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Impact of Soybean Utilization Project on Nutritional Status of under Five Children

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Abstract: A quasi-experimental methodology comprising of repeated cross-sectional survey of 1420 preschool children was conducted to collect information on demographic characteristics, dietary intake and anthropometric data of children within beneficiary area and comparable control area before and after the project. There was no significant difference in the demographic characteristic of children before and after the project in both the study and control area. The average, energy, protein, and magnesium intake is about 65, 44, and 75% respectively of FAO/WHO (2001) reference nutrient intake (RNI) for the children in BA before the project and the children in CCA before and after the project. A significant increase in percentage of RNI was observed for BA children after the project. The proportion of the study children below median - 3 SD (Z-score) was high for all nutritional indicators for both groups before the utilization project. After the project, acute rather than chronic malnutrition as observed before the project was observed among the BA children while the CCA children still shows incidences of chronic malnutrition. A reduction of 68.5%, 78.5% and 65.8% respectively was observed in prevalence of malnutrition for the weight-for-age, height for age and weight for height indicators among the BA children after the project. The findings of the present study revealed positive effect of soybean utilization in alleviating prevalence of under nutrition among pre-school and highlight a need for an integration of micronutrient intake in any nutritional program aimed at improving nutritional status.

Key words: Soybean utilization project, prevalence of malnutrition, nutritional indicators, dietary intake

Introduction

Despite the global drop in prevalence of stunting and underweight in children from Asia, Latin America and the Caribbean, increased from 40 to 45 and 25 to 31 million is reported for stunting and underweight respectively in Africa children (de Onis *et al.,* 2004; de Onis and Blossner, 2000). Haddad *et al.* (1999) show that 150 million children in the developing world remain underweight and 182 million remain stunted (low height for age) with under nutrition accounting for over 50% of death in developing countries (UNICEF, 1998). Eze and Ejezie (1990) identify protein energy malnutrition (PEM) as the leading cause of death among Nigerian children. The Nutrition Society of Nigeria noted that malnutrition is still a very serious problem in Nigeria with mortality rate of 146/1000 live births of under five children and about 45% stunting (NSN, 2000). Therefore, the country's nutrition situation shows continued existence of protein-energy malnutrition which is largely manifested among children. These nutritional problems have been due to interactive social, political and economic factors. The inadequacy both in quantity and quality (energy and protein) of diet consumed by Nigerians especially children has been established (Obatolu and Cole, 2000). One of the reasons is the very high cost of conventional protein sources coupled with the low purchasing power of large percentage of the people. Important determinants of under nutrition among children include the education, income and nutritional status of parents, access to clean water and sanitation, and access to primary health care and immunization facilities (UNICEF, 1998, Nyovani *et al.,* 1999). Due to scarcity of food with high nutritional value, the complementary utilization of high carbohydrate and protein foods such as cereals and legumes is essential for good nutrition of the populace especially those at risk of malnutrition. Nigeria is one of the seven countries in Africa where there has been little or no change in child mortality rates over the past 50 years (Lancet, 2003). Child malnutrition is internationally recognized as an important public health indicator for monitoring nutritional status and health in populations (Sachdev, 1995; de Onis *et al.*, 2004).

To achieve the desired goal of improved nutritional status, many international organizations (International Development Research Centre (IDRC) Canada, UNICEF, and Ford Foundation), have funded research on soybean utilization in different part of Nigeria. The project, known as Soybean utilization project, aimed at documenting the status of soybean utilization, developing and disseminating household and small scale processing technologies for soy-based foods in an attempt to reduce under-nutrition among especially the rural populace. The project major activity is dissemination of household level soybean recipe through education and participatory cooking sessions conducted with women groups, men, mothers and their children on a monthly period for six years with the aim of educating and developing complementary protein rich foods for household especially the young children. Specifically, recipes are prepared, tasted, and

discussed to evaluate their acceptability, feasibility, and affordability for inclusion in household diets. This technique of developing enriched complementary foods that are based on locally known recipes as well as local ingredients has been used in a number of countries, with adaptations to each context (Fomon 2001) .
This study assesses the impact of soybean utilization project on the nutritional status of children aged 2 to 3 years within the project areas in south western Nigeria before and after the project as well as assessing the frequency of soybean consumption in project areas.

Materials and Methods

Prior to the start of the project, a baseline survey is conducted in three beneficiary areas (BA) and in three comparable control areas (CCA). A follow-up survey in the same areas is conducted after the six years project ended. A quasi-experimental methodology comprising of repeated cross-sectional survey of 1420 preschool children aged 2 -3 years is conducted. This range of age group is chosen because of similarity in their reference nutrient intake (RNI). The sample size is estimated to be 710 at 95 per cent confidence interval (CI) with 5 per cent precision each for BA and CCA. However, considering anticipated non response in the field situation, over sampling of 10% is made to achieve the estimated sample size. Thus, 781 children were covered from each of the surveyed area (BA and CCA) to give a total of 1562 children.

Demographic and socioeconomic data: The mother of each child is privately interviewed at home by trained enumerators using structured questionnaire to collect information on demographic and socioeconomic characteristics of the household (monthly family income and maternal age, education and employment) as well as child-related data, such as number of children under five years in the household, child breast feeding history and sanitary conditions. The age of the child is determined to the nearest month using date of birth.

Dietary intake data: Frequency of consumption of certain foods is recorded as well as determining nutrient intake with two 24 hour dietary recalls (Rasanen, 1979) for each child in the study. Amounts were recorded in terms of measuring devices used by the mother in the home, and later converted into grams. Nutrient content of each dietary recall is calculated using the food composition tables for Africa (FAO, 1968). Samples of food not in the food composition table were analyzed for energy content as described by Cohen *et al.* (1994), protein by Kjeldahl method (AOAC, 2000) and mineral concentration by flame atomic-absorption spectrophotometry (Clegg *et al.*, 1981). Values were averaged for each child. In order to compare the dietary intake of children study population (BA and CCA), the nutritional adequacy of the diet is expressed as the percentage of the FAO/WHO (2001) reference nutrient intake (RNI). The nutrient density of the diets is also expressed as Index of Nutritional Quality (INQ), which provided an overall figure for the nutrient content of the diet (Hansen *et al.*, 1979). INQ is the ratio between the percentage of reference nutrient intake (RNI) of each nutrient and the percentage of the requirement for energy provided by the diet (Hansen *et al.*, 1979).

Anthropometric data: Anthropometric measurements were made by a trained research assistant. Height is recorded to the nearest 0.1 cm and the weight of the children wearing minimum clothing is measured to the nearest 0.1 kg using a standard technique described by WHO (1995). The height of children is measured standing. The accuracy of the scales is checked before use and at least twice daily during the survey using a known weight. The research scientist is responsible for checking the quality of measurements; this is achieved by routinely repeating measurements.
Weight and height for age, weight for height were used as criteria for assessing nutritional status. Using computer programs developed by the World Health Organization (Geneva, Switzerland) and the Centers for Disease Control and Prevention (Atlanta, GA) for nutritional anthropometry (Epi-Info version 3.3.2), weight-for-age, height-for-age and weight-for-height Z scores were calculated, and interpreted relative to the NCHS/WHO international reference population value. (WHO, 1986; de Onis and Habicht, 1996). The extent of malnutrition is expressed as the percentage of children Z-score falling below -2 standard deviations (SD) or more below the median. Children were classified as stunted when their height-for-age is below minus two standard deviations of the reference median value. They were considered as wasted when their weight-for-age or weight-for-height is below minus two standard deviations of the reference median value. Children with more than two standard deviations below the reference median on any of the indices were considered to be undernourished and the children who fell within or < -3SD below the reference median were considered to be severely undernourished.

Statistical analysis: Results are expressed as the mean ± SD. Comparison of statistical differences before and after the project is assessed using a student's t-test. For comparison of more than two means, an analysis of variance of repeated measurements is used. The level of significance chosen is $p< 0.05$. Analyses were performed using the SPSS computer statistical package.

Results and Discussion

Data and observation on hygienic practices revealed that open air defecation is done in both area of study. Mothers often give children a bowl to sit and defecate in

Table 1: Demographic characteristics and frequency of soybean consumption of the children

	BA		CCA	
	Before	After	Before	After
Maternal age (years)	25.5±3.0	22.6±7.2	24.8±5.4	25.2±3.0
Maternal education (yrs of schooling)	< 4	< 6	< 6	< 6
Family income($/month)*	34.4±2.8	29.7±5.0	33.4±1.3	35.4±2.4
Occupation of Mother (%)	53.5±4.2	55.7±3.1	44.8±1.8	44.3±3.6
House wife	1.7±0.5	-	55.7±3.6	54.8±2.0
Farming or Trading	42.9±3.3	43.1±3.3	1.4±0.3	2.1±0.2
Government Employed	2	1	1	1
Number of under five				
Children sex (% male)	46.6	38.2	42.4	40.2
Frequency of Soybean product consumption (per week)	0.0	12.3±5.1	0.0	0.6±0.8

*Includes values of crop grown for home consumption

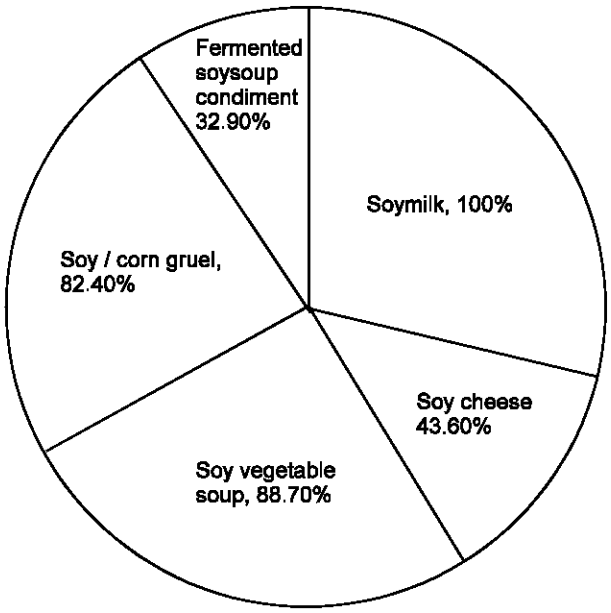

Fig. 1: Percentage of household within beneficiary area (BA) consuming the various soybean products after the project.

and clean them up with water after. This is later watched away in open space little distance away from the houses. Children within the two areas (BA and CCA) of study were given exclusive breast feeding up to 6 months and supplementary feeding of thin cereal gruel without milk and sugar introduced to the children by six month until gradual weaning to household meal by the age of 18 months.

Table 1 gives the demographic characteristics of the households selected for the study. There were no significant differences in maternal age, education, occupation and family income at the beginning and after the soybean utilization project in both BA and CCA. Maternal education is low with all mothers spending less than 6 years in school. Other studies (Gopaldas *et al*., 1988; Rea, 1971) however observed that the magnitude of undernutrition is pronounced among children from households, whose heads had no education, thereby demonstrating the impact of parents' level of education on the nutritional status of their children. All surveyed families were poor, with an average family income of between $30 and $35 per month. Mothers employed in government establishment were employed as office laborers. Most of the mothers are either housewife or petty farmers or traders. The lack of difference in the family income before and after the project confirms the previous reports (Braun *et al*., 1993; Haddad *et al*., 1999) that increase in poverty in Nigeria is on the increase due to low income level of most households. Family income earning opportunities has been reported to be a key to family well-being, especially in poor households that are net food buyers (Miller and Korenman, 1994). Average number of children under five years of age per family at time of both surveys is not more than two. The prevalence of malnutrition tends to increase with the number of children in a household (Rao *et al*., 2005). This is to be expected in families with economic constraints, as the limited food available has to be shared among all family members. Previous studies (Dewey, 1983; Iqbal *et al*., 1999) has shown that the socioeconomic status of a family significantly affect the nutritional status of a child. Paternal characteristics is not emphasized in the present study as previous studies (Martorell *et al*., 1984) identify no close relationship between them and prevalence of malnutrition among children. There is no significant difference in the number of female and male chosen for the study in both area of study. However percentage of female children is higher than male in both area of study.

A high frequency of soybean product consumed per week after the project in BA site was observed. On the average, soybean is consumed about twice a day after the project by children within the BA. Soybean product consumption is non existence before the project in both BA and CCA and insignificant after the project years in CCA. This is attributed to lack of knowledge about the crop in CCA. Fig. 1 shows the percentage of households

Table 2: Nutritional adequacy of the diet expressed in terms of the percentage of Reference nutrient intake (RNI)

Nutrients	RNI**	BA		CCA	
		Before	After	Before	After
Energy (KJ/day)	5700	3745± 122 (65.7)[1]	5630 ± 104 (98.8)*	3747 ± 98 (65.7)	3699 ± 132 (64.9)
Protein (g/day)	15.5	6.7± 0.4 (43.2)	0.3 ± 0.4 (66.5)*	6.5± 0.6 (41.9)	6.9± 0.2 (44.5)
Calcium (mg/day)	500	125.2 ± 13.2 (25)	187.5± 22.7 (38)*	124.9 ± 24.1 (25)	136.1 ± 19.3 (27)
Iron (mg/day)	5.8	2.6± 0.8 (44.8)*	3.0± 1.0 (51.7)	3.1 ± 0.3 (53.4)	3.0± 0.4 (51.7)
Magnesium(mg/day)	60	45. 7± 4. 7 (76.1)	50.4 ± 5.5 (84.0)*	44.8± 2.2 (74.7)	45.3 ± 2.3 (75.5)

*Values significantly different within column:**Source: FAO/WHO 2001; [1]Figures in parenthesis are percentage of RNI

within BA consuming soybean as different products. Soybean milk and soup were the most popular products within the BA household.

Dietary intake: Data from the frequency of food consumption show that the typical diet of children in the study is adequate in carbohydrate foods but low in protein foods like milk, meat and poultry as well as in fruits. Plant protein consumption in-form of soybean milk, soybean soup, soybean cheese, soybean soup condiment and soy/corn gruel (Fig. 1) is high among the BA children after the soybean utilization project. Animal protein is consumed less than two times a week (Sundays or during a festival). Root and tuber as well as cereal products are consumed everyday of the week complimented with vegetable soup which could have been over cooked. A typical day's diet of the children includes a gruel from corn without milk sometimes with sugar, pudding from cassava or yam tuber complimented with vegetable soup. In beneficiary area (BA) the vegetable soup is cooked in soybean paste and the cereal served with soybean milk after the soybean utilization project which mothers claim increased there knowledge of soybean and other bean in the household diet. A child in the BA consumed at least 500ml of soybean milk in a day after the project as the amount prepared in a day could not be stored till the next day. Occasionally, the midday meal contained rice, bean with a piece of meat less than 10gm. The child consumed liquids in form of water and soybean milk in beneficiary area throughout the day.

Nutritional adequacy of the 24 hour dietary recall expressed in terms of the percentage of the reference nutrient intake (RNI) is shown in Table 2. On the average, energy, protein, and magnesium intake is about 65, 44, and 75% respectively of FAO/WHO (2001) reference nutrient intake (RNI) for the children in BA before the project and the children in CCA before and after the project. These intakes were far below the RNI, an implication of undernutrition among the study group. After the project, the energy, protein and magnesium intake of the children in BA increased significantly ($p < 0.01$) to 98, 66 and 84% respectively of RNI but less than the RNI for the reference population. The lowest intake of nutrient is calcium and iron, with an average of only 25 and 45% respectively of the RNI before the project. The iron intake of children in the BA is particularly low before the project when compared to children in CCA. At the end of the project, the micro nutrient intake though still low, the percentage of the RNI for the BA children is increased. Soybean is not a major source of micro nutrient but contribute to its total intake (Murray-Kolb *et al*. 2003). These results reflect the inadequate consumption of milk and other dairy products and fruits that are rich in micronutrients by children in the study. The nutrient density of the 24hr dietary recall expressed as Index of Nutritional Quality (Ekelund *et al*., 2000) is given in Fig. 2. Jeszka and Czlapka-Matyasik (2001) reported that a well balanced diet in regard to a particular nutrient has an INQ close to 1. In the present study, it is found that the diets of children of both groups are not balance ib regard to all nutrients before the soybean project. After the project, the balance in regard to energy, protein and fat intake was observed for BA children while all nutrient intake of CCA children remain unbalance. This could be attributed to the high consumption of soybean products within the BA group after the project and the high protein and fat content in soybean. The micronutrient density of the children were very low but is improved in the BA after the project. An improvement in nutritional status of protein energy malnourished children has been reported when rehabilitated with soybean based products (Obatolu *et al*., 2003).

Anthropometric data: Table 3 shows distribution of pre-school children according to Standard Deviation (SD) classification of the three nutritional indicators. All the children in both BA and CCA were between minus 2 and minus 3 median weight-for-ages and between 97 and 98% of median height-for-age and weight for height respectively before the commencement of soybean utilization project. This is an implication of a major nutritional problem of long-term, chronic malnutrition, or stunting, rather than acute malnutrition or wasting among the children. The proportion of the study children below median-3 SD is high for all nutritional indicators (weight-for-age, height-for-age and weight for height) in both the BA and CCA before the soybean utilization project. There is no significant difference in the high prevalence of stunting (height for age) among the children in both BA (97.0%) and CCA (96.7%). The study

Table 3: Percentage distribution of Nutrition Indicators at start and end of the soybean utilization project

	Weight for age		Height for age		Weight for Height	
	Before	After	Before	After	Before	After
-1 SD						
BA	-	13.8	3.0	21.2	1.7	30.2
CCA	0.7	2.4	3.3	3.5	1.2	2.6
-2 SDBA	10.6	70.9	17.7	63.1	33.5	53.2
CCA	6.5	2.2	19.3	16.5	38.3	27.3
-3SD						
BA	46.0	14.5	53.2	14.1	48.6	16.6
CCA	40.5	50.4	54.0	51.8	55.1	60.6
< -3 D						
BA	43.4	0.8	26.1	0.6	16.2	0.0
CCA	53.0	45.0	23.4	28.2	5.0	9.5

Table 4: Effectiveness of the Soybean Utilization project expressed as percentage reduction in prevalence of Malnutrition

	Weight for age	Height for age	Weight for Height
-3 SD median			
BA	68.5	73.5	65.8
CCA	-24.4	4.7	-100
Below -3 SD median			
BA	98.2	97.7	100
CCA	15.1	-20.5	-90

Reduction is expressed as difference between final and initial -3 SD median value (Table 3) as percentage of initial value [(Initial value - Final value) / Initial value] X 100

revealed severe degree (below -3SD) of underweight, stunting and wasting in 43.4, 26.1 and 16.2% respectively for BA children and 53.0, 23.4 and 5.0% respectively for CCA children before the project. This gives a high prevalence of undernutrition in terms of underweight, stunting and wasting in both BA and CCA children at the beginning of the project. Improvement is observed in all the nutritional indicators for BA children but not for CCA children after the project. A high proportion of BA children moved from below -3SD before the project to within the -2SD for all nutritional indicators after the project. Thus acute rather than chronic malnutrition as observed before the project is observed among the BA children while the CCA children still shows incidences of chronic malnutrition. The improvement in nutritional indicator of children in BA could only be attributed to incorporation of soybean into their diet. Previous studies (de Onis and Blossner 2000; Hagenimana *et al.* 2001) have shown that children whose mothers participated in Agriculture-plus group benefited the most in terms of their dietary intake and nutritional status.

Though the nutritional status of the BA children is improved, there are still signs of malnutrition as majority of the children were within -2SD reference median nutritional indicators. This implies that soybean or food rich in protein alone is not enough to completely alleviate malnutrition problem in developing countries. Allen and Gillespie (2001) reported that if malnutrition is to be reduced in a sustained manner, there is a need for micro-nutrient supplementation and fortification, the provision of medical services to help reduce infectious diseases, improvements in access to clean water and sanitation, and increased education. Well-nourished children have a better chance of surviving, of learning more easily, and of growing into healthy adults who in turn can give their children a better start in life (Del Rosso and Marek, 1996). Quisumbing *et al.* (1995) identify adequate and safe food intake, freedom from illness, and appropriate family care as the three pillars for improving nutritional status.

Effectiveness of the soybean utilization project: The effectiveness of the soybean utilization project is expressed (Table 4) in terms of the difference between the final and initial prevalence values of -3SD reference median as a percentage of initial value for the three nutritional indicators between the start and the end of the study. Table 4 shows a reduction of 68.5%, 78.5% and 65.8% in prevalence of malnutrition respectively for the weight-for-age, height for age and weight for height indicators among the BA children after the project. On the contrary, negative signs for weight for age and weight for height indicators were observed for CCA children. Negative sign indicators show an increase in prevalence of malnutrition. The reduction and increase in BA and CCA respectively could be attributed to effect of the soybean utilization project that improves nutritional knowledge of mothers within the BA. Nutritional knowledge of mothers have shown significant influence on household dietary intakes and the nutritional status of young children within the household (Tilden, 1993). The difference in the type and prevalence of malnutrition among the groups is a reflection of the role of soybean consumed by the households at beneficiary areas (BA) since other variables are not significantly different to the

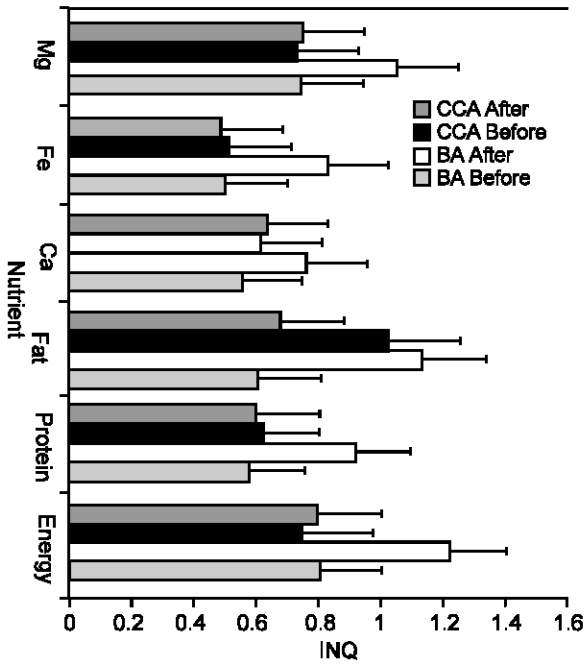

Fig. 2: Index of nutritional quality (INQ) of dietary intake of children from beneficiary area (BA) and comparable control area (CCA)

comparable control area (CCA). Brown *et al.* (1995) recommends the optimal use of complementary feeding practice to prevent childhood malnutrition in developing countries. The results of this study support the conclusion of other investigators that have reported (Obatolu and Ashaye, 2000; Reid *et al.* 2002; Obatolu *et al.* 2003) that soybean protein could be use to improve nutrient consumption of a population.

Conclusion: Current study shows that before the introduction of soybean utilization to beneficiary area (BA) children are severely malnourished as counterpart children in comparable control area (CCA). With the introduction of soybean utilization and subsequent adoption, the nutritional status of children within the BA are significantly improved even though they are still under nourished due to the absence of adequate micro nutrient in their diet.

References

Allen, L. and S. Gillespie, 2001. What Works? A Review of Efficacy and Effectiveness of Nutrition Interventions. ACC/SCN Nutrition Policy Paper No. 19, ADB Nutrition and Development Series No. 5. Geneva, Switzerland and Manila.

AOAC., 2000. Official Methods of Analysis. 17th ed. Gaithersburg, Maryland, USA.

Braun, J., J. McComb, B. Fred-Mensah and R. Pandya-Lorch, 1993. Urban food insecurity and malnutrition in developing countries: Trends, policies, and research implications. Ishington, D.C.

Brown, K.H., H. Creed-Kanashiro and K.G. Dewey, 1995. Optimal complementary feeding practices to prevent childhood malnutrition in developing countries. Food Nutr. Bull., 16: 320-339.

Clegg, M.S., C.L. Keen, B. Lönnerdal and L.S. Hurley, 1981. Influence of ashing techniques on the analysis of trace elements in animal tissue. Biological Trace Element Research, 3: 107-115.

Cohen, R.J., K.H. Brown, J. Canahuati, L. Rivera and K.G. Dewey 1994. Effects of age of introduction of complementary foods on infant breast milk intake, total energy intake, and growth: a randomized intervention study in Honduras. World Bank. Lancet, 344, 288-93.

Del Rosso, J.M. and T. Marek, 1996. Class Action. Improving School Performance in the Developing World through Better Health and Nutrition. Ishington, DC.

de Onis, M. and M. Blossner, 2000. Prevalence and trends of overweight among preschool children in developing countries. Am. J. Clin. Nutr., 72: 1032-1039.

de Onis, M., M. Blossner, E. Borghi, R. Morris and E.A. Frongillo, 2004. Methodology for estimating regional and global trends of child malnutrition. Int. J. Epidemiol., 33: 1260-1270.

de Onis, M. and J.P. Habicht, 1996. Anthropometric reference data for international use. recommendations from a World Health Organisation expert Committee. Am. J. Clin. Nutr., 64: 650-658.

Dewey, K.G., 1983. Nutrition survey in Tabasco, Mexico: Nutritional status of preschool children. Am. J. Clin. Nutr., 37: 1010-1019.

Eze, D.E. and G.C. Ejezie, 1990. A retropective study of malaria and malnutrition in the University of Calabar teaching hospital, Calabar, Nigeria. Trop. Geo. Med., 4: 207.

Ekelund, U., M. Sjostrorn, A. Yngve and A. Nilsson, 2000. Total daily energy expenditure and pattern of physical activity measured by minute-by-minute heart monitoring in 14-15 years old Swedish adolescents. Eu. J. Clin. Nutr., 54: 195-202.

FAO, 1968. Food and Agriculture Organization. Food composition table for use in Africa. Rome: FAO.

FAO/WHO, 2001. Human vitamin and mineral requirements. Report of a joint FAO/WHO expert consultation Bangkok, Thailand. Food and Nutrition Division, FAO Rome.

Fomon, S.J., 2001. Infant feeding in the 20th century: formula and beikost. J. Nutr., 131: 409S-420S.

Gopaldas, T., P. Patel and M. Bakshi, 1988. Selected socio-economic, environmental, maternal and child factors associated with the nutritional status of infants and toddlers. Food Nutr. Bull., 10: 29-34.

Haddad, L. M.T. Rue and J.L. Garrett, 1999. Are urban poverty and undernutrition growing? Some newly assembled evidence. FCND discussion paper no. 63. Food Consumption and Nutrition Division. International Food Policy Research Institute. Ishington, D.C. U.S.A.

Hagenimana, V., J. Low, M. Anyango, K. Kurz, S.T. Gichuki and J. Kabira, 2001. Enhancing Vitamin A Intake in Young Children in Western Kenya: Orange-Fleshed Sweet Potatoes and Women Farmers Can Serve as Key Entry Points. Food Nutr. Bull., 22: 376-387.

Hansen, R.G., B. Wyse and A.W. Sorenson, 1979. Nutritional Quality Index of Foods. Avi Press Westport, Connecticut.

Iqbal, H.M., R. Yasmin and I. Kabir, 1999. Nutritional and immunisation status, weaning practices and socioeconomic conditions of under five children in three villages of Bangladesh. Ind. J. Pub. Hlth., 43: 37-41.

Jeszka, J. and M. Czlapka-Matyasik, 2001. Physical activity and nutritional value of diets in selected population of lacto-ovovegetarian women. Electronic J. Polish Agri. Univ., http://www.ejpau.media.pl 4, Issue 1.

Lancet Editorial, 2003. The World forgotten Children. Lancet, 3519351.:1.

Martorell, R., J. Leslie and P.R. Moock, 1984. Characteristics and determinants of child nutritional status in Nepal. Am. J. Clin. Nutr., 391: 74-86.

Miller, J. and S. Korenman, 1994. Poverty and children's nutritional status in the United States. Am. J. Epidemiol., 1403: 233-243.

Murray-Kolb, L.E., R. Welch, E.C. Theil and J.L. Beard, 2003. Women with low iron stores absorb iron from soybeans. American Journal of Clinical Nutrition 771., 180-184.

Nyovani, J.M., Z. Matthews and B. Margtts, 1999. Hetrogeneity of child nutritional status between households: A comparison of six Sub-Saharan African Countries. Population Studies, 53: 331-343.

NSN, 2000. The Nutrition Society of Nigeria 30th Annual Scientific Communiqué 101., 2.

Obatolu, V.A. and O.A. Ashaye, 2000. Assessing the contribution of soybean utilization on the nutritional status of children in Lagos state, Nigeria. Int. J. Food Sci. Nutr., 506: 375-381.

Obatolu, V.A. and A.H. Cole, 2000. Functional property of complementary blends of soybean and cowpea with matlted or unmalted maize. Food Chem., 70: 147-153.

Obatolu, V.A, S.M. Osho and A. Cole 2003. Effect of soy based diets on the serum albumin, haemoglobin and packed cell volume of protein-energy malnourished PEM. children. Nig. J. Nutr. Sci., 242: 44-47.

Quisumbing, A.R., L.R. Brown, H.S. Feldstein, L. Haddad and C. Pena, 1995. Women: The Key to Food Security. Food Policy Statement No. 21. Ishington, DC.

Rao, V.G., R. Yadav, C.K. Dolla, S. Kumar, M.K. Bhondeley and M. Ukey, 2005. Undernutrition and childhood morbidities among tribal preschool children. Ind. J. Med. Res., 122: 43-47.

Rasanen, L., 1979. Nutritional survey of Finish rural children: methodological study comparing the 24 hr recall and dietary history interview. Am. J. Clin. Nut., 32: 2560-2567.

Rea, J.N., 1971. Socio and economic influences on growth of pre-school children in Lagos Nigeria. Hum. Biol., 43: 46-63.

Reid, M., A. Badaloo, T. Forrester, W.C. Heird and F. Jahoor, 2002. Response of splanchnic and whole-body leucine kinetics to treatment of children with edematous protein-energy malnutrition accompanied by infections. Am. J. Clin. Nutr., 763: 633-640.

Sachdev, H.P.S., 1995. Assessing child malnutrition - some basic issues. Bulletin Nutrition Foundations India 16: 1-5.

Tilden, R., 1993. A nutritional improvement project in rural Vietnam on rates of xerophthalmia, nutritional status, maternal attitude and practices, household production and consumption patterns, and children's dietary practices FAO, Rome.

UNICEF, 1998. The State of the World's Children: Focus on Nutrition. Oxford University Press, New York.

WHO, 1995. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organisation Technical Report Series, 854: 1-452.

WHO, 1986. Use and interpretation of anthropometric indicators of nutritional status. WHO Working Group. Bulletin World Health Organisation, 64: 929-941.