ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 19 No. 2
March 2019
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2019; 19(2): 14277-14290 DOI: 10.18697/ajfand.85.17775

A CONSENSUS ON MALNUTRITION IN AFRICA: A REPORT FROM THE MICRONUTRIENT DEFICIENCY AWARENESS FORUM (NAIROBI 2017)

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ABSTRACT

While most forms of malnutrition are easy to identify at an early age, micronutrient deficiency also manifests in form of "Hidden Hunger", where children could seem to be well fed, but still suffer from deficiencies due to lack of key micronutrients in their diets whose absence is hard to detect. While the symptoms of micronutrient deficiency may not be obvious in the short-term, they translate into cognitive deficiencies in the long-term that negatively affect the economic productivity of these infants when they become adults, perpetuating the malnutrition cycle. The Micronutrient Deficiency Awareness Forum was held in April 2017 in Nairobi Kenya, comprising seven specialties from across sub-Saharan Africa. The forum was convened to discuss how to increase awareness of conditions associated with micronutrient deficiencies developing from early childhood, especially those impacting brain development, identify sections of the population that were at high risk of micronutrient deficiencies, outline available guidelines on diagnostic tools, assessment and management of deficiencies, and develop a consensus on best practices in diagnosing, managing, and preventing micronutrient deficiency and malnutrition. It is estimated that 40% of the children in sub-Saharan Africa are affected by stunting, which is the most prevalent form of malnutrition, and an estimated 69-82% of malnutrition cases are not properly treated. This phenomenon is not without a cost, as malnutrition greatly undermines cognitive development, and ultimately economic productivity. A 2014 study revealed that Ethiopia lost the equivalent of 12% of its GDP to malnutrition in 2009. Studies in different countries across the world have shown that focused interventions work. For instance, early childhood macronutrient intervention led to a 46% higher wage in adult years in Guatemala. The Micronutrient Deficiency Awareness Forum 2017 Consensus Report provides suggestions on policy design and implementation strategies that may lead to early detection, treatment, and ultimately prevalence reduction of malnutrition across the region.

Key words: Malnutrition, Micronutrient Deficiency, Kenya, Africa, Nutrition, Infant Screening, Supplementation

DOI: 10.18697/ajfand.85.17775

MALNUTRITION IN AFRICA

Malnutrition can take several forms including hunger, undernutrition and overnutrition all of which are also associated with micronutrient deficiencies. In its common usage, hunger describes the subjective feeling of discomfort that follows a period without eating. However, even temporary periods of under-nourishment can cause stunting in children, which is the most prevalent form of malnutrition.

Globally, malnutrition remains a challenge. Malnutrition causes the death of an estimated 2.6 million children annually, which is about a third of all child deaths globally, while stunting affects an estimated 161 million children worldwide and about 40% of children in sub-Saharan Africa [1]. Evidence assembled over nearly three decades now suggests that malnutrition is an associated cause of half the deaths occurring in children in developing countries [2]. An estimated two billion people in the world suffer from hidden hunger, meaning they suffer from micronutrient deficiencies [3]. Moreover, the synergistic relationship between malnutrition and disease is now well understood.

The high malnutrition rates in Africa are a threat to the gains the region has made in growing school enrollment, as malnutrition greatly undermines cognitive development. In a survey of 350,000 children in Kenya, Uganda and Tanzania by Uwezo, an education advocacy organization based in Kenya, it was found that two out of every three children in grade three failed to pass basic tests in English, Kiswahili or numeracy, set at the level of grade two. The study also revealed that children from poor households, who were more likely to be malnourished, perform worse on all tests at all ages [4]. Similarly, a report by Save the Children Fund [5] revealed that compared with normal children, stunted children:

- score seven percent lower on mathematics tests;
- are 19% less likely to be able to read a simple sentence at age eight, and 12% less likely able to write a simple sentence; and,
- are 13% less likely to be able to be in the appropriate grade for their age at school.

In many cases, the plight of these underachieving children begins with a malnourished mother. Undernutrition among pregnant women in developing countries leads to one out of six infants being born with low birth weight. This means that policy interventions must start with adequate nutrition for women, especially adolescents before they become pregnant, to reduce the risks associated with malnutrition [6].

SOCIO-ECONOMIC EFFECTS OF MALNUTRITION

While there is consensus on the consequences of malnutrition on cognitive capacity, morbidity and mortality, the understanding of the aggregate effect on the economy and society in general is just beginning to emerge. Poor nutrition in childhood including *in-utero* can have a long-term impact on productivity and lifetime earnings.

The socio-economic impact of malnutrition in the continent has been studied and quantified. In Ethiopia, for example, according to the Cost of Hunger in Africa Report, the economic losses due to undernutrition were the equivalent of about 12% of Ethiopia's GDP in 2009 [7].

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Similar observations were made in Kenya, which has a national stunting rate of about 30%, with marginalized areas of the Coast, Northern and North-Eastern Kenya experiencing rates of up to 40% [8]. These children under-achieve in school and are unlikely to achieve their full productivity and earning potential in life, and it is also likely that their own children will be malnourished and may l be susceptible to chronic diseases in adulthood. Invariably, these stunted, under-achieving children will contribute to a growing lower economic class, with all the attendant socio-economic consequences. Considering that Kenya has an annual birth cohort of about 1.5 million children over the next 20 years, it is estimated the country will have about nine million new stunted children within that time, unless effective intervention is undertaken in a timely manner [9].

Although studies are few and far apart, there is evidence that early interventions work. For instance, early childhood macronutrient intervention led to a 46% higher wage in adult years in Guatemala [10].

DIAGNOSIS AND ASSESSMENT OF MICRONUTRIENT DEFICIENCIES IN INFANTS

A complicating factor in the diagnosis of micronutrient deficiencies is that clinical features appear late, when the deficiency has been present for a significantly long period of time. Deficiencies can, however, be established through a three-stage assessment process, as outlined in Figure 1 below.

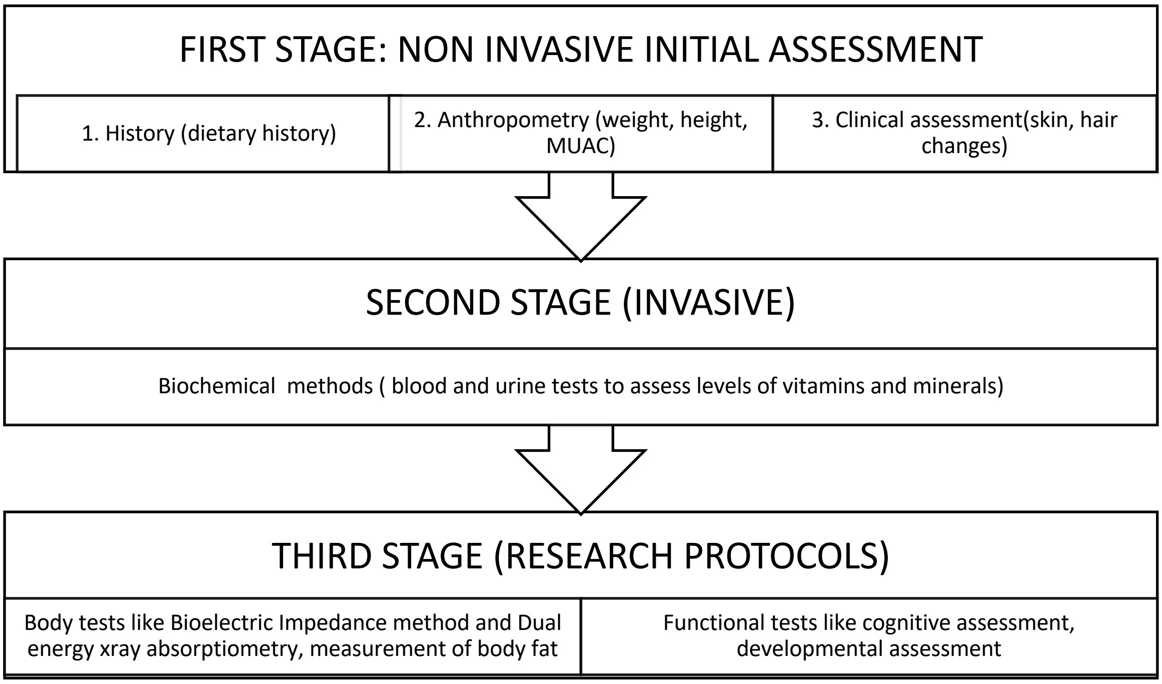

Figure 1: Assessment of nutritional status in a clinical setting [11]

Initially, an assessment of the child's **dietary history** is carried out to determine the quantity and quality of food to which the child has access. This includes the assessment

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of the frequency of feeding and whether the diet is sufficient and includes a variety of food sources from the different food groups.

Anthropometry is a non-invasive method used to assess nutritional status. The infant's weight and height are taken and these parameters are compared to reference values using centile charts or standard deviation / Z score charts to determine if the child's parameters are appropriate for that age and sex. The key anthropometric measures and their interpretation are depicted in Table 1.
The body mass index (BMI) is also used to classify children as underweight, normal weight, overweight, or obese based on their weight and height. Tables 2 and 3 demonstrate the BMI classification according to the World Health Organization [12].

Diagnosis of micronutrient deficiency is mostly done through the clinical procedures outlined above; rarely are biochemical methods used for diagnosis. They can, however, be used to confirm the suspected micronutrient deficiency. For iodine, iron, Vitamin A, folate and zinc, which are the five (5) key micronutrients of public health significance, blood tests augment the clinical procedures (See Table 4).

FRAMEWORK FOR DESIGNING A NUTRITION-SENSITIVE POLICY

Nutritional guidelines for children and infants exist and they aim to facilitate the earliest possible identification of life-threatening conditions in newborns and their correction. The uptake, however, varies from region to region with the poorer parts of the world, having the lowest coverage.

This consensus report proposes strengthening of these processes, particularly as a tool for enhancing appropriate nutrition from birth through early infancy. Identifying inadequate growth early may help protect cognitive development, if corrective measures are deployed in time. The following are our recommendations for early detection and correction of malnutrition:

1. Screening at birth and follow up

For appropriate interventions to be achieved in a timely manner, the newborns must first be delivered under the care of a skilled health care worker (HCW) and then have access to continuing care by the same. This is currently not the case in most developing countries where over 50% of deliveries take place in the home [13]. After birth, only a small number visit a health facility (HF) and even fewer numbers among those delivered in the home, ever get reviewed as early as stipulated [14]. The World Health Organization guidelines specifically recommend that all newborns should be reviewed within 24 hours of birth, and then again at 48 - 72 hours, and 7 - 14 days and six weeks of age [15]. Premature or low birth weight infants have special needs and an additional visit at four weeks is recommended. This is especially so because their growth parameters and feeding characteristics during the neonatal period, have been found to be predictive of important outcomes later in life [16].

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Screening processes

First Review *(by age 24 hours)*

This should be mandatory for all children born in health facilities and the ones born at home should be assessed at the nearest health center, as soon as is feasible. The review provides the earliest opportunity for the baby to receive a comprehensive clinical evaluation as recommended by the WHO [17]. The newborn also has anthropometric measurements taken, as well as an assessment of lactation and establishment of the most appropriate feeding mode.

Second Review *(age 48-72 hours)*

This review is essential for all babies and may serve as the first visit for those born at home. The Health Care Provider (HCP) should perform a clinical evaluation, assess lactation and measure the weight (or full anthropometric measurements if not yet done). Biochemical screening of specific locally prevalent in-born genetic/biochemical conditions can also be done if available and possible. There is no comprehensive or reliable data to advise this practice for most of sub-Saharan Africa. Nevertheless, extrapolating from American data from the 4 most common conditions justifying universal screening are sickle cell Disease, hypothyroidism, galactosaemia and cystic fibrosis [18].

Third Review *(age 7-14 days).*

This review provides an opportunity for a neonatal mid-point anthropometric measurements and lactation assessment while allowing provision of feedback on biochemical screening results or performing them, if not yet done.

Special 4^th^ Visit *at four weeks (for pre-terms and those born weighing < 2 kg)*

The main objective of this visit is to determine growth velocity during the first month of life. The anthropometric measures are determined accurately to avail the following computations:

1. Weight gain in grams per kilogram (birth weight) per day. This should be at least 15 g/kg/day during the first month [19].
2. Increment in length and head circumference in centimeters per week. The target is at least 0.5 cm/week during the first month [19].

Fourth Review *for all infants (age six weeks)*

This is essentially the visit that allows estimation of risk levels among newborns who may require ongoing special care. The two most critical parameters used are growth/nutrition and functional integrity of key organ systems. During the visit:

- Measurements are taken of weight, height and head circumference and are accurately noted and plotted against the standard charts. For pre-term infants, an interpretation is noted with adjustment for gestation (six weeks from the expected date of delivery and not the date of birth).
- A comprehensive feeding assessment is also done.
- A comprehensive examination of the major organ systems is carried out by skilled HCWs. Any anomalies noted should be referred to the appropriate special

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care unit. If the primary provider is unable to determine the risk category, the baby should be referred to a higher level.

2. Use of pre-term formula for very low birth weight infants

The importance of early nutrition and growth as predictors of later outcomes in high-risk infants, such as those born with Very Low Birth Weight (VLBW), has been well described in the literature [20]. A study conducted on 175 VLBW neonatal survivors, revealed the following [20]:

- Infants fed exclusively on pre-term formula (PTF) gained weight at two and five grams/kg/day faster than those on mixed feed (breastmilk and PTF) and exclusive breastmilk, respectively. This pattern repeated in the median weight at term as well as for the body length and head circumference.
- Neonatal feeding regime with the highest nutritional density (PTF) was associated with one and three developmental points higher than mixed and EBM (Exclusive Breast Milk) alone, respectively (as assessed using the Dorothy F. Egan tool [21]). Two-year-old children who had achieved optimum neonatal and catch-up growth by expected dates of delivery, scored three units higher than those who had not.

Breast milk remains the gold standard for infant nutrition, though in many instances, pre-term breastmilk may not deliver the required nutrition. Pre-term milk on a mother lasts on average between eight days and two weeks. Thereafter, it is back to 0.9 to 1.1 grams of protein.

Generally, pre-term mothers' milk has an average of 2.7 grams per 100 mls, which is sufficient, but the median range is usually between one to four grams per 100 mls. It is hard to monitor which mother is producing more than two grams and, therefore, once the baby can feed orally, the standard should be to supplement breastmilk.

3. Comprehensive nutrition education

Nutrition education is a key contributor to preventing malnutrition and undernutrition. Education efforts should start with young women, even before they become mothers, to improve their health.

Antenatal clinics and postnatal clinics are ideal to teach mothers about the importance and benefits of exclusive breastfeeding. Furthermore, people who are often involved in food preparation for children (parents, grandparents, food vendors and catering officers at schools) must all be educated to provide a variety of foods and to prepare them correctly, to ensure that the different nutrients are incorporated into a child's daily diet.

Guidance on how to achieve a well-balanced diet should be based on foods that are available and affordable to the mother and family. The population should be educated on diversification using the foods that are available, affordable and are in season, with less emphasis on formal food groups.

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Nutrition education as part of the curriculum is key in influencing the meal choices children make.

4. Supplementation and fortification of foods

All children under five years in Kenya are supplemented with Vitamin A during routine immunization, following a 1999 micronutrient study [22]. Other strategies for addressing micronutrient deficiencies such as fortification of staple foods (sugar, flours, and fats) with vitamin E, A, and other micronutrients have been pursued as a public health approach for addressing micronutrient deficiencies, with reasonable success in areas which had access.

Kenya has a donor-funded strategy for use of micronutrient powders for children under two years, but the powders are not available for wide-use across different age groups.

For supplementation to work effectively, the government must put in place policies that ensure the following:

- Sufficient follow up on vitamin A supplementation after two years. Most children do not receive follow-up vitamin A supplementation after two years, once the regular immunizations are over, yet it should be given up to five years. Incorporation of vitamin A supplementation into immunization campaigns, like the door-to-door polio campaign, will greatly increase impact.
- Micronutrient powders should be made widely available and freely accessible for the vulnerable groups, with the necessary education for home fortification.

CONCLUSION

Micronutrient deficiency and the resulting impairment of cognitive function in malnourished children has severe, cyclical, long-term effects on the affected families and impacts the economic growth of a country negatively [23]. Though policy interventions can be costly to devise and implement, it is cheaper if the government underwrites the human capital upfront, as opposed to delayed interventions through treatment of diseases and economic subsidies. Everyone benefits when more children are able to grow into healthy productive citizens.

Therefore, health policy makers must design policies that are based on nutrition interventions right from birth, through schooling age and into adulthood.

Key interventions for success include proper assessment at birth, use of nutrient supplements and formulas for vulnerable infants, as well as nutrition education that is tailored towards locally available foods and the supplementation of existing foods.

ACKNOWLEDGEMENT

The Micronutrient Awareness Deficiency Forum was sponsored by MERCK Consumer Healthcare.

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Table 1: Different categories of nutritional status using weight for age, height for age and weight for height [24]

Anthropometric parameter	Category	Standard deviation score
Weight	Underweight	<-2 SD
	Normal weight	-2 SD to +2 SD
	Overweight	> 3 SD
Height	Stunted	<-2 SD
	Normal height	-2 SD to +2 SD
	High HAZ	> 2 SD
Weight for height	Wasting	<-2 SD
	Normal weight	-2 SD to +2 SD
	Overweight	> 2 SD

Adapted in accordance with WHO child growth standards and the identification of severe acute malnutrition in infants and children

Table 2: WHO BMI classifications (WHO AnthroPlus) [25]

BMI centile	**WHO Nutritional classification using BMI**
<5th centile	Underweight
5th to <85th	Normal weight for height
≥85th centile	Overweight
≥95th centile	Obese

Adapted in accordance with WHO Athroplus software [Cited 2017 May 12]

Table 3: World Health Organization (WHO) diagnostic criteria for Acute malnutrition [25]

	Bilateral pitting oedema	**Mid Upper Arm circumference MUAC**	**WFH (weight for height) z score**	**WFH as a percentage of median**
Severe Acute Malnutrition	Present in oedematous type	<11.5cm (severe wasting)	<-3SD (severe wasting)	<70%
Moderate Acute Malnutrition	Absent	≥ 11.5cm but <12.5cm	≥-3SD and <-2 SD	≥70% and <80%

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Table 4: Biochemical markers for diagnosis of micronutrient deficiency [26]

Micronutrient	Biomarkers
Iron	• Hemoglobin concentration • Plasma ferritin • Transferrin
Vitamin A	• Serum retinol (concentration of less than 0.70 umol/l[1])
Iodine	• Urinary iodine content of less than 100 micrograms per litre and • <150 micrograms per litre in pregnancy • Thyroid hormones are not very sensitive to change in iodine status except for thyroglobulin
Zinc	• Difficult to assess using biomarkers
Folate	• Serum or plasma or erythrocyte folate concentration • Blood film will also show megaloblastic anaemia

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