite high low birthweight and under-nutrition rates, infant mortality rate (IMR) and under-five mortality rates (U5MR) in Indian children are relatively low (South Asian Enigma).[27] It is unlikely that India will be able to achieve a 30% reduction in low birth weight by 2025. However, it is likely to achieve the targets set for mortality reduction for 2030.

The deviation in the mean length, weight and BMI in Indian children as compared to the WHO MRGS standards was the lowest at birth and in the first month. During the first three months, there was no increase in underweight and stunting rates (Figure 1-2). In India breast feeding is universal and majority of women exclusively breast-feed their infants in the first three months and nutrition toll of infection was low because of low morbidity rates. This might be the reason for the relatively good growth in the first three months[28]. The increase in underweight rates between 3-5 months might be due to introduction of animal milk and increase in morbidity due to infections.[28,29] The further rise in underweight and stunting rates between 6-11 months might be due to late introduction, inadequate quantity, frequency and low-calorie density of complementary feeds as well as increase in morbidity due to infections.[28-33] Increase in the underweight and stunting rates between 12-23 months could be the result of inadequate energy intake when children shift to household diet. In India, the habitual family diets have relatively low-calorie density; infants have small stomach capacity and need to be fed 5-6 times a day to meet their food requirements.[28-33] Nutrition education has a major role to play in improving infant and young child feeding practices thereby preventing rise in stunting and under-weight rates. Low birthweight children grow along a lower growth trajectory as compared to normal birthweight children; when their weight or length are compared to WHO standards they are misclassified as stunted and under-weight.[25] India has emphasised the need for plotting monthly weight-for-age of all children in the growth chart in Mother Child Protection Card (MCPC) to track growth of individual child, so that the small statured infant growing along its trajectory is recognised as normal.[28] The MCPC card has been provided to over 80% of all infants; usually the data on immunisation is entered in the card; however monthly weighing and monitoring growth by plotting weight- or height-for-age in WHO standard growth chart is yet to get fully operationalized.[28] It is essential to improve the use of MCPC growth chart both for identifying small infants growing along their trajectory as normally growing children who require no intervention and for early detection and correction of growth faltering before the child becomes under-nourished.

About 20% of Indian children are wasted and 10% of children in AHS states and 12% of children in DLHS4 states were severely wasted (z score <-3 of BMI-for-age). Monitoring changes in BMI-for-age will provide early warning of worsening of wasting and enable initiation of interventions to correct it. Wasting could be chronic, acute or acute exacerbation of the chronic wasting. In India severe wasting due to acute food insecurity due to calamities is relatively uncommon.[9] The relatively low mortality in under-five children despite high under-nutrition rates might be due to predominance of chronic wasting. Cross-sectional surveys cannot differentiate between acute or chronic wasting. There is a need for community based long term follow-up studies in under-five children to assess the prevalence of chronic, acute or acute exacerbation of chronic wasting, moderate and severe acute wasting. Such studies will also be able to provide the adverse health consequences of wasting and impact of interventions to reduce wasting.

Stunting and wasting rates change with age. The high wasting rates in the first three months is due to relatively low stunting rates; the steady decline in the wasting rates between 9-23 months is due to poor linear growth and steep increase in stunting rates in this period. This should not be interpreted as improvement in nutritional status of children. About 5% of DLHS4 children and 10% of AHS CAB children had both stunting and wasting in the first 18 months; subsequently prevalence was around 5% in both surveys. Comparison of frequency distribution of the z scores for height, weight-for-age of the Indian children showed that as expected the distribution was to the left of WHO z scores of the for these two parameters (Figure 4).

It is noteworthy that the range in z scores for height of Indian children was between -7 to +5 indicating that while the majority face severe constraints in linear growth, some children do have the potential for linear growth comparable to the WHO standards. Within India the frequency distribution for weight and height in AHS CAB children were to the left of the DLHS4 children. The distribution of the WHO z scores for BMI-for-age ranged between -5 to +4; the difference between the AHS CAB and DLHS4 children were minimal.

Prevalence of stunting and underweight in the first three months in AHS CAB children were double that of DLHS4 children. There is not much of difference in height of men and women between AHS and DLHS4 states. The lower mean weight, lower weight gain during pregnancy, higher prevalence of anaemia, poor availability and utilisation of antenatal care, food supplementation programme and iron folic acid supplementation to mothers might account for the substantially higher prevalence of intrauterine growth retardation in AHS CAB infants. Improvement in access to and utilisation of antenatal care and food supplementation programmes can lead to substantial reduction in low birthweight rates in infants in AHS states. Prevalence of stunting and underweight rates across all age groups was higher in AHS CAB children as compared to the DLHS4 children. The subsequent rise in underweight and stunting rates in AHS states, may partly be due to household food insecurity among the poorer segments of population; in DLHS4 states and better off segments of the population poor infant and child feeding practices might be the important factor in the rise in under-nutrition.

Prevalence of over-nutrition (BAZ>+2) is relatively low in Indian children. The risk of over-nutrition and NCD is higher in children who crossed the BMI centiles during early childhood.[33] Long term follow up studies from India and other developing countries have shown that the underweight and overweight children were at higher risk of over-nutrition through childhood, adolescence, adult life and NCD in early adult life.[33-37] Monitoring children for an upward deviation from their earlier trajectory of growth is critical for early detection of over-nutrition; monitoring impact on interventions on growth trajectory may go a long way in halting the rise in over-nutrition. Strengths of the current study was that the data was from large scale well-designed surveys across diverse Indian states; height and weight measurements were taken by well-trained para-professionals using accurate instruments. These surveys provide the baseline data for monitoring progress towards the WHO nutrition goals.

Limitations

Limitation of current study was data from cross-sectional surveys can provide only information on temporal relationships between stunting, wasting and over-nutrition but causality could not be explored.

CONCLUSION

Indian infants begin their life with a lower mean weight, height and BMI as compared to the WHO MGRS standards. They grow along a lower trajectory as compared to the WHO growth standards in the 0-5 years. Over the last five decades the reduction in stunting rates has been 1%/year. It is unlikely that the country will be able to achieve the target of 40% reduction in stunting rates by 2025. Wasting rates in India are high but this is not due to food insecurity. It is possible that wasting is chronic starting at birth and continuing through infancy and child hood. Early identification and effective management can reverse wasting. Though it may not be possible to bring down wasting to 5% at national level, states with lower wasting level may be able to achieve the target. Over-nutrition rates in India are relatively low. Monitoring upward deviation in trajectory of growth and appropriate intervention can enable India to halt rise in over-nutrition by 2025.

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REFERENCES

1. Food and Agriculture Organization of the United Nations, technical report series. Available at: https://apps.who.int/iris/handle/10665/40921. Accessed on 28 August 2021.
2. Waterlow JC. Classification and definition of protein-calorie malnutrition. Br Med J. 1972;3:566-9.
3. Physical status: the use and interpretation of anthropometry technical report series. Available at: http://whqlibdoc.who.int/trs/WHO_TRS_854.pdf. Accessed on 28 August 2021.
4. de Onis M, Onyango AW, Borghi E, Garza C, Yang H. Comparison of the World Health Organization (WHO) Child Growth Standards and the National Center for Health Statistics/WHO international growth reference: implications for child health programmes. Public Health Nutr. 2006;9(7):942-7.
5. Ramachandran P, Gopalan HS. Assessment of nutritional status in Indian preschool children using WHO 2006 Growth Standards. Indian J Med Res. 2011;134:5-11.
6. WHO Global Database on Child Growth and Malnutrition, Geneva, Switzerland. Available at: https://www.who.int/teams/nutrition-and-food-safety/databases/nutgrowthdb accessed on 27.8.2021. Accessed on 28 August 2021.
7. WHO nutrition landscape information system (NLIS) country profile indicators: interpretation guide 2019. Available at: https://apps.who.int/iris/bitstream /handle/10665/332223/9789241516952-eng.pdf?is Allowed=y &sequence=1. Accessed on 28 August 2021.

8. The state of food security and nutrition in the world. Available at: http://www.fao.org/publications/sofi/2021/en/ . Accessed on 28 August 2021.
9. Ramachandran P. Food and nutrition security: challenges in the new millennium. Indian J Med Res. 2013;138(3):373-82.
10. IIPS National Family Health Survey (NFHS-4), 2015-16. Available at: http://rchiips.org. Accessed on 28 August 2021.
11. Prentice AM, Ward KA, Goldberg GR, Jarjou LM, Moore SE, Fulford AJ, et al. Critical windows for nutritional interventions against stunting. Am J Clin Nutr. 2013;97(5):911-8.
12. Richard SA, Black RE, Gilman RH, Guerrant RL, Kang G, Lanata CF. Wasting is associated with stunting in early childhood. J Nutr. 2012;142(7):1291-6.
13. Khara T, Mwangome M, Ngari M, Dolan C. Children concurrently wasted and stunted: a meta-analysis of prevalence data of children 6-59 months from 84 countries. Matern Child Nutr. 2018;14(2):e12516.
14. Myatt M, Khara T, Schoenbuchner S, Pietzsch S, Dolan C, Lelijveld N, et al. Children who are both wasted and stunted are also underweight and have a high risk of death: a descriptive epidemiology of multiple anthropometric deficits using data from 51 countries. Arch Public Health. 2018;76:28.
15. Schoenbuchner S, Dolan C, Mwangome M, Hall A, Richard S, Wells JC, et al. The relationship between wasting and stunting: a retrospective cohort analysis of longitudinal data in Gambian children from 1976-2016. Am J Clin Nutr. 2019;110(2):498-507.
16. Angood C, Khara T, Dolan C, Berkley JA, Wa S. Research priorities on the relationship between wasting and stunting. PLoS One. 2016;11(5):e0153221.
17. Briend A, Khara T, Dolan C. Wasting and stunting similarities and differences: policy and programmatic implications. Food Nutr Bull. 2015;36(1):S15-23.
18. Martorell R, Young MF. Patterns of stunting and wasting: potential explanatory factors. Adv Nutr. 2012;3(2):227-33.
19. Khara T, Dolan C. Associations between wasting and stunting, policy, programming and research implications. Emerg Nutr Net Tech. 2014;6:34-8.
20. Global nutrition targets 2025: wasting policy brief. Available at: https://apps.who.int/iris/handle/10665/149023. Accessed on 28 August 2021.
21. Global nutrition targets 2025: stunting policy brief. Available at: https://apps.who.int/iris/handle/10665/149019. Accessed on 28 August 2021.
22. Global nutrition targets 2025: childhood overweight policy brief. Available at: https://apps.who.int/iris/bitstream/handle/10665/149021/WHO_NMH_NHD_14.6_eng.pdf. Accessed on 28 August 2021.
23. Ghosh S, Bhargava SK, Madhavan S, Taskar AD, Bhargava V, Nigam SK. Intra-uterine growth of North Indian babies. Pediatrics. 1971;47:826-30.
24. Gopalan S. Low birth weight causes, consequences and interventions to achieve reduction. Proc Indian Natn Sci Acad. 2018;84(4):843-51.
25. Ghosh S, Bharghava SK, Moriyamma IW. Longitudinal study of survival and outcomes of a birth cohort. Report of the research project -01-658-2-NCHS Maryland USA.
26. Ramachandran P. Nutrition and child survival in India. Indian J Pediatr. 2010;77:1-305.
27. Ramalingaswami V, Jonsson U, Rhode J. Malnutrition: a south Asian enigma. In: Gillespie S, eds. Malnutrition in South Asia: a regional profile. Netherlands: Springer Nature; 1997:11-22.
28. Prabhakar K, Kalaivani K, Kowsalya S. Ramachandran P 33 use of mother child protection card for improving infant feeding practices. Indian J Nutr Diet. 2019;56(4): 351-64.
29. Lakshmi RV, Subapriya SM, Kalaivani K, Ramachandran P. Morbidity due to infections in preschool children from urban low income households. Indian J Nutr Diet. 2018;55(4):488-99.
30. Prabhakar P, 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.
31. Paul VK, Sachdev HPS, Mavalankar D, Ramachandran P, Sankar MJ, Bhandari N, et al. Towards Universal Health Coverage, Reproductive health, and child health and nutrition in India: meeting the challenge. Lancet. 2011;431:675-9.
32. Lakshmi RV, Subapriya SM, Kalaivani K, Ramachandran P. Nutritional status of pre-school children from urban low income families. Indian J Nutr Diet. 2019;56(3):265-73.
33. Bhargava SK, Sachdev HPS, Fall C, Osmond C, Lakshmy R, Barker DJP, et al. Relation of serial changes in childhood body mass index to impaired glucose tolerance in young adulthood. N Engl J Med. 2004;350:865-75.
34. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, et al. Maternal and child undernutrition: consequences for adult health and human capital. Lancet. 2008;371(9609):340-57.
35. Richter LM, Victora CG, Hallal PC, Adair LS, Bhargava SK, Fall CHD, et al. Cohort profile: the consortium of health-orientated research in transitioning societies. Int J Epidemiol. 2012;41(3): 621-6.
36. Fall CH, Sachdev HS, Osmond C, Restrepo-Mendez MC, Victora C, Martorell R, et al. COHORTS investigators. Association between maternal age at childbirth and child and adult outcomes in the offspring: a prospective study in five low-income and middle-income countries (COHORTS collaboration). Lancet Glob Health. 2015;3(7):e366-77.
37. Fall CH. Nutrition in fetal life and childhood and its linkage with adult non-communicable disease: lessons from birth cohort studies in India. Natn Sci Acad. 2015;84(4):881-9.

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