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Nutrition Transition in India and Emerging Dual Nutrition Burden in Children

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Abstract

India was one of the first countries to recognise the linkages between under-nutrition and ill health in children and invest in efforts to combat these through focussed health and nutrition interventions. Over years there has been a progressive increase in the coverage under these programmes. Today both Integrated Child Development Services (ICDS) programme and National Rural Health Mission (NRHM) and its urban counterpart cover the entire country. These interventions did result in steady improvement in nutritional status of children but the pace of improvement is slow. Poverty was the major cause of under-nutrition five decades ago; during the current decade, poor infant and young child feeding and poor access to health care are emerging as important determinants of under-nutrition in children. Nutrition and health education and improved access to health and nutrition care can therefore lead to substantial reduction in under-nutrition in children over the next decade.

During the last decade overnutrition in children especially from urban affluent sections of the population is emerging as a major public health problem. Research studies in India are highlighting the possibility that under-nutrition in childhood might be one of the predisposing factors for over-nutrition and obesity and higher risk of noncommunicable disease risk in adult life. Prevalence of overnutrition in India except among urban high income group is still relatively low. As health hazards associated with overnutrition in children are well understood by the urban high income population, effective nutrition and health education targeted to school children

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might enable the country to prevent any escalation of the over-nutrition rates in children. The current phase of dual nutrition burden, should therefore be viewed as a opportunity window for effectively combating both under and over-nutrition in children.

Introduction

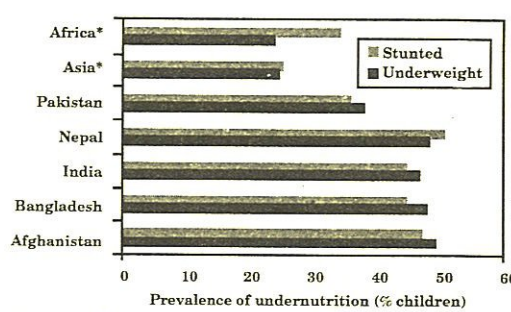
At the time of Independence over three fourths of Indian children were undernourished and about one in five infants died before first birth day. Recognising the importance of child nutrition for survival, health and child development, India adopted multi-sectoral, multi-pronged strategy to combat under-nutrition and ill-health in children. Special emphasis was laid on meeting the nutrient gap in this vulnerable group through supplementary feeding programmes and improving the access to health care so that nutritional toll of morbidity can be reduced. These interventions did result in steady improvement in nutritional status of children but the pace of improvement is slow. In the last five decades, the mortality rate has come down by 50% and the fertility rate by 40 % but the reduction in under-nutrition in children is only 20%. There is a growing concern that increase in outlays in nutrition sector has not been translated into improvement in outputs such as improvement in content, quality and coverage of nutrition programmes and outcomes such as reduction in under-nutrition rates in children.

During the last decade the country witnessed a rapid economic growth; there were concomitant rapid changes in dietary intake and physical activity patterns in all age groups especially among the urban high income segment of the population. These have led to an increase in over-nutrition rates in children especially in urban high-income group. Research studies in India are highlighting the possibility that under-nutrition in childhood might be one of the predisposing factors for over-nutrition and obesity in adult life, providing yet another urgent reason to strive for accelerating the pace of reduction in under-nutrition. Some of the dimensions of ongoing nutrition transition and determinants of the emerging dual nutrition burden in children are reviewed in this communication.

Dual nutrition burden – global dimensions

Preschool children have been considered as one of the most

Figure 1 : Under-nutrition prevalence in South Asian countries is much higher than in Africa

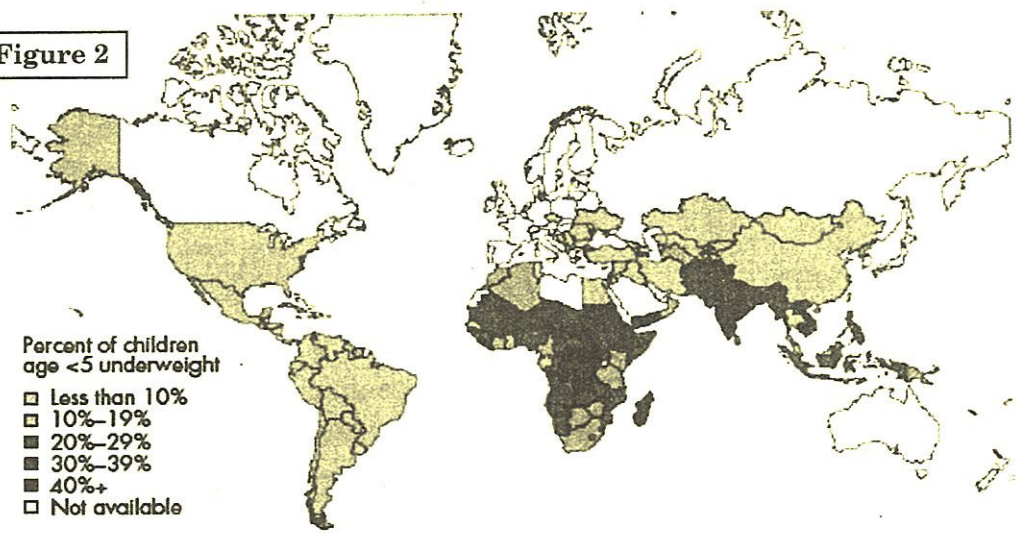


Source : De Onis and others (2004a); SCN (2004)

nutritionally vulnerable segments of the population. Nutrition during the first five years has an impact not only on growth and morbidity during childhood, but also acts as a determinant of nutritional status in adolescent and adult life. Global comparative data indicate that contrary to common perception, prevalence of under-nutrition is highest in children from South Asia and not sub-Saharan Africa (Figure 1 and 2). India is home to the largest number of underweight and stunted children in the world (1, 2).

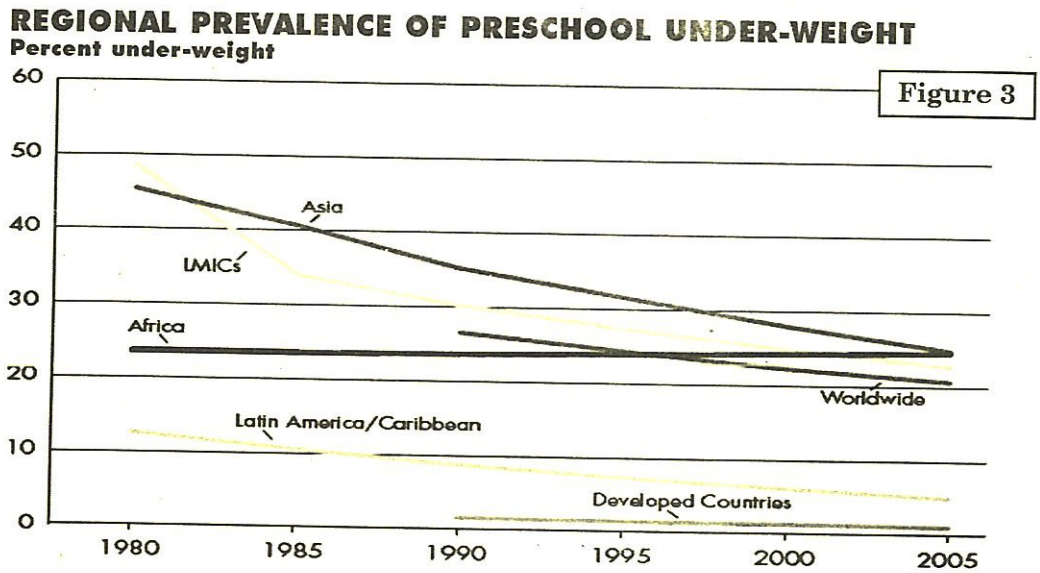
REGIONAL PREVALENCE OF UNDER-WEIGHT AMONG CHILDREN UNDER AGE 5

Figure 2



SOURCE: Carl Haub, *2007 World Population Data Sheet* (Washington, DC: Population Reference Bureau, 2007).

Over the last three decades, there has been a relatively steep and sustained reduction in under-nutrition rates in Asia especially South Asia (Figure 3). Despite this decline, the prevalence of under-nutrition in Asia continues to be the highest in the world. Projected trends in number of underweight under five children over the next decade is given in Figure 4. In South Asia, especially India there will be continued substantial reduction in under-nutrition rates; but because of their share in the world population Asia and India will contribute by far the largest number of underweight children in the world in 2015. Simultaneously over-nutrition is emerging as a major problem in children all over the world (Figure 5); currently prevalence of over-nutrition in Asia is



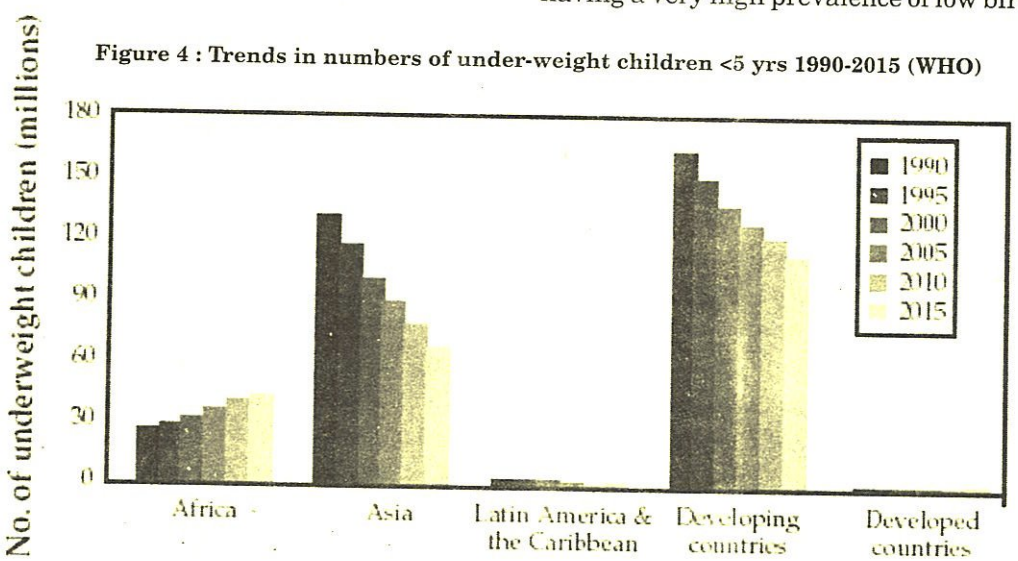
SOURCE: United Nations Standing Committee on Nutrition (SCN), *Fifth Report on the World Nutrition Situation: Nutrition for Improved Development Outcomes* (Geneva: SCN, 2004).

relatively low but given the large population the contribution of Asia to global number of overnourished children is quite high (3).

Intrauterine under-nutrition and low birth-weight

India has the dubious distinction of having a very high prevalence of low birth

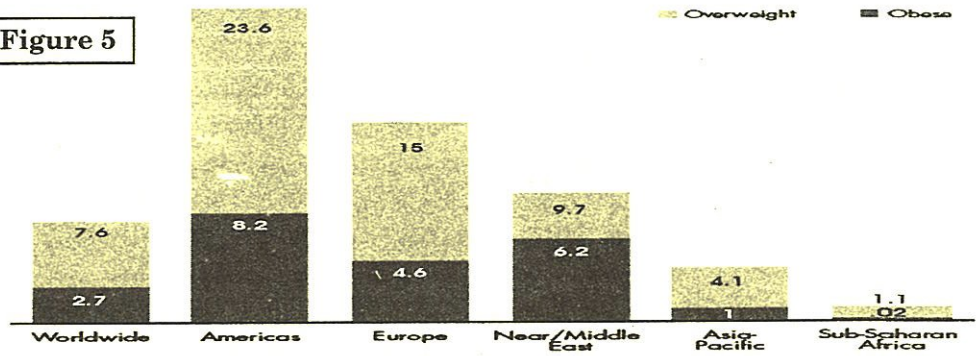
Figure 4 : Trends in numbers of under-weight children <5 yrs 1990-2015 (WHO)



Source : De Onis and others (2004a, 2004b) Note : Estimates are based on WHO

PERCENT OVER-WEGHT AND OBESE AMONG SCHOOL-AGE CHILDREN

Figure 5



SOURCE: United Nations Standing Committee on Nutrition (SCN). "Overweight and Obesity." *SCN News* 29 (Late 2004-Early 2005).

weight. Estimates based on available data from institutional deliveries and smaller community- based studies suggest that nearly one-third of all Indian infants weigh less than 2.5 kg at birth. Both hospital based (Figure 6, 7) and community based studies indicate that there has hardly been any change in birth weight trends in the past three decades (4, 5). Some factors, which have significant influence on birth weight, such as the parents' height are not amenable to short term corrective interventions. On the other hand, factors like anaemia, pregnancy induced hypertension and low maternal weight gain during pregnancy can be corrected. Such interventions could result in substantial reduction both in pre-term births and birth of small for date neonates. The National Rural Health Mission (NRHM) (6) attempts to improve the coverage, content and quality of antenatal care and bring about a convergence with the efforts of the ICDS system to provide food supplements to improve maternal nutrition. Effective implementation of these interventions would result in some reduction in low birth weight rates.

Figure 6 : Time trends in birth weight

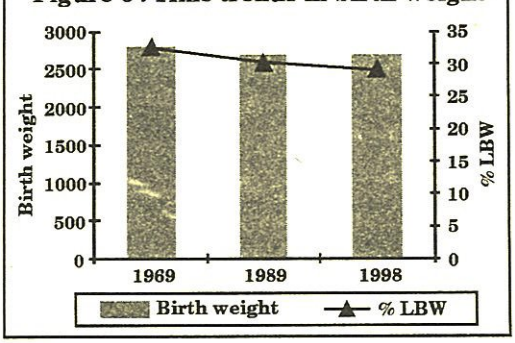
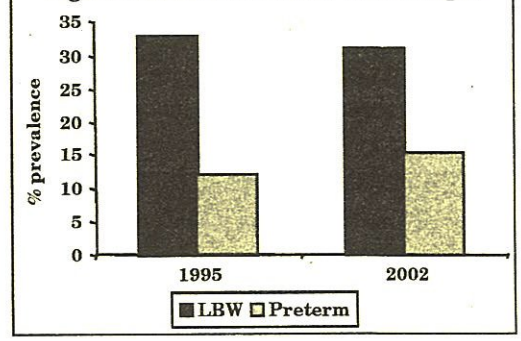
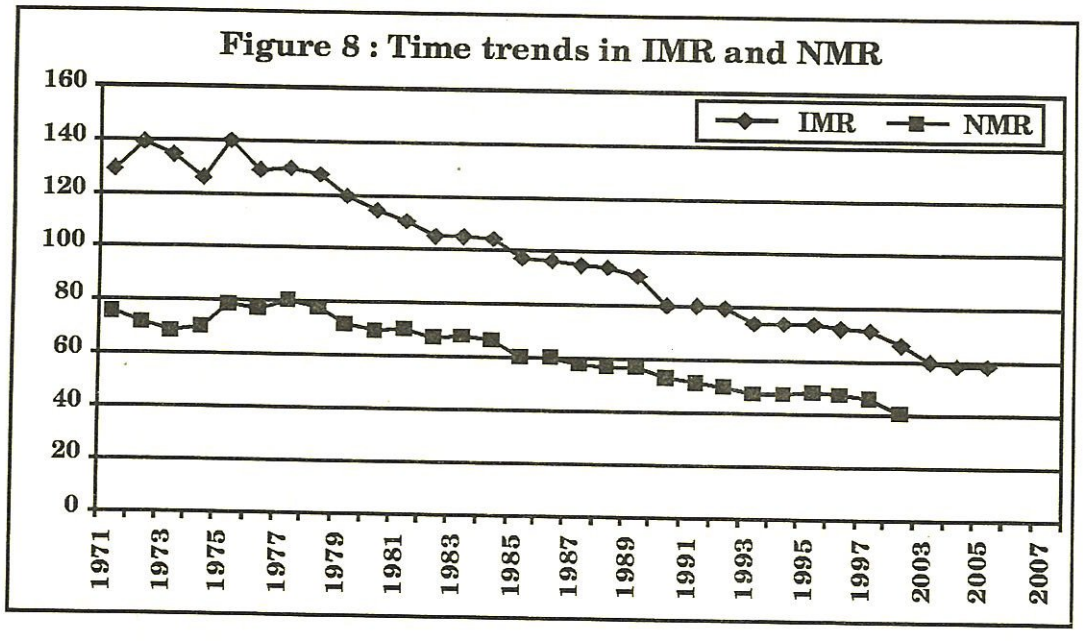


Figure 7: Prevalence of low birth weight



Studies on effect of birth weight on neonatal mortality carried out by Ghosh *et al* (7) showed that majority of LBW babies in India are born at term but have intra-uterine growth retardation; their survival chances are much better than the pre-term babies with similar birth weight. The demonstration that most term IUGR babies will survive if warmth and breast feeding are provided and infections are prevented, paved way for efforts to provide essential new born care in primary health care settings. Inspite of the fact that there has been no decline in the prevalence of low birth weight, the country has achieved substantial decline in IMR (8) and some reduction in NMR (Figure 8). In Kerala low birthweight rates are over 20%, but neonatal mortality rates are comparable to the developed countries (8) because nearly all deliveries occur in hospitals and almost all get access to essential obstetric and neonatal care.

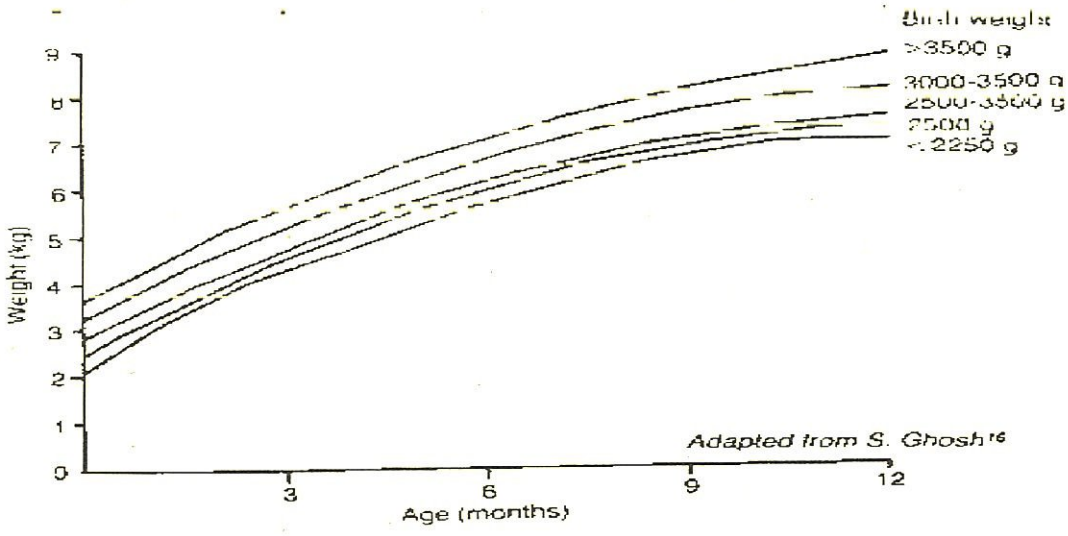
Figure 8 : Time trends in IMR and NMR



With improving survival, the issues pertaining to nutritional and health status of children are becoming major concerns. Studies carried out by Ghosh and coworkers in the seventies and later confirmed by other investigators have shown that LBW children have a low trajectory for growth in infancy and childhood (Figure 9) (9) . Thus the high low birth-weight rates in India are at least partly responsible for the under-nutrition in childhood and adolescence.

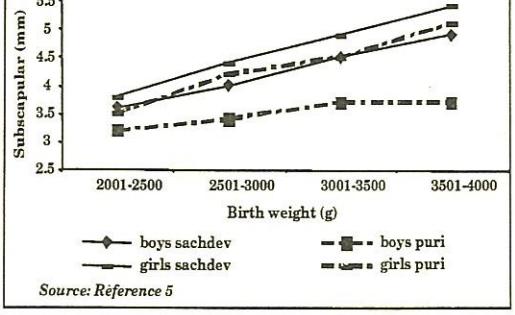
It is however important to remember that the seeds for obesity in adult life might also be sown during the intrauterine period. Studies on

Figure 9 : Growth in relation to birth weight



anthropometric parameters of neonates in a Delhi hospital showed that over the last two decades the birthweight of neonates had remained unaltered but there was an increase in fat fold thickness in all gestational age and birth weight categories (Figure 10) (10). The implications of these findings are not clear; an increase in adiposity in neonates is a matter of concern and these children should be carefully followed up.

Figure 10 : Time trends in subscapular fat fold thickness (mm)

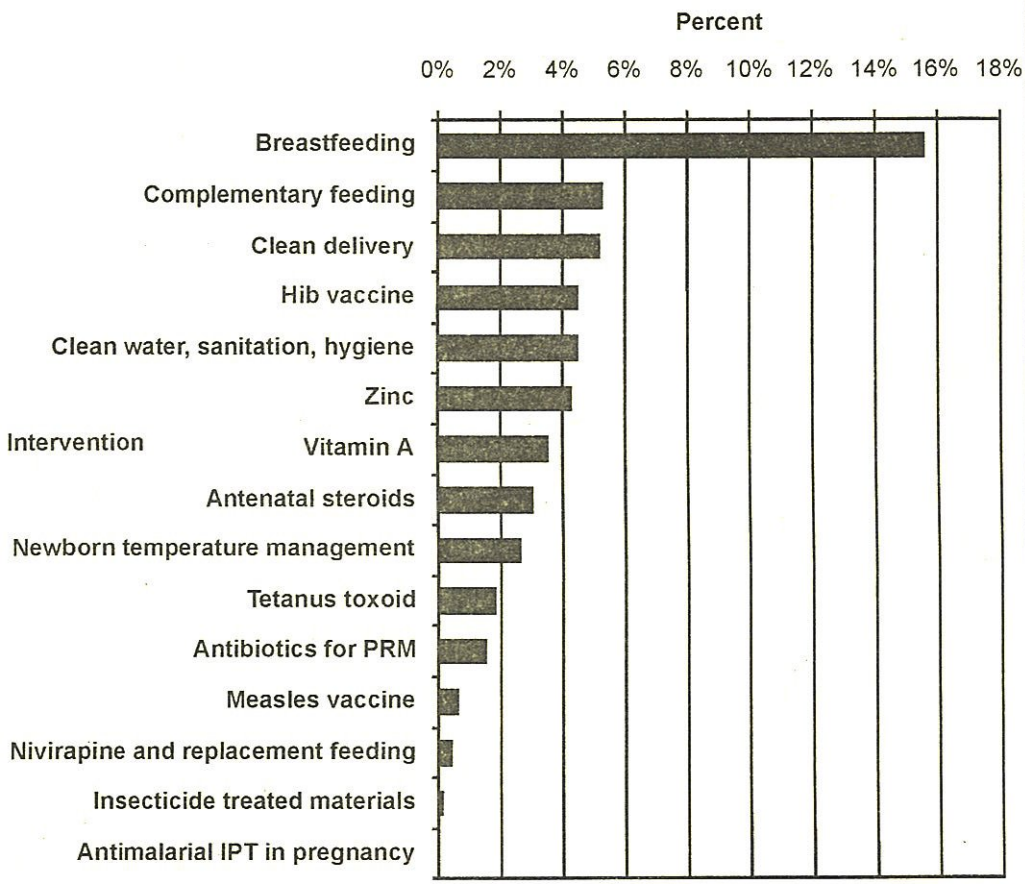


Source: Reference 5

Nutrition in infancy and early childhood

Global pattern of under-nutrition in relation to age in preschool children is shown in Figure 11. In all the developing countries, there is a progressive increase in under-nutrition rates with increasing age between 3-24 months. Asian especially Indian children start with a disadvantage because approximately 30% of children in India are born with low birth weight; under-nutrition rates rise steeply between 3-18 months of age in Asian children. By the age of two years most growth retardation has already taken place and subsequently there is no improvement in nutritional status (11). It would therefore appear that it is essential to combat under-nutrition right in the first year of life.

Figure 16 : Under-5 deaths preventable through universal coverage with individual interventions (2000)



and health status during the critical first year of life.

WHO Growth standards (2006) for under fives

During the nineties, a WHO Working Group analysed available data on growth of infants who were breast fed in the first year of life and found that the growth curve of breast fed infants differed significantly from the NCHS standards. In order to derive appropriate global standards for growth of breast fed infants during early childhood, WHO conducted a multi-centre study in Brazil, Ghana, India, Norway, Oman, and United States. Weight-for-age, height-for-age and weight-for-height and BMI for age standards for preschool children were

computed from this study. In April 2006, WHO released the new growth standards for preschool children based on this study and recommended that instead of the NCHS growth standards, member states may use new standards in view of:

- the WHO policy on promoting breast feeding and
- the urgent need to use the standards for BMI for age for early detection and correction of under and over nutrition in preschool children.

Under-weight rates: comparison between NCHS and WHO (2006) standards

It is important to assess whether changing over to WHO (2006) standards will lead to changes in prevalence of under-nutrition and if so the magnitude of the change in different age groups. Analysis of data on weight for age of 2.4 lakh preschool children from the District Level Household Survey was taken up for this purpose. International Institute of Population Science (IIPS) Mumbai provided the District Level Household Survey (DLHS) database to National Institute of Health and Family Welfare (NIHFW). Data analysis plan was prepared through collaboration between Nutrition Foundation of India (NFI) and NIHFW. Data analysis was done at NIHFW and the results were shared with NFI. There were substantial differences in prevalence of under-nutrition (weight for age) as assessed by NCHS and WHO standards (Figure 17 and 18). The maximum difference in underweight rates is in the critical first year of life (12). In the first six months, computed under-weight rates using WHO (2006) standards are higher as compared to the computed under-weight rates using NCHS standards. This should be viewed as a correction of a historical fallacy of using NCHS standards based on formula fed infants and not as alarming rise in under-weight rates in the 0-6 month age group. After first year the prevalence of under-

Figure 17 : Prevalence of under-nutrition (wt/age) WHO vs. NCHS (DLHS data)

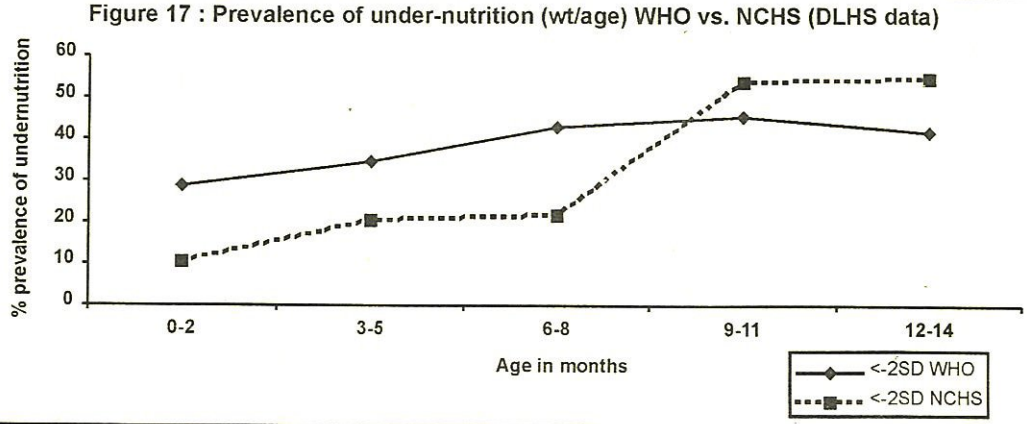


Table 1- Time trends in nutrient intake among pre-school children										
	1-3 years					4-6 years				
	75-79	88-90	96-97	00-01	05-06	75-79	88-90	96-97	00-01	05-06
Protein (g)	22.8	23.7	20.9	19.5	20.2	30.2	33.9	31.2	28.2	28.7
Energy (Kcal)	834	908	807	729	719	1118	1260	1213	1066	1020
Vitamin A (µg)	136	117	133	106	126	159	153	205	127	166
Thiamin (mg)	0.5	0.52	0.4	0.4	0.5	0.76	0.83	0.7	0.7	0.7
Riboflavin (mg)	0.38	0.37	0.4	0.3	0.3	0.48	0.52	0.6	0.6	0.4
Niacin (mg)	5.08	5.56	4.6	5.1	5.2	7.09	8.4	7.4	8.1	7.9
Vitamin C (mg)	15	14	15	17	17	20	23	25	24	25
Source: NNMB Reports										

the prevalence of over-nutrition also is the highest in this age group (15). Further analysis should be done to identify the profile of these over-weight infants. Clearly time has come for India to screen for both under and over nutrition in all age groups beginning right from birth and infancy.

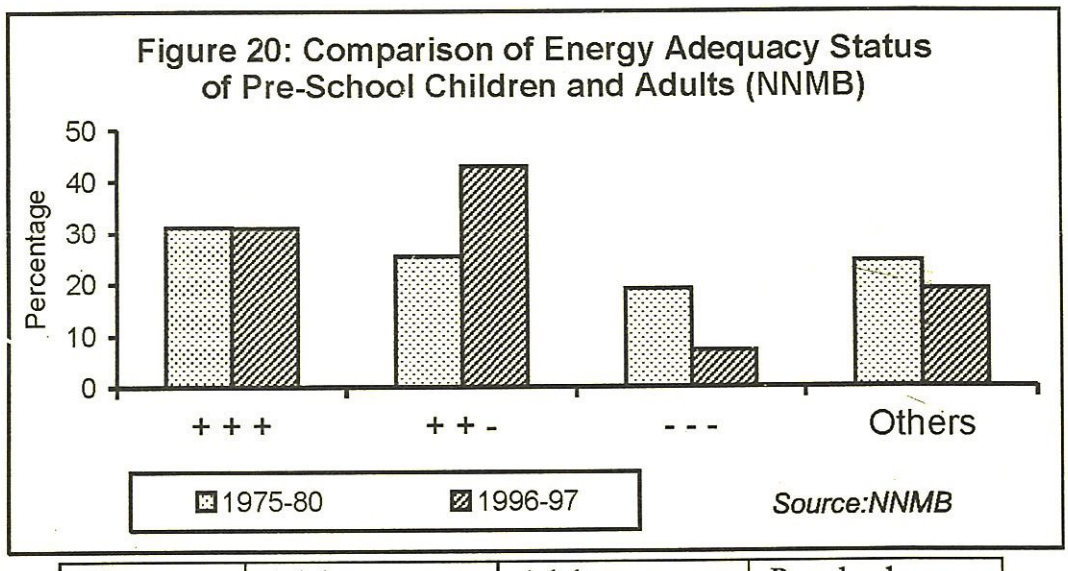
Time trends in under-nutrition rates in preschool children

Preschool children constitute one of the most nutritionally vulnerable segments of the population and their nutritional status is considered to be a sensitive indicator of community health and nutrition. Data from National Nutrition Monitoring Bureau surveys on dietary intake in preschool children between 1975 and 2005 is given Table 1 (16). There has not been a substantial improvement in their dietary intake over the last three decades.

Data from all the NNMB surveys including the 2004-05 survey (Table 2) indicate that in most households the gap between the RDA and actual intake is the widest in preschool children (whose requirements are the lowest)and narrowest in adults (whose requirements are the highest) (16).

Time trends in intra familial distribution of food (Figure 20) from NNMB surveys indicate that while the proportion of families where both the

Table 2 : Mean energy intake Children / Adolescents and Adults											
	Boy and Girl			Male				Female			
Years	1-3	4-6	7-9	10-12	13-15	16-17	≥18	10-12	13-15	16-17	≥18
Kcals	719	1020	1230	1423	1645	1913	2000	1389	1566	1630	1738
RDA	1240	1690	1950	2190	2450	2640	2425	1970	2060	2060	1875
% RDA	58.0	60.4	63.1	65.0	67.1	72.5	82.5	70.5	76.0	79.1	92.7
Source: NNMB 2005-06											

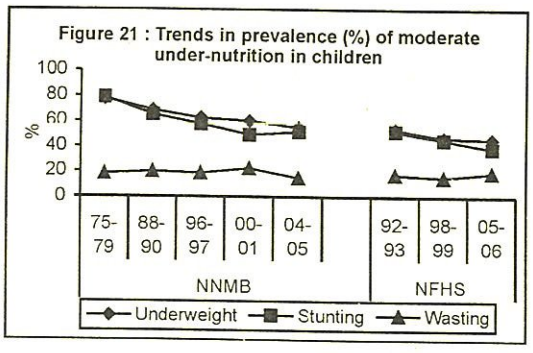


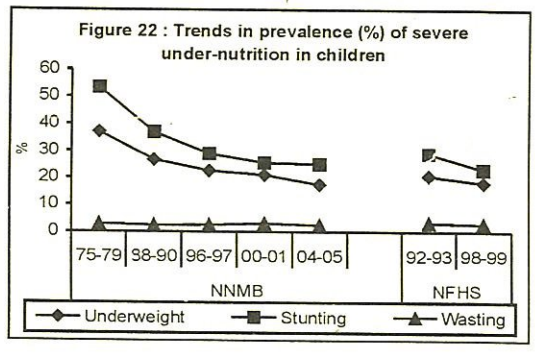
Dietary Intake	Adult Male	Adult Female	Preschool Children
+ + +	Adequate	Adequate	Adequate
+ + -	Adequate	Adequate	Inadequate
- - -	Inadequate	Inadequate	Inadequate

adults and preschool children have adequate food has remained at about 30% over the last 20 years, the proportion of families with inadequate intake has come down substantially. However, the proportion of families where the pre-school children receive inadequate intake while adults have adequate intake has nearly doubled (16). This is in spite of the fact that the RDA for preschool children forms a very small proportion (on an average 1300 Kcal/day) of the family's total intake of around 11000 Kcal/day (assuming a family size of 5). These data confirm that in the last decade more than poverty, poor young child feeding and caring practices are responsible for inadequate dietary intake in preschool children.

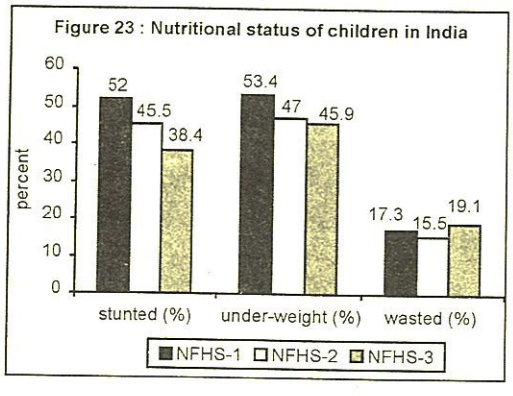
Data from NNMB surveys have shown that over the last three decades there has been a steep decline in the prevalence of moderate and severe under nutrition as assessed by weight for age and height for age. In spite of the steep decline in the prevalence of stunting over the last three decades, the change in the mean height of children is very low. There has been a decline in under-weight children but even now nearly 50% of the children are under-weight as compared to

the NCHS norms. It is not clear how much of this is attributable to the fact that Indian children are shorter as compared to NCHS norms and will therefore weigh less, event though their body weight is appropriate for their current height (Figure 21 and 22). Over the last three decades there has not been any reduction in the wasting rates in preschool children.





2 but not much change between NFHS 2 and 3. There were small reductions in the stunting and wasting rates between the three surveys (Figure 23). Inappropriate infant and young child feeding and caring appears to be responsible for the relatively slow reduction in under-nutrition rates between the three NFHS surveys. Unlike



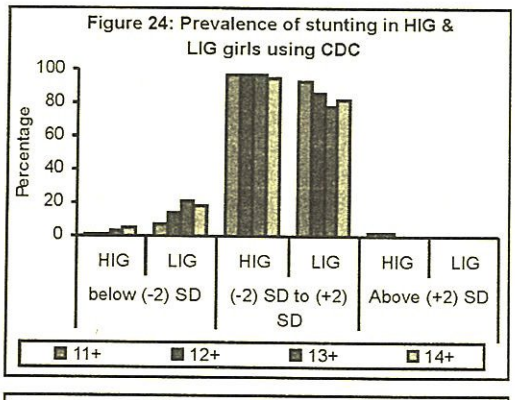
The significance of this finding is not clear.

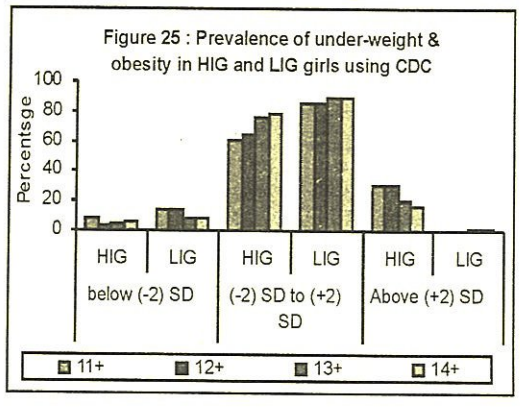
NFHS 1, 2 and 3 (13,17,18) provide information on time trends in nutritional status of under three children over the last fifteen years from a representative sample of children from all the major states. There has been some reduction in underweight rates between NFHS 1 and under-weight and stunting the wasting rate did not show a sustained decline. The reported wasting rates were highest in NFHS 3. The reason for this has to be ascertained. It is essential that under-nutrition rates are computed from the data from all the three surveys using the BMI for age from the WHO 2006 standards

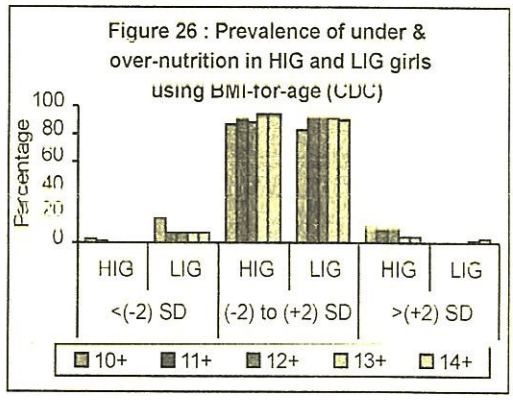
Nutritional status of urban school children

Data from studies carried out by several investigators in Delhi has shown that while under-nutrition is the problem in children from low income group studying in government schools, over nutrition is the cause for worry in children from high income group studying in public

schools. Nutrition Foundation of India carried out a study to assess under and over-nutrition in school children in government and public schools. Data were analysed to assess prevalence of under and over-nutrition using weight, height and BMI for age (as compared to CDC norms) as indices for assessment of nutritional status (Figures 24, 25 and 26) (19). Prevalence of under-nutrition was higher in government schools and over-nutrition was higher in public schools (NFI unpublished data). Even among children from affluent segments, there are some children who are under-weight, stunted and undernourished. There are over-weight children in all classes right







from play school. After the age of ten there is a reduction in over-weight children because they are conscious of being over-weight and try to lose weight either through exercise or through skipping meals. However consistent habits in eating and exercise often elude these adolescents; as a result they have cyclical weight gain and loss and incur all the health hazards associated with it.

Assessment of nutritional status in dual nutrition burden era

India has clearly entered the era of dual nutrition burden where under - and over-nutrition are becoming major public health problems. Ample data exist to show that Indian children and adults are shorter as compared to their developed country counter parts and therefore they will weigh less and be classified as undernourished by weight for age index even though they have appropriate weight for their height. Practicing pediatricians always clinically categorize children on the basis of height and weight into (Figure 27):

status in children and adolescents because it will enable early detection of both under and over-nutrition; early detection and effective management are essential to ensure these children grow into healthy normally- nourished adults.

Under-nutrition- over-nutrition linkages

It is possible that the seeds for obesity in adult life might be sown decades earlier. The thrifty gene hypothesis proposes that populations who had faced energy scarcity over millennia may evolve so that majority have thrifty gene, which conserves energy. If this population gets adequate or excess energy intake, they lay down fat, develop abdominal obesity, insulin resistance, which may progress to diabetes, and incur risk of hypertension and CVD. Barker's thrifty phenotype hypothesis (21) shifts the evolution of thriftiness to intrauterine period; Indians with one-third low birth weight rate can be deemed to have acquired the risk of metabolic syndrome *in utero*. Over the last decade several investigators have explored these possibilities.

Gupta *et al* (22)showed that both the low birth weight neonates with intrauterine growth retardation and the high birth weight neonates (many of whom are born to mothers with IGT or gestational diabetes) may develop insulin resistance and are at risk of developing metabolic syndrome at later life.

Yajnik and coworkers in Pune explored the relationship between low birth weight and insulin metabolism using Oral Glucose Tolerance Test (OGTT) in 477 children born in KEM hospital, Pune (23). They found that Indian neonates were small because they had poor muscles and small abdominal viscera. These neonates however had conserved their subcutaneous fat. At 4 years of age, plasma glucose and insulin

Table-3 : Birth weight, plasma glucose and insulin concentrations in 4-year old urban children

Birth weight (kg)	Number of children	Plasma glucose (mmol/l) at 30 min	Plasma insulin (pmol/l) at 30 min
=< 2.4	36	8.1	321
2.6	36	8.0	307
-2.8	44	7.8	309
-3.0	42	7.9	298
=>3.0	43	7.5	280
All	201	7.9	310
P for trend		0.01	0.04

Source: Yajnik et al, 1998

Table- 4: Time Trends in nutritional status of Delhi cohort

	Male		Female	
Age	No.	Weight (Kg)	No.	Weight (Kg)
At birth	803	2.89±0.44	561	2.79±0.38
2 yrs	834	10.3±1.3	609	9.8±1.2
12 yrs	867	30.9±5.9	625	32.2±6.7
30 yrs	886	71.8±14.0	640	59.2±13.4

Source: Bhargava et al, 2004

Table –5: Current Status of Delhi cohort

Characteristic	Men		Women	
	No.	Value	No.	Value
Weight (Kg.)	886	71.8±14.0	640	59.2±13.4
Height (m)	886	1.70±0.06	638	1.55±0.06
BMI	886	24.9±4.3	638	24.6±5.1
Waist:Hip ratio	886	0.92±0.06	639	0.82±0.07
BMI>_25	886	47.4	638	45.5
BMI>_23	886	66.0	638	61.8
Central Obesity (%)	886	65.5	639	31
Impaired GTT	849	16	539	14

Source: Bhargava et al, 2004

concentrations 30 minutes after glucose were inversely related to birth weight (Table-3) but directly related to current weight and fat fold thicknesses. The relationship between glucose/insulin and birth weight was independent of current weight. Thus poor intra-uterine growth, but relatively excess growth later ('obesity') was associated with metabolic endocrine abnormalities, which could lead to diabetes in adult life.

Bhargava and co-workers (24) have shown that life styles of urban Delhites in the nineties makes even low middle-income adults who were undernourished in infancy, childhood and adolescence, develop obesity- both general and abdominal- hypertension and diabetes by the time they are thirty (Table 4 and 5). The study demonstrated the potential adverse consequences of rapid change in the dietary habits and life style of urban population in Delhi in the last decade.

Conclusion

All developing countries in the world are undergoing socioeconomic, lifestyle and health and nutrition transition. In the last decade pace of nutrition transition in India has accelerated. While under-nutrition in children remains the major public health problem in India, over-nutrition is emerging as a problem especially among the urban high income group. Poverty was the major cause of under-nutrition five decades ago; during the current decade, poor infant and young child feeding and poor access to health care are emerging as important determinants of under-nutrition in children. Nutrition and health education and improved access to health and nutrition care can therefore be very effective interventions which could result in substantial reduction in under-nutrition in children over the next decade.

Available data from recent studies in India suggest the possibility that under-nutrition in childhood may predispose to over-nutrition and NCD in adult life; these data provide yet another rationale for energetic interventions to reduce under-nutrition in childhood. Prevalence of over-nutrition in India except among urban high income group is relatively low. Health hazards associated with over-nutrition in children are well understood; effective nutrition and health education targeted to school children might enable the country to prevent escalation of the over-nutrition rates in children. The current phase of dual nutrition burden, should therefore be viewed as a opportunity window for effectively combating both under and over-nutrition in children.

The lesson to be learnt from these data is that it is never too early for Indians to start practicing healthy lifestyle and dietary habits. Early detection and correction of under-nutrition until children attain appropriate weight for their height is essential to promote linear growth. Adolescents and adults should

have balanced diet with just adequate energy intake. Exercise has to become a part of daily routine to promote muscle and bone health as well as prevent development of adiposity in all age groups.

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