Situational analysis and expert evaluation of the nutrition and health status of infants and young children in five countries in sub-Saharan Africa

Martine Alles, Simone Eussen, Odile Ake-Tano, Saliou Diouf, Agatha Tanya, Alice Lakati, Abiola Oduwole, and Celine Mauras

Abstract

Background. *The poor feeding practices of pregnant women, infants, and young children contribute to the burden of malnutrition and subsequently to childhood morbidity and mortality in sub-Saharan Africa. Gaining insight into the nutritional and health status of infants and young children will help to focus future nutrition programs and actions.*

Objective. *To assess the nutrition and health status of infants and young children in five sub-Saharan African countries: Ivory Coast, Senegal, Cameroon, Kenya, and Nigeria.*

Methods. *Published and gray literature was critically reviewed and enriched with the views of local experts from academia, hospitals, and institutions to assess infants' and children's diet and health in the five sub-Saharan African countries. Subsequently, the Africa Nutriday Conference was held in Senegal in November 2011 to further discuss key challenges, action plans, and recommendations for future research.*

Results. *This review highlighted the need for education of parents and healthcare professionals in order to increase their knowledge of breastfeeding, vaccination programs, and over- and undernutrition. An integrated health and nutrition surveillance is needed both to identify micronutrient deficiencies and to recognize early signs of overweight. These data will help to adapt nutrition education and food fortification programs to the target populations.*

Conclusions. *Different countries in sub-Saharan Africa face similar nutrition and health issues and are currently not sharing best practices, nutrition programs, and scientific studies optimally. There is a need for closer collaboration among scientists within and between countries.*

Key words: Breastfeeding, children, health status, infants, nutrition, pregnancy, sub-Saharan Africa

Introduction

The life stages of pregnancy, lactation, and infancy are periods of high nutritional demand due to rapid development and growth of the child. In sub-Saharan Africa, mortality among children under 5 years of age is high, mainly because of deaths from acute respiratory infections, malaria, diarrhea, and malnutrition [1]. Globally, well over two-thirds of these deaths, which are often associated with inappropriate feeding practices, occur in the first year of life. One of the reasons for this is that not more than 30% of infants in sub-Saharan Africa are exclusively breastfed during the first 4 months of life [2]. Complementary feeding frequently begins too early [3]. Foods are often nutritionally inadequate and unsafe because of microbiological contamination. Malnourished children who survive are frequently ill and suffer lifelong consequences of impaired development. Paradoxically, there is at the same time an increasing incidence of overweight and obesity in children. This double burden of malnutrition is a rising concern [4, 5].

Poor feeding practices are a major threat to social and economic development; thus, improving the nutritional status of women and their newborns is critical to promote development as well as survival [6]. Recent

Martine Alles and Simone Eussen are affiliated with Nutricia Research, The Netherlands; Odile Ake-Tano is affiliated with the Institut de Santé Publique (INSP), Ivory Coast; Saliou Diouf is affiliated with the Institut de Pédiatrie Social UCAD, Dakar, Senegal; Agatha Tanya is affiliated with the Department of Public Health of the University of Yaounde, Cameroon; Alice Lakati is affiliated with AMREF, Nairobi, Kenya; Abiola Oduwole is affiliated with the College of Medicine, University of Lagos, Nigeria; Celine Mauras is affiliated with Danone Baby Nutrition Africa and Overseas, Villefranche sur Saone, France.

Please direct queries to the corresponding author: Martine Alles, Nutricia Research, Uppsalalaan 12, 3584 CT Utrecht, PO Box 80141, 3508 TC Utrecht, The Netherlands; e-mail: martine.alles@danone.com.

publications on the nutritional situation in sub-Saharan Africa [1, 7–10] all point to the same challenges in the region: compromised breastfeeding practices, poor quality of complementary feeding, vitamin A and iron deficiencies, lack of nutrition education and counseling, and a need for regional collaborations on nutrition and health.

In this paper we will focus on the current nutrition and health status of infants and young children in five sub-Saharan African countries (Ivory Coast, Senegal, Cameroon, Kenya, and Nigeria) to deepen our understanding of the regional issues. A critical analysis of the available literature was performed and enriched by information from local experts. To bring together the data from the region and to discuss the implications and solutions, the Africa Nutriday Conference was then held in Dakar, Senegal, in November 2011. The conference was attended by scientists (e.g., nutritionists), healthcare professionals (e.g., pediatricians, neonatologists), and institutions (representatives from nongovernmental organizations [NGOs] and governments). The outcomes of the analysis were discussed for each country and then through a transversal analysis of the five countries to identify commonalities. The key challenges were further discussed in small workshops with participants having different expertise and origins. This paper presents the methodology and main outcomes of the critical analysis and reflects the discussions of the workshops, including action plans and recommendations for future research.

Methods

Danone Research developed an analysis to describe the public health and nutritional situation of target groups within a country. This critical analysis is intended to be a first step in a long-term process to increase knowledge on concerned countries, followed by more specific field surveys (dietary surveys, food style surveys) to address knowledge gaps. The analysis consists of two complementary approaches. First, an extensive literature review is performed; this literature review involves structured searches for relevant published literature using a range of healthcare-related databases (PubMed, Medline, Pascal, Web of Science) as well as gray literature obtained from international and national organizations (e.g., the Food and Agriculture Organization, UNICEF, the World Health Organization [WHO], the US Agency for International Development, the CIA World FactBook, the World Bank, and websites of Ministries of Health and NGOs). Secondly, the literature review is enriched by the views, opinions, and experience of different local experts from academia, hospitals, and institutions.

In the past 2 years, the analysis was used to assess infants' and children's diet and health in 24 countries throughout the world, 5 of which are sub-Saharan African countries (Ivory Coast, Senegal, Cameroon, Kenya, and Nigeria); these were done by a consulting agency or through collaboration with local experts. In these sub-Saharan African countries, the literature search focused on infant and child mortality, general health issues, vaccination regimes, breastfeeding practices, feeding habits, and the incidence and causes of nutritional deficiencies and excesses. General key search terms for public health and nutritional aspects in young children, women of childbearing age, pregnant women, and lactating women were combined with country-specific key words. Literature searches were limited to articles published after January 1990. Additional unpublished literature was obtained from opinion leaders and other stakeholders.

An average of 18 interviews per country were then conducted with key opinion leaders, ranging from 12 in Senegal to 26 in Nigeria (**table 1**). These interviews were conducted face-to-face when possible, otherwise by phone. All interviews in Nigeria were conducted by phone due to difficulties of traveling in the country.

The selection of experts was based on the following steps:

Step 1: Establishment of the most exhaustive list of relevant key opinion leaders. For this, the approach consisted of selecting key representatives of the main nutrition and public health institutions of the country (ministries, universities, associations, and hospitals and other healthcare institutions), identifying key authors emerging from the literature review, and completing the list based on local inputs obtained from key opinion leaders already involved.

Step 2: Selection of key opinion leaders, focusing on those most representative of the different forms of

TABLE 1. Overview of interviews and selected literature by country

Interviews/literature	Ivory Coast	Senegal	Cameroon	Kenya	Nigeria
Interviews					
Total	22	12	17	15	26
Face-to-face	7	12	10	8	0
Phone	15	0	7	7	26
Total publications	23	15	21	21	30
Additional reports and others	Not evaluated	Not evaluated	17	5	Not evaluated

expertise (e.g., pediatricians, neonatologists, nutritionists, and gynecologists), responsibilities (e.g., academic professionals and healthcare practitioners), and geographic areas within the country. The interviewees were asked to provide an overview of the country's priorities, programs, and recommendations, and also to reflect on what they perceived to be health concerns, issues, and knowledge gaps related to children's nutrition and health in the country.

All data from the literature review and expert interviews were entered into a database and categorized on the basis of the following themes: general country information (e.g., population, vital statistics, and economy), infant and child health and mortality, breastfeeding practices and main feeding patterns (e.g., meal frequency and staple foods), nutritional status (e.g., local nutrient recommendations and intakes), local and national health programs, and recommendations for future research and actions.

Workshop sessions were organized in six groups on the key challenges identified in the transversal analysis: How to improve breastfeeding practices? How to improve the transition from exclusive breastfeeding to family foods? How to improve the impact of food fortification programs for young children? How to implement healthy eating habits in nutrition-transition countries? How to break the vicious circle of nutrition-related issues? How to improve the quality of mothers' nutrition knowledge?

Participants were divided into cross-functional and cross-country groups, each one dealing with two subjects. French-speaking and English-speaking participants were assigned to separate groups to facilitate discussions and sharing.

Outcomes of the transversal analysis and the workshops

Country general information

The data presented in **table 2** provide a comparison of the population and growth rates of the sub-Saharan African countries examined in this study [11–13]. Population growth rates are high, and so are infant mortality rates. Although some of the countries in the region, such as Senegal, are making progress toward Millennium Development Goal 4.1 to reduce mortality among children under 5 years of age by two-thirds by 2015, the countries are still high on the list of those with high mortality among children under 5 years of age. Regionally, the probability of dying before the age of 5 years has decreased from 180 to 140 per 1,000 live births. **Figure 1** shows how the five countries are progressing toward the three nutrition-related Millennium Development Goals [14–16].

The population in Ivory Coast, Senegal, Cameroon, and Nigeria is evenly distributed between urban and rural areas, as is the world's population. In contrast, almost 80% of people in Kenya live in rural areas. However, Kenya is currently experiencing rapid rates of urbanization; each year, 4.2% of the population moves from a rural to an urban area.

Sub-Saharan Africa is the poorest region in the world. The per capita gross domestic product (GDP) in purchasing power parity ranges from US$1,600 in Ivory Coast to US$2,600 in Nigeria, compared with the world average of US$11,800 (**table 2**). In the selected sub-Saharan African countries, 42% to 70% of the population is defined as poor and living below the poverty line. Literacy levels vary considerably in

TABLE 2. Population characteristics of the five sub-Saharan African countries

Characteristic	Ivory Coast	Senegal	Cameroon	Kenya	Nigeria	World
Population	21,504,162	12,643,799	19,711,291	41,070,934	155,215,000	6,928,198,253
Population growth rate (%)	2.08	2.56	2.12	2.46	1.94	1.09
Birth rate (/1,000 population)	31.0	36.7	33.0	33.5	35.5	19.2
Death rate (/1,000 population)	10.2	9.3	11.8	8.9	16.1	8.1
Infant < 1 yr mortality (/1,000 live births)	64.8	50	60.9	52.3	91.5	41.6
Children < 5 yr mortality (/1,000 live births)	114	75	149	128	138	NA
Life expectancy at birth (yr)	56.8	59.8	54.4	59.5	47.6	67.1
Rural population (%)	49	58	42	78	50	49.5
GDP per capita (US$)	1,600	1,900	2,300	1,700	2,600	11,800
Below poverty line (%)	42	54	48	50	70	NA
Access to clean drinking water (%)	80	69	74	59	58	87
Access to sanitation (%)	23	51	47	31	32	61
Children < 5 yr underweight (%)	16.7	14.5	16.6	16.5	26.7	NA
Literacy (%)	48.7	39.3	67.9	85.1	68.0	83.7

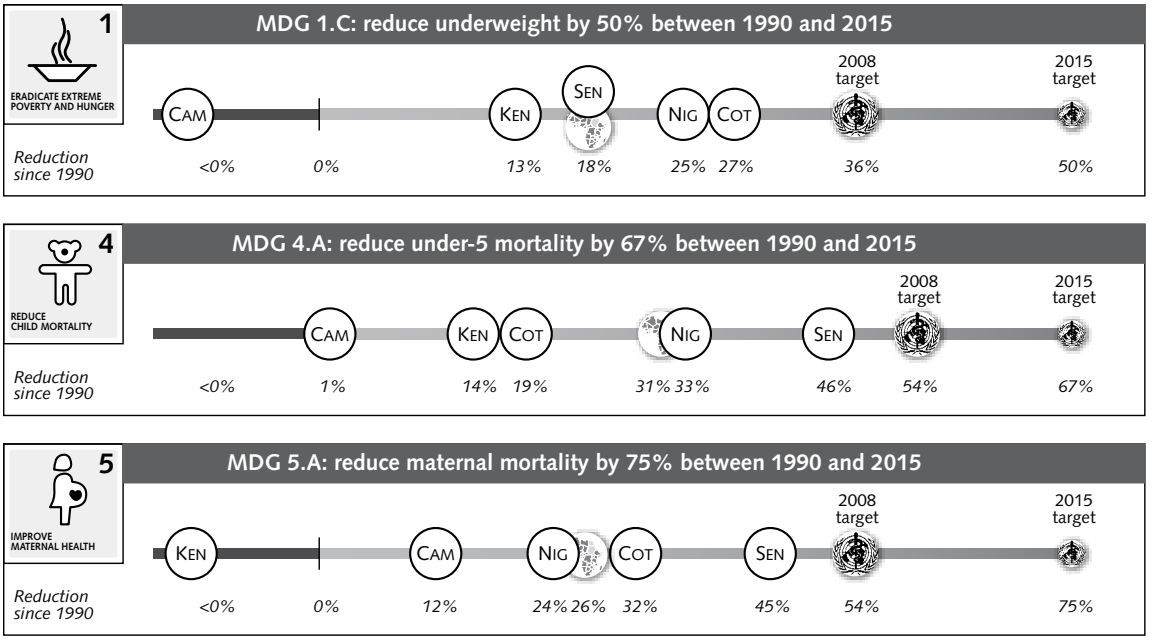

FIG. 1. Progress toward the three nutrition-related Millennium Development Goals (MDG) in the five sub-Saharan African countries. CAM, Cameroon; COT, Ivory Coast; KEN, Kenya; NIG, Nigeria; SEN, Senegal

the sample countries, with the highest level in Kenya (85%), followed by Cameroon and Nigeria (68%), Ivory Coast (49%), and finally Senegal (39%). In all countries, there is gender disparity in education in favor of boys. Moreover, girls in rural areas are roughly only half as likely to receive education as girls in urban areas [17, 18].

The healthcare system in sub-Saharan Africa is generally organized and managed on three levels: national (e.g., teaching and specialist hospitals), regional (e.g., general hospitals and medical clinics), and local (e.g., health posts, dispensaries, and nursing homes). The countries face major challenges in providing universal access to health services. The high cost of medical care, lack of resources, and long distances to healthcare facilities are important problems in access to healthcare. In Kenya, Cameroon, and Ivory Coast, more than 50% of all health workers are nurses and midwives, who are the main providers of care to women throughout pregnancy, delivery, and the early postnatal period. In Nigeria and Senegal, doctors, including gynecologists, play a more important role in providing maternal and newborn healthcare. WHO recommends a minimum of four antenatal visits, consisting of pregnancy monitoring; managing problems such as high blood pressure, infections, and nutritional deficiencies; health and nutrition counseling; and vaccination. The proportion of women receiving antenatal care is relatively high in Kenya (92%), Ivory Coast (85%), Senegal (87%), and Cameroon (82%), compared with only 58% in Nigeria [19]. However, in all of these five countries, only about half of pregnant women have the recommended four or more antenatal visits [19]. The main reasons for underutilization of antenatal care in Nigeria are women's perceptions that they are healthy, disapproval by husbands, distance to health facilities, and cost [20].

Infant and child health and mortality

Diarrhea, malaria, and pneumonia are the main causes of child mortality in the selected sub-Saharan African countries (**fig. 2**) [21]. In cases of diarrhea, families are encouraged to rehydrate their children with either commercially packaged oral rehydration solution (ORS) or fluids prepared at home. However, the management of acute diarrhea is still not satisfactory. In Kenya, 78% of children suffering from the disease are given ORS or increased fluids, compared with 37% and 57% in Nigeria and Cameroon, respectively [17, 18, 22]. Malaria is effectively and easily prevented by using insecticide-treated mosquito nets. There is a high degree of variability in the use of insecticide-treated nets between and within sub-Saharan African countries. In Kenya, 56% of households have at least one insecticide-treated net, compared with 20% in Senegal, 8% in Nigeria, and only 2% to 3% in Ivory Coast and Cameroon. Ownership of insecticide-treated nets increases with wealth [17, 18, 22–24]. In Senegal, mortality from malaria is rapidly decreasing due to the combined use of mosquito nets, indoor spraying with low doses of insecticides, prophylaxis during pregnancy, and rapid diagnostic tests [25].

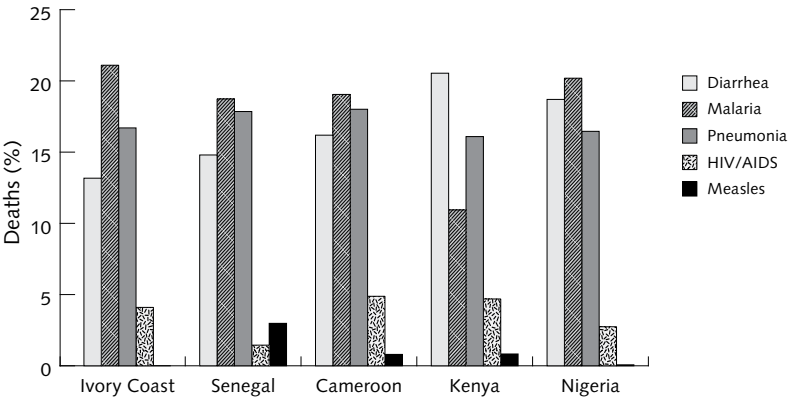

FIG. 2. Main causes of death among children under 5 years of age in the five sub-Saharan African countries in 2008

Malnutrition is the main contributor to the burden of disease, partly because it depresses the immune system. Malnourished children have a greater incidence and increased severity of persistent diarrhea, malaria, and pneumonia. Moreover, these infectious diseases also contribute to malnutrition, which constitutes a vicious cycle [26].

The WHO Expanded Program on Immunization (EPI), which was launched in 1974, has been a key tool to reduce child mortality in sub-Saharan Africa. The diseases included in the EPI in the five sub-Saharan African countries are diphtheria, tetanus, pertussis (combined in the DTP triple vaccine), measles, polio, tuberculosis, and yellow fever. **Figure 3** shows the vaccination rates among children aged 12 to 23 months by type of vaccine and year [27]. Although vaccination coverage in Nigeria has increased in the past 10 years, the country is still lagging behind other countries in sub-Saharan Africa. Many children in rural areas, especially in the North, are not immunized because their parents believe that the vaccines have negative effects on their children. In Ivory Coast, immunization programs were largely disrupted because of the civil war (2002–07), leading to an increase in reported cases of measles, neonatal tetanus, and polio. Efforts have been made to revive the vaccination program, and since 2008 coverage has slowly begun to increase again.

Breastfeeding practices

WHO recommends exclusive breastfeeding during the first 6 months of life for optimal growth, development, and health [28]. Breastfeeding should continue up to 2 years or later, and nutritionally adequate, safe, and appropriately fed complementary foods should be introduced at the age of 6 months to meet the evolving needs of the growing infant. Promotion of breastfeeding is seen as the most effective way to reduce child mortality [29], and it is estimated that 1.4 million child-lives could be saved by improving breastfeeding practices [30]. "Exclusive breastfeeding" is defined by WHO as giving no food or drink—not even water—except human milk. It does, however, allow the infant to receive ORS, drops, and syrups (vitamins, minerals, and medicines). Overall breastfeeding rates in sub-Saharan Africa are high. However, although exclusive breastfeeding rates in the first 6 months of life have increased significantly in sub-Saharan Africa [31] from 20% to 30% on average, the rates are still low, and a large percentage of newborns are not breastfed in the first hour after delivery. **Figure 4** gives an overview of specific breastfeeding rates in the five sub-Saharan African countries, showing that the rate of exclusive breastfeeding in the first 6 months of life ranges from 4% to 34%. The rate of exclusive breastfeeding is especially low in Ivory Coast (4%) [32] and is highest in Kenya (32%) [17] and Senegal (34%) [24, 33]. However, exclusive breastfeeding rates vary widely within the countries. For example, a recent study showed that the rate of exclusive breastfeeding is extremely low (2%) in poor urban settlements in Nairobi, Kenya [34].

The total duration of breastfeeding is globally long in the five countries; e.g., in Nairobi 85% of women were still breastfeeding at 11 months [34], and the mean duration of breastfeeding was almost 18 months in Nigeria and Cameroon and 20 months in Ivory Coast, Kenya, and Senegal [17, 18, 24, 32, 35].

Reasons for discontinuing breastfeeding, as indicated by mothers, are not enough breastmilk, mother going to work, and advice of healthcare professionals. The Baby-Friendly Hospital Initiative (BFHI), launched in 1991, is an effort by UNICEF and WHO to ensure that all maternity facilities, whether free-standing or in a hospital, become centers of breastfeeding support [9]. The analysis showed that the BFHI, supported by local associations, has a real impact on breastfeeding practices in sub-Saharan Africa. Similarly, when the initiative was interrupted, breastfeeding rates generally declined. For example, breastfeeding rates dramatically decreased in Ivory Coast due to the civil war from 10%

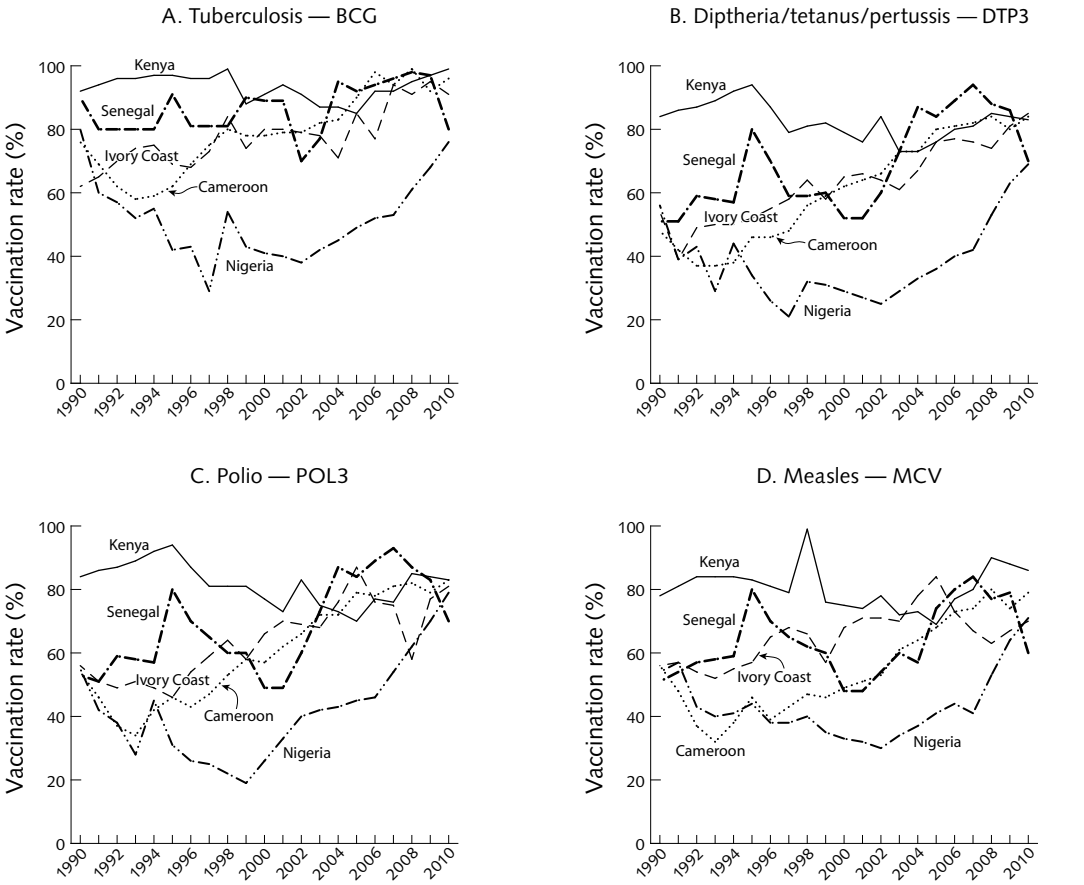

FIG. 3. Vaccination rates for (A) tuberculosis and bacillus Calmette–Guérin (BCG), (B) third dose of diphtheria–tetanus–pertussis mixed vaccine (DTP3), (C) third dose of oral poliovirus vaccine (Pol3), and (D) measles vaccine (MCV) by country and year

to 4% and went down in Nigeria due to the transfer of BFHI responsibility from UNICEF to the state [36].

In many young infants breastfeeding is combined with the consumption of water, tea, fruit juice, regular cows' or goats' milk, coffee, and other liquids (**fig. 4**). Mothers generally follow traditional practices and are usually unaware of the possible negative effects of cofeeding liquids on the risk of malnutrition and infection for their child.

Another harmful practice is that infants are not always breastfed in the first hour after delivery. The proportion of infants that were placed to the breast in the first hour was 25% in Ivory Coast, 23% in Senegal, 20% in Cameroon, 60% in Kenya, and 32% in Nigeria. These low rates can be explained by the widespread belief in sub-Saharan Africa that colostrum is dirty and by mothers' limited knowledge of the immunologic advantages of early breastfeeding [37]. It is estimated that 5% of adults in sub-Saharan Africa are infected with HIV [38]. Recommendations for optimal feeding methods to prevent mother-to-child transmission of HIV have recently been revised [39]. Until recently, WHO advised HIV-positive mothers to avoid breastfeeding if they were able to afford, prepare, and store formula milk safely. However, recent evidence, especially from South Africa, showed that a combination of exclusive breastfeeding and the use of antiretroviral treatment can significantly reduce the risk of transmitting HIV to babies through breastfeeding. Based on this evidence, the new recommendation on infant feeding by HIV-positive mothers is that the HIV-positive mothers or their infants take antiretroviral drugs throughout the period of breastfeeding and until the infant is 12 months old. This means that the child can benefit from breastfeeding with very little risk of becoming infected with HIV.

The analysis we did in the five sub-Saharan African countries indicates poor adherence to WHO recommendations for breastfeeding. In the workshop. the question "how to improve breastfeeding practices" was addressed. Three categories of opportunities were identified:

» Convince and involve: convince local policymakers of the danger of nonexclusive breastfeeding and show

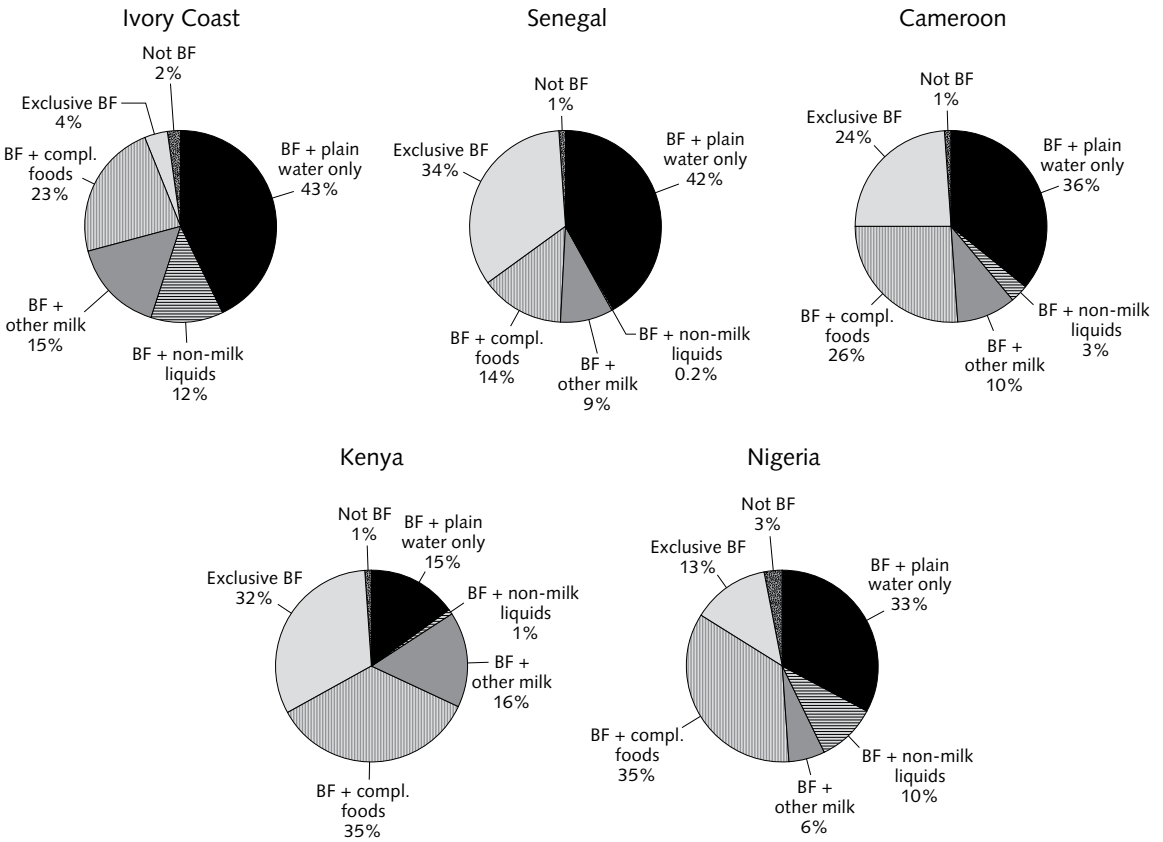

FIG. 4. Breastfeeding (BF) rates and practice in the first 6 months of life in the five sub-Saharan African countries

them the need to prioritize. Create a Government and Support Group (i.e., relevant stakeholders such as health professional associations, NGOs, Ministry of Health) to build relevant and realistic solutions to improve breastfeeding practices.

» Information and education: re-energize the breastfeeding initiative. Involve healthcare professionals in a more aggressive communication on the issue and thereby increase the impact of the message. Make sure that education starts early during antenatal care. There was optimism about the possibility of overcoming negative cultural practices with active involvement of healthcare professionals such as midwives.

» Approach peer educators: identify the influencers (e.g., mothers, neighbors, mothers-in-law) to create a protective environment. Make use of female social networks (e.g., national women's organizations) to promote breastfeeding.

Feeding habits

After the 6th month of life, exclusive breastfeeding is no longer sufficient to meet the nutritional needs of the growing infant. Well-adapted complementary foods should be given to help the infant gradually make the transition to an adult diet. Lutter et al. [40] indicated that infant and young child nutrition will only improve if activation of breastfeeding practices, increased sanitation, and health improvements are combined with improvements in complementary feeding behavior. WHO recommends introducing safe and nutritionally adequate complementary foods from the age of 6 months. It was shown in a review by Onyango in 2003 [41] and now confirmed in our analysis that many infants in sub-Saharan Africa begin to receive cereal-based foods well before this age. The mean age of introduction was around 2 months in Nigeria, Kenya, and Senegal and 4.5 months in Cameroon [17, 18, 24, 35].

Two strategies of complementary feeding were identified. In Kenya, complementary foods consist mainly of adult-type diets introduced in an adapted portion size. In the other countries, complementary foods usually consist of specific child-adapted meals, but these foods are monotonous and bulky. In both cases, cereals, roots, and tubers account for a large percentage of the energy intake of infants and young children. The specific staple foods used, such as maize, millet, sorghum, and cassava, vary between and even within countries. For infants and young children, gruel and porridges are

prepared from these staples, sometimes accompanied by fruits and legumes. Most affordable carbohydrate staples are limited in their protein and micronutrient composition. They often contain antinutritional factors (such as phytates) that reduce the bioavailability of micronutrients. Animal-source foods (milk, fish, meat, eggs, or milk-based products), which are high in proteins and fats, are only occasionally part of the diet [41]. As a result, the diets do not supply sufficient amounts of energy, essential fatty acids, and micronutrients for infants and young children.

The nutritional recommendations as issued by WHO are locally translated into food-based dietary guidelines. However, the guidelines are either not well adapted to the country's situation or not implemented. From the experts in our analysis, we understood that they do not refer to local traditional foods. Other major barriers are the poor (seasonal) availability of foods, their high price, and the difficulty of implementing the guidelines due to specific cultural behaviors. Mothers are often confused about what to give their babies as complementary foods and prefer to stick to traditional practices. In addition, it was indicated that most healthcare professionals are not updated or trained on the nutritional guidelines and rather rely on their initial training. Lack of time and interest from healthcare professionals is another frequently mentioned problem.

Specific cultural habits and food taboos may play a role. For example, it is common that the youngest child in the family takes the last and smallest portion if egg, fish, or chicken is part of the meal. In some parts of Cameroon, children are not allowed to eat eggs because of a belief that it will lead to children's stealing in later life.

In one of the workshop sessions, improvement of the transition from exclusive breastfeeding to family foods was discussed. Several opportunities were identified:

» Availability and accessibility of dedicated foods: push industry for small portions of adapted products that are affordable and create quality standards through the Ministry of Health.
» Create a national and international supporting base to influence decisions: local platforms dedicated to infant nutrition and a Pan-African Science and Nutrition Society.
» Make use of existing traditional products: use food demonstrations to show how local foods can be used to improve nutritional status.

Incidence and causes of nutritional deficiencies

Eradicating hunger is part of Millennium Development Goal 1. Overall, there has been insufficient or no progress in the region toward Millennium Development Goal 1.8: to halve the rate of underweight among children under 5 years of age between 1990 and 2015. WHO indicates that the total number of undernourished people has been rising for the past decade, mainly due to population growth. Increased food prices leading to income loss, local conflicts, and climate change are seen as other important causes. Stunting rates in Africa have remained around 40% since 1990, and little improvement is anticipated according to the WHO [42]. In our analysis, we found the highest prevalence rates of both stunting (height-for-age) and underweight (weight-for-height) in Nigeria: 27% and 57%, respectively [18]. Infants between 6 and 9 months of age in rural areas are especially affected. The possible effects of living in an urban environment on nutritional status were studied in detail by Kennedy et al. [43]. They concluded that differences in the prevalence of stunting were largely due to differences in wealth and not simply due to disparities between urban and rural regions.

Findings from the Nutritional Collaborative Research Support Program (CRSP) in Kenya, for example, demonstrate how the etiology of the early onset of stunting varies among populations in varying biological, environmental, and cultural circumstances [44]. In Kenya, the problem has its origin in prepregnancy and pregnancy. Maternal size upon entry into pregnancy and weight and fat gain during pregnancy and lactation are powerful determinants of an infant's size at birth and during the first 6 months of life.

Nutritional deficiencies are widespread in sub-Saharan Africa. In our analysis, and confirmed by Drorbaugh and Neumann [10], vitamin A and iron deficiencies continue to be the main deficiencies in the region. The most common deficiency in children under 5 years of age is iron deficiency. It is estimated that 7.6 million children in western Africa are anemic, and rural households are especially at risk [45]. Both vitamin A and iodine deficiencies have decreased significantly due to prevention programs. The prevalence of zinc deficiency among children under 5 years of age in Nigeria is reported to be 20%. Information from the other four countries is lacking, but the experts consulted suspect a high prevalence. One of the experts attending the conference indicated that there seems to be an overall lack of information on the intake of essential fatty acids in the sub-Saharan African countries.

As already discussed, there is a strong relationship between infectious diarrhea and malnutrition. At the same time, it is known that infants born of obese mothers have an increased risk of developing metabolic disease later in life. These complex interrelationships were discussed in one of the sessions of the workshop: "how to break the vicious circle between nutritional status and child disease." It was indicated by the groups that more research is needed to better understand some of the relationships. Some opportunities were seen:

» Implement an integrated management of child disease, with a focus on improved access to care and medication and extended vaccination programs. Use

of zinc supplements in case of diarrhea. More focus on possible hidden micronutrient deficiencies, such as iron deficiency.
» Improve education of the population, including healthcare professionals.
» Define a specific nutrition and health strategy for preterm infants.
» Develop affordable products that can help overcome the nutritional problems.

Food fortification is implemented via habitual foods such as wheat, oil, sugar, and salt. Iodized salt and wheat fortified with zinc are used in Kenya and Cameroon. In Ivory Coast, fortification of cereals is part of the Infant and Young Children Nutrition Program (IYCNP). The program aims to increase awareness of optimal nutrition among mothers and healthcare professionals and to improve access to high-quality complementary foods. The program started in 2009 and will be evaluated in 2014 [46]. In 2011, the IYCNP activities in Burkina Faso and Senegal were evaluated [47, 48]. It was concluded that promotion of exclusive breastfeeding up to 6 months of age and vitamin A supplementation should continue to get attention and national coverage. Regarding the efficacy of fortification programs, several problems are faced, according to the experts we consulted. The right type of food is not always chosen, and coverage is not always nationwide, lacking the capacity to reach the whole population of young children. The duration of the programs is not always optimal for effectiveness, and program evaluation is lacking.

Some micronutrient deficiencies, such as those of calcium and vitamin D, are less studied but may deserve attention. These deficiencies should be studied especially in women of childbearing age to prevent negative effects on the fetus and the infant during pregnancy and lactation. Supplementation might need to start early. Possible deficiencies of vitamins B_2 and B_{12} were mentioned by many experts. Chromium deficiency, resulting in glucose intolerance, may occur in infants with protein–calorie malnutrition [49]. This was seen in Nigeria, a country with a high prevalence of type 2 diabetes mellitus.

The workshop also discussed how to improve the impact of food fortification programs to young children, specifically with respect to iodine and other nutrients. Several barriers were identified: the price of iodine, lack of control of supply in rural areas, lack of local interest to produce fortified palm oil, lack of knowledge of the optimal storage conditions of commercial fortified products, and cultural barriers (e.g., no negative perception of goiter). The following opportunities were identified:
» Increase access to fortification via the normal food. Use base foods (like flour), produce locally, and subsidize the nutrients.
» Adapt to the target population: base the fortification on thorough dietary and nutrient intake data and take cultural habits into account; improve the nutritional education of the communities.
» Partner with industry and all governmental partners (e.g., ministries of health, agriculture, and finance).

The rising problem of obesity

Many low- and middle-income countries are now facing a double burden of disease. Where the problems of infectious disease and undernutrition are still very common, they also deal with noncommunicable disease risk factors such as obesity and overweight. It is not uncommon to find undernutrition and obesity coexisting within the same country, the same community, or the same household [50]. The prevalence of overweight is rising in sub-Saharan Africa and reaches 25% to 30% among women of childbearing age [17, 18, 24]. Few data are available on the actual rates of overweight and obesity in young children. However, the available data show a prevalence of overweight of up to 6% among those under 5 years of age [51, 52]. Transition to a more Western-style diet, as well as some cultural aspects, underlies the rise. General access to food has increased, and the costs of sugar and fat are lower than those of nutritionally more healthful foods. An increased consumption of snacks was observed in our analysis. In addition, chubby infants are seen as healthy infants, and in some regions women will aim to increase weight before marriage.

The workshop discussed how healthy eating habits can best be implemented in nutrition-transition countries. The following opportunities were identified:
» Change individual behavior (nutrition and physical activity) by communicating about good habits, especially to the urban population, starting early at school, and using modern media, for example, with promotions by famous sports heroes.
» Change the image of overweight in the population. Overweight is still seen as a sign of wealth and prosperity. Educate healthcare professionals and stimulate early detection of signs of overweight.

Conclusions and recommendations from the workshops

The starting point for the African Nutriday Conference was a critical landscape analysis of the current health and nutrition situation in five sub-Saharan African countries, enriched by the views of local experts. Although we actively searched for unpublished information, we might have missed some. Experts were selected by the steps described in the Methods. It was not possible to interview all of them individually, but in the conference we gathered 31 experts from the region. In the workshop sessions, data from the transversal

analysis and knowledge of the local experts were used to deepen our understanding of the nutrition and health issues that are faced by infants and young children in sub-Saharan Africa. Most of the opportunities and prioritized actions are described above. The following main calls for action were identified:

» A need for improvement of the nutrition education of both mothers and healthcare professionals was identified. This was reported in all sessions. One of them was specifically dedicated to the topic and revealed the need for more efficient parental education. Focus should be on both the mother and the father, on antenatal education (e.g., via midwives), and on the use of new media (mobile phones, radio, and television). Women can be accessed in churches or other places of worship, family meetings, and women's associations.
» Breastfeeding habits in sub-Saharan Africa are still far below the target. The rate of exclusive breastfeeding is low and could be improved by dedicated education of local healthcare professionals on the important role of colostrum in the early phase of life and the adverse effects of early introduction of liquids in the infant's diet.
» A need was identified for affordable fortified foods that can be integrated easily in local feeding habits. The participants saw a role for industry to develop fortified foods, as long as strict regulation of the quality of the foods is applied.
» An integrated health and nutrition surveillance is needed in which there is sufficient attention to identifying micronutrient deficiencies and recognizing early signs of overweight.

As a final point, the audience of the African Nutriday Conference was ready for the establishment of a Pan-African Science and Nutrition Society. The experts from the different countries realized that they were facing similar nutrition and health issues and were not sharing best practices, nutrition programs, and scientific studies optimally. The need for a closer collaboration among scientists within and between countries was clearly highlighted.

References

1. Lartey A. Maternal and child nutrition in sub-Saharan Africa: challenges and interventions. Proc Nutr Soc 2008;67:105–8.
2. World Health Organization/UNICEF. Global strategy: breastfeeding critical for child survival. Available at: http://www.who.int/mediacentre/news/releases/2004/pr19/en/index.html. Accessed 13 May 2013.
3. Kramer MS, Kakuma R. Optimal duration of exclusive breastfeeding. Cochrane Database Syst Rev 2002:CD003517.
4. Mokhtar N, Elati J, Chabir R, Bour A, Elkari K, Schlossman NP, Caballero B, Aguenaou H. Diet culture and obesity in northern Africa. J Nutr 2001;131:887S–92S.
5. World Health Organization/Food and Agriculture Organization. Report of the Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases. Geneva: WHO, 2002.
6. World Health Organization. Global strategy for infant and young child feeding. Geneva: WHO, 2003.
7. Daelmans B, Mangasaryan N, Martines J, Saadeh R, Casanovas C, Arabi M. Strengthening actions to improve feeding of infants and young children 6 to 23 months of age: summary of a recent World Health Organization/UNICEF technical meeting, Geneva, 6–9 October 2008. Food Nutr Bull 2009;30:S236–8.
8. Wuehler SE, Hess SY, Brown KH. Situational analysis of infant and young child nutrition activities in the Sahel—executive summary. Matern Child Nutr 2011;7(suppl 1):1–5.
9. Wuehler SE, Hess SY, Brown KH. Accelerating improvements in nutritional and health status of young children in the Sahel region of sub-Saharan Africa: review of international guidelines on infant and young child feeding and nutrition. Matern Child Nutr 2011;7(suppl 1):6–34.
10. Drorbaugh N, Neumann CG. Micronutrient deficiencies in food aid beneficiaries: a review of seven African countries. Afr J Food Agric Nutr Dev 2009;9:990–1018.
11. World Health Organization. Country health profile. Senegal. Available at: http://www.afro.who.int/en/senegal/country-health-profile.html. Accessed 13 May 2013.
12. Central Intelligence Agency USA. The world factbook. Available at: https://www.cia.gov/library/publications/the-world-factbook/index.html. Accessed 10 June 2013.
13. UNICEF. Senegal statistics. Basic indicators. Available at: http://www.unicef.org/infobycountry/senegal_statistics.html. Accessed 13 May 2013.
14. World Health Organization. Trends in maternal mortality: 1990 to 2008. Geneva 2010.
15. UNICEF. Levels and trends in child mortality. New York: United Nations Inter-Agency Group for Child Mortality, 2011.
16. UNICEF. Tracking progress on child and maternal nutrition: a survival and development priority. New York: UNICEF, 2009.
17. Kenya National Bureau of Statistics. Kenya Demographic and Health Survey 2008–09. Calverton, Md, USA: Kenya National Bureau of Statistics, 2010.
18. National Population Commission. Nigeria demographic and health survey 2008. Available at: http://pdf.usaid.gov/pdf_docs/PNADQ923.pdf. Accessed 13 May 2013.
19. UNICEF. Childinfo. Monitoring the situation of children and women. Maternal, newborn and child survival country profile. Available at: http://www.childinfo.org/country_list.php. Accessed 13 May 2013.
20. Federal Ministry of Health. Saving newborn lives in Nigeria: newborn health in the context of the Integrated Maternal, Newborn and Child Health Strategy. Abuja: Federal Ministry of Health, Save the Children, Jhpiego, 2011.

21. Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, Jha P, Campbell H, Walker CF, Cibulskis R, Eisele T, Liu L, Mathers C. Global, regional, and national causes of child mortality in 2008: a systematic analysis. Lancet 2010; 375:1969–87.
22. Institut National de la Statistique and ORC Macro. Enquête démographique et de santé Cameroun 2004. Calverton, Md, USA: Institut National de la Statistique and ORC Macro, 2005.
23. Institut National de la Statistique et Ministère de la Lutte contre le Sida [Côte d'Ivoire] and ORC Macro. Enquête sur les indicateurs du Sida, Côte d'Ivoire 2005. Calverton, Md, USA: Institut National de la Statistique et Ministère de la Lutte contre le Sida [Côte d'Ivoire] and ORC Macro, 2006.
24. Salif N, Ayad M. Enquête démographique et de santé au Sénégal 2005. Centre de Recherche pour le Développement Humain [Sénégal] and ORC Macro. Calverton, Md, USA: Centre de Recherche pour le Développement Humain [Sénégal] and ORC Macro, 2006.
25. Thiam S, Thior M, Faye B, Ndiop M, Diouf ML, Diouf MB, Diallo I, Fall FB, Ndiaye JL, Albertini A, Lee E, Jorgensen P, Gaye O, Bell D. Major reduction in anti-malarial drug consumption in Senegal after nation-wide introduction of malaria rapid diagnostic tests. PLoS One;6:e18419.
26. Katona P, Katona-Apte J. The interaction between nutrition and infection. Clin Infect Dis 2008;46:1582–8.
27. World Health Organization/UNICEF. Immunization surveillance, assessment and monitoring. Estimated coverage by country, year and vaccine. Available at: http://www.who.int/immunization_monitoring/routine/immunization_coverage/en/index4.html. Accessed 13 May 2013.
28. World Health Organization. The optimal duration of exclusive breastfeeding. A systematic review. Geneva: WHO, 2001.
29. Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS. How many child deaths can we prevent this year? Lancet 2003;362:65–71.
30. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet 2008;371:243–60.
31. UNICEF. Progress for children: a world fit for children statistical review. MDG 1: infant feeding. Available at: http://www.unicef.org/progressforchildren/2007n6/index_41511.htm. Accessed 13 May 2013.
32. Ministère d'Etat, Ministère du Plan et du Développement/Institut National de la Statistique (INS)/UNICEF. Multiple Indicator Cluster Survey 3. République de Côte d'Ivoire. Suivi de la situation des enfants et des femmes. Enquête par grappes à indicateurs multiples 2006. Abidjan: Ministère d'Etat, Ministère du Plan et du Développement/Institut National de la Statistique (INS)/UNICEF, 2006.
33. UNICEF. Childinfo: monitoring the situation of children and women. Infant and young child feeding. Available at: http://www.childinfo.org/breastfeeding_iycf.php. Accessed 13 May 2013.
34. Kimani-Murage EW, Madise NJ, Fotso JC, Kyobutungi C, Mutua MK, Gitau TM, Yatich N. Patterns and determinants of breastfeeding and complementary feeding practices in urban informal settlements, Nairobi Kenya. BMC Public Health 2011;11:396.
35. Ministère de l'Economie, de la Planification et de L'Aménagement du Territoire/UNICEF. Multiple Indicator Cluster Survey 3. Cameroun. Suivi de la situation des enfants et des femmes. Enquête par grappes à indicateurs multiples 2006. Yaoundé: Ministère de l'Economie, de la Planification et de L'Aménagement du Territoire/UNICEF, 2006.
36. World Health Organization/UNICEF. Baby-Friendly Hospital Initiative: revised, updated and expanded for integrated care. Geneva: WHO/UNICEF, 2009.
37. Britton C. Breastfeeding: a natural phenomenon or a cultural construct? In: Squire C, ed. The social context of birth, 2nd ed. Oxford: Radcliffe, 2009:305–17.
38. Joint United Nations Programme on HIV/AIDS (UNAIDS). UNAIDS report on the global AIDS epidemic. Geneva: WHO, 2010.
39. World Health Organization. HIV and infant feeding. Revised principles and recommendations. Rapid advice. Geneva: WHO, 2009.
40. Lutter CK, Daelmans BM, de Onis M, Kothari MT, Ruel MT, Arimond M, Deitchler M, Dewey KG, Blossner M, Borghi E. Undernutrition, poor feeding practices, and low coverage of key nutrition interventions. Pediatrics 2011;128:e1418–27.
41. Onyango AW. Dietary diversity, child nutrition and health in contemporary African communities. Comp Biochem Physiol A Mol Integr Physiol 2003;136:61–9.
42. de Onis M, Blossner M, Borghi E. Prevalence and trends of stunting among pre-school children, 1990–2020. Public Health Nutr 2011;14:1–7.
43. Kennedy G, Nantel G, Brouwer ID, Kok FJ. Does living in an urban environment confer advantages for childhood nutritional status? Analysis of disparities in nutritional status by wealth and residence in Angola, Central African Republic and Senegal. Public Health Nutr 2006;9:187–93.
44. Neumann CG, Harrison GG. Onset and evolution of stunting in infants and children. Examples from the Human Nutrition Collaborative Research Support Program. Kenya and Egypt studies. Eur J Clin Nutr 1994;48(suppl 1):S90–102.
45. Magalhaes RJ, Clements AC. Mapping the risk of anaemia in preschool-age children: the contribution of malnutrition, malaria, and helminth infections in West Africa. PLoS Med 2011;8:e1000438.
46. Global Alliance for Improved Nutrition (GAIN). Project to promote fortified complementary foods for young children. Available at: http://www.gainhealth.org/project/projet-de-promotion. Accessed 13 May 2013.
47. Wuehler SE, Ly Wane CT. Situational analysis of infant and young child nutrition policies and programmatic activities in Senegal. Matern Child Nutr 2011;7(suppl 1):157–81.
48. Wuehler SE, Ouedraogo AW. Situational analysis of infant and young child nutrition policies and programmatic activities in Burkina Faso. Matern Child Nutr 2011;7(suppl 1):35–62.
49. National Science Foundation. The relation of selected trace elements to health and disease. In: U.S. National Committee for Geochemistry. Subcommittee on the geochemical environment in relation to health and

disease. Geochemistry and the environment. Washington, DC: National Academy of Sciences, 1974:29–35.
50. Vorster HH, Kruger A, Margetts BM. The nutrition transition in Africa: can it be steered into a more positive direction? Nutrients 2011; 3:429–41.
51. UNICEF. Progress for children: a world fit for children statistical review. MDG 1: stunting, wasting and overweight. Available at: http://www.unicef.org/progressforchildren/2007n6/index_41505.htm. Accessed 13 May 2013.
52. Diouf S, Moreira C, Camara B, Sylla A, Signate HS, Ouattara A, Ndiaye O, Nicolas K. [Obesity of child in two Dakar hospitals: epidemiological aspects and problems of management]. Arch Pediatr 2004;11:155–6.