The Double Burden of Childhood Undernutrition and Overweight Globally and the Situation in South Asia

Robert E. Black, MD, MPH
Edgar Berman, Professor and Chair Department of International Health Johns Hopkins Bloomberg School of Public Health Baltimore, MD, USA

B. Sesikeran MD, Former Director, National Institute of Nutrition (ICMR) Hyderabad, India

Malnutrition has been receiving more attention recently, both for continuing problems of undernutrition and a growing problem of obesity and related diseases, but remains a neglected area globally. In low- and middle-income countries (LMICs), maternal and child undernutrition is still the predominant concern for its direct effects on morbidity, mortality and human capital, as well as its link to chronic diseases in adulthood, particularly in countries undergoing nutritional transition. Crises, both local and regional, such as conflict, drought and natural disasters can have profound effects on human nutrition in the short term. Longer term trends, such as climate change, water scarcity and reduction in land for agriculture can threaten the availability of sufficient food to feed the anticipated population of 9 billion people by the year 2050. At the same time, overweight and obesity continue to increase in prevalence worldwide. Many factors contribute to this increase including urbanization and more sedentary life- styles, an increase in consumption of meat and fats with economic development and wide availability of energy- dense foods. This presence of both undernutrition and overweight and obesity in many LMICs has been referred to as the «double burden» of malnutrition.

UNDERNUTRITION

There is recognition that undernutrition is linked to poverty and in setting the Millennium Development Goals (MDGs) two indicators were selected, the number of people who suffer from hunger and the number of children who are underweight. Both of these are targeted to be halved between 1990 and 2015. The estimated number of people suffering from hunger, defined as the proportion of the population below a minimum level of calorie consumption, was 824 million in 1990-92. In 2003-05, the figure stood at 848 million and reached 923 million in 2007, indicating that there has been no progress on this target.[1] Undernutrition more broadly includes deficiencies in energy, protein, and/or essential vitamins and minerals. It is the result of inadequate intake of food—in terms of either quality or quantity—and poor utilization of nutrients due to infections or other illnesses. An additional measure is the Global Hunger Index (GHI), which is calculated for 122 developing countries and countries in transition. For each country, data on the three equally weighted components of hunger (the proportion of people who are undernourished, the proportion of children under five who are underweight, and the child mortality rate) are available.[2]

The GHI ranks countries on a 100-point scale, with 0 being the best score (no hunger) and 100 being the worst, although neither of these extremes is reached in practice. Since 1990, the world's GHI score has decreased by nearly 25%. However, global hunger remains at a serious level and South

Asia and Sub-Saharan Africa continue to suffer from the highest levels of hunger, with regional scores of 22.9 and 21.7, respectively.

More direct measures of nutritional status, which result from inadequate diets and infectious diseases are underweight and stunting of linear growth. In their review of the global situation of undernutrition in the Lancet series in 2008, Black et al[3] estimated that there were a total of 112.4 million underweight young children globally — 28% of whom were in Africa and 70% in Asia, with more than 90% of those in Asia being in South Asia, particularly India. In addition, 13 million infants were born annually with intrauterine growth restriction (IUGR) resulting in low birth- weight. The Lancet series underscored the importance of stunting and estimated that worldwide,178 million children under five years suffered from stunting, of which 57 million lived in Africa, 112 million in Asia and 9 million in Latin America, respectively. The global prevalence of stunting in children under five in 2005 was 32%, with rates in Africa, Asia and Latin America averaging 40%, 31% and 16%, respectively. The series also provided robust estimates of wasting for the first time and indicated that 10% of all children globally (55 million) were wasted and 19 million children were severely wasted.

The mismatch between economic growth and investments in addressing undernutrition is underscored by the fact that in some countries with high economic growth, undernutrition persists or has worsened, reflecting persistent societal inequities. At national level, income growth has had a steady but slow effect on undernutrition rates. On average, undernutrition rates decline at half the rate that GNP per capita increases. In contrast, poverty rates decline at twice the rate of GNP growth per capita.[4]

Economic growth does contribute to improving nutrition outcomes, but the trickle-down effect can be slow. Uneven growth and inequity contribute to this phenomenon. There are also positive examples of economic growth combined with a reduction of poverty (resulting from macro-economic policy reforms) that have been associated with rapid improvements in child underweight and reduction of stunting in many developing countries (e.g. Brazil).[5] Too often, however, the contrast is with countries like India where the benefits of large-scale economic growth have yet to trickle down to the poorest with manifest changes in undernutrition. India is home to 40% of the world's malnourished children and 35% of the developing world's low birth-weight infants.

Undernutrition thus represents the non-income face of poverty. Though many countries are on-track in improving income poverty (MDG 1a), few have a strong chance of meeting the MDG target for reduction of underweight in children.[6] In addition, deficiencies of essential vitamins and minerals continue to be highly prevalent. Vitamin A and zinc deficiencies are important because they increase the risk of infectious diseases and death in childhood. Iron deficiency is widespread, resulting in anemia, and iodine deficiency, if severe, adversely affects brain development. The little progress in nutrition that has been made in the last two decades has been compromised by a series of global trends, such as rising food and oil prices, reduced water availability and changing weather patterns, possibly due to climate change.

Estimates from the World Bank indicate that as a consequence of recent food price shocks and economic downturn as many as 130 to155 million more people in the world might have been

forced into extreme poverty. Higher food prices during 2008 alone may have increased the number of children suffering permanent cognitive and physical injury due to malnutrition by as much as 44%.[7]

Past experiences with food price and economic crises indicate that rising food prices significantly erode households' purchasing power, especially of the poorest that already spend high proportions of their household income on food. Those that mostly depend on the market to access food were particularly affected (e.g. urban settlers, poor rural households). The loss of purchasing power also affected households' ability to buy other goods and services, including heating, lighting, water, sanitation, education, and health care, all of which are important inputs to nutrition.

Alongside rising food prices, oil prices have also been increasing. Rising oil prices lead to increased cost of nitrogen-based fertilizer and transport costs. Increased fuel costs have increased the cost of operating machinery and transporting food and agricultural inputs, with the consequent increase in food prices. The production of crops for biofuel may also limit the output of food for human or animal consumption and thus raise food prices. The negative impact of the high food prices is likely to be further deepened by the economic downturn. Reduced remittances into developing countries, loss of job opportunities and lower wage rates are likely to reduce households' income and purchasing power. The severity and incidence of poverty are likely to increase, leading to a rise in undernutrition.

Despite the controversy that has plagued some of the issues around global climate change, most scientists concur that this is the single largest challenge facing humanity and threatens to impact all aspects of the way we live. The Intergovernmental Panel on Climate Change (IPCC) estimated that climate change alone could potentially increase the number of people directly at risk of hunger by a figure between 40 million and 170 million, with many more at risk from other socio-economic impacts of the changes.[8] Climate change can be linked to health and nutrition through several pathways including changing patterns of disease and mortality, an increase in extreme weather events, and threats to agriculture and water availablity.[9] Climate change and variability may lead to more intense and longer droughts as well as periodic flooding and exceptional rainfall. Droughts and water scarcity reduce dietary diversity and overall food availability and prices, which in turn, may lead to undernutrition.[10] The frequency of heavy rainfall has increased over many land areas affecting the risk of flooding from both sea-level rise and increased heavy precipitation in coastal areas. This is likely to increase in the number of people exposed to diarrheal and other infectious diseases especially in children, thus creating a catabolic cost and lowering their capacity to utilize food effectively. Perhaps the most striking examples of the impact of extreme weather in recent years are the widespread drought and crop failures in Russia and Brazil at the time of torrential rains and heavy floods in Pakistan, affecting almost 20% of the landmass and displacing over 8 million people.[11]

Changes in vegetation on a large scale will affect surface temperatures and alter regional rainfall patterns.[12] Climate change is projected to increase the burden of diarrheal diseases in low-income regions and lead to population movement as a consequence of water shortage and food insecurity. It is estimated that a 2°C rise in temperature would lead to 220 million people at risk of

undernutrition due to reduced agricultural output and that a 3°C rise would expose 440 million more to the risk of undernutrition.[13]
Although some dispute the adverse effects of climate change on crop yields universally, predictive modeling suggests even if crop yields might increase at mid to high latitudes, they would decrease at low latitudes further affecting poor populations in the South.[14]

At present, even as we are considering the longer-term effects of climate change, there is active discussion on how to make better conceptual and operational bridges between promotion of agriculture to enhance food security and economic development and promotion of approaches to improve human nutrition. A particular emphasis in this rethinking of linkages is how to meet the maternal and child nutritional needs in low and middle-income countries. Major initiatives by the G8 on food security are promoting agricultural productivity, while health agencies and partners, such as in the Scaling Up Nutrition (SUN) movement, are focused on nutrition in the first 1000 days of a child's life from pregnancy to the second year of life.

The goals of enhancing food security need to be brought conceptually together with the needs to ensure nutrition security especially for the poor.

OVERWEIGHT AND OBESITY

Evidence shows that overweight coexists in countries where both child and maternal undernutrition are widespread and in many countries with low per capita Gross National Product (GNP).[15] The World Bank's strategy (Repositioning Nutrition as Central to Development)[16] also identifies trends in overweight among children under five that are a cause for concern for many developing countries and particularly for those in Africa, where rates seem to be increasing at a far greater rate (58% increase) than in the developing world (17% increase). It has been estimated that in 2010 there were 43 million children (more than 80% of these in LMIC) who were overweight or obese. The global prevalence of these conditions increased from 4.2% in 1990 to 6.7% in 2010 and is expected to reach 9.1% by 2020.[17] Linking the two ends of the spectrum of the double burden of malnutrition is the evidence that maternal and child undernutrition increases the risk of adult chronic diseases related to nutrition, shorter adult height and reduced income.[18]

With economic growth and increasing wealth, countries generally undergo a nutrition transition, including shifts in the structure and composition of the diet. Increased family income often results in increases in refined sugar and animal fat and protein, as well as total energy intake, and decreases in the proportion of energy in the diet from carboyhydrates.[19] These changes in the diet, along with more sedentary life-styles, result in changes in body composition that may include overweight and obesity and their consequences for nutrition-related chronic diseases. These changes usually occur first in the high-income urban populations, but soon shift to toward lower income groups.[20] Low-income women are at greater risk of obesity than their male counterparts. While the prevalence of childhood overweight/obesity tends to lag behind that in adults, the problem is beginning to emerge in children in countries such as China.[21] Along with these changes in body composition are increases in diabetes, hypertension, atherosclerosis and related cerebral and cardiovascular diseases.

In many settings there is a high prevalence of overweight or obesity in women, but high prevalence of undernutrition in their children.[22] In addition, countries do not develop with uniform economic progress. Inequities may remain resulting in some groups of the society becoming overweight while others have food insecurity and undernutrition. Furthermore, even overweight individuals may have deficiencies of vitamins and minerals that are essential for health and development. Notably iron and zinc deficiencies may be common even in populations with increasing obesity because of consumption of high energy but poor quality diets that are deficient in essential micronutrients.

MALNUTRITION IN SOUTH ASIA

The malnutrition situation in South Asia has been changing in tandem with increasing population and urban migration, as well as economic growth that has not equally benefitted all segments of society. Among the poor, economic growth has not reduced undernutrition among infants and young children due to unequal distribution of wealth. Varying degrees of undernutrition persist and continue to dominate the nutritional scene in South Asia. The high percentages in under 5 year olds of moderate and severe underweight in Afghanistan (33), Bangladesh (41), Bhutan (13), India (43), Maldives (17), Nepal (39), Pakistan (31) and Sri Lanka (21) indicate the need for urgent attention. The high percentages of stunted linear growth in children in South Asia [Afghanistan (59), Bangladesh (43), Bhutan (34), India (48), Maldives (19), Nepal (49), Pakistan (42) and Sri Lanka (17)] is alarming, because of its association with long-term adverse effects for the stunted individual and for society (WHO, 2010). These overwhelming numbers of children are caught in the vicious cycle of poverty that is directly related to poor education levels, inadequate diets, poor health and low cognitive capabilities. Poor urban migrants face even worse food insecurity and labor-intensive, poorly paid jobs, adding to the increasing numbers of those with severe undernutrition in urban areas.

With the unequal distribution of wealth and the results of recent economic growth, those in the middle- and high- income groups have a steady rise in overweight and obesity. The percentage of overall overweight and obesity was 7.6 and 1.1 in Bangladesh, 23.4 and 5.3 in Bhutan, 11 and 1.9 in India, 51.4 and 19.4 in Iran, 35.4 and 12.9 in Maldives, 9.1 and 1.4 in Nepal, 27.1 and 7.8 in Pakistan and 21.9 and 5.1 in Sri Lanka.[23] The economically better-off urban populations in cities, especially young adolescents and children are constantly exposed to media-influenced food choices and in the name of 'modernity', subsist on non- nutritious food; high-sugar drinks and high- fat, low-fiber foods. The health impact of these changes in diets on an urban migrant population is greatest due to their transition from a physically active rural lifestyle to one that is drastically low in physical activity. With increase in weight, these groups are relatively more prone to acquire chronic diseases such as diabetes and cardiovascular disease earlier in life.[24] The existing government and NGO efforts to stem undernutrition have had meager effects despite huge expenditure on providing food supplements to children and pregnant and nursing mothers (e.g., the Integrated Child Development Services (ICDS) Scheme in India), in part because of poor targeting of this program to children after the first two years of life rather than to infants. India and its neighbors, Pakistan, Nepal, Sri Lanka and Bangladesh in the South Asian region, continue to struggle with the great challenges that require multi-pronged coordination and commitment among different administrative agencies interacting with the providers of resources at the

grassroots to reach the needy population. However, stemming corruption and addressing administrative inefficiencies seem to be the most important actions that governments and the civil society have to take to ensure that resources meant for the vulnerable segments of the population actually reach them.

Current understanding on pre- and post-natal nutritional needs is that the first 1000 days after conception are critical, during which undernutrition has long-term adverse consequences on physiological and neurological development. «Intervening within this period will have life-long and life-changing impacts on educational attainment, labor capacity, reproductive health and adult earnings. If we wait until a child is two years old, the effects of undernutrition are already irreversible».[18] Neonates and infants at any point of time may require immediate intervention through the provision of nutritional supplementation (protein, calories and micronutrients, iron, etc.) and education to their mothers and caregivers. Long-term benefits can be expected by intervening with adolescent girls and boys to improve their nutrition of status and also prepare them for future parenting, with their offspring having improved birth weights, neonatal and infant survival rates, improved growth and development and better academic achievement.

The South Asia Infant Feeding Research Network, is one of the first groups[25] that worked on analyses of existing Demographic and Health Survey data on complementary feeding practices using the new global feeding indicators.[26] The results of their analyses of the introduction of complementary foods and dietary diversity practices among infants aged 6-23 months in 5 countries within South Asia found:

- In Bangladesh, rates for introduction of complementary food at 6-8 months of age was 71% but the minimum dietary diversity was 42% and the minimum acceptable diet for those breastfed was low at 40% in infants 6-23 months. Factors associated with poor complementary feeding were low household wealth and low parental education.
- Only half (55%) of Indian children (6-8 months old) were fed solid foods. The minimum dietary diversity was just 15% and the minimum acceptable diet for those breastfed (9%) was alarmingly low in children 6-23 months. Factors associated with inappropriate feeding were poverty, low maternal education, low frequency of antenatal visits and no exposure to media.
- Nepal had reasonable rates of introduction of complementary food at 6-8 months of age (70%), but the minimum dietary diversity (42%) and minimum acceptable diet for those breastfed (40%) were low in infants 6-23 months. Consistent with Bangladesh and India, poverty and maternal illiteracy were major factors associated.
- The rate of introduction of complementary food at 6-8 months among infants in Pakistan was 39%. However, among infants aged 3-5 months, 11% already received solids, semi-solid or soft foods, which indicates too early introduction of complementary feeding in this population.
- In contrast, indicators of complementary feeding practices in Sri Lanka were higher than in all other South Asian countries. Introduction of complementary food at 6-8 months of age (84%), the rate of minimum dietary diversity (71%), and minimal acceptable diet for those breastfed (68%) were much higher. Children living on tea estates had lower dietary diversity and minimum acceptable diet than children in urban and rural areas. Other determinants included lower maternal education, lower wealth index, lack of post-natal visits, unsatisfactory exposure to media and acute respiratory infections.

Concerted efforts to educate mothers and caregivers among the vulnerable populations especially on exclusive breastfeeding and introduction of appropriate and varied complementary foods, responsive feeding i.e., how to feed needs much more attention in South Asia.[27] In this context, the micronutrient content of complementary foods, food consistency and number of meals needs to be especially addressed. Changing existing behaviors of mothers and caregivers requires the application of proven behavior modification techniques that take existing economic and food security constraints into account and are facilitative rather than authoritarian. These therefore require an understanding of the «whys» of existing behaviors beforehand and hence have to be tailor-made for specific population groups within regions of a country.[28]

In India, the National Nutrition Monitoring Bureau provides an additional source of information through regular surveys on dietary intakes of population groups at the household level in ten states. Recent surveys in rural and tribal districts found that the average consumption of protective foods, such as, pulses and legumes, milk and milk products and fruits were grossly inadequate, while that of cereals, roots and tubers was satisfactory, compared to recommended levels.[29] Consequently, the intakes of micronutrients such as iron, vitamin A, riboflavin and folic acid were far below the recommended levels in all the age groups. Only a fourth of the pre-school and school-age children were consuming diets adequate in protein and energy, the proportion of which was higher in adolescents (30-60%) and in adults (70-80%).[24]

The intra-family distribution of dietary energy also revealed that about 52% of preschool children, 45% of school age children and 27% of adolescents were not meeting energy requirements (<70% of RDA), even though the adult men and women in the same households were consuming adequate diets.30 The distressing part is that this disparity has been gradually increasing over a period of time.[24, 29]

Prevalence of undernutrition among children 1-5 years age over a period from the 1970s to 2011 showed a decline of severe underweight (<-3SD) from 42.2% (1975-79) to 15.2% in 2010-11. Underweight (<—2SD) also declined significantly from 75.5% (1975-79) to 42.2% in 2010-11, with similar trend observed in stunting.31, 32 However, there was no decline observed in wasting. Chronic energy deficit (CED) among adults is of concern as functional impairment and increased sickness days induce low productivity with decline in BMI levels below <18.5.[33] The CED was about 33% and 36% among adult men and women respectively and a significant decline from 56% in 1975-79 to 33% in 2011 in men and 52% to 36% among women was observed.[32]

Micronutrient deficiencies can lower disease resistance in children, affect survival rates of mothers during childbirth due to poor health, cause premature death, blindness, growth stunting and low work capacity and affect cognitive development. The economic and health losses lost because of these deficiencies in terms of lives lost, quality of life are staggering. Clinical vitamin A deficiency (Bitot Spots) was 0.8% being more than the WHO cut-off level of 0.5% in all the states surveyed, except Kerala (0%). The sub-clinical VAD (blood vitamin A <20 mcg I dl) ranged from 50 to 90%. Only about 25% of preschool children received the stipulated two doses of vitamin A and 30% received only one dose of vitamin A. Iron deficiency and anemia prevalence was high among lactating women (78%), followed by pregnant women (75%), preschool children (70%) and adolescent girls and adult males (55%). Prevalence of iodine deficiency in 40 select districts in 2002-03 was found to

be high with highest prevalence of goiter in the north-eastern region of the country. The prevalence of total goiter was 10%. NNMB survey during 2002-03 found only 31% of households consumed adequate amounts of iodine.[34]

Diet and lifestyle-related diseases such as obesity, type 2 diabetes, metabolic syndrome, cancer and cardiovascular diseases are increasing in epidemic proportions in the region including India. The prevalence of obesity, diabetes, and hypertension is also increasing among children and adolescents. A positive association was observed between prevalence of hypertension and obesity.[24]

In South Asia there is an urgent need to strengthen the implementation of all the existing nutrition intervention programs and improve infant and young child feeding practices. The assessment and use of food security data to target interventions based on availability of both calorie and protein as well as micronutrient rich foods at community level is needed urgently. Further work is needed to test additional strategies to achieve behavioral change for improving dietary diversity and increased quantities of locally available foods, particularly animal-source foods during late infancy and toddlerhood. Micronutrient fortification and supplementation might be more effective and scalable options. Strengthening environmental sanitation, supply of safe drinking water, income generating programs and initiation of timely interventions in emergencies such as droughts, earthquakes and floods are important for achieving nutritional goals. Simultaneously, there is a need to sensitize the community regarding the causes and consequences of overweight and obesity, hypertension and diabetes and also educate them to adopt appropriate lifestyles and dietary habits.

CONCLUSIONS AND RECOMMENDATIONS

Low-and middle-income countries must confront the double burden of malnutrition, including stunting, and deficiencies of essential vitamins and minerals. This double burden has serious adverse consequences in death, illness and delayed development during childhood. It also has important consequences for adult obesity and non-communicable diseases. Urgent attention should be given to adolescent and maternal nutrition to ensure proper fetal growth and to infant and young child feeding. Breastfeeding according to current international guidelines and the use of high quality complementary foods after 6 months of age are essential to promote growth and development. These practices along with ensuring adequate micronutrient intakes and avoiding excessive weight gain after two years of age can also be expected to reduce the risk of stunting, adult obesity and related diseases. Enhancing and supporting these practices are a current priority and must be accomplished in the face of continuing, but hopefully reducing, poverty. Societies must also address increasing concerns about food prices and agricultural productivity for foods as a consequence of competition with crops used for biofuels, water scarcity, and weather instability. These global challenges require concerted and coordinated actions by governments and civil society now and for years to come to ensure population health, better educational attainment and economic productivity.

REFERENCES

1. World Hunger and Poverty Facts and Statistics. 2010 www.worldhunger.org/articles/Learn/world%20hunger%20 facts%202002.htm.
2. International Food Policy Research Institute. 2010 Global Hunger Index. www.ifpri.org/publication/2010-global-hunger-index.
3. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J; Maternal and Child Undernutrition Study Group. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet. 2008; 371:243 — 60.
4. Alderman, H.J. Behrman and J. Hoddinott, 2004, Improving Child Nutrition for Sustainable Poverty Reduction in Africa, IFPRI.
5. Requejo J, Bryce J, Victora C, Barros A, Berman P, Bhutta Z, Boerma T, Daelmans AD, Lawn J, Mason E, Newby H, Starrs A. Countdown to 2015. Building a future for women and children: the Countdown 2012 report. World Health Organization and UNICEF 2012. www.countdown2015mnch.org/reports-and- articles/2012-report (accessed Oct 5, 2012).
6. Stevens GA, Finucane MM, Paciorek CJ, Flaxman SR, White RA, Donner AJ, Ezzati M, on behalf of Nutrition Impact Model Study Group (Child Growth). Trends in mild, moderate, and severe stunting and underweight, and progress towards MDG 1 in 141 developing countries: a systematic analysis of population representative data. Lancet. 2012; 380:824 — 34.
7. World Bank, 2009, Global Economic Prospect — Commodities at the Crossroads.
8. Easterling, W.E., P.K. Aggarwal, P. Batima, K.M. Brander, L. Erda, S.M. Howden, A. Kirilenko, J. Morton, J.-F. Soussana, J. Schmidhuber and F.N. Tubiello, 2007: Food, fibre and forest products. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 273 — 313.
9. Costello A et al. Managing the health effects of climate change, Lancet and UCL for Global Health Commission, 2009; 373: 1693 — 1733.
10. Cohen, M J, Tirado, C, Aberman, N L and Thompson, B, 2008, Impact of Climate Change and Bioenergy on nutrition, IFPRI, FAO,Rome.
11. Bhutta ZA, Bhutta SZ. The unfolding human tragedy in Pakistan: fighting alone, Lancet 2010; 376: 664 — 665.
12. Defries, R.S., L. Bounoua and G. J. Collatz, 2002, «Human Modification of the Landscape and Surface Climate in the Next Fifty YearsD, Global Change Biology, 8, 438 — 458.
13. King, D, The Science of Climate Change, 2007.
14. Perrin, N, Health Consequences of Climate Change, 2007.
15. Kennedy ET. The global face of nutrition: what can governments and industry do? J Nutr. 2005; 135:913 — 5.
16. The World Bank. Repositioning Nutrition as Central to development: a strategy for action. Directions in Development. 2006. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ EXTHEALTHNUTRITIONANDPOPULATION/EXTNUTRITION/0,,co ntentMDK:20787550— menuPK:282580—pagePK:64020865—piP K:149114—theSitePK:282575,00.html
17. de Onis, Blössner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children 1 — 4. Am J Clin Nutr 2010; 92: 1257 — 64.

18. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, Sachdev HS, for the Maternal and Child Undernutrition Study Group. Maternal and child undernutrition: consequences for adult health and human capital. Lancet. 2008; DOI: 10.1016/S0140-6736(07)61692 — 4.
19. Popkin B, Drewnowski A. Dietary fats and the nutrition transition: new trendsin the global diet. Nutr Rev 1997; 55 (2): 31 — 43.
20. Monteiro CA, Moura EC, Conde WL, Popkin BM. Socioeconomic status and obesity in adult populations of developing countries: a review. Bull World Health Organ 2004; 82 (12): 940 — 946.
21. Popkin BM, Richards MK, Monteiro CA. Stunting is associated with overweight in children of four nations that are undergoing the nutrition transition. J Nutr 1996; 126 (12): 3009 — 3016.
22. Steyn K, Bourne L, Jooste P, Fourie JM, Rossouw K, Lombard C. Anthropometric profile of a black population of the Cape Peninsula in South Africa. East Afr Med J 1998; 75 (1): 35 — 40.
23. World Health Organization 2010, Geneva.
24. NNMB technical report series No: 24 (2006) Diet and nutritional status of population and prevalence of hypertension among adults in rural areas. National Nutrition Monitoring Bureau, National Institute of Nutrition (ICMR), Hyderabad, India.
25. Senarath and Dibley MJ. Complementary feeding in South Asia 2011 Blackwell Publishing Ltd Maternal and Child Nutrition (2012), 8 (Suppl. 1), pp. 5 — 10
26. Working Group on Infant and Young Child Feeding Indicators (2006) Developing and validating simple indicators of dietary quality and energy intake of infants and young children in developing countries: Summary of findings from analysis of 10 data sets. Report submitted to the Food and Nutrition Technical Assistance (FANTA) Project/Academy for Educational Development (AED), August 2006.
27. Black MM and Aboud FE (2011) Responsive feeding is embedded in a theoretical framework of responsive parenting. The Journal of Nutrition 141, 490 — 494.
28. Vazir S, Engle P, Balakrishna N, Griffiths PL, Johnson SL, Creed-Kanashiro H, Fernandez Rao S, Shroff MR, Bentley ME. Cluster-randomized trial on complementary and responsive feeding education to caregivers found improved dietary intake, growth, and development among rural Indian toddlers. Paper published online, MCN, May 2012. DOI:
10.1111/j.1740 — 8709.2012.00413.x
29. NNMB technical report series No: 20 (2000) Report on diet and nutritional status of adolescents, National Nutrition Monitoring Bureau, National Institute of Nutrition (ICMR), Hyderabad, India.
30. Vijayaraghavan K., Surya Prakasam, B and Laxmaiah, A. «Intra Family Distribution of Dietary Energy in Rural India and Time trends Food and Nutrition Bulletin. 2002; 23: p 390 — 394
31. NNMB Technical Report No: 6: 1980 (1975 — 79) National Institute of Nutrition (ICMR), Hyderabad, India.
32. NNMB Technical Report No:25 Diet and Nutritional Status of rural population (in press) National Institute of Nutrition (ICMR), Hyderabad, India.
33. Shetty PS and James WPT Body mass index - A measure of chronic energy deficiency in adults. FAO FOOD AND NUTRITION PAPER 56. Food and Agriculture Organization of the United Nations. Rome, 1994
34. NNMB Technical report series No: 21 (2002) Diet and nutritional status of rural population. National Nutrition Monitoring Bureau, National Institute of Nutrition (ICMR), Hyderabad, India.