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PREVALENCE AND RISK FACTORS FOR STUNTING AMONG TRIBAL UNDER-FIVE CHILDREN AT SOUTH-WEST, RAJASTHAN, INDIA

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ABSTRACT

Background: Stunting is one of key factor of chronic undernutrition is a major health problem in South Asia. It consequences increased morbidity & mortality during childhood.

Objectives: This study aims to explore the socio-economic determinants of stunting among under-five children of rural tribal India.

Methodology: It was cross sectional study and carried out in rural community in Jhalawar District in children's aged 6-59 months of age during period of February 2014 to April 2014 in 570 study samples.

Results: There were almost equal numbers of male and females participated and it was observed that stunting was positively associated with birth weight, birth order, ANC visit at health care facilities & family monthly income while inversely associated with age of baby, birth interval, EBF, PNC visit at health care facilities, & family size. Logistic regression analysis showed association with gender, working status of mother, history of TB in family member, ANC care, illiteracy of parents, mass media, overcrowding, and type of water supply.

Conclusion: Our analysis confirms the multifactorial nature of child stunting. It emphasizes the programmes should specifically target higher-risk groups such as young children, residents of rural community, less educated fathers, poor family social life, low-quality household environment, various morbidity and low birth weight.

Key Words: Stunting, risk factors, tribal community, under five children, north-west India

INTRODUCTION

Malnutrition responsible for serious health, social and economic consequences throughout the life course as well as across generations, making it the leading risk factor among children under five worldwide.[1-5] In recognition of the burden of malnutrition among under-five children, four of the eight United Nations' Millennium Development Goals (MDGs) are specifically directed towards improving child health outcomes in developing countries.

In India, like many developing countries, the most common nutritional problems in infancy and early childhood are stunting, wasting; iron-deficiency anaemia, poverty and low birth weight.[6] Malnutrition during the first 2 years of life can lead to mortality and morbidity in childhood and is one of the most preventable risk factors for mortality. [7-8] Nationally, more than 48%, 19.8% and 42.5% of under-5 children were stunted, wasted and under-

weight respectively (NFHS-3). Madhya Pradesh (55%), Bihar (54%), Orissa (54%), Uttar Pradesh (52%) and Rajasthan (51%)are highest burden states of India where prevalence of under nutrition have more than 50 percent (NFHS-3).[9]

Stunting or low height-for-ageis one of key factor of chronic under-nutrition reflects breakdown to reach linear growth capability. Globally, more than one quarter (26 per cent) of children under 5 years of age were stunted in 2011 – roughly 165 million children worldwide.[10] Sub-Saharan Africa and South Asia are home to three fourths of the world's stunted children and in South Asia, 39 per cent are stunted. Stunting is related to mental capacity, school performance and working capacity in the adult period.[11] The consequences of stunting in early life include increased susceptibility to infectious diseases, attenuated cognitive ability and increased behavioural problems during childhood[12].

Although significant efforts have been made to improve the nutritional statusin India, a large proportion of under- five children are still malnourished in India. While studies on nutritional status of under-five children in other developing countries are enormous, little is known on the socio-economic correlates of under-nutrition, particularly of rural children of India where the vast majority of people live in. This study aims to explore the socio-economic determinants of stunting among under-five children of rural tribal India. The findings may get better understanding of the burden and risk factors that are essential in order for better design and implementation of nutritional interventions to reduce child mortality and morbidity in India.

METHODOLOGY

Study Site: The study was carried out in rural community in Jhalarapatan block, Rajasthan state, Jhalawar District during period of February 2014 to April 2014. Administratively the district has 6 blocks. The district has 1481 villages with a rural population of 1181838, comprising of 237702 inhabitants according to census 2011. The under five year constitute 14.7% of the total rural population. Health services are delivered at grass root level through one Medical College, 14 community health centers (CHC), 30 Primary Health Centres (PHC) and 273 sub-health centre's (SC) in Jhalawar District. The study area was a tribal hilly area & endemic for malaria and other communicable disease infection.

Sampling procedure: The present study is a cross sectional study design with its study unit as children's aged 6-59 months of age. Sample size was calculated using W.H.O one sample situation criteria for estimating population proportion with specified absolute precision were allowable difference (d) was fixed at five percent and a confidence level of 95 percent was set while prevalence of stunting 45% hence the estimated sample size was of 380. However to nullify the design effect due to clustering 1.5 study subjects were incorporated in our study thus a sample size of 570 satisfying the inclusive criteria was studied. Multistage sampling procedure was adapted to select the sampling units i.e. the study population. There are 6 blocks in Jhalawar district. One of the blocks in the district was randomly selected, for the present study PHC Mandawar constituting a population of eighteen thousand comprising of 32 villages was chosen. Among 32 villages eighteen villages were randomly shortlisted using simple random sampling technique (SRS) from each selected village a cluster i.e. the household were selected using PPS (Probability proportion to size) technique more than one cluster was chosen from bigger samples thus resulting in a total 24 clusters selection so a total 420 household were selected however only 396 household have under five population hence 396 households were included in the present study. If more than one child between the ages of 6 months to 59 month were found in the same household, then one of them was randomly selected. The child selected was referred to as an index child. If the index child was from a multiple birth (twin or triplet), then both or all the children of that birth were assessed in order to evaluate the cultural practices. A household with no child under five years of age was skipped. Anthropometric measurements (weight and height) were taken, and the children aged 6-59 months were also examined for oedema. Values of the reference median (<median – 2 SD) on the basis of 'weight-for-age', 'height-for-age' and 'weight for- height' indices were classified as under-weight, stunting and wasting respectively, while children who were below three SD values of the reference median (<median – 3 SD) were classified as 'severe under-weight, 'severe stunting' and 'severe wasting' respectively.

Ethical clearance: Ethical clearance was obtained from the Institutional Ethical Review Committee of Jhalawar Medical College, Jhalawar & District Health Society. Proper informed consent was obtained from the mothers/caretaker involved in the study.

RESULTS

Coverage particulars and socio-demographic profile of study subjects (Table 1): A total of 570 children were covered and were equal numbers of male (48.4%) population as compared to females (51.6%). The mean age of under-five child was al-

most (29.5±14.5) thirty months. Majority (92%) of the households were Hindus, and about one thirds (36.7%) were living in Kutcha houses and fifty seven percent of the households were nuclear families, while 17% were joint families. The average family size was 5.74 (±2.36). Illiteracy rate was much (69.2%) higher among females than males (31.3%). Almost three fourth (73%) male population and less than one fourth (20%) female population were engaged in either agriculture or non-agriculture labour work (Table 1). Prevalence of overall stunting was about 64%, and of them, about 3.2% were severely stunted.

Table 1: Descriptive Characteristics of Socio-Demographic Variable (N=570)

Characters	Children (%)
Sex of children	
Male	272 (47.7)
Female	298 (52.3)
Age of children (months)	
06-Dec	120 (21.05)
13-36	310 (54.39)
37-59	140 (24.56)
Type of Family	
Nuclear	327 (57.37)
Joint	96 (16.84)
Ext. Nuclear	147 (25.79)
Family size	
01-Apr	221 (38.77)
04-Sep	310 (54.39)
10 or more	39 (6.84)
Religion	
Hindu	511 (89.7)
Muslim	59 (10.3)
Caste	
General	71 (12.5)
OBC	231 (40.6)
ST/SC	268 (46.9)
Type of House	
Kutcha	221 (38.8)
Semi pacca	167 (29.3)
Pacca	182 (31.9)
Literacy status of Mother	
Illiterate	392 (68.8)
Literate	178 (31.2)
Literacy status of Father	
Illiterate	169 (29.64)
Literate	401 (70.36)
Working Status of Mother	
Working	112 (19.7)
Not Working	458 (80.3)
Occupation of Father	
Skilled Worker*	163 (28.6)
Unskilled Worker	407 (71.4)
Monthly Family Income	
Up to 5000	263 (46.2)
5001 to 10000	209 (36.7)
>10000	98 (17.1)

*Govt or Private Job, Business

Table 2: Linear regression analysis for predictors of weight-for-height z-scores for prominent continuous variables among children aged 6-59 months (n-570)

Variable	Coefficient [95% CI]
Child Level Factors	
Age of baby	-0.61[-0.74, -0.42]**
Birth Weight	3.44 [1.17, 5.07]**
Birth Interval	-0.01[-0.08, 0.01]
Birth Order	0.42[-0.46, 1.48]
Exclusive Breast Feeding	-0.46[-0.78, -0.04]*
Maternal Factors	
ANC	0.38[-0.36, 0.99]
PNC	-1.74[-0.86, 0.48]
Household Factors	
Family size	-0.30[-0.74, 0.21]
Family monthly Income	0.0003[0.00002, 0.0005]**

*=p<0.05; **=p<0.005; ***=p<0.0001

Nutritional status by age groups, gender and socioeconomic and demographic variables

Linear regression analysis (Table 2) was used for predictors of weight-for-height and it was observed that stunting was positively associated with birth weight, birth order, ANC visit at health care facilities & family monthly income while inversely associated with age of baby, birth interval, EBF, PNC visit at health care facilities, & family size. Statistically significant association was observed for stunting with age of baby, birth weight, EBF & family monthly income variables.

Logistic regression analysis (Table 3) was used to identify significant association between stunning socio-economic, environment, demographic, maternal and child health variables.

Analysis of this study showed that stunting was 1.48 time more in female than in male child (OR=1.48; Cl=1.00-2.47). There was 1.7 time increase the risk of stunting among those had received 4 or more ANC visits service (OR=1.70; Cl=1.20-2.44) as compared to whose mother received less than 4 ANC services at health care facilities during pregnancy. The risk of stunting was about thrice (OR=2.98;Cl=1.29-3.29) among children whose mother had any type of severe illness during pregnancy as compared those children whose mother did not had any type of illness during pregnancy. Illiteracy plays a vital role in promoting stunting the risk was 2.54 (1.10-5.45) and 2.22 (CI=1.09-4.23) times higher among children whose mothers were illiterate and those educated up to 8th standards, as compared to children whose mothers were educated to the level of higher secondary and above. There was fourfold increase risk of stunting among whose family had TB case (OR=4.82; Cl=1.32-17.29) as compared to whose family did not have TB case. Analysis of this study showed that children from those family who had

access to Mass media were about 0.6 times less likely to be stunted as compared to those children who come from family without access to any type of Mass media (OR=0.59; Cl=0.46- 0.97). Children living in overcrowded families had a two time risk (2.2; CI=1.16- 4.27) of being stunted as compared to children from non-overcrowded families. (Table 3)

Table 3A: Logistic regression analysis for prominent demographic & Environmental factors with Stunting

Variable	Stunting OR [95% CI]
(A) Demographic Factors	
Gender of child	
Male	1
Female	1.48[1.00, 2.47]*
Type of family	
Nuclear	1
Joint / Ext. Nuclear	1.55[0.94, 2.44]
Working status of mother	
Working	1.81[1.14, 2.73]*
Not working	1
Literacy status of Mother	
Illiterate	2.54[1.10, 5.45]*
1st to 5th Class	1.38[0.69, 2.89]
6th to 8th Class	2.22[1.09, 4.23]*
≥ 9th Class	1
Household Member	
≤5 members	1
≥6 members	0.92[0.75-1.26]
Type of Food consumption in family	
Vegetable	1
Non-vegetable	1.19[0.85, 1.68]
History of TB in any Family member	
No	1
Yes	4.82[1.32, 17.29]*
(B) Environmental Factors	
Exposure to Media	
No	1
Yes	0.59[0.46, 0.97]*
Type of House	
Kutcha	1
Pucca	0.56[0.36, 0.89]**
Semi- Pucca	0.48[0.22, 0.61]***
Over-crowding	
No	1
Yes	2.2[1.16, 4.27]*
Safe Water supply	
Hand pump	1
Other source	2.12[1.32, 3.29]**
Place of Defecation	
Closed (Sanitary Latrine)	1
Open air	3.28[1.18, 5.07]
Water Purification	
No	1
Yes	1.07[0.12, 2.65]

*=p<0.05; **=p<0.005; ***=p<0.0001

Children belonging to families to those living in Pacca and Semi-Pacca houses had 0.56 (CI=0.36-0.89) & 0.48 (CI=0.22-0.61) times lower risk of stunting as compared to children belonging families to those living in kutcha houses. Risk of Stunting was twice in children (OR=2.12, Cl=1.32-3.29) belong to those houses where water supply through hand pump as compared to houses where water supply through other method. Children whose mother's workings were 1.8(OR=1.81; Cl=1.14-2.73) more likely to be stunted as compared to those mothers were housewife.

Table 3B: Logistic regression analysis for prominent Children & Maternal factors with Stunting

Variable	Stunting OR [95% CI]
(C) Child Level Factors	
Exclusive Breastfeeding	
>6months	1
<6months	1.41[0.88, 2.37]
H/o of Morbidity in past one month	
No H/o of morbidity	1
H/o morbidity	1.49[0.85, 2.25]
Umbilical Cord Application after delivery	
No	1
Yes	1.11[0.29, 2.12]
History of mud eating	
No	1
Yes	1.17[0.49, 2.13]
(D) Maternal Factors	
ANC care during pregnancy	
4 or more visits	1
3 or less visits	1.70[1.21, 2.44]*
BMI of Mother	
Normal	1
Underweight	1.06[0.71, 1.58]
Overweight	2.12[0.77, 5.45]
Type of delivery	
Term	1
Pre-term	1.89[0.82, 3.44]
Provided with nutritional information during preg	
No	1
Yes	0.72[0.55-1.05]
Consumption of Iron Folic Acid tablet	
Yes	1
No	1.40[0.65, 2.06]
Any illness during pregnancy	
No	1
Yes	2.98[1.29, 3.29]*
Place of Delivery	
Hospital	1
Home	1.10[0.55, 2.47]

*=p<0.05; **=p<0.005; ***=p<0.0001

DISCUSSION

In South and South-East Asia, India is the only country with a higher prevalence of undernutrition in rural areas (underweight 43%, stunting 48% and wasting 20%). Neighbor countries, such as Nepal (stunting 49%), and Bangladesh (stunting 43%) had similar prevalence of under nutrition in rural areas while prevalence of stunting lower in Pakistan (stunting 37%).[13]

In the present study, the prevalence stunting was 54% while high prevalence (67.8%) stunting was reported in a study conducted on Saharia tribe population of Rajasthan by Rao et al [14]. The findings of this study shows rural residence as a determinant of child malnutrition which was in accordance with several other studies [15-16]. People living in rural areas are provided with less access to health services, education and other social support systems which are either more available or easily accessible to residents in urban areas.

The present study showed the negative association of age of baby with stunting, Higher prevalence of under nutrition among early age of children might be due to faulty feeding practices such as untimely initiation of complementary feeding, non-exclusively breast feeding up to first six months and high prevalence of infections such as diarrhoea, ARI, worm infestation in this age group.

Inequity-driven health and education service expansion in India, stunting was related to living in rural areas. Gender is an important aspect of equity. The prevalence of stunting in current study was higher among girls than established boys; the cause of this discrepancy is might be due to gender-centric discrimination in early childhood & negative family and community attitudes towards the girl child.

In the current study, paternal education and age were significant factors associated with stunting in the current study. Higher education could reflect higher income and more paternal interest in child nutrition. More educated fathers are more likely to have educated wives. Educated mothers are known to be older at their first birth and are more knowledgeable about care practices. Educated families live in smaller households, in better houses, they are better able to use health-care facilities, and are more adept at keeping their environment clean[16-18]. Logistic regression revealed that Stunting was significantly higher among children whose mothers were illiterate or had primary or upper primary education compared with children whose mothers were educated (Higher secondary and above). Higher level of maternal education leads to efficient management of limited household resources, optimum utilization of modern health care services, better health promoting behaviour, as well as change in traditional beliefs about diseases causation, and use of contraceptives for birth spacing and more child-centred caring practices [19-20].

Low family income results in lower literacy rate, low purchasing capacity and thus accelerating food insecurity resulting higher under nutrition rates. Present study explores a directly proportional relationship between income of a family to its nutritional status and one can say household per capita income is the indicators for socio-economic development and observed to be associated with stunting. Similar observations were quoted by other authors too [21-25]. Although the economic differentials seem to be silent in rural society it appears to be an important predictor of childhood nutritional status which can't be ignored. Low income also increases the likelihood of infection through inadequate personal and environmental hygiene mechanisms [21-25].

Consistent with many other studies [26-27], the logistic regression of this study revealed that mother's BMI is positively associated with nutritional status of children. Higher the BMI, lower the risk of being stunting over normal BMI. This study showed that underweight mothers have a greater risk of their children being malnourished. A healthy mother can have healthy children. Children of well-nourished mothers had a lower risk of being stunted compared to children of undernourished mother.

Antenatal care, the care a woman receives throughout her pregnancy, is important in determining child nutritional status. Lowest risks of stunted children were found among mothers having complete antenatal care visits. Results of this study show that there is a significant association between mother's antenatal care visit and child nutritional status.

Environmental factors refer to the availability of safe water, sanitation and environmental safety, including shelter. Environmental factors such as poor housing and exposure to untreated water are known to be associated with stunting[28]. In fact, most of the positive effect of income on child height could be mediated by the quality of family housing.Present study showed that, children from families not treating their drinking water by boiling, straining through cloth and bleaching/chlorine were more likely to be affected by stunting as compared to children were from families treating their drinking water. Therefore, diarrhoea and water born diseases caused by unsafe drinking water at households' level might increase the prevalence of malnutrition directly or indirectly[29].

Breast milk contains the mix of nutrients that is best suited to the infant's metabolism. An initial period of exclusive breast-feeding is essential to lower the risk of stunting, after which supplementary foods should be introduced appropriately into the child's diet.[29] The use of bottle feeding predisposes to infections and may be associated with diluted non-nutritive formula preparation. Early introduction of complementary foods is a known predictor of undernutrition, but there is a debate as

to the most suitable age that supplements should be first given[42]. In the current study, breast-feeding was considered optimal if it started early, if it was continued for 12 months and if weaning started at 6–8 months. It was considered appropriate if weaning started earlier (between 4 and 6 months). In the current study, optimal breast-feeding was not as protective as appropriate breast-feeding. In addition, there was a protective effect of bottle feeding and early introduction of breast milk substitutes such as powder milk or pasteurized bottled milk. Previous studies reported a similar observation where, for example, longer breast-feeding was associated with both higher stunting and severe stunting risk. This should be viewed as failure of optimal complementary feeding and the inability of the household to provide supplemental foods, and should not be an argument for advertising of these substitutes[30]. In other cases, when a child is severely stunted, mothers may respond by a decision to continue breast-feeding. Moreover, none of the dietary intake factors in the current study persisted in the multivariate model.

Children living in overcrowded families are found to be at greater risk of stunting, a finding supported by other studies [30]. This could be attributed to the facilitated spread of infections such as ARI and diarrhoea in overcrowded families.

Apart from the above factors associated with stunting, other factors such as type of delivery (preterm/term), place of delivery (institutional or home), type of family, supplementation of IFA tablet during pregnancy, food habits, occupation of father, applicant on cord, vegetarian or non-vegetarian, availability of toilet facilities in house, & family size, are all important determinants of under nutrition that needs further study to explore their association.

CONCLUSION

The present study revealed the widespread prevalence of stunting among pre-school children of rural tribal community and stunting was positively associated with birth weight, birth order, ANC visit at health care facilities & family monthly income while inversely associated with age of baby, birth interval, EBF, PNC visit at health care facilities, & family size. The various factors like gender, working status of mother, history of TB in family member, ANC care, illiteracy of parents, mass media, overcrowding, and type of water supply were also responsible for stunting in our study. So stunting problem amongst pre-school rural tribal children should be addressed through comprehensive preventive, promotive and curative measures. The community should to be educated about personal and environmental sanitation hygienic practices, and also proper child rearing, breast-feeding and weaning practices. Appropriate nutritional programmes like ICDS should be designed to meet the requirements with supplementary feeding, growth and development monitoring and early, prompt treatment during illness needs to be devised and implemented ensuring community participation.Further research, particularly on regional differences, is required to design relevant and effective intervention programmes.

REFERENCES

1. UNICEF WHO, The World Bank and United Nations DESA/Population Division (2011) Levels and trends in child mortality: Report 2011. New York: Oxford University Press, 19.
2. Caulfield LE, Richard SA, Rivera JA, Musgrove P, Black RE (2006) Stunting, wasting and micronutrient deficiency disorders. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, et al, editors. Disease control priorities in developing countries. New York: Oxford University Press. 551–567.
3. Dewey KG, Begum K (2011) Long-term consequences of stunting in early life Matern Child Nutr (Suppl 3): 5–18.
4. Martorell R, Zongrone A (2012) Intergenerational influences on child growth and undernutrition. Paediatr Perinat Epidemiol (Suppl 1): 302–314.
5. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, et al. (2012) A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 380: 2224–2260
6. Rice, A. L., Sacco, L., Hyder, A. and Black, R.E.(2008) "Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries", Bulletin of the World Health Organization, 2000;78(10):1207-21. PMid:11100616 PMCid:2560622
7. Das, S, Hossain, MZ and Islam, MA. Predictors of Child Chronic Malnutrition in Bangladesh. Proceedings of Pakistan Academy of Sciences, 2008; 45(3):137-55.
8. World Health Organization. Measuring change in nutritional status. Guidelines for assessing the nutritional impact of supplementary feeding programmes for vulnerable groups.Geneva: WHO; 1983.
9. National Report on "A World Fit for Children", 2007. Ministry of Women and Child Development Government of India, pp: 1-24
10. Global and regional estimates in this chapter reflect those consistent with the UNICEF, WHO, World Bank Joint Child Malnutrition Estimates from analysis of the Joint Global Nutrition database from 1990 to 2011. The data presented here supersede relevant historical data published by UNICEF and WHO. Further details of the harmonized methodology are available at <www.childinfo.org/malnutrition.html/
11. United Nations Children's Fund (1998) The State of the World's Children. UNICEF New York, NY.
12. Berkman DS, Lescano AG, Gilman RH, Lopez SL & Black MM (2002). Effects of stunting, diarrhoeal disease, and parasitic infection during infancy on cognition in late childhood: a follow-up study. Lancet 2002, 359: 564-571.

13. Pasricha SR, Biggs BA. Undernutrition among children in South and South-East Asia. J Paediatr Child Health. 2010; 46: 497-503.

14. Rao VG, Yadav R, Dolla CK, Kumar S, Bhondeley M, Ukey M. Undernutrition & childhood morbidities among tribal preschool children. Indian J Med Res. 2005;122:43-7.

15. Mahapatra A, Geddam JJB, Marai N, Murmu B, Mallick G, Bulliyya G, et al. Nutritional status of preschool children in the drought affected Kalahandi district of Orissa. Indian J Med Res 2000; 111 : 90-4.

16. Caputo A, Foraita R, Klasen S & Pigeot I (2003) Undernutrition in Benin – an analysis based on graphical models. Soc Sci Med 2003, 56, 1677–1691.

17. Aerts D, Drachler Mde L & Giugliani ER (2004) Determinants of growth retardation in Southern Brazil. Cad Saude Publica 2004, 20, 1182–1190.

18. Marins VM & Almeida RM (2002) Undernutrition prevalence and social determinants in children aged 0–59 months, Niteroi, Brazil. Ann Hum Biol 29, 609–618

19. Ramli, Agho KE, Inder KJ, Bowe SJ, Jacobs J & Dibley MJ (2009). Prevalence and risk factors for stunting and severe stunting among under-fives in North Maluku province of Indonesia. BMC Pediatrics 9: 64.

20. Semba RD, de Pee S, Sun K, Sari M, Akhter N, Bloem MW (2008). Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: a cross-sectional study. Lancet 2008,371: 322-328.

21. Reyes H, Perez-Cuevas R, Sandoval A, Castillo R, Santos JI,Doubova SV & Gutie´rrez G (2004) The family as a determinant of stunting in children living in conditions of extreme poverty: a case–control study. BMC Public Health 2004, 4, 57.

22. Aerts D, Drachler Mde L & Giugliani ER (2004) Determinants of growth retardation in Southern Brazil. Cad Saude Publica 2004, 20, 1182–1190.

23. Steyn NP, Labadarios D, Maunder E, Nel J & Lombard C (2005) Secondary anthropometric data analysis of the National Food Consumption Survey in South Africa: the double burden. Nutrition 2005, 21, 4–13.

24. Bloss E, Wainaina F & Bailey RC (2004) Prevalence and predictors of underweight, stunting, and wasting among children aged 5 and under in western Kenya. J Trop Pediatr 2004, 50, 260–270.

25. Brennan L, McDonald J & Shlomowitz R (2004) Infant feeding practices and chronic child malnutrition in the Indian states of Karnataka and Uttar Pradesh. Econ Hum Biol2004, 2, 139–158.

26. Hien NN & Kam S (2008). Nutritional status and the characteristics related to malnutrition in children under five years of age in Nghean, Vietnam. J Prev Med Public Health 2008, 41: 232-240.

27. Hong R & Mishra V (2006). Effect of wealth inequality on chronic under-nutrition in Cambodian children. J Health Pupul Nutr 2006, 24: 89-99.

28. El-Sayed N, Mohamed AG, Nofal L, Mahfouz A & Zeid HA (2001) Malnutrition among pre-school children in Alexandria, Egypt. J Health Popul Nutr 2001, 19, 275–280.

29. Bloss E, Wainaina F & Bailey RC (2004) Prevalence and predictors of underweight, stunting, and wasting among children aged 5 and under in western Kenya. J Trop Pediatr 2004, 50, 260–270.

30. Shah SM, Selwyn BJ, Luby S, Merchant A, Bano R. Prevalence and correlates of stunting among children in rural Pakistan.Pediatr Int. 2003 Feb;45(1):49-53.