International Journal of Nutrition and Food Sciences
2013; 2 (1) : 17-23
Published online January 10, 2013 (http://www.sciencepublishinggroup.com/j/ijnfs)
doi: 10.11648/j.ijnfs.20130201.14

Socio-economic manifestations of hidden hunger in schoolchildren in Sub-Saharan Africa

Gilbert Mangusho

Department of Vocation Teacher Education, Oslo and Akershus University College of Applied Sciences, Kjeller, Norway

Email address:
Gilbert.Mangusho@hioa.no (G. Mangusho)

To cite this article:
Gilbert Mangusho. Socio-Economic Manifestations of Hidden Hunger in Schoolchildren in Sub-Saharanafrica. *International Journal of Nutrition and Food Sciences.* Vol. 2, No. 1, 2013, pp. 17-23. doi: 10.11648/j.ijnfs.20130201.14

Abstract: Hidden hunger or micronutrient deficiency continues to bedevil developing economies in Sub-Saharan Africa. Cumulatively, efforts to alleviate micronutrient deficiency have not been as great as those directed towards protein-energy malnutrition and altogether less on the important age group, the school age children. There is lack of clear understanding of the relationships between hidden hunger and the more obvious socioeconomic conditions. Good education is regarded as the window of opportunity to break the vicious cycle of poverty. Poverty eradication programmes have often been contextually delinked from nutrition interventions and education provision and as a result, nutrition interventions have focused much less on the school child.For all intentions, nutritional interventions targeted at pregnancy, infancy and early childhood, as is the status quo, are all proactive approaches intended to produce better outcomes in the long term. Perhaps it is important to have a holistic approach that includes school children in nutritional interventions in sub-Saharan Africa. This study therefore sought to uncover the problem of hidden hunger among school children and illuminate on the linkages between this problem, educational achievement and the socioeconomic conditions prevailing in Sub-Saharan Africa. This was done by reviewing published literature accessed through the internet. Almost all studies exploring micronutrient malnutrition among school children show that it is a big problem in Sub-Saharan Africa which has received little attention. Deficiencies of Iron, Zinc and vitamin A, nutrients which affect immensely the health and well-being of school children, are commonplace in Sub-Saharan Africa, and individual nutrient deficiencies often interact to disrupt educational progress of the children and dampen their future socioeconomic prospects. This could partly be explained by high levels of school dropouts and inadequate foundational skills attained by children upon completion of primary school. It is therefore recommended that Sub-Saharan African countries strengthen schoolchild micronutrient nutrition efforts in conjunction with education provision and poverty alleviation.

Keywords: Micronutrient Deficiency, Schoolchildren, Sub-Saharan Africa, Education, Socioeconomic Development

1. Introduction

The Sabiny people of Eastern Uganda have a saying, "Makoporunekeykakwoon," literally meaning, "It will show itself by swelling." In an era, the 21st century, in which it is possible to detect micronutrient deficiencies before they actually show up ("swelling"), it is probably unjustifiable to remain blind to theiroccurrence and effects. This nutrition problem is widespreadin developing countries especially Sub-Saharan Africa[1]. Consequently, substantial resources have been invested in tackling the problem, although it still remains a formidable challenge [2]. There are a plethora of studies showing the enormity of the hidden hunger problem across all age-groups in Sub-Saharan Africa. Stein and Quaim [1] have reported up to three billion people at risk of Zinc deficiency and several millions affected by Iron and vitamin A deficiencies.

Similarly, many studies have traced the connections between general malnutrition and the chronic socioeconomic problems that face the developing world today. According to Mukudi [3], nutritional stress among Kenyan school children was closely linked to both low educational achievement and poor socioeconomic status. A variable selection of micronutrient deficiencies have been estimated to cost an average of about 5% of the GDP of developing countries and contributing up to 10% of the global burden of disease [1]. Poverty has been argued as both a fundamental cause and outcome of undernutrition[4].However, one of the challenges that exist is, perhaps, lack of clear understanding of the cause-effect relationships between hidden hunger and the more obvious socioeconomic conditions. The link between the two still appears blurred.Hence, policy responses are always multifaceted. an approach that may not be adequately effective unless the root causes and relationships between different aspects and synergistic effects of interventions are clearly understood [5]. As a result, it is often, perhaps, the symptoms rather than the root causes that get addressed.

For all intentions, nutritional interventions targeted at pregnancy, infancy and early childhood, as is the status quo in several countries [6], are all proactive approaches intended to produce better outcomes in the long term. The actual target in these interventions is always the child who often is not being "educated" but being formed. It should be imperative that such or similar interventions are continued at the time when the child's brain is being trained to perform more complex activities, during the early school years. Moreover, this ought to be the period to possibly address any nutritional deficits carried over from the early childhood developmental stages [7,8]. Apart from infancy and early childhood, another significant point of nutritional interaction is during pregnancy [9].This practice of intervening nutritionally at isolated stages in the life-cycle rather than a systematic continuum of intervention, for a chronic and self-sustaining problem, obviously leaves out some categories of the population, most importantly, the school age children. Incidentally, countries are always put on the back foot: are always wont to prescribe analgesics to soothe the problem rather than comprehensively solving it. It is possible that for this reason, there has not been sufficient positive progress since micronutrient malnutrition and poverty still remain endemic. Nutritional interventions, therefore, should critically include early school age.

On the other hand, poverty reduction programmes are usually implemented with a view of childhood malnutrition as a symptom rather than a causeof poverty [10]. A more proactive approach for long term sustainable development would have to encompass well-nourished school children to benefit maximally from the opportunities that education offers [11] and get well empowered to deal with the nutrition and poverty issues of their day. The enormous amount of resources spent on education in low and middle income countries ought to be allowed to bear fruit in a sustainable manner. Unfortunately, despite increased enrollments in primary schools after many governments in Sub-Saharan Africa provided free access to primary education, large numbers of school-age children continue to drop out and still many others perform poorly in school [12]. Progress in education and the quality thereof have been subjects of debate for a long time. Further still, chronic underdevelopment has characterized the same countries that are struggling to improve their educationwhile at the same time having high levels of malnutrition [3]. The often invisible problem of micronutrient malnutrition probably continues to plague the economies of these societies and dampen opportunities for a better future.

There remains always a need for deeper comprehension of the relationships between the rampant poverty and widespread hidden hunger in Sub-Saharan Africa. This can help build the evidence base for the targeting of nutritional interventions and offer the opportunity to refine approaches fordisruption of these chronic interrelated challenges. This study was carried out with the primary purpose of highlighting the relationships between three phenomena: school age micronutrient nutrition, education and social and economic development in Sub-Saharan African societies. This is hoped to contribute to efforts to improve the future outcomes in these areas.

To achieve this purpose a review of pertinent literature was carried out.

2. Methodology

This study reviewed literature obtained from the internet. Google *Scholar* was predominantly used to access scholarly articles from journals. Areas of focus included nutrition, in general and among school children; Education, and economic development. The main focus was on areas linking the three aspects namely nutrition, education and socio-economic development in Sub-Saharan African countries. Relevant literature from regions outside Sub-Saharan Africa were included in as far as they examined the same or similar aspects as are the objectives of this study, or helped to expound on linkages, theories and principles involved. Four micronutrients: Iodine, Zinc, Vitamin A and Iron were selected for this study because they are the most common micronutrients that are limited in diets in Sub-Saharan African countries.

*3.*Results and Discussion

Important findings from this study are presented in this section.Outstanding items are headlined as statements followed by a brief discussion of the significant aspects of the statement.

3.1. UndernutritionStudies have Focused Relatively Less on Micronutrients than on Macronutrients

In the past, most of the attention has been directed toward inadequate protein-energy intake, but the important role of micronutrients is gaining increasing attention [4].The nutrition community now recognizes that micronutrient malnutrition is very widespread, and isprobably the main nutritional problem in the world. Micronutrient deficiency has been called the "most widespread and devastating nutritional deficiency on earth, inspite of it being largely eradicated in the developed world" [13].

For a long time starting from the 1930s, a lot of focus had been placed on addressing a perceived protein gap, and then later, protein and energy malnutrition. Although micronutrients had not been the focus of most interventionsuntil the mid to late 1980s, harmful effects of their deficiency had been recognized [5]. By 1990, micronutrient deficiency problems had become so well noted that the World Summit for children had to set goals to eliminate Iodineand Vitamin A deficiencies and reduce Iron deficiency anaemia[14]. Later, the highly prevalent milder forms of Zinc deficiency also got recognized [15].

3.2. MicronutrientsImportant for Cognitive Development and Intellectual Functioning

Inadequate intake of micronutrients is now recognized as an important contributor to the global burden of disease through increased rates of illness and death from infectious diseases, and of disability such as mental impairment [15].A number of micronutrients are important for cognitive development. Iodine, iron, and folate are important for the development of the brain and the emergent cognitive functions, and there is some evidence to suggest that zinc, vitamin B12, and omega-3 polyunsaturated fatty acids may also be important. Other micronutrients such as Vitamin A, Selenium, copper, Choline have also been said to be important [16].

Moreover, interactions between micronutrients couldhave diverse effects on cognitive function which may not have been clearly understood [7]

3.2.1. Iodine

Iodine is required for the production of the thyroid hormones triiodothyronine (T3) and thyroxine (T4), both of which are essential for the growth and development of the brain. While the developing organism is most severely affected if iodine is deficient during fetal brain development, chronic hypothyroidism can also have ongoing effects across all ages. Hypothyroid individuals suffer from a variety of adverse effects such as seizures, motor dysfunction, dementia, depression, and disorders of vigilance, visuomotor planning, and abstract thinking.Iodine status has been found to be positively related to cognitive performance in a number of studies [7]. Some intervention studies have found positive correlations between iodine status and mental performance [7]. These observations underline the need to emphasize adequate micronutrient nutrition during early school years as the brain continues to develop.

3.2.2. Iron

Iron affects the proper myelination of neuronsandis a cofactor for a number of enzymes involved in neurotransmitter synthesis, including tryptophan hydroxylase (serotonin) and tyrosine hydroxylase (norepinephrine and dopamine). Thus, the brain is sensitive to dietary iron status [7]. Also correlation studies have found associations between hemoglobin concentrations and cognitive performance or school achievement scores, especially among iron-deficient individuals.In addition, comparisons of iron-deficient, anemic, and non-anemic children with regard to developmental levels, cognitive performance, or school achievement measures indicate that anemic children perform more poorly [7].

Other studies described infants with iron-deficient anemia as wary and irritable and that ironsupplementedchildren were less wary and hesitant than those not supplemented. These behavioural differences were seen to continue into childhood. Iron has multiple roles in neurotransmitter systems and may affect behavior through its effects on dopamine metabolism.Dopamine clearance has strong effects on attention, perception, memory, motivation and motor control.Behavioural challenges of these types can significantly discount educational achievement.

3.2.3. Zinc

Zinc is important in processes of gene replication, activation, and repression, as well as DNA transcription and translation, and protein synthesis. Its deficiency in children has been associated with reduced growth and development, impaired immunity, and increased morbidity from infectious diseases[7]. Zinc deficiency may affect cognitive development by alterations in attention, activity, neuropsychological behavior, and motor development. Research in animals has demonstrated the effects of severe zinc deficiency, including a decreased performance in short-term memory[17]. These deficits in neuropsychologic functioning undermine academic performance [18] and Zinc repletion can improve neuropsychological performance including reasoning school-aged children [7, 17].

3.3. Not Only Single Nutrients but Different MicronutrientsInteract and Can Produce Significant Effects on School Children

Micronutrient interactions are complex yet very critical. For instance, it is almost common knowledge that vitamin C improves iron absorption and so it is advisable to have the two concurrently in the diet. Also, vitamin A supplementation has been found to improve hemoglobin concentrations in pregnant women and iron status of children[7].Multiple micronutrient deficiencies occur simultaneously [4].It has been shown that only 50% of anemia is caused by iron deficiency while the remainder is caused by vitamin A deficiency and other non-micronutrient factors[17].Iron and zinc deficiencies commonly occur together because they are most bioavailable from many of the same foods and their absorption is inhibited by many of the same dietary substances [7, 17].In low income countries, the diet is largely based on cereal staples and vegetable proteins both of which have low micronutrient densities and high phytate (inhibits micronutrient absorption) content [19].Therefore, presence of one micronutrient deficiency, most likely signals the presence of deficiency of another micronutrient.

Importantly, combinations of zinc and other micronutrients have been found to be beneficial toneuropsychological performance in a large sample of urban and rural school-aged Chinese and Mexican-American children [7]. Indirectly, zinc deficiency may affect cognitive performance through its interactions with other nutrients.Zinc is also known to interact with vitamin Ametabolism,and zinc deficiency might thereby contributeto the consequences of vitamin A deficiency [7,20].

Due to the critical role of micronutrient interactions in the etiology of hidden hunger it is recommended that holistic approaches to addressing problems of micronutrient malnutrition are adopted rather than single micronutrient interventions.

3.4. There is often High Prevalence of Micronutrient Deficiencies and Other Forms of Malnutrition among School Children

Micronutrient deficiencies often occur in the context of poverty and among families who are beset by multiple stressors that may interfere with the healthy development of their children.

3.4.1. Iron Deficiency Anaemia

Iron deficiency is the most common nutritional deficiency in the world. The World Health Organization (WHO) estimates that, worldwide, there are 2 billion individuals with anemia and up to 5 billion who are iron deficient[17]. This iron deficient population includes school children.Among school children in a rural district in Uganda, the prevalence of anaemia, mostly due to iron deficiency was found to be over 24%[12].

3.4.2. Iodine Deficiency

The link betweeniodine deficiency and cognitive development is direct. Iodine deficiency can be prevented through public health methods such as universal salt iodization, making it the most preventable cause of mental retardation in the world[17]. Nevertheless, Iodine deficiency still prevails in some populations especially in Iodine deficient and impoverished areas[17]. Acham et al [21] identified a proportion of school children in Uganda suffering from Iodine deficiency and attributed it to inadequate Iodine intake.

3.4.3. Zinc Deficiency

Zinc deficiency is a veritable public health concern in developing countries and some industrialized countries [22]. Globally, the prevalence of zinc deficiency has been estimated to be 31% [22]. Among school children in a peri-urban area of Uganda, the prevalence of zinc deficiency was estimated at 28.8%[23].

3.4.4. Vitamin A Deficiency

Marginal vitamin A status, unlike overt vitamin A deficiency is generally still prevalent and difficult to diagnose[24]. Studies, however, show high levels of vitamin A deficiency among school children in Sub-Saharan Africa. Acham*et al*.[21] found that vitamin A deficiency levels (30.3%) among the school children in a rural area of Uganda were above those reported for children under five years and even for women of child bearing age in Uganda (20% and 19%, respectively). These levels were comparable to those found by Mangusho[20] for primary school children in peri-urban area of Uganda. These studies show that vitamin A deficiency among school children in Sub-Saharan Africa is a big problem. Given the role of Vitamin A in immunity and prevention of disease morbidity plus key relationship with iron and Zinc, it is possible that it plays a huge role in academic achievement in school children.

3.5. Nutrition in School Children is Neglected in Many Studies and Nutrition Interventions

Most nutrition research and policy have tended to neglect the post-infancy period [7, 10] including the school age years. Yet nutrition may have a significant role in cognitive development in children in this category.In Uganda, Acham et al [21] found micronutrient deficiency levels among school children surpassing those reported for children under five years of age and women of child-bearing age and that school children that were studied did not have organized meals at school. The study highlighted a need to refocus attention on school children in the country, just as there is focus on children under five and women of child-bearing age.

The view that the effect of nutrition on cognitive development occurs predominantly in children under the age of two years and therefore the tendency for research to concentrate here overlooks the fact that certain brain areas continue to develop during childhood, adolescence and even adulthood including areas that are responsible for executive functions [19].

Notwisthstanding the obscurity of micronutrient deficiencies in general and among school children, Acham et al.[21] notes that malnutrition in all its forms remains largely a "hidden problem" among school children since the majority of children affected are moderately malnourished or have micronutrient deficiencies that are not routinely assessed. So the question is, if other "obvious" forms of malnutrition are "hiding" in schoolchildren, then how "hidden" is the hidden hunger among the same group? One critical solution that this and related studies are offering is uncovering the problem of hidden hunger in a population that appears hidden to both nutritional research and intervention. This, among others is a significant cue to public policy regarding long-term social and economic development.

3.6. The Influence of Nutrition on School Children and Their Education

One of the major global health problems faced by developing countries today is malnutrition [10].Nutritional deprivation is a serious international problem that can lead to long-term deficits in growth, immune function, cognitive and motor development, behavior, and academic performance [18]. Furthermore, most previous studies are focused on children under five years, while neglecting subjects in the pre-adolescent range[10].

An extensive body of literature has emerged confirming the negative impact of poor nutrition on learning outcome. Researchers have noted that when children go hungry or undernourished, they manifest a number of behaviors including irritability, apathy, and physical inactivity that have a negative impact on learning. These childrenoften have little energy and exhibit difficulty concentrating. Hungry students are at increased risk for infection and are more likely to miss school; therefore, they fall behind in class work [25].Glewwe and others [26] went into great detail to show that better nourished children performed better in school than those less well-nourished mostly because of greater learning productivity per year of schooling, and to demonstrate that good nutrition for children is an outstandingly profitable investment in terms of academic achievement.

In a well-controlled observational study in Bangladesh, investigators found that children with mild hypothyroidism had deficits in spelling and reading compared to healthy controls[17]. This may show that, regardless of the origin, the consequences of early developmental problems in children, which may be a result of malnutrition, can be long lasting and compromise academic performance and the ability to contribute to society [18].

Bekefi, (13) reported a review carried out by the Asian Development Bank that found that in almost all of the countries reviewed,intellectual capacity was lowered by approximately 10% to 15% due to iodine deficiency and that mental development of 40% to 60% of infants between 6 and 24 months was impaired due to iron deficiency.

In sum, the interference of micronutrient deficiencies on on-going cognitive and intellectual development, emotional, psychological and physical well-being due to improper metabolism and occurrence of infections among school children variably limits their educational abilities and progress.

3.7. Micronutrient Deficiency Has a Cyclical Relationship with Economic Development

It has been variously demonstrated that micronutrient deficiencies impose a heinous drain on the countries' and households' economic resources and at the same time hinder the realization of economic potential. Productivity losses resulting from cognitive delays in children due to iron deficiency anaemia have been estimated atabout $4 per capita or 0.9% ofGDP. Others have estimated annual GDP losses to iron deficiency anaemia in affected countries at 2% [13]. For south Asia, where the prevalence ofanemia is highest, losses were estimated to be around $5 billion annually. The dominant effect for all countries is the loss associated with cognitive deficits in children [2].

Micronutrient deficiencies have been a major nutritional problem in developing countries, adversely affecting people's health, performance and income and thereby impeding economic development [27]. The economic effects of micronutrient deficiencies come aboutdirectly through reduced work productivity and output, and indirectly through: the costs of health system usage, low cognition and success of the educational system, and diminished incentives to save and invest in children. Evidence to this end should enable allocation of more resources to fight micronutrient deficiencies throughout all life-stages [13, 15, 28].

The co-occurrence of micronutrient deficiencies and socioeconomic poverty has been demonstrated variously. For example, according to Black [15], families who live in iodine-deficient areas are often more impoverished than families in areas where iodine status is adequate.Further, it has been reported that vitamin A deficiency is a major public health problem in many parts of the world where poverty is extensive [29].

3.8. Education is Critically Important to Socio-Economic Developmentin Sub-Saharan Africa

In drawing up the Framework for action on the Education for All goals, UNESCO [30] reiterated that education is a fundamental human right, pointing that it is the key to sustainable development and peace and stability within and among countries, and therefore indispensable for economic development in the twenty-first century. It is imperative for developing countries to invest as much resources as possible, in sectors such as educationthat promote long-term equitable social and economic growth and development, as this has the potential to yield high returns and promote economic diversification [12,31]. Access to education for marginalized groups, especially women in low income countries, has the potential to improve many other socioeconomic outcomes including nutrition [4]

3.9. Dropouts and Non-Completion of Primary School Remain as Key Challenges to Education in Sub-Saharan Africa

In its assessment of the skills needed by youth in order to access work, UNESCO [12] highlights the relevance of foundational skills. It is noted also, that these skills are lacking among many youths for a variety of reasons including non-schooling and dropouts in many sub-Saharan African countries, where those who make it to school often drop out before completing the primary schoolcycle. Addressing the problem of foundational skills requires different policy responses. For example, addressing the plight of children from marginalized households and going beyond abolition of school fees to examining other costs associated with schooling that tend to be inhibitive of schooling [12].

3.10. Education Provision in Sub-Saharan Africa Must Shift Emphasis Beyond Enrolment to the Quality of Educationwhere Nutrition Must be a Priority

It is not enough only to have the children in school, as indeed many African countries have made good progress in since barriers such as school fees were abolished. Making sure that children actually learn should be at theheart of any education system[12]. There is wide inequality in learning achievement nationally and internationally among many nations. The scale of learning deficits shows thatthere is far more to be done to ensure not only that more children get into school, but also that they achieve expected learning outcomes. Socioeconomic, demographic and geographical factors seem to be responsible for the widespread inequality.

Consequently, a combination of dropouts, low education quality, non-completion of the primary school cycle, and inequalities in learning outcomes create non-achievement ofcritical foundational skills such as literacy and numeracy. Low literacy hinders participation in many ways that impact on the economy including even merely applying for a job. It can also act as a barrierto further education, social mobility and civicengagement through many life stages [12,32].

4. Conclusion

There are inextricable linkages between nutrition, education and sustainable development. Micronutrient deficiencies (hidden hunger), especially of Iron, Vitamin A and Zinc, is a big problem among school children in Sub-Saharan Africa. There is little attention given to schoolchild nutrition and that is contributing to the unacceptable school dropout rates and poor academic performance. This paper clarifies further, that inadequate education due partly to micronutrient deficiencies among preadolescent school children in Sub-Saharan Africa is responsible for the chronic poverty affecting the region.

These findings should convince Sub-Saharan African countries not only to strengthen nutrition interventions generally, but also to focus specifically on a relatively neglected group, the school children. By so doing, the problem trio consisting of micronutrient deficiency, education system inefficiencies and chronic underdevelopment will be addressed holistically and in an integrated manner. This is likely to bring about sustainable economic development in the medium to long-term in these countries.

Despite these important findings, more research should be carried out on how micronutrient nutrition/malnutrition, education and economic development relate to one another.

References

[1] Stein AJ and Qaim M. 2007. The human and economic cost of hidden hunger. *Food and Nutrition Bulletin,* 28 (2): 2007, The United Nations University.

[2] Darnton-Hill I, Webb P, Harvey PWJ, Hunt JM, Dalmiya N, Chopr M, Ball MJ, Bloem MW, and de Benoist B. 2005. Micronutrient deficiencies and gender: social and economic costs. The American Journal of Clinical Nutrition. The American Nutrition Society.

[3] Mukudi E. Nutrition Status, Education Participation, and School Achievement Among Kenyan Middle-School Children. *Nutrition* 2003;19:612– 616. Elsevier Inc.

[4] ACC/SCN (2001). What Works? A Review of the Efficacy and Effectiveness of Nutrition Interventions, Allen LH and GillespieSR. ACC/SCN: Geneva in collaboration with the Asian Development Bank, Manila.

[5] Shonkoff JP, Richter R, van der Gaag J and Bhutta ZA. An Integrated Scientific Framework for Child Survival and Early Childhood Development. Pediatrics 2012;129;e460. Available at: http://pediatrics.aappublications.org/content/129/2/e460.full.html.

[6] Allen LH, 2003. Interventions for Micronutrient Deficiency Control in Developing Countries: Past, Present and Future. J. Nutr. 133: 3875S–3878S, 2003.

[7] Bryan J, Osendarp S, Hughes D, Calvaresi E, Baghurst K and Jan-Willem van Klinken JW. 2004. Nutrients for Cognitive Development in School-aged Children. Nutrition Reviews 62 (8): 295–306. International Life Sciences Institute.

[8] Hack M, Weissman B and Borawski-Clark E. Catch-up Growth During Childhood Among Very Low-Birth-Weight Children. *Arch PediatrAdolesc Med.* 1996;150(11):1122-1129.

[9] Lartey A. 2008. Maternal and child nutrition in Sub-Saharan Africa: challenges and interventions. *Proceedings of the Nutrition Society* (2008), 67, 105–108.

[10] Goon TD, Toriola AL, Shaw BS, Amusa LO, Monyeki MA, Akinyemi O and Alabi OA. Anthropometrically determined nutritional status of urban primary schoolchildren in Makurdi, Nigeria. Available at: http://www.hsag.co.za.

[11] WHO. 2006. Report of the Brainstorming Meeting on the development of a framework on the Nutrition-Friendly Schools Initiative, 27-28 February 2006. Montreux, Switzerland.

[12] UNESCO, 2012. EFA Global monitoring report 2012. UNESCO Publishing. Paris. Pp122-131.

[13] Bekefi T. 2006. Micronutrient Deficiency and the Global Alliance for Improved Nutrition: Lessons in Multisectoral-Parternship. *Corporate Social Responsibility Initiative Report* No. 7. Cambridge, MA: John F. Kennedy School of Government, Harvard University.

[14] UNICEF. Goals for Children and Development in the 1990s Available at: http://www.unicef.org/wsc/goals.htm.

[15] Black R. 2003. Micronutrient deficiency—an underlying cause of morbidity and mortality. Bulletin of the World Health Organization 2003, 81 (2). Geneva.

[16] Georgieff MK. Nutrition and the developing brain: nutrient priorities and measurement*Am J Clin-Nutr*2007;85(suppl):614S–20S. American Society for Nutrition.

[17] Black MM. 2003. Micronutrient Deficiencies and Cognitive Functioning. J. Nutr. 133: 3927S–3931S.

[18] Black MM. 1998. Zinc Deficiency and Child development. Am J ClinNutr 1998;68(suppl):464S–9S. American Society for Clinical Nutrition.

[19] Branca F and Ferrari M. Impact of Micronutrient Deficiencies on Growth: The Stunting Syndrome *Ann NutrMetab 2002;46(suppl 1):8–17.*

[20] Mangusho G. 2011. Effect Of Vitamin A-Mineral Supplementation On Serum Retinol And Overall Nutritional Status Of School Children Aged 6-10 Years In Wakiso District, Uganda: A Randomized Controlled Trial. Makerere University Kampala, (MSc. Thesis). Available at

http://news.mak.ac.ug/documents/Makfiles/theses/Mangusho_Gilbert.pdf.

[21] Acham H, Kikafunda JK, Tylleskar T and Malde MK. 2012. Nutritional and Health Status of Primary Schoolchildren in Rural Uganda. African journal of Food, Nutrition, Agriculture and Development. 12 (2): 5862 – 588.

[22] Samuel, F.O., Egal, A.A., Oldewage-Theron, W.H., Napier, C.E. & Venter, C.S., 2010, 'Prevalence of zinc deficiency among primary school children in a poor peri-urban informal settlement in South Africa', Health SA Gesondheid 15(1), Art #433, 6 pages. DOI: 10.4102/hsag.v15i1.433.

[23] Kajjura BR, 2007. Assessment of dietary zinc intake, serum zinc concentration and nutritional status of school children aged 60-120 months in Wakiso District in Central Uganda. Available at http://hdl.handle.net/123456789/1231.

[24] Tanumihardjo SA. Biomarkers of vitamin A status: what do they mean? In: World Health Organization. Report: Priorities in the assessment of vitamin A and iron status in populations, Panama City, Panama, 15–17 September 2010. Geneva, World Health Organization, 2012.

[25] Symons CW, Cinelli B, Tammy CJ, Patti G. Bridging Student Health Risks and Academic Achievement Through Comprehensive School Health Programs. J Sch Health. 1997;67(6):220-22.

[26] Glewwe P, Jacoby HG, King EM. Early childhood nutrition and academic achievement: a longitudinal analysis. *Journal of Public Economics* 81 (2001) 345–368 2001. Elsevier Science B.V.

[27] Arlappa N, Laxmaiah A, Balakrishna N, Harikumar R, Kodavanti MR, Reddy CG, Saradkumar S, Ravindranath M and &Brahmam GNV. Micronutrient deficiency disorders among the rural children of West Bengal, India. Annals of Human Biology, May–June 2011; 38(3): 281–289. Informa UK, Ltd.

[28] Pettifor JM, Zlotkin S. 2004. Micronutrition Deficiencies during the weaning period and the first years of life. Nestle Nutrition Series. Nestec Ltd. Basel.

[29] Taren D. Historical and practical uses of assessing night blindness as an indicator for vitamin A deficiency. In: World Health Organization. Report: Priorities in the assessment of vitamin A and iron status in populations, Panama City, Panama, 15–17 September 2010. Geneva, World Health Organization, 2012.

[30] UNESCO (2000). The Dakar Framework for Action. Paris. P8.

[31] Collier P, Van Der Ploeg R, Spence M, and Venables AJ. 2009. Managing Resource Revenues in Developing Economies. IMF Staff Papers. 57(1) International Monetary Fund.

[32] Jenkins A, Ackerman R, Frumkin L, Salter E and Vorhaus J. 2011. Literacy, Numeracy and Disadvantage Among Older Adults in England: Final report for Nuffield Foundation. Institute of Education, University of London.