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Food and Nutrition Bulletin, vol. 30, no. 2 (supplement)

United Nations University Press
Published by the International Nutrition Foundation for The United Nations University
150 Harrison Avenue, Boston, MA 02111 USA
Tel.: (617) 636-3778 Fax: (617) 636-3727
E-mail: FNB@inffoundation.org
ISSN 0379-5721
Design and production by Digital Design Group, Newton, MA USA
Printed on acid-free paper by Webcom, Toronto, ON Canada

Introduction

Maternal, infant, and young child nutrition: Combining efforts to maximize impacts on child growth and micronutrient status

Kathryn G. Dewey and Sandra L. Huffman

The objective of this *Food and Nutrition Bulletin* supplement is to focus attention on the need to integrate actions to improve maternal, infant, and young child nutrition across the different stages of the key "window of opportunity" from preconception through pregnancy, the period of exclusive breastfeeding (0 to 6 months), and the target age for complementary feeding (6 to 24 months). It is essential that program managers, policymakers, and researchers have a clear understanding of how nutrition during each of these different phases can affect the health outcomes that are the focus of their efforts. Understanding the synergistic effects of improved nutrition across these different phases, and which interventions are appropriate during each phase, is necessary in order to work jointly, efficiently, and with greater success to reduce the high rates of stunting and micronutrient deficiencies we still see around the world.

The life-cycle approach to nutrition has been discussed previously, but the intention of this supplement is to consider both the current scientific evidence on effective interventions and the practical issues of how to incorporate such interventions into a comprehensive approach. Efforts to improve maternal, infant, and young child nutrition must start with the period of preconception and the nutrition of adolescent girls and women. It has long been recognized that pregnancy is a critical period, but more attention is needed to actions that can occur at the moment of delivery (a key "contact" opportunity) and the early neonatal period to improve the health and nutritional status of both the mother and the baby. Following birth, the period of lactation (especially the first 6 months) is a critical window not only for improving breastfeeding practices, but also for addressing the mother's needs. How do we support her nutrition during this very vulnerable time period?

Lastly, we need to focus on the complementary feeding period from 6 to 24 months. There are many issues that need to be addressed at this time, including the importance of continued breastfeeding as well as improving the quality and accessibility of foods available for complementary feeding. The information provided to mothers on the use of complementary foods (including fortified products) needs to be conveyed in a way that supports continued breastfeeding and encourages optimal feeding practices, including responsive feeding [1].

Data from a study conducted by Maleta et al. among 767 children in Malawi followed from birth through 36 months of age show why it is so important to integrate actions throughout these stages of life [2]. **Figure 1** illustrates the cumulative deficit in height of children (both sexes) in the Malawi sample compared with the median of the World Health Organization (WHO)

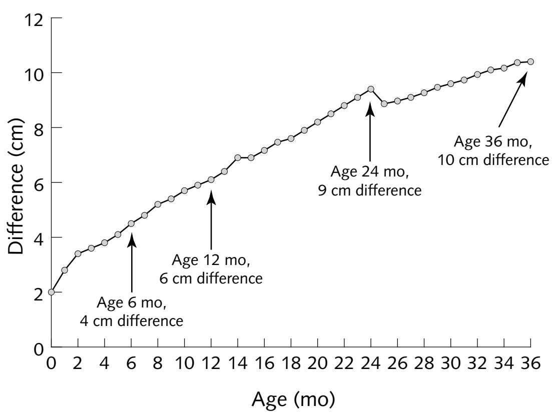

FIG. 1. Cumulative difference in stature (cm length or height) between Malawi children (both sexes) and the median of the WHO Child Growth Standard (for girls).
Source: Maleta et al. [2] and World Health Organization [3]

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Child Growth Standard for girls [3].

By 2 years of age, there is a 9-cm difference between the Malawian children and the WHO standards; only 1 additional centimeter of the total 10-cm deficit occurs between 2 and 3 years of age. Two centimeters of the deficit (20%) is already present at birth, 4 cm (40%) occurs between birth and 12 months of age, and another 3 cm (30%) occurs between 12 and 24 months. By 6 months of age, the infants are already 4 cm below the WHO standard; half of the deficit is attributable to low birth length and half to growth faltering after birth. The latter is presumably caused by a combination of a) the trajectory of growth established in utero, b) suboptimal postnatal nutrition due to lack of exclusive breastfeeding in the first 6 months (only 28% of infants were exclusively breastfed at 4 and 5 months) and possibly low breastmilk concentrations of certain nutrients due to maternal malnutrition, and c) postnatal infection. **Figure 2** compares length-for-age during the first 6 months with the WHO third percentile for girls, and illustrates that the Malawi infants track on the third percentile during this interval but do not exhibit catch-up growth. After this, from 6 to 24 months of age, their linear growth deteriorates so that the mean is well below the third percentile.

These two figures indicate that if we address only the period of complementary feeding, we may be disappointed by the degree of impact on stunting, even if the intervention is highly effective. The observation that 40% of the cumulative deficit in stature occurred before 6 months of age indicates that we need to intervene earlier and integrate actions across all these time periods.

Maternal undernutrition, especially among younger mothers, is an important part of this picture. For example, in Malawi, 13.8% of women aged 15 to 19 years have a low body mass index (BMI) (< 18.5 cm/kg^2) and 4.7% are less than 145 cm in height, as compared with 8.1% and 2.3%, respectively, for women 20 to 24 years of age [4]. Thirty-one percent of Malawian 17-year-old women have begun childbearing, and the percentage rises to 50% by the age of 18 years [4]. Thus, many young mothers have not reached their full growth potential and are more likely to have low weight-for-height.

In other developing countries, the situation is quite different. In Cambodia, for example, the deficit in stature by 36 months of age (according to Demographic and Health Survey data from 2006), relative to the WHO standard, is 6 cm (compared with 10 cm in Malawi), with about 1 cm "lost" by 6 months, 4 cm by 12 months, and 6 cm by 24 to 36 months (**fig. 3**) [5]. As in Malawi, growth faltering during the complementary feeding period (6 to 24 months) contributes 5 cm to the growth deficit, but in Cambodia growth faltering during this period represents the vast majority of the total growth deficit, whereas in Malawi it is only half. Low birthweight is less common in Cambodia, even though there is a high prevalence among young women of BMI less than 18.5 cm/kg^2 (28% of those aged 15 to 19 and 19% of those aged 20 to 24 years) and short stature (11.3% of those aged 15 to 19 and 7.2% of those aged 20 to 24 years have heights less than 145 cm) [5]. A key explanatory factor is that only 6% of Cambodian 17-year-old women and 12% of 18-year-olds have begun childbearing. Thus, far fewer girls in Cambodia than in Malawi become pregnant before reaching their full growth potential. Improving the nutritional status of adolescents and delaying childbearing are two important preconceptional issues that will affect birthweights and subsequent infant growth.

Maternal nutrition needs more attention during lactation as well as during pregnancy. Although breastmilk production is generally not related to maternal BMI, and many of the nutrients in breastmilk are

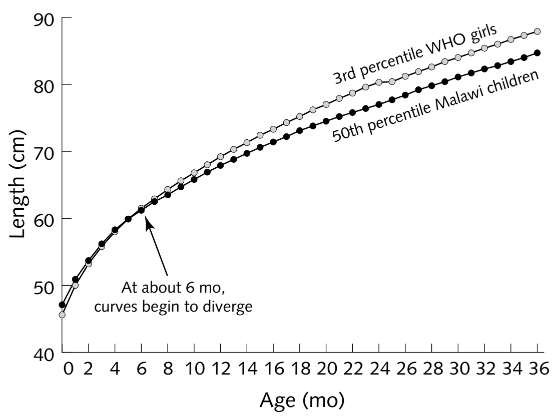

FIG. 2. Comparison of linear growth (cm) of Malawi children with WHO third percentile for length-for-age of girls.
Source: Maleta et al. [2] and World Health Organization [3]

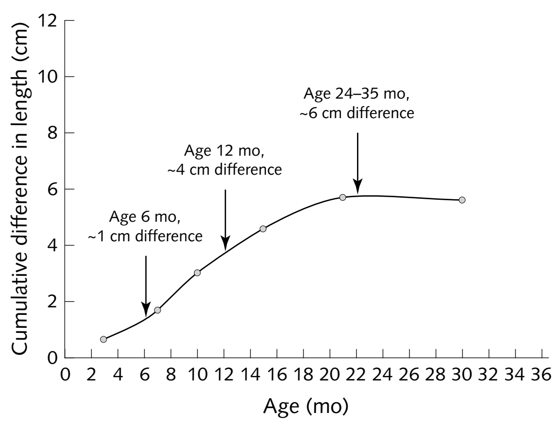

FIG. 3. Cumulative difference in stature (length or height) between Cambodian children (both sexes) and the median of the WHO Child Growth Standard (for girls).
Source: World Health Organization [3] and National Institute of Public Health/National Institute of Statistics/ORC Macro. Cambodia Demographic and Health Survey 2005 [5]

relatively "buffered" against maternal malnutrition, the concentrations of some key nutrients may be suboptimal because of low maternal dietary intake (particularly for some of the vitamins, as well as iodine and selenium). Even if the amounts of nutrients delivered to the infant via breastmilk are unaffected by maternal malnutrition, there may be adverse effects on the mother's health. When the mother's health and ability to function are compromised, the child's health is also compromised, thus creating a double burden for the child.

In addition, new evidence is pointing to the effects of maternal nutrition on the mental health of the mother. For example, adequate omega-3 polyunsaturated fatty acid status appears to be important in preventing depression [6]. Several studies in developing countries have shown a link between maternal depression and infant growth faltering [7]. Depression receives more attention in affluent countries because more resources are available for mental health, but surveys conducted in developing countries suggest even higher levels of postpartum depression than those seen in the United States, Europe, and other affluent countries [8]. Of course, nutrition is probably only a small part of the etiology of maternal depression, but these relationships are another example of why a more comprehensive, integrated approach to improving maternal and child health is needed.

As we move forward toward a common vision for optimal maternal, infant, and young child nutrition, it is essential to avoid polarization based on one's "favorite" stage of the window of opportunity. There have been fears that a new emphasis on complementary feeding might take away resources or political will from efforts to promote, protect, and support breastfeeding. None of us wants to see that happen. We need to pull together and speak with one voice as much as possible while working to increase visibility regarding the importance of improving all aspects of maternal, infant, and young child nutrition.

The papers presented in this supplement cover many of the themes described above, ranging from the need to delay childbearing beyond the teen years, improve adolescent nutrition, and enhance women's nutrition prior to pregnancy to the need for improved feeding practices for children under two and increased availability of high-quality complementary foods.

Acknowledgments

We would like to thank GAIN for supporting the meeting that led up to this supplement, and for the publication of this document. We would also like to thank the Bill and Melinda Gates Foundation for their support of the IYCN program at GAIN.

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Integrating maternal, infant, and young child nutrition: Report on the Ten Year Strategy Infant and Young Child Nutrition (IYCN) Working Group October 2008 Workshop

Elizabeth R. Zehner

Abstract

Members of the Infant and Young Child Nutrition (IYCN) Working Group of the Ten Year Strategy for the Reduction of Vitamin and Mineral Deficiencies and several guests and speakers participated in a workshop in Geneva on 10 October 2008. The workshop had two broad objectives. The first objective was to review the evidence base for maternal and IYCN actions and explore how to integrate action throughout the window of opportunity from the prenatal period through the first 2 years of life. The second objective was to discuss the development of the Maternal, Infant, and Young Child Nutrition (MIYCN) Network in relation to the IYCN Working Group's role and structure. The speakers identified a spectrum of efforts needed to improve maternal, infant, and young child nutrition. The group decided to continue discussion on initiating a structure for an MIYCN Network to enhance collaboration.

Key words: maternal nutrition, multiple micronutrient supplementation, newborn care, infant nutrition, young child nutrition

Introduction

The Ten Year Strategy for the Reduction of Vitamin and Mineral Deficiencies is a major initiative that includes United Nations partners, nongovernmental organizations, donors, and private-sector companies. The Initiative is working for better alignment and a more strategic approach to ending malnutrition, particularly micronutrient malnutrition. A reference group drives the Ten Year Strategy, whereas working groups are aligned on different topics (such as Infant and Young Child Nutrition [IYCN]), and regions. The plans of the Ten Year Strategy Group for the next several years include joint policy and advocacy work, expanded efforts in four to six high-burden countries, and development of a joint funding platform.

A workshop was held by the IYCN Working Group of the Ten Year Strategy in Geneva on 10 October 2008, attended by members of the IYCN Working Group, speakers, and guests (see the **Annex**). Dr. Dewey introduced the two broad objectives for the workshop. The first objective was to review the evidence base for maternal, infant, and young child nutrition actions and explore how to integrate action throughout the window of opportunity from pregnancy through the first 2 years of life. The second objective was to discuss the development of a Maternal, Infant, and Young Child Nutrition (MIYCN) Network in relation to the role and structure of the IYCN Working Group. The hope was to initiate a structure for the network to enable members to work together more effectively.

Evidence base for maternal nutrition and IYCN actions

Improving the nutritional status of women before and during pregnancy needs to be given more attention because of its impact on both women's health and newborn birthweights and micronutrient status. A meta-analysis of 12 studies in developing countries was reported on by Dr. Margetts, illustrating that multiple-micronutrient supplementation in pregnancy increased birthweight by 22 g and substantially reduced the rates of low birthweight (by 11%) and of small-for-gestational age births. Details of implementation of a large-scale multiple-micronutrient supplementation program and how it was able to successfully deliver multiple-micronutrient supplementation and improve quality of prenatal care using the health infrastructure in Lombok, Indonesia, were discussed by Dr. Shankar

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and reported on in this volume [1, 2].

The importance of best practices at birth for infant iron status, breastfeeding practices, and mortality was emphasized by Dr. Lutter and reported on in this volume [3]. Best practices include delayed umbilical cord clamping, immediate skin-to-skin contact, and early initiation of exclusive breastfeeding. The evidence and controversy around vitamin A supplementation and infant survival were also addressed. Guidance was given on how recommended interventions can become part of the standard of care.

Ms. Elder identified key gaps in coverage along the continuum of newborn care. These key gaps occur at birth and in the first week, when the risk of death is high yet coverage is low for mothers and babies. Early success in averting neonatal deaths is possible in settings with high mortality and weak health systems through outreach and family-community care, including health education to improve home-care practices, create demand for skilled care, and improve care-seeking. She highlighted the importance of essential newborn care provided by trained and supervised community health workers in the first few days of life (days 1, 3, and 7) for substantially reducing neonatal mortality. Simultaneous expansion of clinical care for mothers and newborns is also essential for achieving the Millennium Development Goals for child survival. Challenges for implementation include sociocultural challenges and resistance to referral, as well as the challenges of pregnancy surveillance, retention of health workers and volunteers, linkages between homes and facilities, weak health systems, policy barriers, absence of experience with program implementation at scale, and issues of scalability. Noting that breastfeeding is now accepted as a critical component of newborn care, she identified the need for a parallel programmatic "home" for young child feeding as well as the critical need for indicators.

The newly released World Health Organization (WHO) Indicators for infant and young child nutrition are reported in this volume [4]. Improving the nutritional status of lactating women is important both for maternal health and for the health of breastfed infants. Dr. Dewey reviewed the influence of maternal nutrition on various components of breastmilk. Maternal diet has little or no effect on breastmilk concentrations of protein, total fat, lactose, and most minerals but can influence concentrations of most vitamins and some trace elements (selenium, iodine, fluorine, and manganese).

The importance of adequate polyunsaturated fatty acid status in early life was addressed. Maternal intake of DHA (docosahexaenoic acid) influences the concentrations of DHA in milk and infant red blood cells [5], but further research is needed to assess the impact of higher DHA levels on infant outcomes. Adequate DHA intake may also benefit mothers as well as infants and should be further explored.

Dr. Fawzi presented information from studies showing a high prevalence of vitamin B_{12} and vitamin A depletion in breastmilk in developing countries. Maternal vitamin A supplementation during lactation has been found to have beneficial effects on maternal plasma levels and on breastmilk levels in some settings. However, there is a need to consider the clinical implications of improvements in biomarkers, since these often have not appeared to translate into impact on infant health markers.

Multiple-micronutrient supplementation of HIV-positive mothers was associated with improvement in breastmilk levels and infant status of vitamins A, E, and B_{12}; however, vitamin A supplementation alone was associated with a higher risk of HIV-1 transmission [6]. Multivitamin supplementation (vitamins B, C, and E) excluding vitamin A was associated with a reduced risk of HIV-1 transmission through breastfeeding and reduced child mortality among immunologically and nutritionally compromised women [7]. Multivitamin supplements also significantly slowed HIV disease progression and reduced morbidity and mortality from HIV-related causes among women, as well as resulting in an overall reduction in the risk of diarrhea and overall improvements in child growth and hematologic status [8].

The question is often asked whether complementary feeding can be improved solely through counseling on use of local foods, or whether distribution of fortified processed foods is also needed. Dr. Bhandari reported on efforts in North India to improve complementary feeding through counseling alone and counseling with provision of a fortified complementary food. Provision of a micronutrient-fortified food supplement supported by counseling was shown to increase energy intakes and growth compared with nutritional counseling alone in an urban slum [9]. Energy intake also increased significantly in the counseling group compared with the control group, but there was no impact on weight gain. Among those infants receiving the supplement, there was, however, a reduction in the frequency of breastfeeding and the proportion of infants breastfed and an increase in morbidity.

In order to assess whether multiple channels enhance the impact of counseling on growth, a study in rural India found that among those who received counseling, there was a significant increase in adoption of recommended recipes and a significant increase in meal frequency and energy intake compared with controls [10]. In addition, there was a positive impact on the use of routine services (increased attendance to primary health care, increased BCG/OPB/DPT immunization rates, and higher coverage for vitamin A and iron supplementation.) The greater the number of channels from which counseling was received, the higher the adoption of promoted behaviors. Although improving complementary feeding practices through existing channels was feasible, the effect on physical growth was limited.

Dr. Michaelsen noted that outcomes examined in the presentations included birthweight and weight and length gain but suggested that it is also important to focus on functional outcomes, including body composition if feasible to measure, mental and motor development, morbidity and mortality, and fatty acid and immune status (which are difficult to measure). Physical activity is another important outcome that should be measured.

Dr. Michaelsen also emphasized important dietary issues for complementary feeding. He highlighted the importance of animal foods—including milk, eggs, meat, offal, fish, and insects—which provide high protein quality, high micronutrient quality, and low content of antinutrients. He noted the importance of oil and fat with optimal n-6/n-3 content and ratio. He also warned of the content of antinutrients and fibers, which may be growth limiting because of poor availability of energy, protein, and minerals. He underscored the possibilities of dietary supplements, including point-of-use fortification through micronutrient supplements, micronutrient supplements plus essential fatty acids and/or milk powder, and lipid-based nutrient supplements. In addition, fortified blended foods provide additional possibilities for improvement in nutritional status.

Dr. Briend presented information on a recent WHO meeting to address the management of moderate malnutrition (30 September–3 October 2008). The background papers and discussion will be published in the *Food and Nutrition Bulletin* in September 2009. Ms. Saadeh reported on a WHO meeting held on 6–9 October 2008 to review effective interventions and delivery approaches to optimize feeding of children 6 to 23 months of age, presented in this volume [11]. The participants agreed to develop a framework that will include what is known, what works, and what actions are needed (similar to a framework for priority action on HIV and infant feeding) [12].

Summary of workshop presentations

The workshop presentations clearly illustrated the need for a spectrum of efforts to improve maternal, infant, and young child nutrition. Improving maternal nutrition needs to begin before conception by focusing on the health and nutrition of adolescents before pregnancy and delaying first births so adolescents do not become pregnant until they have finished their own growth [13].

Actions are needed to improve weight gain during pregnancy and ensure that mothers receive sufficient macro- and micronutrients in pregnancy along with health care. As shown by Shrimpton et al. [14] in this volume, provision of sufficient nutritious food to pregnant women can improve the birthweight of newborns without compromising the health of their mothers. Improving micronutrient status through supplementation during pregnancy was also shown to be feasible and to have positive outcomes for both mothers and their infants [1, 2].

Delivery practices can have major impacts on the initiation of breastfeeding, the duration of exclusive breastfeeding, and iron status in the infant [3]. Support for actions such as the Baby Friendly Hospital Initiative [15], scaling up actions to protect, support, and promote breastfeeding [16], and strengthening community support to improve feeding of infants and young children 6 to 23 months of age [10], all reported in this volume, are needed to improve infant and young child feeding. Improving the quality of fortified complementary foods and supplements was also emphasized in the workshop. There is a need to balance the amounts of food provided so as not to interfere with breastfeeding [17]. The private sector can play a role in this whole continuum by providing high-quality, appropriately labeled fortified foods and supplements for adolescents, pregnant women, and children 6 to 23 months of age, supporting baby-friendly hospitals and workplaces, and complying with the International Code of Marketing of Breastmilk Substitutes and related resolutions of the World Health Assembly.

Discussion of MIYCN Network

Dr. Dewey introduced the discussion of the MIYCN Network. She presented the following list of potential objectives for the MIYCN Network to consider:

» To share state-of-the-art research results that are programmatically relevant, including both outcomes research and operational research;
» To share results of recent reviews and meta-analyses;
» To provide an opportunity for international agencies to report on recent consultations, strategy documents, and global progress toward meeting the Millennium Development Goals;
» To share information on program implementation, monitoring, and evaluation findings (e.g., “best practices”), including costs, cost-effectiveness, and cost-benefit analyses;
» To allow nongovernmental organizations, foundations, and potential funding institutions to share information on their current and future programs;
» To provide a venue for presentation of survey data (Demographic and Health Survey, Multiple Indicator Cluster Surveys [MICS], etc.), including trend analyses;
» To encourage government ministry representatives to share reports on their activities;

» To discuss private sector initiatives and public–private partnerships.

The anticipated benefits from pursuing these objectives would be the following:

» Better coordination of efforts;
» Fostering and strengthening partnerships;
» Better integration with other health, nutrition, and economic initiatives;
» Opportunity for program implementers to become aware sooner of the most effective strategies to improve maternal, infant, and young child nutrition;
» Increased visibility of maternal, infant, and young child nutrition and ability to advocate for funding maternal, infant, and young child nutrition activities;
» Better communication between program implementers and researchers regarding critical needs for research and appropriate design of evaluation studies;
» Opportunity for networking and training of young professionals interested in MIYCN;
» Increased quality of monitoring and evaluation of programs.

She noted that other areas of nutrition, such as micronutrients, have been successful at garnering visibility and resources. The maternal, infant, and young child nutrition community has been less successful at generating support, even though recent publications and analyses document that it is a critical area in which to invest.

Following the introduction, the group was tasked with discussing future funding, organizational structure, meeting plans, communications, and guidelines for involvement with the private sector for the MIYCN Network. Extensive discussion took place about the group's goals and objectives. Proposed goals included "to improve maternal, infant, and young child nutrition, thereby reducing stunting, low birthweight, anemia, and child mortality via coordination and integration of efforts." The group's objectives could then be more specific. Themes consistently expressed included

» Increase visibility;
» Increase integration across stages;
» Increase coordination;
» Share information;
» Provide global vision and leadership.

Concerns were expressed over how the governance structure of the MIYCN Network should be developed. It was suggested that the IYCN group wait until completion of the global architecture review currently being conducted by the Center for Global Development with support from the Bill and Melinda Gates Foundation. In light of the review, the group could address how the MIYCN Network would fit and what the structure would be.

In order to move forward in the short term, a motion was proposed and approved to expand and rename the Infant and Young Child Nutrition (IYCN) Working Group the Maternal, Infant, and Young Child Nutrition (MIYCN) Working Group. Over the long term, there could be continued discussion over how to evolve into something with a more official governance structure with an open and transparent process.

Summary and conclusions

» The Infant and Young Child Nutrition (IYCN) Working Group has been renamed and will be expanded to become the Maternal, Infant, and Young Child Nutrition (MIYCN) Working Group.
» Discussion should continue over the MIYCN Network's vision, goals, and objectives.
» Discussion should continue over whether and how to develop a more official governance structure with open and transparent processes.
» The MIYCN Group should identify those global health and agriculture groups with which it should consider engaging and create a strategy for raising awareness and developing combined activities.
» The efforts of the MIYCN Network over the next year should be spent in developing this strategy rather than organizing a meeting. The need for a meeting will be determined after the strategy is completed.

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Trends in low birthweight among the Bhutanese refugee population in Nepal

Roger Shrimpton, Andrew Thorne-Lyman, Katie Tripp, and Andrew Tomkins

Abstract

Background. *Although much is known about risk factors for low birthweight, an important cause of neonatal death, little is known about how to reduce or prevent low birthweight.*

Objective. *This study aimed to verify a low rate in the incidence of low birthweight reported in the Bhutanese refugee camps in Nepal and, if true, to try to understand how this came about.*

Methods. *Medical records from 1994 to 2001 were recovered for half of the refugee population, and birthweight and other maternal factors were analyzed. The adequacy of the food ration provided to the general population was assessed by comparing it with the nutrient requirements of pregnant women.*

Results. *The rates of low birthweight were indeed low in the refugee camps, averaging 11% in the years reviewed. Between 1996 and 1998, the mean rate of low birthweight fell from 16% to 8% and mean birthweight increased from 2.84 kg (SE, 2.80–2.87) to 3.0 kg (SE, 2.97–3.03). The increase in birthweight occurred following improvements in the micronutrient-to-energy ratios of the general ration.*

Conclusions. *Rates of low birthweight comparable to those in developed countries were achieved in an ethnic Nepali population within 5 years of settlement in refugee camps. These low rates were probably achieved because basic needs of mothers were met, including both the quantity and the micronutrient content of food, water and sanitation, antenatal care, and education. The improvement from 1996 to 1998 coincided with increased availability of micronutrients in the food ration. We hypothesize that increased periconceptional micronutrient intake may be responsible for the increase in birthweight.*

Key words: Food supplementation, low birthweight, micronutrients, pregnancy, refugee

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Introduction

Low birthweight (< 2,500 g) is known to be an important indirect cause of the nearly 4 million annual neonatal deaths, two-thirds of which occur in African and Southeast Asian countries [1]. In addition to increasing the risk of neonatal death by more than four times, low birthweight is also associated with increased morbidity from diarrhea and pneumonia, poor cognitive development, and impaired immune function [2, 3]. There is a wealth of knowledge about the risk factors that predispose women in developing-country settings to adverse pregnancy outcomes such as low birthweight. In developing country settings, a greater proportion of low birthweight is thought to originate from intrauterine growth retardation (IUGR) than from preterm births [4], largely the result of insufficient energy intake, both during and before pregnancy [5]. A meta-analysis of data from randomized, controlled trials concluded that balanced protein–energy supplementation interventions are effective in improving birthweights in developing country settings [6]. Research has also demonstrated the effectiveness of iron–folate and multiple-micronutrient supplements in improving birthweights [7–13].

Despite the growing body of scientific evidence of the risks of low birthweight, knowledge of how to implement low-birthweight prevention programs is poor, with few programmatic approaches tried and tested [14]. Furthermore, improving birthweight is considered to be programmatically difficult, requiring considerable investment and several generations [2].

This research was commissioned on the basis of anecdotal findings of a Joint Food Assessment Mission of the United Nations High Commissioner for Refugees (UNHCR) and the World Food Programme (WFP) from 2000 reporting that the rates of low birthweight were close to 10% [15], as compared with 15% for Bhutan as a whole and 21% for Nepal [16]. This report was both surprising and intriguing, since the rates of low birthweight at hospitals in the same area where the camps are located in Nepal are reported to be greater than 30% [17]. South Asia as a whole has rates of 33% and is home to half of the low-birthweight babies in the world [16]. With these considerations in mind, a retrospective analysis of birthweights and of the situation of the Bhutanese refugees in the camps was undertaken in hopes of gaining policy insight into the factors associated with such low rates in a South Asian setting.

The investigation of the birth outcomes in the refugee camps was carried out in November and December 2001. The study had two objectives: to verify reports that the rates of low birthweight in the camps had decreased to extraordinarily low levels, and to investigate what conditions might have changed over time in the camps and contributed to any improvement in birthweight.

Background

Approximately 100,000 Bhutanese refugees have resided in seven refugee camps in eastern Nepal on the border with India since 1992. The majority of Bhutanese refugees belong to a Nepali-origin ethnic group known as the Lhotshampa, who migrated to the southern part of Bhutan in the late 19th century on the invitation of the Bhutanese government. Many then fled Bhutan after they were persecuted by the government in the early 1990s.

The overall responsibility for administration of the camps lies with His Majesty's Government of Nepal (HMGN), which supervises the camps with technical supervision and logistical support provided by the UNHCR and WFP, together with their partners. The Bhutanese refugees are not allowed to work outside the camps and have no access to land for agricultural production. The result is a relatively controlled environment, in the sense that the population is essentially entirely dependent on services and goods provided to them through the camp infrastructure, although there is some trading within the camps. Movement of the refugees is also restricted; since the settlement of the camps in 1992, the population size has changed only through intrinsic population growth.

Most indicators of the health and nutrition situation of the Bhutanese refugees are markedly better than that of the population of Nepal [18]. Shelter, food, water, medical care, education, and community services are provided to all registered refugees by the camp authorities. The maternal mortality rate in the camps was 68.9 per 100,000 live births in the year 2000, as compared with a national figure of 475 per 100,000 live births, and the crude birth rate was half the national average [17]. The infant mortality rate in the camps was 21.5 per 1,000 live births, as compared with 74.4 per 1,000 live births nationally. The rate of stunting among preschool refugee children was 33%, as compared with a national rate of 54%. The rate of primary school enrollment is near 100%, and the rate of secondary school enrollment was also quite high (> 80%), although it is higher for boys than for girls [19].

WFP provides a dry food general ration every two months to each refugee family on a per capita basis, depending on the number of registered refugees. In addition, UNHCR provides approximately 100 g of complementary fresh vegetables and spices on a weekly basis. As shown in **table 1**, the general food ration over time has been composed of rice, pulses, vegetable oil, sugar, and salt, which are provided together with the spices and fresh vegetables. Unlike many refugee camps throughout the world that consistently face funding problems, the food supply for the Bhutanese refugees was close to fully funded from 1994 to 2001, enabling WFP and UNHCR to provide the same rations that they had planned with considerable consistency.

Despite the steady provision of food, the refugee population has still proven very susceptible to micronutrient deficiencies. In 1993, cases of beriberi were observed among the refugees, and further investigation found signs of scurvy and angular stomatitis [20]. From mid-1994, to combat deficiencies of vitamin B and vitamin C, polished rice was replaced with parboiled rice and UNILITO, a multiple-micronutrient–fortified blended food, was added to the general ration [21]. The inclusion of UNILITO in the general ration was discontinued in 1998 in order to simplify the general food ration provision, but parboiled rice was continued.

Targeted supplementary feeding rations are provided to vulnerable population subgroups through the health services. The supplementary food ration for pregnant mothers consists of 80 g of UNILITO, mixed together with 10 g of vitamin A–fortified vegetable oil and 15 g of sugar, providing an extra 455 kcal per mother per day during pregnancy and lactation, as well as associated micronutrients. This ration has remained the same over the entire period from 1994 to 2001. Normally, women do not report to receive this ration until the beginning of the second trimester, but coverage of the supplementary feeding program is high. Pregnant women attending antenatal clinics also receive iron–folate tablets providing 60 mg of iron for daily consumption during pregnancy, although adherence is uncertain. Following the discontinuation of UNILITO in the general ration, UNILITO supplements were subsequently provided to adolescents in schools during the dry season, when angular stomatitis was most common.

TABLE 1. Foods in the ration provided to families for general consumption and in food supplements for pregnant women, and their estimated daily nutrient content, during four food-ration periods in Bhutanese refugee camps in Nepal (1993–2001)

Component	Ration 1 (1993–94)	Ration 2 (1995–97)	Ration 3 (1998)	Ration 4 (1999–2001)	Supplement (1993–2001)
Foods (g/person/day)					
Rice[a]	430	430	410	410	—
Lentils[b]	60	60	60	60	—
Vegetable oil	25	25	25	25	10
Sugar	20	20	20	20	15
Salt	5	7.5	7.5	7.5	—
UNILITO[c]	0	40	40	0	80
Potato	42.8	42.8	42.8	42.8	—
Onion	7.1	7.1	7.1	7.1	—
Banana, cabbage, or pumpkin	42.8	42.8	42.8	42.8	—
Garlic	2.8	2.8	2.8	2.8	—
Green chili	2.8	2.8	2.8	2.8	—
Turmeric	1.4	1.4	1.4	1.4	—
Nutrients[d]					
Energy (kcal)	2,139	2,305	2,232	2,079	455
Protein (g)	43.9	51.4	50.1	43.4	13.4
Fat (g)	29.8	32.3	32.1	29.6	24.9
Calcium (mg)	58.0	149.0	148.0	82.0	130.7
Iron (mg)	6.2	17.2	14.2	10.6	7.2
Zinc (mg)	7.8	10.7	10.4	8.4	4
Vitamin A (µg RE)	570	730	730	570	500
Thiamine (mg)	0.5	1.5	1.5	1.3	0.4
Riboflavin (mg)	0.2	0.6	0.6	0.5	0.2
Niacin (mg)	7.7	18.7	18.2	15.4	5.6
Vitamin C (mg)	14.9	34.9	34.9	14.9	40

RE, retinol equivalent

a. Polished rice was gradually replaced with parboiled rice from the middle to the end of 1994.

b. In 2000, 20 g of lentils was replaced with 20 g of chickpeas for sprouting to increase intake of riboflavin, but these changes were not taken into account in calculation of nutrients.

c. UNILITO is a fortified corn–soy blended food that was provided to pregnant mothers as a food supplement throughout. It was included in the general ration from September 1994 and removed in December 1998.

d. Nutrient composition of foods was obtained from McCance and Widdowson [22] except for that of UNILITO and vegetable oil, which was taken from WFP Reports [23]. Polished rice was used to calculate the nutrient content of ration 1 and parboiled rice to calculate the nutrient content of the other rations.

Methods

Permission to carry out this retrospective research was granted by HMGN through the local offices of WFP. An initial assessment was made of the records available in Nepal that would permit the construction of an accurate camp history. The annual reports produced by the Joint Food Assessment Missions carried out by WFP and UNHCR were an important source of information identifying camp events, survey results, problems encountered, and recommendations for future action. The quality of the medical records kept in the health centers of each of the seven camps was also reviewed in order to discover what data could be recovered.

Based on the initial assessment of the medical records, it was decided that only four of the seven camps had a sufficient spread of years with reasonable records still intact that were legible and thus suitable for inclusion in the study. These four camps (Beldangi I, Goldhap, Khundunabari, and Timai) contained 48,000 people, approximately half of the total refugee population. Data were transcribed from the newborn record logbooks and the antenatal card medical records onto data-collection sheets in each camp. In the first camp, the data were collected and entered by one of the researchers, after which local staff, selected because of their familiarity with the records, were trained to collect record data in each of the other three camps. A 20% random sample of all the data-collection sheets was checked each day against the original records. Data entry was performed with the use of EpiInfo (version 6.4) at a central point outside the camps, and a randomly selected 10% of the data being entered each day by each of the three data enterers was double-checked.

The nutritional adequacy of the food ration provided to all refugees and the supplements given to pregnant mothers were also evaluated. The amounts of foods provided to the refugees in the camps over the period of study, as shown in **table 1**, were obtained from annual Food Assessment Mission Reports. The nutritional content of the general food ration and the supplementary foods for pregnant women was calculated with the use of food-composition tables [22] for all foods except UNILITO and vegetable oil [23]. The adequacy of the ration and of the food supplements provided to pregnant women was calculated for four different periods (1993–94, 1995–97, 1998, and 1999–2001) and assessed by comparing the nutrient energy density of the ration provided to the general population both with and without the supplement provided to women during pregnancy in the four periods, with the nutrient energy densities required by women during pregnancy in accordance with the most recent international recommendations [24, 25].

The significance of differences in maternal and birth characteristics across the years of the study was determined by the chi-square test for categorical variables and Student's *t*-test for continuous variables. Statistical analysis of the data was performed with the use of SPSS (version 11).

TABLE 2. Number of births reported to the United Nations High Commissioner for Refugees according to year, as compared with the number of antenatal and newborn records recovered from the medical archives in four of the eight Bhutanese refugee camps studied in Nepal

Year	No. of births reported	Antenatal records — no. (%)	Newborn records — no. (%)
1994	827	125 (15)	456 (55)
1995	1,028	245 (24)	938 (91)
1996	714	299 (42)	665 (93)
1997	876	913 (104)	840 (96)
1998	1,028	884 (86)	1,088 (106)
1999	965	648 (67)	511 (53)
2000	1,253	614 (49)	711 (57)
2001	1,429	619 (43)	984 (69)
All	8,120	4,342 (53)	6,193 (76)

Results

Table 2 shows the total number of births in the four camps, as reported to UNHCR by the camp authorities for the period from 1994 to 2001, compared with the number of newborn records and antenatal records that

TABLE 3. Changes in birthweight and maternal characteristics among babies born in four Bhutanese refugee camps in Nepal from 1994 to 2001

Characteristic	1994	1995	1996	1997	1998	1999	2000	2001	All years	*P* value[a]
Birthweight										
Total no. of infants	452	562	660	818	1,041	505	684	950	5,672	
% of infants										< .0001
< 2.5 kg	16	18	16	11	8	8	8	10	11	
2.5 – 3.4 kg	76	73	75	72	73	75	74	70	73	
≥ 3.5 kg	7	8	10	17	19	17	18	21	16	
Age of mother										
Total no. of mothers	456	899	66	546	1,078	507	705	977	5,234	
% of mothers										< .0001
< 20 yr	20	24	17	17	17	17	16	14	18	
≥ 20 yr	80	76	83	83	83	83	84	86	82	
Time of 1st antenatal care visit										
Total no. of mothers	125	242	293	908	870	643	611	608	4,300	
% of mothers										< .0001
< 20 wk	63	37	46	45	53	52	51	59	51	
≥ 20 wk	37	63	54	55	47	48	49	41	49	
Weight of mother at 1st antenatal care visit										
Total no. of mothers	117	236	291	879	782	586	611	613	4,115	
% of mothers										< .0001
< 45 kg	32	18	36	27	27	23	29	22	28	
≥ 45 kg	68	82	64	73	73	67	71	78	72	

a. Chi-squared test.

were recovered from the medical archives. The coverage of the newborn records was 75% of all reported births in the four camps over the time period. The antenatal records covered only half of the estimated pregnancies that took place over the same period. The highest coverage of births was for 1997 and 1998, with nearly 100% coverage of records for both years.

Table 3 shows that from 1994 to 2001 there were significant improvements in several key maternal and child characteristics of those pregnancies and births in the medical records recovered from the four camps. Confirming previous reports, there was a significant shift from lower to higher birthweights during the period. Whereas the average incidence of low birthweight (< 2.5 kg) was 11% across the period, the rate fell from 18% to 8% between 1995 and 1998 and remained low until 2000. Furthermore, the rate of higher birthweight (≥ 3.5 kg) tripled from 7% to 21% between 1994 and 2001, but the proportion of very large babies (> 4 kg) remained stable at around 2% throughout. The proportion of mothers coming to the antenatal clinic before 20 weeks of pregnancy also increased significantly from 37% in 1995 to 59% in 2001. The proportion of teenage pregnancies also showed a significant decreasing trend from above 20% before 1996 to 14% after 2000. Despite the trend toward earlier first antenatal visits, the proportion of women weighing less than 45 kg at their first antenatal visit showed a decreasing trend (from 32% in 1994 to 22% in 2001), possibly reflecting the trend of reduced teenage pregnancies as well as improved maternal nutritional status.

Figure 1 shows the relationship between mean birthweight and changes in the general ration from 1994 to 2001. Between 1996 and 1998, the mean rate of low birthweight fell from 16% to 8% and mean birthweight increased from 2.84 kg (SE, 2.80–2.87) to 3.0 kg (SE, 2.97–3.03). Birthweight increased by 170 g (6%) from 1995 to 1998, after parboiled rice and UNILITO were introduced into the general ration (ration 2) during the second half of 1994. The upward trend in mean birthweight continued, despite a reduction of 20 g of rice per person per day in 1997 (ration 3), and leveled off when UNILITO was removed from the general ration at the end of 1998 (ration 4). The increase in birthweight was not likely to be related to differences in the treatment of mothers in the later half of pregnancy, which was after they notified the health services of their pregnancy at the first antenatal visit. These treatments, which included receipt of a UNILITO supplement, remained the same throughout the period, although it could be that they were received slightly earlier in pregnancy, as explained above. Neither were the increases likely to be because of changes in the teenage pregnancy rate, since these remained the same from 1996 to 2000.

As shown in **figure 2**, after 1994 the qualitative adequacy of the general food ration available to women during the first half of pregnancy was greatly improved. The adequacy of the nutrient density of the ration was worst for mothers in the first half of pregnancy for ration 1, when all eight nutrients considered were less than 100% of recommended levels and six were less than 50% of recommended levels. Adding parboiled rice and UNILITO to the general ration (ration 2) improved the nutrient energy density of the ration for zinc, vitamin A, thiamine, riboflavin, niacin, and vitamin C to the recommended levels for pregnant mothers. The removal of 20 g of rice per day (ration 3) had little or no effect on the quality of the diet. Removal of UNILTO from the general ration after 1998 (ration 4) had a relatively small negative impact on adequacy of nutrient energy densities, with vitamin C content being most affected.

Figure 3 shows the nutrient and energy densities of the food available to mothers from the general ration during the second half of pregnancy, as well as the

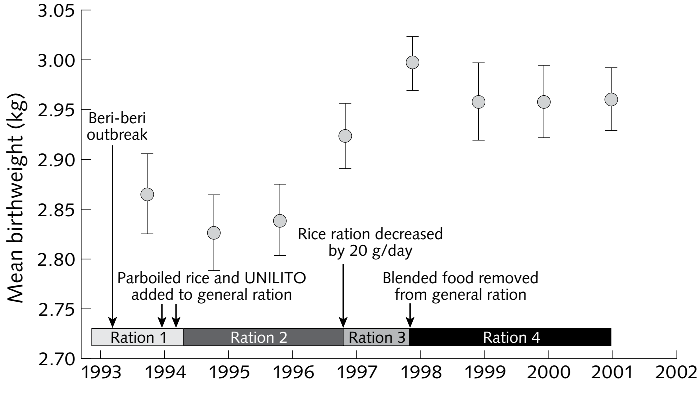

FIG. 1. Birthweight (mean and SE) of babies born to Bhutanese women in four refugee camps in Nepal according to year during four food-ration periods (1994–2001)

contribution of the supplementary ration of UNILITO. Although the same general pattern of adequacy of the ration is observed, the adequacy tended to be greater than for the first half of pregnancy. The exception was zinc, which in the second half of pregnancy was inadequate in all four ration periods. The ration remained inadequate for calcium, iron, and riboflavin during all ration periods and both halves of pregnancy.

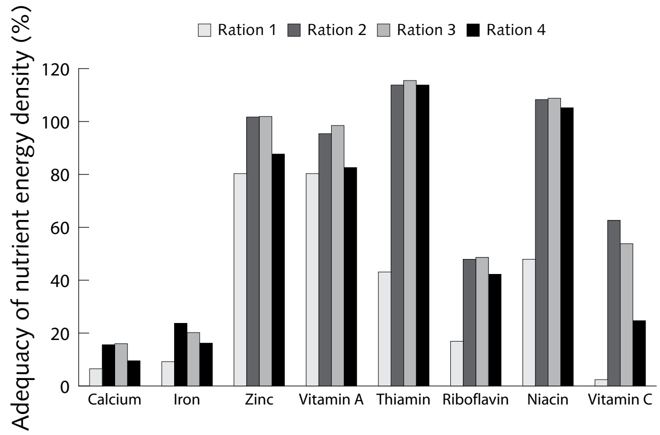

FIG. 2. Adequacy of the general food ration available to Bhutanese women during the first half of pregnancy in refugee camps in Nepal during four food-ration periods (1994–2001)

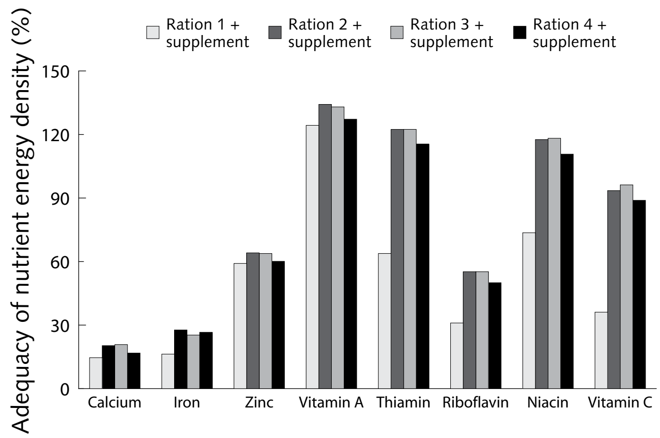

FIG. 3. Adequacy of the general food ration and the food supplements provided to Bhutanese women during the second half of pregnancy in refugee camps in Nepal during four food-ration periods (1994–2001)

Limitations and bias

Selection bias is an issue in most studies of low birthweight in developing countries because of the tendency for data to be available only from hospitals or clinics serving populations who can afford to use them, and difficulties involved with collecting data from women who deliver at home. Such bias is thought to have been minimal in this study because of the incentive that women in the camps have to report their delivery soon after birth; once a delivery is reported, a woman becomes eligible to receive supplementary feeding as a lactating mother. Additionally, it is required that all births in the camps (and hence birthweights) be registered in order for the household to receive general rations.

Despite the incompleteness of the records, it seems likely that the data collected provide a reliable estimate of the birth outcomes in the refugee camps in the period studied. Although it is possible that the 25% of missing birthweights from the four camps might have included a higher proportion of low-birthweight babies, this seems unlikely, given that the coverage of the reported births in the years 1996–98 was about 100%, the period when the rate of low birthweight was only 8%. Consistent with the findings of this study, a representative population-based demographic study carried out in the refugee camps in 1996 found that 18.2% of babies born in the previous year had been born with low birthweight [26], a rate that is similar to the 18% reported in the present study. The missing birthweight records from the years since 1998 seem more likely to have been destroyed rather than not collected, since the paramedics reported that in recent years they had used pages of their old logbooks to wrap up the iron–folate tablets given to the mothers during pregnancy. Because such destruction was random, it is unlikely to have biased the results.

The birthweight information recovered from the medical archives also seems to be reasonably accurate. Camp paramedical staff reported that weighing scales were calibrated annually, and they showed familiarity with the rigor needed in weight and length measurements, undoubtedly gained from being trained to conduct the annual nutrition surveys. Even though the Salter scale used in all clinics weighed to the nearest 100 g, the birthweight distribution showed peaks around the 500-g divisions (i.e., 2.5, 3.0, and 3.5 kg), which suggests rounding to the nearest half-kilogram. The actual rates of low birthweight are thus likely to be slightly higher than those reported here, but this phenomenon is a universal one [27] and is not peculiar to just these refugee camps. The effect on the mean birthweight is likely to be less influential because the rounding up and down will tend to balance out.

Since this was a retrospective observational study, it is not possible to definitively tease out the actual causes of changes in the rate of low birthweight. We also make the assumption that food provided to the refugees was actually consumed in proportion to needs, although it is difficult to estimate actual consumption, given the unavailability of information on intrahousehold food allocation in this population.

Discussion

Efforts to lower rates of low birthweight at the population level in developing countries have generally met with little success or have been seldom documented [2]. The popular conception that reducing the incidence of low birthweight in Asian populations takes a long time to achieve is not supported by these data. Data from the refugee camps over the period studied support the original claim made during the joint food-needs assessment that the rate of low birthweight in the camps is virtually as low as that in the United Kingdom (6%) [28] and certainly lower than those reported for Nepali populations living in either Nepal or Bhutan [16]. These results also support the notion that the basic food and health needs of the refugee mothers were successfully provided for during pregnancy.

It may seem surprising that just 2 years after camp settlement, the rates of low birthweight inside the refugee camp came down very quickly and were approximately a third of those estimated outside in ethnically very similar populations. There is other evidence in the literature, however, that supports the plausibility of such a rapid change. Birth outcomes in refugee camps have been reported previously to be better than in the general population of the host country or the country of origin of the refugees [29]. In two refugee camps studied in Tanzania, similarly dramatic declines in rates of low birthweight (from about 30% to 10%) were observed from July 1998 to July 1999, after which they stabilized at around 10%. This decline was attributed to stabilization following displacement and a comprehensive set of interventions, including supplementary food rations, malaria control, improved antenatal care, iron–folate supplementation, deworming, and screening and treatment for sexually transmitted diseases [30]. There is also evidence that foreign-born immigrant populations settling in Europe and North America have rates of low birthweight similar to those of the local population within 5 years of arrival [31, 32], although Asian-born immigrants residing in the United States still have a greater risk of low birthweight than other population groups [33, 34].

The period covered by this study began 2 years after final settlement of the camps and probably did not capture much of the improvement in rates of low birthweight that would be expected with the initial provision of food and services to the refugee population and the ensuing stabilization of the emergency situation. Nonetheless, an improvement in mean birthweights was captured over the study period, which was most notable over the period from 1994 to 1996. It is intriguing that most services that might be expected to result in changes in birthweight (such as iron supplementation and supplementary feeding with fortified foods of pregnant women) remained constant over the period captured by the study.

We hypothesize that several factors may have been responsible for this change from 1996 to 1998. During this period of improvement, both the energy supply and the micronutrient content of the general ration improved as a result of the addition of fortified blended food to the general ration and the replacement of polished rice with parboiled rice. This change in micronutrient content is particularly intriguing, since it dramatically increased the nutrient energy density of thiamine, riboflavin, niacin, and vitamin C for the entire population, including women in the first half of pregnancy. Prior to this change, the consumption of most micronutrients was far below adequate levels, especially among mothers during the first trimester of pregnancy before they registered at antenatal clinics and became eligible for supplementary feeding. It may be hypothesized that the increase in birthweight during the period from 1996 to 1998 provides circumstantial evidence of the importance for fetal growth of maternal micronutrient status during the first 4 months of pregnancy, a time when consumption of vitamins and minerals among refugee populations is often low.

Evidence from the literature that multiple-micronutrient supplementation in the second half of pregnancy has any additional impact on birthweight over iron–folic acid supplementation is still far from conclusive [7, 35]. Studies from Mexico [36] and Nepal [8] have similarly shown that antenatal multiple-micronutrient supplementation confers no additional benefit on birthweight over iron–folic acid supplementation. However, another study from Nepal did find an additional benefit of a multiple-micronutrient supplement on birthweight compared with iron–folic acid alone [13]. A trial of thiamine supplementation during pregnancy in Karen refugees eating rice-based rations in Thailand also failed to have an impact on birthweight [37]. In all of these studies and reviews, micronutrient supplementation began only after pregnancy was reported at the health facility, and in most situations mothers were at least 3 months pregnant when supplementation began.

Although efficacy studies have yet to be reported, considerable evidence is emerging from the literature for the importance of periconceptional micronutrient status in improving birth outcomes. Although it is unclear which period of gestation is most important for determining birthweight [38, 39], it seems that the risk of delivering a low-birthweight baby at full term is determined very early in pregnancy [40]. Furthermore, several studies in developed countries have shown associations between the micronutrient content of the diet of mothers and/or their micronutrient status during pregnancy and fetal growth, implicating vitamin C and E as well as riboflavin and n-3 fatty acids [41–44]. A case–control study in China found significant associations between preterm birth and both elevated plasma homocysteine and low plasma vitamin B_{12}, but not folate, measured before conception [45]. An observational study in the United States showed that the use of multivitamin supplements during the first and second trimesters reduced the risk of low birthweight twofold as a result of a twofold reduction in the rate of preterm delivery [46]. Of even greater relevance, perhaps, is evidence from rural India that consumption of micronutrient-rich foods (milk, green leafy vegetables, and fruits) during pregnancy and erythrocyte folate levels at 28 weeks of gestation were independently and positively associated with the size of the infant at birth [47].

As is perhaps to be expected, considering the qualitative inadequacy of the general ration for iron, anemia is still a problem in the refugee camps, and more could still be done to further improve the micronutrient situation of this and other refugee populations [48]. Angular stomatitis caused by riboflavin deficiency still persists in the camps [20]. The Centers for Disease Control adolescent survey, a representative household-based survey of the refugee population 10 to 19 years of age, found that 24% were anemic, although the rate of anemia rose to 37% in postmenarchal girls [20]. It is thus highly likely that a third of mothers are anemic when they enter pregnancy. These multiple-micronutrient deficiency issues should be further considered, and measures should be taken to improve the micronutrient status of refugee women before they become pregnant.

It is likely that the reduced number of teenage pregnancies made an important contribution to these improved birth outcomes among the refugees. The practice of prepubertal marriage, which was apparently common among refugee families while they were still in Bhutan, has been strongly discouraged since the establishment of the refugee camps [26]. Less than 2% of births in the past 5 years were to mothers under 16 years of age, and the rate of teenage pregnancies had decreased to less than 20%. This contrasts with Nepal, where 51.8% of women had given birth by the age of 20 [49].

In adolescent mothers who are still growing, there is a maternal–fetal competition for nutrients, and infant weight is a significantly smaller proportion of total gestational weight gain, with birthweight being lower by 150 to 200 g [50]. Teenage pregnancies make an important contribution to the very high rates of maternal mortality and low birthweight found outside the camps in Nepal as a whole [51]. The improvements in birthweight observed in the refugee camps did not seem to be associated with any increase in negative obstetrical consequences. Limited information extracted from the birth records (data not presented) suggests that three-quarters of babies were delivered at home in the refugee huts, with the remaining babies delivered in either the camp health center (9%) or a hospital outside the camp (15%). The great majority of births were normal (96%), with very few cesareans (2%) or breech and forceps deliveries (2%), and these proportions did not change over the period.

In conclusion, despite the unique nature of this refugee population, this study provides an example that it is possible to improve birthweights in developing-country contexts over a relatively short period and achieve rates of low birthweight similar to those observed in developed-country settings. Likely contributors to this outcome are the provision of basic needs in shelter, food, water, sanitation, and health services and the reduction in teenage pregnancies. The improvements in birthweight observed in the period from 1996 to 1998 are also supportive of the hypothesis that improving micronutrient status periconceptionally and during early pregnancy has an important influence on fetal development over and above that achieved by meeting the basic protein and energy needs of the mother. It would be important to test some of the hypotheses raised by the findings of this study in full programmatic settings, besides institutionalizing qualitative improvements in the diets of women of reproductive age in refugee settings across the world.

Acknowledgments

The study was funded by the World Food Programme (WFP) and carried out by the Institute of Child Health, London, and WFP. Keith Sullivan provided statistical advice for the analysis of the data. We appreciate the assistance and support in Nepal from the WFP Nepal Country Office, the Nepal office of the United Nations High Commissioner for Refugees, the Nepali Technical Assistance Group, and the Association of Medical Doctors of Asia.

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Programmatic effects of a large-scale multiple-micronutrient supplementation trial in Indonesia: Using community facilitators as intermediaries for behavior change

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Abstract

Background. *Clinical trials can serve as an opportunity gateway for enhanced health benefits to the target population, above and beyond the specific intervention being tested.*

Objective. *The Supplementation with Multiple Micronutrients Intervention Trial (SUMMIT), a randomized, controlled clinical trial in Lombok, Indonesia, found that supplementation during pregnancy with multiple micronutrients reduced 90-day infant mortality by nearly 20% as compared with iron–folic acid. This trial was designed as both a program and research trial and used community facilitators to serve as liaisons between the study and the pregnant women. This analysis documents the programmatic impacts of SUMMIT on health-seeking and early infant mortality resulting from community facilitators' field activities.*

Methods. *Data on compliance, human resource practices, health-seeking, and health outcomes from the 31,290 SUMMIT enrollees were analyzed.*

Results. *Overall compliance with either iron–folic acid or multiple micronutrients was high in the program, at 85.0%. Early prenatal care visits increased significantly. Sixty-three percent of primiparous women used a skilled birth attendant (SBA); among multiparous women, the rate of use of a SBA rose from 35% for the last birth to 53%. Use of a SBA resulted in a 30% reduction in early infant mortality (RR, 0.70; 95% CI, 0.59 to 0.83; p < .0001), independently of any reductions due to multiple micronutrients. The community facilitators played a central role in improving health-seeking; however, the quality of the community facilitators' performance was associated with the impact of the micronutrient supplement on infant health. In a subsample of community facilitators, better-performing facilitators were found to markedly improve the overall impact of the multiple micronutrients on early infant mortality (RR, 0.67; 95% CI, 0.49 to 0.92; p = .0117). In contrast, infants of women with poorly performing community facilitators were found to derive no additional benefit from the multiple micronutrients (RR, 1.04; 95% CI, 0.64 to 1.72; p = .8568).*

Conclusions. *Systematic enhancements to the quality of implementation of SUMMIT led to significant increases in use of SBAs at delivery, resulting in a 30% reduction in early infant mortality independent of the impact of micronutrient supplementation. Therefore, if women were to consume multiple micronutrients on a regular basis and were to use a SBA at delivery, the risk of early infant mortality could be reduced by nearly 50%. The impacts of community facilitators in effecting changes in women's health behaviors are notable and are applicable to other health programs. Enhancements to program implementation should be driven by evidence, be accountable to the communities the program serves, and be evaluated on the basis of measurable gains in health for women and children.*

Key words: nutrient supplementation, pregnant women, program implementation, community health workers

Introduction

As we strive to achieve the Millennium Development Goals, it is critical to identify mechanisms that can substantially improve the health of mothers and their children. One such crucial measure is to combat

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micronutrient deficiencies, which affect more than 2 billion individuals worldwide, many of whom are pregnant and lactating women [1–3]. Nutrition interventions have focused on iron-deficiency anemia as the single most prevalent type of nutrient deficiency; however, these pregnant women typically have deficiencies of many additional nutrients, such as iodine, vitamin A, and zinc that can lead to greater morbidity and mortality for both mother and child [3, 4].

Supplementation with either single or multiple nutrients has been shown to markedly improve health and prevent death [5, 6]. However, the benefits of supplementation can only be realized if individuals have access to the supplements and consume them as recommended. Past experience with iron-supplementation programs has demonstrated limited reductions in iron-deficiency anemia, due in part to insufficient coverage and poor compliance [1, 7, 8], as well as lack of proper health-seeking behaviors of pregnant women and the ineffective attitudes and actions of health delivery staff [9–11]. Efforts are needed both to identify new interventions to enhance health and to examine methods of expanding coverage and increasing demand for good-quality services. The primary focus of these analyses is to examine the additional health-care impacts that have resulted from the overall engagement of the Supplementation with Multiple Micronutrients Intervention Trial (SUMMIT) program activities within the community and the role of the community facilitators in promoting positive health behaviors.

In 2000, SUMMIT was established on the island of Lombok in West Nusa Tenggara Province, Indonesia. As a randomized, double-blind, controlled clinical trial, SUMMIT was designed to compare the maternal and child health benefits of providing a cohort of 31,290 pregnant women with multiple-micronutrient supplements versus iron and folic acid, with both groups being supported by community facilitators [12]. The central vision of this programmatic research was to create a new paradigm that would allow rigorous field research to be carried out in a way that prioritizes the needs and interests of the participants and communities, while serving policy planners, public health professionals, and researchers. Thus decision-making was geared, as much as possible, toward the priorities of pregnant women, their families, and their unborn children.

The results from SUMMIT demonstrated an 18% reduction in early infant mortality (death within 90 days after birth) among children whose mothers consumed multiple micronutrients as compared with those whose mothers consumed iron–folic acid. Even greater reductions in early infant mortality were seen in infants of anemic women (38%) and of malnourished (mid-upper-arm circumference < 23.5 cm) women (25%) [12]. In a cohort of SUMMIT infants weighed within 1 hour of birth, for women who received multiple micronutrients as compared with iron folate, the overall incidence of low birthweight was decreased by 14% and by 33% among infants of mothers who were anemic at enrollment [12].

SUMMIT sought to combine the scientific rigor of traditional randomized, controlled trials with the practicality of health programs to create more broadly relevant programmatic research. Drawing on community-based participatory methods in conjunction with iterative evidence-based implementation enhancements, SUMMIT attempted to enrich outputs and improve the overall impacts of the program. Moreover, it was implemented through the existing health infrastructures so that it could ideally result in swift and meaningful health policy formulation and full-scale implementation.

Early formative research on existing health-care delivery and health-seeking patterns revealed the need for a more direct channel of information exchange between SUMMIT activities and pregnant women. This led to the development of the community facilitator post, which became a cornerstone of SUMMIT activities. The mandate of the community facilitator was to work directly with health service personnel and pregnant women to improve health-seeking practices and overall compliance with supplementation. This paper documents the impacts on health-seeking and early infant mortality resulting from the systematic enhancements in program implementation utilized in SUMMIT.

Community facilitator: From recruitment to training and fieldwork

All community facilitators were locally recruited (living and working in the same village) in order to enhance the likelihood of their understanding the native language, customs, and environmental conditions of the area. They worked closely with skilled birth attendants, pregnant women, and informal and formal leaders and assisted in social marketing activities that provided information to the community, especially to pregnant women, on the value of antenatal and delivery care for pregnancy.

As with all SUMMIT employees, selection of community facilitators followed a specific, *locally* developed recruitment procedure. This assessment and selection process exemplifies the systematic enhancement of implementation, as it was developed through an iterative examination of existing human resource practices, successes, and failures of implementation and final outcomes. On the basis of these data, the recruitment process was enhanced accordingly. The recruitment assessments were designed to identify individuals who could demonstrate motivation, determination, compassion, and integrity in their work. Although initially there were significant challenges in hiring women, over time, an increasing number of women served as community facilitators. Eligible applicants, either men or women, who had a minimum of a senior high-school education, were provided with program materials and a short description of the SUMMIT program to review in preparation for a general test one week later. A didactic review was provided prior to the testing to answer questions and explain the program. Each general test was a unique computer-based examination composed of 150 questions randomly selected from a pool of over 600. Those unfamiliar with computer use were allowed to practice using the computer and mouse. All applicants scoring adequately on the entrance examination were invited to participate in a 1- to 2-week training to review information and skills necessary for the job. The applicants were asked to sign a pretraining agreement stipulating that they would be required to pass each module at a certain level and that once hired they would need to go through regular retraining and certifications to maintain their knowledge base. Training included use of the field manual, interview techniques, and accurate data collection. Mastery was assessed by examinations at the end of each training session and evaluation of demonstrated skills. After the participants passed training, they were eligible to undergo technical certification.

The SUMMIT certification examination was designed to objectively assess the candidate's mastery of the principles promoting effective communications and enhanced social interactions, as well as technical knowledge necessary for work. Following the technical evaluation, the candidates completed the field evaluation assessing field practice and community interaction skills. The recruitment procedure is summarized in **figure 1**.

The community facilitator's role was to establish good rapport with the pregnant woman and, to the extent possible, her family, as a means of improving the woman's health-seeking behaviors and knowledge. The community facilitator would travel directly to each woman's home on a regular basis, usually once or twice monthly, as well as participating in monthly activities at the integrated health post. During visits, the community facilitators provided health information, encouraged the women to seek early prenatal care, including acquiring and consuming supplements, and tracked supplement consumption patterns. They also supported social marketing activities including community activities, and distribution of written materials such as brochures covering each stage of pregnancy.

Once hired, SUMMIT community facilitators underwent certification procedures every 3 months. They were paid a modest salary for their work, which was divided into a standard salary and field activities salary. The field activities salary was subject to successful advancements through certification. If the community facilitator did not perform adequately on the certification, they were eligible for further retraining and retesting. The community facilitator supervisors were tasked to assist the community facilitators to maintain certification and continually enhance their skills.

Community facilitators were evaluated with the use of a rating system referred to as the "Head, Heart, and Hands" scores. These scores focused on key aspects of the community facilitator's work in the community. The Head score was based on how well the community facilitator performed on evaluations assessing knowledge of information gained during trainings and certifications. The Heart score was based on how well the community facilitator demonstrated caring for the pregnant woman and her health, gauged by a combination of inputs from the pregnant woman and the facilitator's supervisor. The Hands score reflected how thoroughly and efficiently the fieldwork was completed. This included visiting the women in a timely manner, filling out necessary forms, and turning work in on

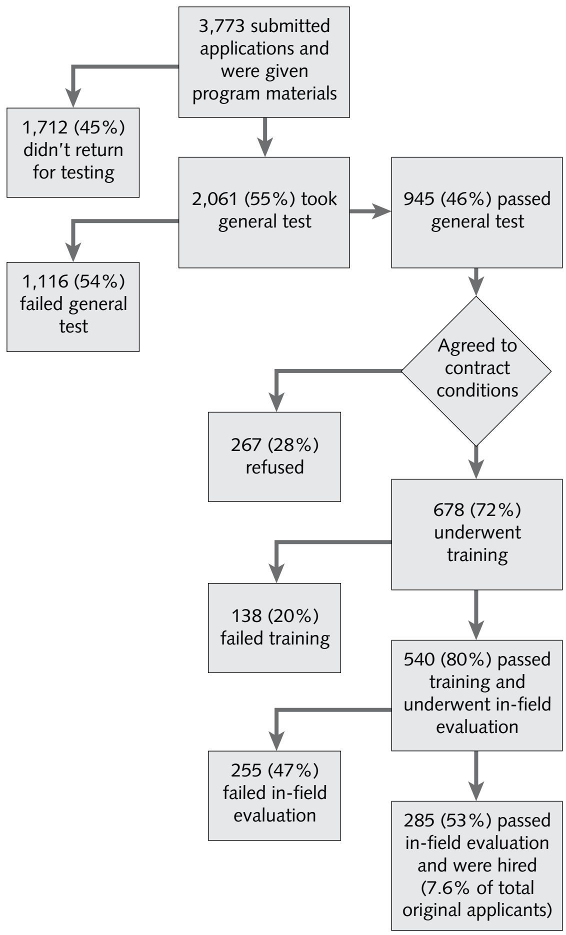

FIG. 1. Flow diagram of recruitment procedures for SUMMIT community facilitators (numbers reflect the sample of community facilitators hired from 2003–2004.)

time. Although individual community facilitator scores were kept confidential, a group score was developed for each area, reflecting the overall quality of the work.

Methods

Compliance was determined by the number of capsules a woman consumed divided by the number of days that capsules should have been consumed since the woman's most recent receipt of supplements. This was an average compliance, as determined through pill counts by SUMMIT staff at the woman's home and pill counts conducted at the local integrated health post when the woman came to replenish her stocks. Comparisons among subgroups were performed using overall median compliance. Simple frequencies were used to compare groups, and statistical significance was checked by Student's *t*-test of means for normally distributed variables and chi-square tests of proportions for categorical variables.

Relative risks of mortality were calculated using the generalized estimating equations fixed-effects model with SAS PROC GENMOD with the log link function and exchangeable correlation [13]. Differences in effects within subgroups were assessed by addition of the appropriate interaction term to the model and by multiple pairwise comparisons of the estimated rates and confidence intervals [14]. The predefined criterion for significance of effect modifiers was $p < .10$.

Results

The SUMMIT program demonstrated significant reductions in early infant mortality and low birthweight as a result of multiple-micronutrient supplementation [12]. The programmatic impacts described here are distinct from the micronutrient supplementation and are related to the actual enrollment and supplementation process. The primary focus of these analyses is to examine the additional health-care impacts that have resulted from the overall engagement of the SUMMIT program activities within the community and the role of the community facilitator in promoting positive health behaviors.

Adherence to supplementation

Overall compliance with either iron–folic acid or multiple micronutrients was very high in the program, with a median compliance of 85.0% overall (85.5% in the iron–folic acid group and 84.4% in the multiple-micronutrients group). Seventy percent (21,847 women) consumed more than half the doses (four or more capsules) per week. Importantly, supplement consumption did not differ between the treatment groups (multiple micronutrients and iron–folic acid). No significant differences were found between low and high compliers in socioeconomic and demographic characteristics, such as age, education, or material wealth.

Timing of prenatal care visits

Previous qualitative data revealed that the first visit to confirm pregnancy generally occurred after a woman noticed a change in her abdominal size (usually during the second trimester), since missing a menstrual period was not considered a reliable sign of pregnancy and menstrual cycles generally were not tracked. In some areas, women delayed pregnancy testing because they believed that early testing could cause a miscarriage, because they faced barriers to obtaining care, such as distance to a health center or lack of money for transportation or pregnancy tests, or simply because they felt physically healthy and did not recognize the need to seek care.

As SUMMIT activities were initiated within each subdistrict, we found that enrollment rates tended to follow similar patterns. In general, the first month showed comparable enrollment rates for each trimester, most likely because all women who were pregnant within a catchment area were encouraged to enroll, regardless of their stage of pregnancy. By the second month, an increasing proportion of first-trimester pregnancies were enrolled. **Figure 2** provides an example of enrollment rates in one subdistrict in Lombok over an 8-month period from July 2001 to February 2002. In this example, a steady increase in first-trimester enrollees was seen over the period, reaching nearly 70% of total enrollees.

Use and impact of a skilled birth attendant at delivery

The impact of use of a skilled birth attendant during delivery is important, as it can significantly reduce the risk of death for both the mother and the child. In 1998, according to the Nutrition Surveillance Survey and the Indonesian Demographic Survey [15, 16], the proportion of women using a skilled birth attendant at delivery varied significantly across subdistricts in Indonesia (ranging from 17% to 78%). In 2000, 60% of women on Lombok interviewed through the Nutrition Surveillance Survey reported delivering with a traditional birth attendant and 40% with a skilled birth attendant.

Within the SUMMIT enrolled cohort (**fig. 3**), our data reveal that of the women who had previously delivered, only 35% had used a skilled birth attendant. After having enrolled in SUMMIT, a significantly ($p < .0001$) greater percentage of these women were found to use a skilled birth attendant (53%), and 63% of primiparous women enrolling in SUMMIT used a

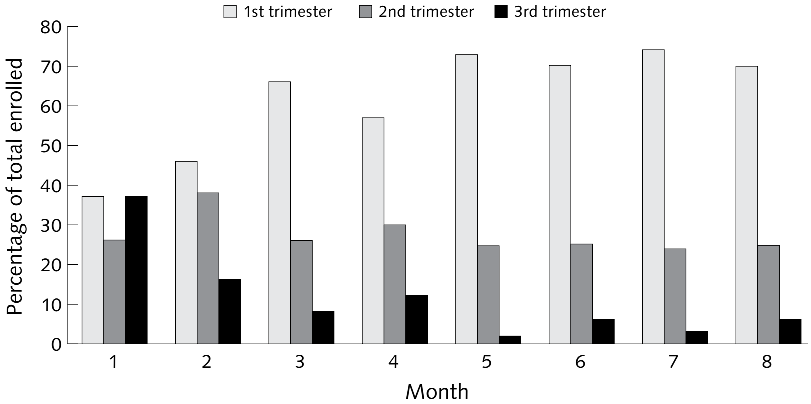

FIG. 2. Changes in gestational age at enrollment in one sub-district from July 2001 to February 2002

skilled birth attendant for their current delivery.

In an effort to examine the impact of use of a skilled birth attendant on early infant mortality, we conducted an analysis of use of a skilled birth attendant while controlling for micronutrient consumption. This analysis demonstrated that use of a skilled birth attendant led to a 30% reduction in early infant mortality (RR, 0.70; 95% CI, 0.59 to 0.83; $p < .0001$) that was independent of an 18% reduction in early infant mortality resulting from consumption of the multiple micronutrients (**fig. 4**). In a separate analysis, we found no impact of the use of a birthing facility on the mortality rate. This may be due to the relatively low numbers attending a birthing facility and the likelihood that the majority of facility-based deliveries are high-risk.

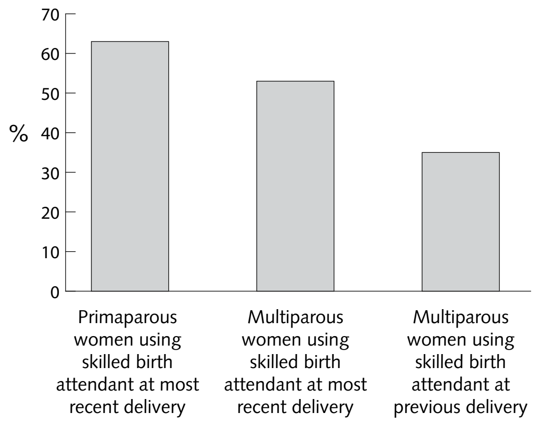

FIG. 3. Percentage of pregnant women in SUMMIT using a skilled birth attendant at delivery ($p < .0001$)

Impact of community facilitator performance on early infant mortality

As a means of ascertaining the overall effectiveness of the recruitment and certification procedures, we examined the relationship between the quality of the community facilitator's performance and the impact of supplementation on infant health within the facilitator's cohort of enrollees. On the basis of the community facilitator's Head, Heart, and Hands scores and discussions with field supervisors in 2003 and 2004, a total of 344 community facilitators were ranked; of these, 46 were ranked as good performers, 262 as average, and 36 as poor. Good and average performers were maintained as SUMMIT community facilitators, and poor performers were generally relieved of their field duties within 3 to 6 months.

Figure 5 demonstrates that for community facilitators whose performance was average, the overall impact of the multiple micronutrients on early infant mortality in those women they serviced was similar to that found for the overall cohort (RR, 0.78; 95% CI, 0.64 to 0.94; $p = .0077$). If the community facilitator performed better than average (i.e., was ranked as "good"), the

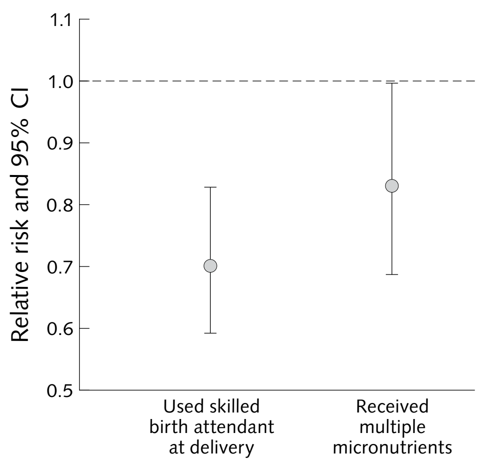

FIG. 4. Independent impacts of use of a skilled birth attendant and multiple micronutrient supplementation on early infant mortality. Bars indicate 95% confidence intervals

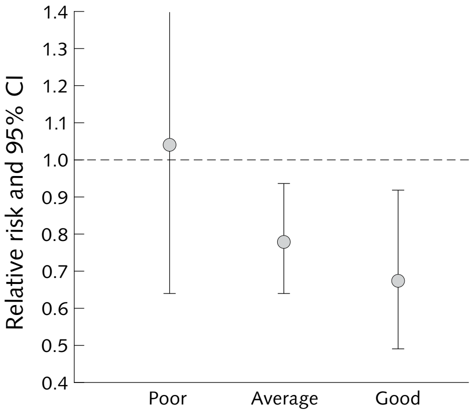

FIG. 5. Impact of multiple micronutrient supplementation on early infant mortality based on community facilitator's performance. Bars indicate 95% confidence intervals

overall impact of the multiple micronutrients on early infant mortality was markedly improved (RR, 0.67; 95% CI, 0.49 to 0.92; p = .0117). However, if the community facilitator was ranked as a poor performer, we found that the multiple-micronutrients supplement conferred no additional benefit to early infant mortality (RR, 1.04; 95% CI, 0.64 to 1.72; p = .8568).

Discussion

There is a tacit assumption among scientists and researchers conducting trials that they are responsible only for demonstrating whether an intervention can or cannot be efficacious in improving health under ideal conditions. In traditional randomized, clinical trials, the impact of the program itself, often referred to as the Hawthorne effect, is considered to be controlled through the use of a placebo group. In the SUMMIT approach, however, the Hawthorne effect is a necessary impact to track. Most research trials in developing-country settings will see an impact on the outcome variable by virtue of the additional inputs within the health system or through efforts to enhance community participation, education, or interaction. These impacts may often have health effects that are above and beyond the specific intervention being tested. This is exemplified by a recent study on the impact of a women's group program on pregnancy outcomes in Nepal, which found that despite an 8% program participation rate, there was a substantial health impact at a population level throughout the intervention areas [17].

The original mandate of SUMMIT was to implement rigorous field research in a way that prioritizes the health needs of the participants and communities. This focus allowed for systematic evaluations of all aspects of SUMMIT activities, with a considerable emphasis on the potential application of the community facilitator's interface with the pregnant woman. Although the community facilitators were not involved in providing any health intervention per se, they did provide information regarding health issues, encourage the women to replenish their stocks of supplements, and work with local health workers to revitalize activities at the integrated health posts.

The impact of the community facilitator on compliance levels was effective in both the multiple-micronutrients and the iron–folic acid groups. The overall compliance rate of 85% is comparable to that found in other clinical trial settings [18, 19], despite the large population that was served [1, 20]. The regular visits of SUMMIT community facilitators were instrumental in maintaining pregnant women's interest in consuming the supplements as well as addressing any barriers to consumption that may exist. A recent study in Mali found similar results, as women were more likely to take micronutrient supplements if access was guaranteed and provided with minimum, consistent, relevant, and easily understandable information and counseling [21].

We propose that substantial behavior change was created through the regular dialogues between community facilitators and pregnant women at their homes and potentially by an increase in earlier use of prenatal care (**fig. 2**). This is evidenced by the nearly doubling in the proportion of women using a skilled birth attendant at delivery. This increase in use of a skilled birth attendant had marked impacts on health outcomes for the newborn, resulting in a 30% reduction in early infant mortality that was independent of the impact of micronutrient supplementation. Therefore, if a woman were to consume multiple micronutrients on a regular basis and were to use a skilled birth attendant at delivery, she would be able to reduce the risk of early infant mortality by nearly 50%. This substantial decrease in early infant mortality can be attained through two relatively simple interventions.

The impact of the community facilitators on health behaviors demonstrates the importance of a rigorous recruitment and certification program. The recruitment procedures used in SUMMIT were developed through a systematic examination of human resource data collected over time. The incremental changes to the evaluation system were made to increase the likelihood of identifying well-performing staff. The documentation of the impact of the SUMMIT recruitment process provides a unique example of how an evidence-based recruitment processes can result in more effective implementation of health programs. Indeed, despite the fact that health workers are critical to achieving national health goals, there is little systematic evidence of the most efficacious strategies for recruitment, training, retention, and supervision in routine programs in low- and middle-income countries [17].

A recent review of health programs using community health workers revealed a number of key lessons learned for optimization and reiterated the need to supervise and support workers and provide significant incentives or remuneration systems to reduce attrition [22]. Many health programs on Lombok are facilitated by local health volunteers. Unfortunately, these volunteers often do not have the resources or capacity to adequately undertake these health initiatives. Moreover, there is little supervision or assessment of the impact of their activities. Indeed, none of the more than 200 local health volunteers who applied to serve as SUMMIT community facilitators were able to sufficiently complete the recruitment assessment procedures.

Research on the effectiveness of community health workers stresses that active involvement of communities is needed to ensure support for the community worker [22]. There are important links between accountability and participation with respect to demand-side approaches to service delivery, and greater participation is frequently linked to improving accountability [23]. Engaging the pregnant women in the community facilitator assessment process not only provided an external accountability for the community facilitators, but also empowered the women to expect good-quality services from health-care personnel. The knowledge that the community facilitators would be evaluated by the experiences of the pregnant women they served provided an additional incentive to actively engage the target population, creating positive relationships for all parties involved.

The most compelling evidence for the importance of active monitoring and supervision of health workers is seen through the disproportionate impacts of the intervention related to the quality of the performance of the community facilitators. As assessed by the Head, Heart, and Hands score, the majority (76%) of the community facilitators performed adequately. In the cohort of adequately performing community facilitators, the impact of the intervention on early infant mortality was 22%—slightly higher than the 18% that was found in the overall cohort. If the community facilitator performed well or above average, however, the overall impact of the supplementation was considerably higher, at more than 30%. Most striking is the evidence that if a community facilitator performs below average or poorly, little or no impact of the intervention can be seen. Therefore, if a health worker is employed to implement a specific intervention, those benefits will only be realized if the health worker is functioning effectively and is able to obtain regular feedback and support to improve. It appears from our data that the more competent the community health worker, the greater the overall health impacts can be.

Although this study focused on the use of community facilitators within the context of a multiple-micronutrient trial, the use of community facilitators to effect changes in health behaviors could be applied to nearly any health program. There is a renewed interest in revitalizing the role of community health workers and in understanding their potential contribution to improve the lives of individuals living in resource-poor settings [24, 25]. In the future, such endeavors should strive to develop sustainable models that will support local development and provide quality service. Implementation of these programs should be driven by evidence, and programs should be accountable to the communities they serve and evaluated on the basis of measurable gains in health for women and children.

Acknowledgments

We would like to acknowledge Mackenzie Green for her contributions towards the development and implementation of the Head, Heart and Hands scoring system for community facilitators. SUMMIT was supported by funds from the Turner Foundation, UNICEF, the Center for Health and Human Development, and the US Agency for International Development (grant 497-G-00-01-00001-00).

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Neonatal period: Linking best nutrition practices at birth to optimize maternal and infant health and survival

Chessa K. Lutter and Camila M. Chaparro

Abstract

Delayed umbilical cord clamping, immediate skin-to-skin contact, and early initiation of breastfeeding have been shown to be simple, safe, and effective and should be implemented in all deliveries, with very few exceptions. Although these practices can also prevent death, their importance extends beyond survival and optimizes both short-and long-term neonatal and maternal health and nutrition. Their implementation requires that they be integrated with one another and included with other standard lifesaving care practices. Leveraging knowledge of efficacious interventions into high-quality programs with broad coverage is often the main obstacle to improving neonatal and maternal health in low-income countries. To achieve results at-scale, attention must be given to increasing access to scientific information supporting evidence-based practices and addressing the skills needed to implement the recommended practices; establishing and communicating global, national, and local policies and guidelines for implementation in conjunction with advocacy and synchronization with other maternal and neonatal care efforts; reorganizing delivery care services; and monitoring and evaluation. This will require international investments similar to those being made for other lifesaving neonatal interventions. Neonatal vitamin A supplementation, recommended for implementation in Asia, is controversial, and the evidence for and against this recommendation is reviewed.

Key words: Anemia, breastfeeding, delayed cord clamping, neonatal mortality

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Introduction

Prevention of neonatal and maternal morbidity and mortality requires the identification of efficacious interventions and investment in public health systems capable of implementing them with high quality and coverage. This is particularly true at birth and during the following 24 hours, when approximately 25% to 45% of neonatal and 45% of maternal deaths occur [1, 2]. Certain delivery care practices, by directly improving infant iron status or creating an environment in which skin-to-skin contact and breastfeeding initiation are promoted, can greatly benefit the short- and long-term health of mothers and newborns. Although these practices can also prevent death, their importance extends *beyond survival* by optimizing short- and long-term maternal and newborn health and nutrition [3, 4]. They are also consistent with and complement other lifesaving interventions currently the subject of global investment, such as the active management of third-stage labor to prevent maternal mortality [5].

This article has two objectives. The first is to examine the evidence base for the short- and long-term benefits to the newborn and/or mother from delayed umbilical cord clamping, immediate skin-to-skin contact, early initiation of breastfeeding, and neonatal vitamin A supplementation. Leveraging knowledge of efficacious interventions into high-quality programs with broad coverage is often the main obstacle to improving neonatal and maternal health in low-income countries [6, 7]. In maternal and newborn care, this translation of efficacious interventions into standard care practices is further complicated by the fact that a number of different and possibly competing health professionals are involved in the care of the mother and newborn, including obstetricians, pediatricians, neonatologists, midwives, nurses, and nursing assistants. Eliminating professional and institutional impediments to implementing integrated interventions that address simultaneously the needs of both the mother and the newborn is a major challenge. Therefore, the second objective is to describe how the practices deemed to be efficacious can be effectively and universally implemented. Because the evidence base for delayed umbilical cord clamping, immediate skin-to-skin contact, and early initiation of breastfeeding has been recently reviewed [3, 4, 8–11] relatively less attention is given to the first objective, except for the review of the evidence around neonatal vitamin A supplementation, which continues to be controversial.

Epidemiology of neonatal mortality

As total infant mortality declines, the proportion occurring during the neonatal period increases [1, 12]. This makes interventions to prevent neonatal mortality of particular relevance for achieving the Millennium Goal of reducing child mortality by two-thirds between 2000 and 2015 (Goal 4) [13]. In the Americas, not only is infant and child mortality increasingly concentrated in the neonatal period, but neonatal mortality has proven intractable to public health efforts to date. Most of the estimated 48% reduction in infant mortality between 1995 and 2005 has been through reductions in postneonatal rather than neonatal mortality (**fig. 1**) [14].

Many causes of neonatal deaths in low-income countries are amenable to intervention, and the majority can be prevented. In an analysis of 4 million neonatal deaths, Lawn and colleagues showed that infections (sepsis, pneumonia, tetanus, and diarrhea) caused 36% of deaths and asphyxia caused 23% of deaths in 192 countries in the year 2000 [15]. Another 27% of deaths were caused by preterm birth, the deleterious effects of which could possibly be prevented or ameliorated by the interventions described in this paper.

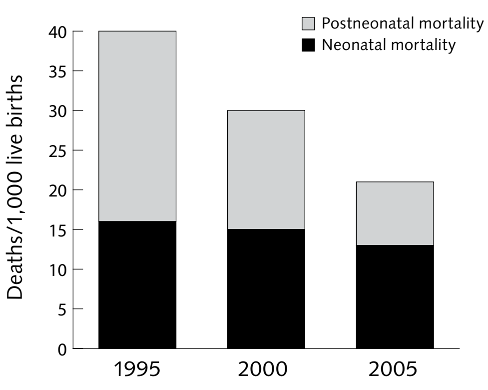

FIG. 1. Trends in neonatal and infant mortality in the Americas, 1995–2005
Source: Pan American Health Organization [14]

Evidence for benefits of delayed umbilical cord clamping, immediate skin-to-skin contact, and early initiation of breastfeeding

Evidence for benefits of delayed umbilical cord clamping, immediate skin-to-skin contact, and early initiation of breastfeeding supports their near universal implementation; there are few exceptions when these practices will not benefit maternal and/or infant health and nutrition. Excellent current reviews are available on the subject, including several on delayed cord clamping [8-11], skin-to-skin contact [10], and breastfeeding [16, 17] and on the three practices combined [3, 4]. Two recent publications have shown that early initiation of breastfeeding substantially reduces infant mortality [18, 19], and the World Health Organization (WHO) recommends delayed cord clamping as part of its protocol for the prevention of postpartum hemorrhage [5].

Delayed umbilical cord clamping

Delayed cord clamping takes advantage of the fact that for several minutes after birth, blood still circulates between the infant and the placenta through the umbilical vein and arteries, which if allowed to flow to the infant is the source of 1 to 3 months of additional iron reserves [20, 21]. Early clamping thus deprives the newborn of this additional source of hemoglobin that is needed to prevent iron deficiency and anemia during the first 6 months of life, when exclusive breastfeeding is recommended and other sources of iron from food or supplements are not recommended. The exception is in the case of preterm or low-birthweight infants, when iron supplements are recommended beginning at 2 months [22]. Short-term benefits of delayed clamping are also evident, particularly for preterm or low-birthweight infants who also begin life with lower iron stores. In these infants, delayed clamping prevents intraventricular hemorrhage [11, 23] and sepsis [23] and reduces the number of days on oxygen [24], the need for or the number of days on mechanical ventilation [25], the need for surfactant [25], and transfusions for low blood pressure or anemia [26].

Concerns about the negative effects of delayed clamping relate to the risks of polycythemia and hyperbilirubinemia resulting from an increased hematocrit. However, a review of 15 controlled trials found that no clinical signs of polycythemia were reported among late-clamped infants, despite their having significantly higher hematocrits during the first 48 hours after birth [8]. This same review also found that late-clamped infants did not have significantly increased mean serum bilirubin, clinical jaundice, or need for phototherapy. A more recent review of 11 trials found that 5% of delayed-clamped infants did require more phototherapy for jaundice, compared with only 3% of early-clamped infants, although the criteria for initiation of phototherapy used in each of the reviewed studies were not discussed [9].

The effects of delayed cord clamping on maternal health have been less rigorously studied than the effects on infant health and nutrition, although there is no evidence that delayed clamping affects the amount of maternal blood loss [20, 27, 28] or hemoglobin levels [28]. The same review of 11 trials cited above also found no association between the timing of cord clamping and maternal blood loss at delivery, length of the third stage of labor, or need for manual removal of the placenta [9]. In summary, delayed umbilical cord clamping has numerous benefits for the newborn and no apparent risks for either the newborn or the mother.

Delayed clamping is important because iron deficiency is the most prevalent nutritional deficiency in the world [22], is thought to be the major nutritional cause of anemia, and is of particular concern in infants and young children because of its pernicious and possibly irreversible effects on motor and cognitive development [29-31]. Although not all anemia is caused by iron deficiency, recent animal and human studies suggest that iron deficiency, even in the absence of anemia, is associated with the same adverse effects [32]. The prevalence of anemia is higher during infancy and early childhood than at any other time in the life cycle, including pregnancy [33]. Among children under 5 years of age, the prevalence of anemia (defined as hemoglobin < 110 g/L) ranges from around 35% to 90% [34]. Among infants, the prevalence of anemia ranges from 25% to nearly 100%, with the majority of countries having a prevalence in excess of 70%. Recent estimates put the global prevalence of anemia in young children at 42% [35]. The very high prevalence of anemia by 6 months of age among infants in Latin America and the Caribbean (**fig. 2**) as well as in other world regions is alarming, because it indicates that infants are becoming anemic early in life when iron reserves should still be adequate to meet iron needs. This implies that even greater numbers of infants are likely to be iron-deficient (but not yet anemic) by these ages.

Iron-deficiency anemia occurring during infancy is associated with poorer cognitive, motor, and social or emotional outcomes, even after treatment to correct the deficiency or anemia [37]. Nerve myelination may be altered in infants suffering from iron-deficiency anemia; one study of 6-month-old infants showed slower conduction times for auditory brainstem responses in infants with iron-deficiency anemia, as compared with normal controls [38]. Of particular concern was that 4 years later, after treatment to correct the anemia, the originally anemic infants still had poorer outcomes than the control infants [38]. The

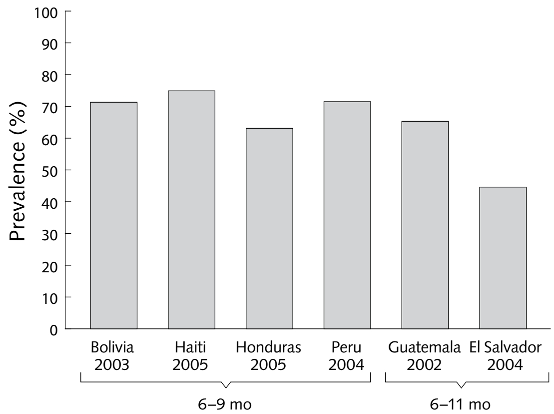

FIG. 2. Prevalence of anemia (hemoglobin < 110 g/dL) among 6- to 11-month-old children in countries of Latin America and the Caribbean with available data
Source: Pan American Health Organization [36]

compounded negative effect of lower socioeconomic status and iron deficiency on cognitive development is highly relevant for public health policy [31]. A study of a cohort of Costa Rican adolescents tested for iron-deficiency anemia as infants and children showed that at 19 years of age, participants of middle socioeconomic status who had chronic iron deficiency in infancy and received treatment scored on average 9 points lower on cognitive testing than their peers of similar socioeconomic status who had not suffered from iron-deficiency anemia. For young adults of low socioeconomic status, the difference in cognitive test scores associated with iron-deficiency anemia during infancy was nearly tripled to 25 points. Because anemia and iron deficiency have proven very difficult to prevent through public health interventions, effective interventions to improve iron status, particularly among infants under 6 months of age, during a critical period of their neurological and motor development, are likely to have important health, educational, and long-term economic benefits [39].

Immediate skin-to-skin contact

The benefits to the mother and newborn of immediate skin-to-skin contact, with respect to promoting early initiation of breastfeeding and enhancing thermal control in the newborn, are well established. Skin-to-skin contact, in which the naked infant is placed in a prone position on the mother's bare chest or abdomen and both are covered with a warm blanket, helps to establish breastfeeding, infant temperature regulation, and maternal–infant bonding. Its effects in eliciting "prefeeding behavior," in which the newborn begins spontaneous sucking and rooting movements to find the breast and to latch on and suckle, without assistance, are important for the establishment of lactation [10, 40–42]. Newborns who were placed skin-to-skin with their mothers for about one and a half hours, starting in the first minute after birth, had significantly better breastfeeding scores for the first latch and time to effectively suckle than newborns who had been wrapped in blankets and held [10]. Inasmuch as breastmilk production is a function of how frequently the infant nurses and empties the breast, early, frequent, and effective nursing will help to both establish milk production and prevent excess neonatal weight loss [43]. Early breastfeeding, resulting from skin-to-skin contact, also results in better breastfeeding outcomes and a longer duration of breastfeeding [10].

Skin-to-skin contact promotes thermal control in the newborn both through direct contact with the warm mother and by promoting early initiation of breastfeeding, since vigorous early suckling also generates heat in the newborn. Studies have shown skin-to-skin contact to be as effective as incubator care for hypothermic newborns and more effective than placing them in cots [43, 44]. Skin-to-skin contact also is beneficial to newborn sleep patterns [45].

Early initiation of exclusive breastfeeding

Breastfeeding is the single most cost-effective intervention to prevent child mortality [46] and has numerous short- and long-term benefits to both infants and mothers [16, 47]. It is also a behavior that is highly amenable to public health intervention (**fig. 3**) [17, 48]. In two studies involving nearly 34,000 newborns, a dose–response relationship was demonstrated between the timing of breastfeeding initiation and mortality. One study showed odds ratios of 2.5 and greater for mortality when initiation began after 24 hours compared with within the first hour after birth [18]. The second study showed a relative risk of 1.4 for late (> 24 hour) initiators versus early (< 24 hour) initiators [19]. The authors estimated that approximately one-fifth of all neonatal deaths (19.1% in one study and 22% in the other) could be prevented if all newborns initiated breastfeeding within the first hour of life. As with delayed umbilical cord clamping, the benefits of early initiation of breastfeeding are particularly pronounced for preterm infants [49, 50]. Given the well-established efficacy of breastfeeding in preventing mortality in infants and promoting health among both mothers and newborns, coupled with the effectiveness and cost-effectiveness of promotion programs [51–59], it is incomprehensible that investment in the promotion, protection, and support of breastfeeding appears to have fallen off the agenda for international public health investment.

Newborn vitamin A supplementation and infant survival: Evidence and controversy

Recommendation of a single high-dose vitamin A supplement of 50,000 IU during the neonatal period only in certain geographic areas (specifically, in Asia but not in Africa) in the recent *Lancet* series on Maternal and Child Undernutrition [48] caused controversy. Benn and colleagues argued that the reported beneficial effects of supplementation at birth and after 6 months were at odds with a lack of effect between 1 and 5 months of age [60]. The effects of vitamin A

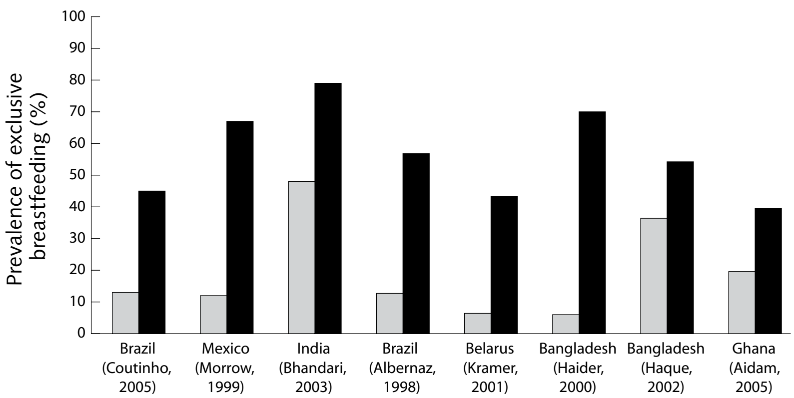

FIG. 3. Importance of health-worker training and lactation counseling after hospital discharge for the duration of exclusive breastfeeding. Control groups [hatched bars] did not receive any additional post-hospital discharge breastfeeding support throughout the study. Intervention groups [solid bars] had some form of postdischarge peer-counseling breastfeeding support, often through home visits. The prevalence of exclusive breastfeeding at the endpoint of each study is noted; for the study from Brazil, the mean aggregated prevalence over the period between 10 and 180 days is presented.
Source: Brazil [53, 54], Mexico [59], India [55], Belarus [58], Bangladesh [56, 57], and Ghana [52].

supplementation depended on the vaccines with which it was distributed, since a negative interaction between vitamin A supplementation and diphtheria-pertussis-tetanus (DPT) vaccine in girls has been observed [61]. As a result, once DPT coverage increases in Asia, neonatal vitamin A supplementation would not be beneficial, at least for girls. Finally, they stated that once neonatal vitamin A supplementation was established as policy, it would be unethical to perform the research needed to understand the sex- and vaccine-specific conditions under which it may or may not be beneficial. Sachdev, a coauthor on the original *Lancet* paper, voiced his concerns regarding the recommendation for neonatal vitamin A supplementation and was overruled; he also argued that additional published studies needed to be considered before making policy recommendations [62]. The response to these concerns from the *Lancet* series authors was that the recommendation that neonatal vitamin A supplementation be scaled up in at-risk populations in Asia was a cautious interpretation [63] of the published evidence, and that a careful evaluation of outcomes and benefits of neonatal vitamin A supplementation had been called for in the *Lancet* paper [64].

A thorny issue in vitamin A supplementation has been its different effects, depending on age, physiological and medical conditions, and geographic location. For example, vitamin A supplementation improves survival in children 6 to 59 months of age in many [65, 66], but not all [67], settings with endemic vitamin A deficiency and high mortality but has no effect on survival in these same settings among infants 0 to 5 months of age [68, 69]. It has no effect on overall infant mortality when women are supplemented during pregnancy [70, 71]. Vitamin A and/or β-carotene during pregnancy reduced maternal mortality by 44% ($p < .005$) in Nepal but had no effect in Bangladesh, where the rates of both maternal vitamin A deficiency and mortality were lower [72].

The effect of vitamin A supplementation on HIV transmission and child mortality in the context of maternal HIV infection is particularly complex. The observation that poor vitamin A status in HIV-positive pregnant women was associated with increased risk of transmission to their children led to a large trial testing the effect of maternal and/or neonatal vitamin A supplementation on the risk of transmission and child mortality [73]. Although there was no effect of either postnatal maternal or neonatal supplementation on postnatal mother-to-child transmission of HIV, the timing of infant HIV infection modified the effect of vitamin A supplementation on child mortality. Among infants who were polymerase chain reaction (PCR)-negative for HIV at baseline and who remained negative, no effect of maternal or neonatal vitamin A supplementation on mortality was observed. Among infants who were PCR-negative at baseline but positive at 6 weeks (indicating they probably contracted HIV during birth or very early postpartum), neonatal supplementation reduced 2-year child mortality by 28% ($p = .01$). Among this same group, maternal supplementation had no effect. However, among infants who were PCR-negative at 6 weeks (but exposed to HIV through breastfeeding), maternal and/or neonatal supplementation was associated with a twofold increase in mortality. Although supplementation did not increase HIV transmission, the authors postulated that among infants who did acquire HIV, vitamin A supplementation may have increased their viral load and hastened their death. They concluded that targeted vitamin A supplementation of HIV-positive children prolongs their survival, but that postpartum maternal and/or neonatal vitamin A supplementation increased the progression to death in breastfed children who were PCR-negative at 6 weeks but became infected through breastfeeding. They therefore voiced concerns about universal maternal or neonatal supplementation in areas with endemic HIV. Contrary to expectation, this study did not reveal information relevant to the prevention of vertical HIV transmission or lead to changes in the current recommendations to reduce such transmission [74, 75].

The results of published studies on early neonatal vitamin A supplementation (within the first few days of birth) are mixed. Of the six published studies, three in Asia showed substantial reductions in infant mortality: 64% in Indonesia, 22% in South India, and 15% in Bangladesh [66, 76, 77]. One in Asia showed no effect on mortality, although the dosing occurred throughout the neonatal period, rather than in the very early neonatal period as in the other five studies [68]. The remaining two studies, in the African countries of Guinea-Bissau and Zimbabwe, showed no effect [78, 79].

WHO recommendations for supplementation can vary, depending on the situation; for example, universal iron supplementation to children was recently recommended only in non-malaria-endemic areas [80]. The quandary with neonatal vitamin A supplementation is that, as yet, a biological explanation as to why newborns in Asia appear to benefit whereas African newborns do not, which would underpin a setting-specific recommendation, has not been elucidated. WHO will be holding an Expert Consultation in 2009 for review of neonatal vitamin A supplementation guidelines and has commissioned a systematic review on the subject, which has been accepted for publication. Until this consultation has occurred, it would be premature to include neonatal supplementation in the practices that should be immediately and comprehensively included in the standard of care described in the second part of this paper, despite the apparently promising results in Asian settings.

Integration of essential delivery care practices within maternal and newborn health services

It is essential that the three delivery care practices described above (delayed umbilical cord clamping, immediate skin-to-skin contact, and initiation of breastfeeding within the first hour of life) be integrated with one another and included as standard delivery care practices [3]. This requires increasing access to scientific information supporting evidence-based practices and addressing the skills needed to implement the recommended practices; establishing and communicating global, national, and local policies and guidelines for implementation in conjunction with advocacy and synchronization with other maternal and neonatal care efforts; organization of delivery care services; and monitoring and evaluation.

Establishing the "why" and "how" underlying the recommended practices

Establishing the "why" and "how" behind the recommended practices is an essential step for their implementation. Dissemination of the evidence base for these practices is necessary and should underlie all clinical practice, medical and nursing school curricula, and public health policy. This knowledge must be accompanied by training and practice in the skills necessary for implementation. Although the skills needed to implement these practices are not new or highly technical, training and practice will be needed for many practitioners. Therefore, training materials that address *how* to deliver each practice and *why* each practice is important and answer concerns and questions related to implementation are essential.

Establishing and implementing global, national, and local policies and guidelines

To ensure that knowledge is translated into appropriate interventions, the recommended practices need to be implemented into global, national, and local policies for delivery care and widely disseminated and communicated. Although policies and guidelines will not be sufficient alone to ensure implementation at the individual level, they are important for changing both current and future practices. They provide a basis for medical curricula, which is particularly important in light of the fact that recent revisions in the WHO Recommendations for the Prevention of Postpartum Hemorrhage [5] call for delayed cord clamping, in contrast to previously established and widely disseminated guidelines calling for early clamping.

To improve public health indicators of maternal and infant well-being, the implementation of these practices needs to occur at several levels. A deliberate and coordinated effort at various levels is needed to avoid delays. At the local or hospital level, it will be important to identify particular individuals who can motivate staff and effectively communicate hospital policy to any new additions to the maternity service. This will be particularly important in teaching hospital settings, where there is frequent rotation of students, interns, and residents who frequently learn by observation and practice.

Advocacy to raise awareness and knowledge among important stakeholders is an essential part of the process for implementing change. Important stakeholders for the recommended practices include international, regional, and national professional associations of obstetrics and gynecology, pediatrics, neonatology, midwifery, and nursing. Obtaining the support and enthusiasm of these associations and leading opinion makers within them is necessary to initiate the implementation process and to give visibility to the integrated care practices being advocated. Ministries of Health through their normative role in establishing policy and monitoring health inputs and outcomes also have a key role to play. Momentum for implementation can also be enhanced by creating demand for the practices; therefore, advocacy among pregnant women is also essential. More often than not, pregnant women have little to no input with respect to the health practices employed in their care, even when those practices are of no benefit (or even of potential harm) to their own or their infant's health. Increasing women's knowledge of the importance of delayed cord clamping, immediate skin-to-skin contact, and early initiation of breastfeeding for the health and well-being of their newborns will help to form a critical mass of beneficiaries that lobby for the institutionalization of these practices.

Lastly, to increase the impact and coverage of the recommended practices and avoid duplication of efforts, their implementation must be coordinated with the efforts of already established global initiatives for improving maternal and neonatal health. These include Saving Newborn Lives, the Prevention of Postpartum Hemorrhage Initiative, and the Partnership for Maternal, Newborn and Child Health.

Organization of delivery care services

The physical organization of maternal and neonatal care services, as well as the "timeline" of when delivery care practices are implemented, is essential for the successful implementation of the recommended practices. This is particularly important in settings with a high volume of births where delivery rooms need to be turned over quickly and space tends to be scarce. However, it is also important where there are few births and the temptation to "keep busy" by "taking charge of the newborn" is greater. Ideally, a mother and newborn would stay together in the quiet of the delivery room in skin-to-skin contact for at least the first hour after birth. This setting provides the cocoon-like atmosphere that probably best fosters maternal–newborn bonding. It also avoids any disruption during the critical period when the newborn is alert and awake and is most likely to initiate breastfeeding with little or no assistance. Since this will not be possible in many settings, the next best option is to initiate skin-to-skin contact in the delivery room and to cover the mother and infant while they are moved to the general maternity ward. Care should be taken to make this transition as easy as possible for the mother and infant and to make a bed immediately available after the move. All routine newborn procedures, such as bathing, weighing, and clinical examination, should be delayed for at least the first hour.

Monitoring and evaluation

The implementation of the recommended practices needs to be monitored and rigorously evaluated so as to make necessary policy and program adjustments and to assess the impact and costs of the results achieved [81]. In implementing new practices such as those recommended in this paper, monitoring (ideally as part of a monitoring system already in place) is particularly important in order to identify program strengths as well as weaknesses. The act of assessing and reporting back on the process of implementation, such as the proportion of births in which the three recommended practices are successfully practiced, is in itself a kind of intervention, since practitioners are much more likely to adopt a certain behavior when they know they are being observed. Communicating the results to the appropriate stakeholders at the hospital, subregional, and national levels will also help to facilitate global adoption.

In conclusion, delayed umbilical cord clamping, immediate skin-to-skin contact, and early initiation of breastfeeding have been shown to be simple, safe, and effective for decreasing neonatal mortality, with benefits for maternal and child health going well beyond survival. Their universal implementation will support the achievement of the Millennium Development Goal related to child survival as well as many other development objectives. Implementation of these practices will improve equity in health as well, since their impact will be greatest in low-income populations, where infants are more commonly born prematurely, with low birthweight, or to mothers who are anemic, and who will derive greater benefit from these practices. Achieving widespread and high-quality implementation so that all mothers and newborns benefit is the next challenge and one worthy of international investments in health.

Acknowledgments

The authors gratefully acknowledge Jose Martines and Leslie Elder for their helpful comments on the section of the paper on neonatal vitamin A supplementation.

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Implementing and revitalizing the Baby-Friendly Hospital Initiative

Randa Saadeh and Carmen Casanovas

Abstract

The Baby-Friendly Hospital Initiative (BFHI) was launched in the 1990s by the World Health Organization (WHO) and UNICEF as a global effort with hospitals, health services, and parents to ensure babies are breastfed for the best start in life. It is one of the Operational Targets of the Global Strategy for Infant and Young Child Feeding endorsed in 2002 by the Fifty-Fifth World Health Assembly and the UNICEF Executive Board. After about 18 years, great progress has been made, and most countries have breastfeeding authorities or BFHI coordinating groups. The BFHI has led to increased rates of exclusive breastfeeding, which are reflected in improved health and survival. Based on this progress, the Initiative was streamlined according to the experience of the countries and materials were revised. The new package consolidated all WHO and UNICEF materials into one package, reflected new research and experience, revisited the criteria used for the BFHI in light of HIV/AIDS, reinforced the International Code of Marketing of Breast-Milk Substitutes, provided modules for mother-friendly care, and gave more guidance for monitoring and reassessment. WHO and partners will continue to give support to BFHI implementation as one essential effort contributing to achievement of the Millennium Development Goals.

Key words: Baby-friendly Hospital Initiative, Global Strategy for Infant and Young Child Feeding, Breastfeeding, HIV/AIDS, International Code of Marketing of Breast-milk Substitutes, Mother-friendly care

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Introduction

Breastfeeding, especially exclusive breastfeeding, is central to achieving the Millennium Development Goal for child survival. The Baby-Friendly Hospital Initiative (BFHI) is a global effort to implement practices that protect, promote, and support breastfeeding. When the BFHI was launched in the early 1990s in response to the Innocenti Declaration's call for action, there were very few countries that had dedicated, national-level, breastfeeding support activities [1]. Today, after nearly 18 years of World Health Organization (WHO) endorsement and UNICEF country-level support for its implementation, most countries have breastfeeding or infant and young child feeding authorities or BFHI coordinating groups and have assessed hospitals and designated at least one facility as "baby-friendly."

The 2002 WHO/UNICEF Global Strategy for Infant and Young Child Feeding [2] includes a call for renewed support — with urgency — for exclusive breastfeeding from birth to 6 months and continued breastfeeding with timely and appropriate complementary feeding for 2 years or longer. At least six of the nine operational targets of the Global Strategy are directly relevant to the BFHI. In addition, step three of the five steps in HIV and Infant Feeding: Framework for Priority Actions [3] is dedicated to improvement of health systems and training of providers, specifically calling for strengthening of the BFHI.

With the renewed call for the BFHI in the Global Strategy for Infant and Young Child Feeding, the challenges posed by the HIV pandemic, and the experiences of countries, WHO and UNICEF led the process through which the global BFHI materials were revised, updated, and expanded for integrated care [4].

Methods

Since the launching of the BFHI, more than 20,000 hospitals in 156 countries have been designated as baby-friendly. During this time, a number of regional meetings offered guidance and provided opportunities for networking and feedback from dedicated country professionals involved in implementing the BFHI. Two of these meetings were conducted in Spain, for the European region, and Botswana, for the Eastern and Southern African region. Both meetings offered recommendations for updating the Global Criteria and related assessment tools, as well as the 18-hour course, in light of experience with the BFHI since the Initiative began, the guidance provided by the new Global Strategy for Infant and Young Child Feeding, and the challenges posed by the HIV pandemic. The importance of addressing mother-friendly care within the Initiative was raised by a number of groups as well.

As a result of the strong interest in the BFHI package and requests for its updating, WHO and UNICEF undertook the revision of the materials in 2004–05, with various people assisting in the process. The process included an extensive user survey among colleagues from many countries. Once the revised course and tools were drafted, they were reviewed by experts worldwide and then field tested in industrialized and developing-country settings. The full first draft of the materials was posted on the UNICEF and WHO websites as the "Preliminary Version for Country Implementation" in 2006. After more than a year's trial, presentations in a series of regional multicountry workshops, and feedback from dedicated users, UNICEF and WHO met with the coauthors and resolved the final technical issues that had been raised. The final version was completed in late 2007.

The updated materials reflect new research and experience, reinforce the implementation of the International Code of Marketing of Breast-Milk Substitutes, include support to mothers who are not breastfeeding, provide modules on HIV and infant feeding and mother-friendly care, and give more guidance for monitoring and reassessment.

Major recent findings on the impact of the original BFHI package

New findings underscore the successful implementation of the BFHI worldwide and the impact of the BFHI on exclusive breastfeeding rates. Studies have also confirmed that exclusive breastfeeding rates increase when a facility becomes baby-friendly, and this increase is reflected in improved health and survival [5]. When included as an essential element in a comprehensive, multisector, multilevel effort to protect, promote, and support optimal infant and young child feeding, the BFHI provides a vital contribution to achieving and sustaining the behaviors and practices necessary to enable every mother and family to give every child the best start in life by creating sustainable change beyond the hospital and throughout the health system.

The impact of the BFHI can be demonstrated at the hospital, community, and country levels.

Evidence from both developed and developing countries indicates that the BFHI has had a direct impact on breastfeeding rates at the hospital level. For example, in Switzerland [6], a 2003 analysis of data from mothers who had given birth in the past 9 months demonstrated that the percentage of infants exclusively breastfed at 0 to 5 months was significantly higher among those who had delivered in baby-friendly hospitals than in the general sample.

The study in Switzerland also noted that the average duration of breastfeeding was longer for those who had given birth in a baby-friendly hospital that showed good compliance with the Ten Steps to Successful Breastfeeding [1] than for those who had given birth in a baby-friendly facility without good compliance, leading investigators to conclude that increases in Switzerland's breastfeeding rates from 1994 to 2003 were attributable in part to the BFHI.

In a randomized, controlled trial in Belarus, Kramer and colleagues noted improved rates of exclusive breastfeeding and any breastfeeding long after the hospital stay, as well as reduced rates of illness, among infants of mothers giving birth at hospitals randomly assigned to follow BFHI policies compared with those delivering at control hospitals [7].

In an urban area of Montes Claros in Brazil, a population area served by three hospitals that were designated as baby-friendly there was a much more rapid increase in initiation and duration of exclusive breastfeeding than in surrounding areas [8].

Although global trends in breastfeeding initiation, duration, and exclusivity have been generally increasing during the years since BFHI implementation, few studies have examined the association between trends in BFHI activities at the national level and improvements in breastfeeding practices. One study conducted in Sweden noted that the percentage of mothers breastfeeding at 6 months increased dramatically from 50% at the start of the country's BFHI in 1993 to 73% in 1997, when 100% of maternity centers had achieved baby-friendly status, a result suggesting that the BFHI was effective in promoting breastfeeding among Swedish mothers [9]. However, trends in breastfeeding have resulted from multiple interventions, policy shifts, and changing social norms, making it difficult to separate impacts specific to this Initiative.

Lessons learned and identified gaps

Country reports presented to WHO and UNICEF found that:

- *The BFHI is doable.* All country reports and studies confirmed that programs to implement the BFHI, following the guidance provided, resulted in an increase in the desired practices.

- *The BFHI is adaptable.* The BFHI was appropriate for countries with vastly differing circumstances and was found to be extremely adaptable, as it has now been implemented in a wide variety of cultural and socioeconomic settings.
- *The BFHI may enhance attention to quality of care for others, based on health worker interviews.* Many health workers and hospital administrators have noted that the BFHI was a catalyst to considering quality of care in other hospital sectors.
- *BFHI sustainability demands ongoing political and financial commitment to quality.* Insufficient recognition of the effectiveness and impact of the BFHI by policy makers, health professionals, and donors can result in a diminution of quality and sustainability.
- *The BFHI will not be fully sustainable until infant and young child feeding support skills, including the techniques of breastfeeding support, are fully integrated into preservice health worker education.* The need for reassessments and refresher training demands constant investment, which could be reduced by strengthening in-service curricula and training for all health workers.
- *Step 10—which is the only step that extends beyond hospital settings and concerns community protection, promotion, and support for breastfeeding – is not well implemented and linked to the facility effort, ensuring support to mothers after discharge, and thus resulting in reduced impact.* Community support—through skills training and social marketing—is a vital link to an effective and sustainable program, whether initially developed as part of the BFHI or integrated into ongoing community activities.

In assessing the overall feedback from and status of BFHI implementation in countries, it was evident that although no basic changes were necessary in the BFHI, there was an urgent need to address maintenance of quality, sustainability, integration and mainstreaming, expansion, including preservice training, implementation of step 10, and awareness of feeding plans of HIV-positive women.

Revised package

The revised BFHI package has five sections:

Section 1: Background and Implementation provides guidance on the revised processes, sustainability, integration, and expansion options at the country, health facility, and community levels, recognizing that the Initiative has expanded and must be mainstreamed to some extent for sustainability. It includes subsections on country- and hospital-level implementation; the Global Criteria for the BFHI; compliance with the International Code of Marketing of Breast-Milk Substitutes; baby-friendly expansion and integration options; and resources, references, and websites.

Section 2: Strengthening and Sustaining the Baby-Friendly Hospital Initiative: A Course for Decision-Makers was adapted from the WHO course "Promoting breast-feeding in health facilities: a short course for administrators and policy-makers." It can be used to orient hospital decision makers (directors, administrators, key managers, etc.) and policy makers to the Initiative and the positive impacts it can have, and to gain their commitment to promoting and sustaining the Ten Steps. There are a Course Guide and eight session plans with handouts and PowerPoint slides. Two alternative session plans and materials for use in settings with high HIV prevalence have been included.

Section 3: Breastfeeding Promotion and Support in a Baby-Friendly Hospital, a 20-hour course for maternity staff, can be used by facilities to strengthen the knowledge and skills of their staff for successful implementation of the Ten Steps to Successful Breastfeeding and the International Code of Marketing of Breast-Milk Substitutes. This course replaces the 18-Hour Course. It includes guidelines for course facilitators, outlines of course sessions, and PowerPoint slides for the course. The section also suggests an agenda and content for training nonclinical staff.

Section 4: Hospital Self-Appraisal and Monitoring provides tools that can be used by managers and staff initially to help determine whether their facilities are ready to apply for external assessment and, once their facilities are designated baby-friendly, to monitor continued adherence to the Ten Steps. This section includes a hospital self-appraisal tool and guidelines and tools for monitoring.

Section 5: External Assessment and Reassessment provides guidelines and tools for external assessors to assess initially whether hospitals meet the Global Criteria and thus fully comply with the Ten Steps and then to reassess, on a regular basis, whether they continue to maintain the required standards. This section includes a guide for assessors, a hospital external assessment tool, PowerPoint slides for training assessors, guidelines and tools for external reassessment, and a computer application for analyzing results.

The revised package of BFHI materials is available on the WHO and UNICEF websites. Sections 1 through 4 can be accessed at: www.unicef.org/nutrition/index_24850.html, or at: www.who.int/nutrition/topics/bfhi/en/index.html.

Section 5, External Assessment and Reassessment, is not available for general distribution. It is available to the regional and national UNICEF officers through the UNICEF Intranet and at WHO regional offices to provide to the national authorities for the BFHI. It is also made available to the assessors who conduct BFHI assessments and reassessment.

The major updates and revisions include the following:

» An updated and enhanced set of guidelines for implementing the BFHI at the country and hospital levels, including options for enhancing sustainability, further integrating the BFHI into the health-care system, and expanding its focus into other health units and into the community.
» Additional content related to:
  – HIV and infant feeding in the two courses (sections 2 and 3) and an optional HIV and infant-feeding module in the self-appraisal, monitoring, and assessment tools (sections 4 and 5).
  – Mother-friendly childbirth practices in the 20-hour course and a new "mother-friendly care" module in the self-appraisal, monitoring, and assessment tools.
  – The International Code of Marketing of Breast-Milk Substitutes in the two courses and a new "Code" module in the monitoring and assessment tools.
  – Support for non-breastfeeding mother–baby pairs in the 20-hour course and added material in the self-appraisal, monitoring, and assessment tools to assess the support for these mothers and their infants.
» An update in the "Medical Reasons for Use of Breast-Milk Substitutes." The list is now available as an attachment to the BFHI material and as an independent document [10].
» Inclusion of updated technical information and data from recent research in the two courses and an updated set of references, including websites, in section 1.
» An enhanced practical focus in the 20-hour course, with the addition of a story of two mothers and role-playing and problem-solving exercises related to their support, and additional clinical practice sessions.
» An upgraded set of assessment tools, with improved key points, added guidance for sampling and tallying results to assist assessors, etc.
» A new self-contained computer-based tool for tallying and presenting assessment results that can be used without any additional software.
» PowerPoint slides and transparency templates for use with the two courses and for training assessors.
» Additional guidance and tools for use in monitoring and reassessment of baby-friendly health-care facilities in sections 4 and 5.

In addition, the updated materials provide guidance on the road to baby-friendly designation at the health facility level. The following points are suggested:

» If your health facility is not yet designated as baby-friendly this is what to do:
  – Obtain the BFHI self-appraisal materials from your country's central BFHI coordination group and complete the self-appraisal.
  – Make an action plan to address any areas that need attention. Find out what support is available from your country's central BFHI coordination group.
  – Develop and undertake a comprehensive training plan to address the needs that will lead to changes in practices supporting the baby-friendly process.
  – When the self-appraisal indicates a high standard of practice, contact your country's central BFHI coordination group to arrange for an external assessment team to visit the health facility.
  – When the health facility is designated as baby-friendly, carry out ongoing monitoring or auditing to ensure that the practices remain supportive.
» If your health facility was designated baby-friendly more than 3 years ago, there may need to be a reassessment to ensure the practices are still in place. Follow the steps for the original assessment: self-appraisal, action planning as needed, seeking external assessment, and then ongoing monitoring or auditing.

The way forward

WHO and UNICEF have policies and strategies in place that outline many of the necessary steps in the way forward, and should continue to support those plans. Governments should ensure that all personnel who are involved in health, nutrition, child survival, or maternal health are fully informed and energized to take advantage of an environment that is conducive for revitalizing the BFHI; incorporate the basic competencies for protection, promotion, and support of optimal infant and young child feeding, including the BFHI, into all health-worker curricula, whether facility- or community-based health workers; recognize that the BFHI has a major role to play in child survival in general and more so in the context of HIV/AIDS; and seek and establish regional collaboration for skills development; seek funding and political support as well as commitment on the part of all UN agencies and governments to revitalize the BFHI in order to achieve Millennium Development Goals.

Decision and policy-makers should be sensitized and encouraged to support the BFHI as an essential part of a comprehensive infant and young child feeding approach. The Innocenti + 15 provides a list of priority actions that include the BFHI [11]. However, the sensitization, or social marketing, for decision makers is a significant undertaking. Country-to-country support and the training of decision makers using the provided tools are two proven options.

Step 10, or community action to protect, promote, and support breastfeeding, must be strengthened. Mainstreaming and integrating breastfeeding into community programs must be carried out in a manner that sustains the good quality of support. This is not simply a matter of community information, but rather necessitates good-quality training, social marketing, community mobilization, and backup from a prepared health system.

The Planning Guide for implementation of the Global Strategy for Infant and Young Child Feeding [12] may provide additional approaches and ideas for exciting and energetic implementation planning. It is important to build upon what exists and to create a situation where there is sustainability of all four pillars: legislation and regulatory support, health-worker education, health-system monitoring and ongoing assessment, and community action may be the key to a comprehensive and sustainable cost-effective initiative. Throughout, the focus should remain on improved quality and impact and the shared global goal of increasing maternal, infant, and child survival.

Conclusions

The BFHI has had great impact on breastfeeding practices. Learning from countries' experience in implementing this Initiative and reflecting new infant-feeding research findings and recommendations, the tools and courses used to change hospital practices in line with baby-friendly criteria have been streamlined, updated, and revised and put into one set of materials. WHO and UNICEF strongly recommend using this new set of materials to ensure solid and full implementation of the BFHI global criteria and sustain progress already made. It is one way of improving child health and survival and moving ahead to meet the Millennium Development Goals.

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Scaling up protection, promotion, and support of breastfeeding at the community level

Carmen Casanovas and Randa Saadeh

Abstract

A World Health Organization (WHO)/UNICEF consultation held in 2008 focused on actions needed to promote infant and young child feeding, including integrating breastfeeding in community and health sector interventions; accelerating progress in breastfeeding protection, promotion, and support among working women; integrating breastfeeding into community development programs; advocacy and communication; situation analysis, monitoring, and evaluation; and planning and capacity building. Recommendations were given on how these could be accelerated based on reviews of country programs.

Key words: Global Strategy for Infant and Young Child Feeding, Breastfeeding, Community outreach, Infant and Young Child Feeding

Introduction

Worldwide, current data show that only about one-third of children are being exclusively breastfed from 0 to 6 months [1]. This is far from the ideal recommendation of exclusive breastfeeding for a full 6 months. In response, the World Health Organization (WHO) and UNICEF have been spearheading a new effort to use the findings in the *Lancet* series on child survival [2], newborn survival [3], and maternal and child undernutrition [4] to raise support and commitment for increasing rates of exclusive breastfeeding and continued breastfeeding, thus contributing effectively to decreasing child morbidity and mortality.

The Global Strategy for Infant and Young Child Feeding [5], developed in 2003 by UNICEF and WHO, provides a framework for action for all concerned parties for achieving the Millennium Development Goals and sets the operational targets to achieve Goal 4 [6]. The Planning Guide for National Implementation of the Global Strategy for Infant and Young Child Feeding provides specific recommendations on how to conduct the process of implementation and which elements are needed at each stage [7].

This strategy reflects a growing awareness of the contribution of community-based activities to child survival and development. The strategy indicates the need to ensure that the health and other relevant sectors protect, promote, and support exclusive breastfeeding for 6 months and continued breastfeeding for up to 2 years of age or beyond, while providing women access to the support they require in the family, community, and workplace.

There is an urgent need to accelerate coverage of community activities at the country level to improve the health status of children and women. In order to support this effort, WHO and UNICEF have begun to compile evidence and support research on improving infant and young child feeding at the community level, including the strengthening of Step 10 of the Baby-Friendly Hospital Initiative (BFHI) [8], development of guidelines and manuals based on research findings, and supporting the use of Infant and Young Child Feeding Counselling: An Integrated Course [9] by all levels of health-care staff, including community workers.

Methods

With this background, WHO, UNICEF, and the Academy for Educational Development (AED)/US Agency for International Development (USAID) collected information on country experiences of expanded community-based breastfeeding protection, promotion, and support [10]. The resulting document was used as part of the background for a consultation on

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"Strategies for Scaling Up Protection, Promotion and Support of Breastfeeding at Community Level."

The consultation was held at WHO in Geneva in April 2008. The objectives were to review experiences in breastfeeding protection, promotion, and support at the community level as an integral part of a comprehensive package of child health and nutrition; summarize lessons learned by countries for accelerating coverage of sustainable community-level interventions on breastfeeding within comprehensive infant and young child health and nutrition programs; make recommendations on approaches for scaling up breastfeeding protection, promotion, and support at the community level; and identify required tools to support planning of community-level interventions for breastfeeding protection, promotion, and support and provide guidance for their development.

The consultation underscored the urgent need to scale up interventions in the area of infant and young child nutrition, with breastfeeding as a key component, to address child malnutrition.

Results

New information and opportunities for expanding coverage of infant and young child feeding interventions

The recent *Lancet* series on maternal and child undernutrition [4] provides compelling information underscoring the need for breastfeeding support in several papers [11–13]. The existence of this new evidence gives us an enormous opportunity to promote breastfeeding. However, the series talks more about the "what" and the "why" but not about "how" to protect, promote, and support breastfeeding.

The development of new WHO Child Growth Standards [14], which are based on the growth of children participating in a multicountry growth reference study, demonstrated that women could breastfeed exclusively with the support of certified lactation counselors who visited them regularly and were available on a 24-hour hotline [15]. Released in 2006, the new standards emphasize that the growth pattern of the breastfed baby is the norm, in contrast to the references used before, which were based primarily on formula-fed and mix-fed babies. Work is in progress to develop tables of the growth velocity of breastfed babies that will provide reassurance to parents that the growth of infants varies among children and that there are times when an infant's growth may be erratic but normal. The new and updated package of materials on the BFHI allows more flexible use according to country needs and provides ideas for establishing "baby-friendly communities" while strengthening Step 10 [8] and moving beyond hospital doors to the communities.

Learning from large-scale community-based programs to improve breastfeeding practices

WHO, UNICEF, and AED reviewed successful community-based interventions in 10 countries: 5 in Africa, 3 in Asia, and 2 in Latin America. The review document identified four challenges: transfer of accumulated evidence, scaling up of proven interventions, identifying innovations to overcome barriers, and sustaining change and commitment [1].

The review also identified the need for advocacy and to reposition breastfeeding as the key intervention for child survival, moving beyond the simple message "breast is best" and capitalizing on the Millennium Development Goals and the recent *Lancet* series on maternal and child undernutrition [4]. Other areas highlighted were the need for strengthening the health system, ensuring that preservice education and in-service training (Integrated Management of Childhood Illness, Making Pregnancy Safer, others) incorporate breastfeeding interventions, simplifying and broadening the scope for scaling up, training on key breastfeeding outcomes (protection, promotion, and support), and defining clear indicators.

The gains in the area of breastfeeding protection, promotion, and support for working women included the International Labour Organization (ILO) Convention 183 on Maternity Protection [16] and subsequent national laws and regulations affecting both formal and informal sectors, such as provision of counseling for milk expression, mother support groups and community-based day care, creation of day-care or child-friendly spaces, commitment from employers to allow women to bring their infants to the workplace or take breastfeeding breaks, working with unions, and creation of lactation stations. It is recognized that, for strengthening and expanding the protection of working women, some important organizations, particularly those promoting breastfeeding, need to be models for mother- and baby-friendly workplaces.

In the areas of advocacy, partnerships, links with health facilities, and harmonization of messages, the review identified key factors that contributed to successful experiences, including the identification of champions to reach out to different sectors, translating benefits of breastfeeding to various sectors at all levels, national-level broad-based stakeholder involvement and commitment, and national dialogue and ownership to draw from best practices and lessons learned. To adapt these experiences to local contexts, there is a need to carefully assess the cost of programs.

Identifying strategies and tools to scale up community-level interventions on infant and young child feeding

WHO has produced a manual for implementing community activities on infant and young child feeding aimed at mid-level managers and nutritionists*. This manual is based on successful experience in Haryana, India [17], where a team developed a cluster-randomized controlled trial and trained health and nutrition workers in the intervention communities to counsel mothers to practice exclusive breastfeeding at various contact points. The team enrolled 1,115 infants born in the 9 months after training, assessing feeding at age 3 months and obtaining anthropometric data and data on diarrhea prevalence at 3 and 6 months. At 3 months, the exclusive breastfeeding rates were 79% in the intervention and 48% in the control communities. The 7-day prevalence of diarrhea was lower in the intervention than in the control communities. The mean weights and lengths and other anthropometric indicators did not differ between groups. The purpose of the manual is to provide clear guidance on designing and implementing a community intervention for improving infant and young child feeding practices, with the potential and within the constraints of an existing health system. The manual includes steps for initiating the process, developing messages and materials, capacity building, and assessing each step.

There is a series of tools and materials on breastfeeding protection, promotion, and support at the community level produced by WHO, UNICEF, and other partners (available at: http://www.who.int/nutrition/publications/infantfeeding/en/index.html, http://www.who.int/child_adolescent_health/topics/prevention_care/child/nutrition/en/index.html, or http://www.unicef.org/). However, there is no clear definition of a minimum package that should or could be made available to the community.

There is also a need for advocacy efforts at multiple levels and opportunities to reach out to a broader audience, not just targeting mothers. The promotion of breastfeeding interventions requires a different strategy. An example would be to overcome the perception among decision makers that "breastfeeding is not a problem—everyone does it." The current emphasis on accelerating child survival provides an opportunity to reemphasize the importance of exclusive breastfeeding to decision makers.

Health workers should have targeted contacts with mothers, including clear directions and tasks for each contact visit. This is particularly useful for less well-trained counselors, who could then be supervised and monitored more effectively. Capacity-building needs to focus on what competencies and skills people need and how these should be acquired and sustained. There is a need for countries to have overall and comprehensive training plans and not conduct training courses on an ad hoc basis.

* World Health Organization/UNICEF. Implementing community activities on infant and young child feeding: A manual based on the experience from Haryana, India. Paper for field-testing. Geneva: WHO, 2008 (not published).

The way forward

During the consultation, it was indicated that in addition to the need to strengthen the promotion of breastfeeding, there needs to be a close link between breastfeeding and complementary feeding interventions. The challenges in supporting appropriate complementary feeding include wide dissemination of recently agreed-upon global indicators, the need to define ways to collaborate with industry, the tension between big corporations and the local producer, the need to improve marketing practices that are compliant with the International Code of Marketing of Breast-Milk Substitutes, affordability and accessibility of foods, and cultural beliefs and habits regarding infant feeding.

It is important to consider whether locally available foods are appropriate (especially in terms of micronutrients) and acceptable for young children. In general it is felt that home-based foods should be favored rather than industrially processed foods, except when fortification is done as part of a comprehensive national program.

Breastfeeding in special situations deserves special attention. These situations include emergencies and infant feeding in the context of HIV or malnutrition. In the context of HIV, new challenges include rapid testing of infants at 6 weeks of age and confusion among counselors about appropriate infant feeding options at that stage, since options could be modified according to test results and acceptable, feasible, affordable, sustainable, and safe (AFASS) situations; issues around maternal antiretroviral therapy during breastfeeding; and the need for countries to update their guidelines on HIV and infant feeding following the publication of the new WHO guidelines in October 2006 [18], based on recent research. In the context of emergencies and malnutrition, is important to ensure that the management of malnutrition, commenced in hospital, is continued in the community. Training of people both in preparation for emergencies and during emergencies is needed. Attention should be paid to the handling of donations of formula milk and compliance with the International Code of Marketing of Breast-Milk Substitutes and subsequent World Health Assembly resolutions during emergency situations.

Partnerships are key to moving forward. There have already been successful experiences with partnerships in breastfeeding programs in various countries, such as the Philippines, Cambodia, and Madagascar. Such experiences demonstrate that for partnerships to succeed, there need to be an overall plan and objectives to be achieved that are clearly stated with well-defined roles and responsibilities of all parties involved in the program. Good communication is needed at all levels, with every effort to maintain the credibility of the process with avoidance of any conflict of interest.

Conclusions and recommendations

The following is a summary of the recommendations reached in the consultation, considering also the paper "Learning from large-scale community-based programmes to improve breastfeeding practices".

Integrating breastfeeding in community and health sector interventions

Breastfeeding is recognized as a key intervention for child survival. To improve measurement and reporting, key breastfeeding indicators should be used for their integration into the health information system.

To facilitate this integration, the following recommendations were made:

» Capitalize on the Millennium Development Goals and the *Lancet* series on child survival, newborn survival, and maternal-child undernutrition for integrating breastfeeding into community and health sector interventions;

» Include in the strategic planning an analysis of the costs of a comprehensive plan that integrates breastfeeding into community and health interventions;

» Develop and implement a capacity-building strategy targeting the different cadres of providers, including community-level workers;

» Include in capacity-building efforts the use of data for decision-making, considering defined indicators of breastfeeding and of infant and young child feeding (such as early initiation of breastfeeding, exclusive breastfeeding, and appropriate complementary feeding).

Accelerating progress in breastfeeding protection, promotion, and support among working women

Women of childbearing age are increasingly entering the workforce, so it is crucial to create an enabling environment that allows them to practice breastfeeding if they choose. Employers and other decision makers are not always aware of the economic benefits of breastfeeding. There have been successful experiences with supporting breastfeeding mothers in the workplace in both urban and rural areas, but the situation of migrant workers remains a challenge.

The following recommendations were made to accelerate this process:

» Provide evidence of the economic and other benefits of breastfeeding to employers and other decision makers;

» Develop a communication strategy targeted at decision makers and the general public, based on the evidence in relation to cost and benefits of breastfeeding protection, promotion, and support among working women;

» Document successful experiences with the implementation of interventions to support breastfeeding women in the workplace and disseminate them broadly. Documented experiences could include barriers and how to overcome them and setting the example: hospitals and Ministries of Health as workplace models and types of practical support that work in different places, such as mother-to-mother support groups or peer counselors in the workplace, day-care centers, and breastfeeding rooms;

» Areas where further information is needed: how to strengthen laws and policies for maternity protection in the workplace.

Integrating breastfeeding into community development programs

Key success factors that facilitate the integration of breastfeeding into community development programs were identified based on the experience of group participants. These factors included advocacy, partnership, links with health facilities, harmonization of messages, setting goals with commitments, use of different incentives or motivators, and creating an enabling environment for breastfeeding.

Based on the findings, the participants made the following recommendations:

» Identify champions to reach out to different sectors;

» Translate benefits of breastfeeding to various sectors through advocacy and communication;

» Determine how different levels of community workers can be included as resources;

» Promote coordination between various stakeholders, such as municipalities, religious leaders, the private sector, and nongovernmental organizations;

» Develop guidance at the community level, considering core messages included in the national or local strategic plans or plans of action.

Advocacy and communication

Capacity-building and implementing services are in themselves advocacy tools. There are tools that can help to advocate: the *Lancet* series on Child Survival, Neonatal Survival and Maternal and Child Undernutrition, which provide evidence and background to support emphasis on infant and young child feeding, the Millennium Development Goals and the WHO Growth Standards. There is a lack of understanding of breastfeeding among decision makers with competing priorities that results in breastfeeding being frequently sidelined. Additionally, there is a tendency to promote breastfeeding in a vague manner, rather than promoting the specific interventions that have been shown to work, such as breastfeeding counseling.

To strengthen activities in this area, the following are recommended:

» Conduct advocacy activities at different levels according to the situation, tailoring the message and the means according to the audience;
» Use communities as communicators, using culturally appropriate channels and model mothers;
» Involve champions and celebrities as advocates or communicators;
» Use locally appropriate media, with tailored messages, to reach a broader audience;
» Use existing advocacy tools for enhanced commitment and support to take community breastfeeding to scale;
» Use data and specific information when advocating for breastfeeding and promote specific evidence-based interventions that have been shown to work.

Situation analysis, monitoring, and evaluation

Monitoring and evaluation provide enormous opportunities for measuring whether desired results have been reached and being able to share achievements with others. But carrying out a situation analysis, monitoring, and evaluation are challenging tasks that are labor- and time-consuming and require significant efforts and funding. As a result, in scaling up programs, there is a tendency to skip carrying out a situation analysis and to start implementation immediately. In most settings it is difficult to find skilled local personnel to carry out appropriately qualitative research. There are often insufficient local data available, although there may be some quantitative data available, at least at a broad level. There is a need at the planning stage to identify key indicators for monitoring.

To improve this area, the following are recommended:

» Ensure that during planning, a budget and source of funds are earmarked to carry out a situation analysis;
» Indicators for monitoring should include the quality of breastfeeding training and counseling, and whether and how supportive supervision is carried out;
» Hold regular feedback meetings between all partners to look at monitoring data and see what is working well and what is not.

Planning and capacity-building

The WHO draft manual (see previous footnote) is an important initial document for planning, with clear steps to follow. The 10 cases included in the paper "Learning from large-scale community-based programmes to improve breastfeeding practices" plus information provided by other countries during the consultation on strategies for scaling up protection, promotion and support of breastfeeding at community level, at WHO Headquarters, Geneva 28–30 April 2008, also provide information to be considered when planning. There are a variety of training materials for various levels of health-care workers. Many countries already have in place various cadres of community workers that can be mobilized for infant and young child feeding. There is need for a system of monitoring and supervision of the community workers to keep them motivated and practicing recommended behaviors and competencies.

Recommendations for strengthening planning and capacity building include the following:

» Field-test and refine the WHO planning manual, integrating the results of the field test;
» Consolidate additional information on country experiences, including materials and tools used, information on how they implement activities, and costs;
» Countries should not wait for scaling up, but should go ahead with the current draft and other available materials already tested in community-based interventions. This process should include a cost analysis exercise;
» For ensuring sustainability, community-level activities should have strong linkages with the health system, for example, through the BFHI. Health-care workers can provide supervision of community workers and serve as resource persons for women referred from the community;
» Be flexible in the training approach, using different methods and targeting different groups, according to settings. Include in the capacity-building plan a strategy for involving all the different types of community workers;
» Define minimum competencies for each cadre of worker before deciding training methods and content;
» Improve practical aspects of preservice education, including community outreach activities for students of health sciences.

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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

Bernadette Daelmans, Nuné Mangasaryan, Jose Martines, Randa Saadeh, Carmen Casanovas, and Mandana Arabi

Introduction

Infant and young child feeding interventions are critical to promote growth, development, and survival of children. It is estimated that over a third of all deaths of children under 5 years of age are directly or indirectly caused by undernutrition. It is also estimated that about 1.4 million child lives could be saved through improved breastfeeding practices [1] and an additional 0.55 million child lives through improved complementary feeding practices [2]. Moreover, appropriate infant and young child feeding practices contribute to prevention of overweight and obesity in early childhood, thus mitigating the dual burden of malnutrition experienced in many countries.

In the past two decades, marked improvements have been made in understanding effective interventions to improve infant and young child feeding. The World Health Organization (WHO) and UNICEF recommend that, on a population basis, children be exclusively breastfed for 6 months, after which nutritiously adequate and safe complementary foods should be introduced along with continued breastfeeding up to 2 years and beyond [3]. The Global Strategy on Infant and Young Child Feeding, which was endorsed by WHO Member States at the World Health Assembly (WHA) and the UNICEF Executive Board in 2002, has provided the overarching framework to guide program actions, and a number of countries have translated the Global Strategy into national action plans [4]. Progress has been made in promoting effective interventions in particular to improve breastfeeding practices, and this has resulted in important increases in rates of exclusive breastfeeding in some countries [5].

The same cannot be said for complementary feeding, which marks a period of great vulnerability for the onset of malnutrition. The Guiding Principles for Complementary Feeding of the Breastfed Child [6] and the Guiding Principles for Feeding Non-Breastfed Children 6–24 Months of Age [7] have provided important new guidance on the various critical dimensions that constitute appropriate feeding in young children. However, much more is needed to translate these guiding principles into effective program actions.

WHO and UNICEF convened a technical meeting "Strengthening actions to improve infant and young child feeding practices in children 6 to 23 months of age" to examine the evidence for effective interventions to improve complementary foods and feeding practices, identify the actions needed to integrate these interventions into health-service delivery, and discuss a planning framework and tools to support managers in designing locally appropriate, effective, and feasible programs.

Effective interventions and delivery approaches

The participants emphasized that the critical window for improving child nutrition is from pregnancy through the first 24 months of life. The deficits acquired by this age are difficult to reverse later. Strategies to improve nutritional status and growth in children should include interventions to improve nutrition of pregnant and lactating women; delayed umbilical cord clamping to improve the infant's iron status; early initiation of breastfeeding with exclusive breastfeeding for 6 months; promotion, protection, and support of continued breastfeeding along with appropriate

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complementary feeding from 6 months up to 2 years and beyond; and micronutrient supplementation, targeted fortification, and food supplementation, when needed.

Within this continuum of care, efforts to improve complementary foods and feeding practice should be context-specific and maximize the use of locally available foods and resources. Although there is no single universal "best" package of interventions to improve complementary feeding, a recent review of effective interventions demonstrated that carefully designed programs that include pretested educational messages provided through multiple channels had an effect in improving nutritional outcomes [8]. A greater impact was seen when animal-source foods, such as meat and milk, were specifically promoted in the messages or when food supplements were provided as well. The use of nutrient-rich, animal-source food in particular had beneficial effects on growth and developmental outcomes.

Counseling of mothers and caregivers and appropriate behavioral-change communication to family and community members and decision makers should be at the heart of all program efforts to improve infant and young child nutrition. Counseling of mothers should be integrated during antenatal care and just after birth, adding to counseling and support for breastfeeding and complementary feeding practices provided during infancy and at critical points in a child's life thereafter.

Effective approaches to improve the quality of the complementary diet include increasing dietary diversity with the use of locally available nutritious foods, in particular animal-source foods; use of appropriately fortified food products; and point-of-use fortification of the local food by adding micronutrients or a nutrient-rich supplement in meals. The use of home-based food technologies such as fermentation or malting can also be appropriate in certain settings.

Promotion of high-quality supplements or fortified blended foods accessible at affordable prices may be needed if they can fill a critical gap in nutrients in an acceptable, affordable, and feasible way and as a complement to continued breastfeeding and the local diet. Where locally available foods alone will not satisfy nutritional requirements, various types of products offer promise. These may include centrally produced fortified foods, micronutrient powders, and lipid-based nutrient supplements. Further research and carefully monitored applications of interventions delivered at scale are needed to generate more evidence on which product is best for which circumstance, how best to promote their correct utilization, and their contribution to improving nutritional, developmental, and health status in different circumstances.

Implications for programming

Effective programming should be based on sound information about the setting. It should follow a systematic approach that includes a situation assessment, formative research to identify locally appropriate feeding recommendations, development and pretesting of a limited set of key messages that promote doable actions, and dissemination of these messages through multiple channels and contacts. National-level advocacy, the adoption of relevant policies, professional training, revision of norms and guidelines and the curriculum, changes in hospitals and health facilities, and community-based approaches are all necessary to improve nutritional support and care for children. Activities should involve multiple sectors. They should aim to influence not only the perceptions and actions of caregivers and families but also those of key decision makers, at community and national levels. The need to link nutrition activities, including education and counseling, to broader poverty reduction and improvement in food security has increasingly become evident from successful large-scale programs.

To promote the production and utilization of food supplements or fortified complementary foods in settings where they are needed, collaboration with the private sector is usually necessary. There is a need for standards for product formulation which may require collaboration with the private sector. However, any collaboration needs to be carried out in such a way that conflicts of interest are minimized and those that cannot be avoided are adequately dealt with. Such efforts must benefit public health and be compliant with the International Code of Marketing of Breast-milk Substitutes and subsequent relevant World Health Assembly resolutions.

The participants identified a range of research priorities related to intervention design, intervention delivery, and program implementation. The importance of research on effective ways to assist mothers to sustain breastfeeding and optimize the use of locally available resources was emphasized as much as the need to develop products to improve the quality of complementary diets when needed.

Next steps

In spite of the evidence discussed above, the participants recognized important gaps in information about what works best and when. They called for large-scale effectiveness studies and well-designed evaluations to provide further evidence and information, not only on effective interventions, but also to learn about their implementation at scale. More clarity is needed about the most effective approaches (and their costs) for counseling and behavioral change communication, sustaining performance of health professionals, integration of interventions in primary health care services, required policy instruments, and the promotion of additional food products when needed.

The availability of new growth standards [9] and indicators for assessing infant and young child feeding practices [10] was identified as an important opportunity to strengthen national programs and generate better information about outcomes. WHO and UNICEF will work with governments and partners in the review and planning of programs to improve infant and young child feeding, with a strengthened focus on complementary feeding. In order to support these processes, both organizations will work together to further develop a framework to help identify and prioritize interventions, update the *Planning Guide* that accompanies the Global Strategy to strengthen guidance on complementary feeding [11] and compile a set of tools to support the planning and implementation of programs.

The full report of the meeting can be accessed at the WHO and UNICEF websites: http://whqlibdoc.who.int/publications/2008/9789241597890_eng.pdf and http://www.unicef.org/nutrition/index_documents.html.

B. Daelmans, J. Martines, R. Saadeh, and C. Casanovas are staff members of WHO; N. Mangasaryan, and M. Arabi are staff members of UNICEF. The authors alone are responsible for the views expressed in this publication and they do not necessarily represent the decisions or policies of WHO or UNICEF.

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Formulations for fortified complementary foods and supplements: Review of successful products for improving the nutritional status of infants and young children

Ten Year Strategy to Reduce Vitamin and Mineral Deficiencies, Maternal, Infant, and Young Child Nutrition Working Group: Formulation Subgroup

Introduction

Exclusive breastfeeding for the first 6 months and continued breastfeeding with appropriate complementary feeding for up to 2 years and beyond is recommended by the World Health Organization (WHO)/UNICEF as part of the Infant and Young Child Feeding Strategy [1]. The use of fortified complementary foods and vitamin–mineral supplements, as needed, is recommended in both the Guiding Principles for Complementary Feeding of the Breastfed Child [2] and the Guiding Principles for Feeding Non-Breastfed Children 6–24 Months of Age [3].

The Maternal, Infant, and Young Child Nutrition (MIYCN) working group of the Ten Year Strategy to Reduce Vitamin and Mineral Deficiencies, Sub-Group on Formulation Guidelines, reviewed recent evidence on complementary foods and supplements since Lutter and Dewey [4] published their article "Proposed nutrient composition for fortified complementary foods." That article discussed the numerous issues that need to be considered when developing a complementary food for infants and young children, including age range; daily ration size; recommended nutrient requirements; contribution of human milk to these requirements and the proportion of total requirements that should be provided through a fortified food; micronutrient interactions; bioavailability of the compounds used and inhibiting and enhancing properties of macronutrients; methods of production and use, such as whether the product is instant or requires cooking, packaging, expected losses during storage, and cost; and overage needed to compensate for losses because of cooking (if required), packaging, and storage. (p. 3012S)

Since that article was published, there have been no updated international standards or guidelines for such products. Of relevance, however, are the background papers and recommendations from a World Health Organization/UNICEF/World Food Programme/United Nations High Commissioner for Refugees informal consultation on Moderate Malnutrition held in October 2008. The purpose of that consultation was to determine what diets should be recommended to feed moderately malnourished children [5], and one objective was to identify areas of consensus on the nutrient needs and dietary management of moderate malnutrition in children that can be translated into evidence-based global guidelines. The dietary recommendations and complementary food supplements discussed are also relevant for young children (6 to 23 months) at risk for developing moderate malnutrition [6], who include low-income children in developing countries.

The results from several research studies and national programs provide examples of products that have led to improvements in nutritional status of low-income young children in developing countries. The purpose of this paper is to summarize the characteristics of fortified blended foods, complementary food supplements, and micronutrient powders for home fortification used successfully in these research studies and national programs in low- and middle-income countries. Many national governments, international agencies, and national and regional food companies produce fortified foods and supplements for complementary feeding but often do not have access to recent information on appropriate characteristics of such products and levels of fortificants. The objective of this paper is to inform such groups of previous experiences. It is important to emphasize that the examples in this document are not intended to provide definitive recommendations for composition, but merely to describe what has been used successfully so far.

A more comprehensive future document will provide background on the need for fortified complementary

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foods and supplements, the pros and cons of different products, cost considerations, and the enormous need for research with respect to basic science (e.g., nutrient requirements for young children), operation and delivery issues, and product improvement.

Types of products

Three types of fortified products have been developed for consumption by infants and young children: fortified blended foods (FBF), complementary food supplements (CFS), and micronutrient powders (MNP).

Fortified blended foods

Definition: Fortified blended foods used as a ***replacement for*** **the traditional local porridge or in addition to traditional porridge.**

Example: Fortified infant cereal made from rice, wheat, corn, or millet; soy, peanuts, or milk; sugar; and oil.

Product examples: Favina (Vietnam) [7], Mi Papilla (Ecuador) [8], Koba Aina (Madagascar) [9].

Although many fortified blended foods contain only cereals, legumes, and sugar or oil, others have been developed to include milk, additional fat sources providing essential fatty acids, high-quality protein, and/or macrominerals such as calcium and phosphorus.

Complementary food supplements

Definition: Fortified food-based products to be **added** to other foods (as "point of use" or "home" fortificants) or eaten alone to improve both **macronutrient and micronutrient** intake.

Example: Fortified peanut spread.

Example: Fortified full-fat soy flour.

Product examples: Ready-to-use supplementary food (RUSF) [10], but given in smaller amounts than recommended for supplementary feeding* and Nutributter® [11].

Complementary food supplements can also provide higher fat content than the normal diet, essential fatty acids, milk, micronutrients, macrominerals, and high-quality protein. Lipid-based nutrient supplements such as Nutributter® are a subcategory of complementary food supplements.

Micronutrient powders

Definition: ***Only*** **vitamins and minerals** added to traditional infant foods; used as "point-of-use fortificants" or "home fortificants."

Example: Fortified powder, crushable tablet.

Product examples: Sprinkles [12], Chispitas [13] (Bolivia).

Micronutrient powders have been designed with a carrier such as maltodextrin or rice flour included in small amounts (e.g., 1 to 3 g). From a nutritional point of view, these carriers do not significantly increase macronutrient intake, but for classification purposes, they can affect whether the product is considered a pharmaceutical or a food.

Product characteristics

The Moderate Malnutrition meeting emphasized the importance of reducing antinutrients and fiber in complementary foods [5]. Antinutrients can inhibit the bioavailability of nutrients (e.g., phytate and tannins) or interfere with digestion (e.g., α-amylase inhibitors and protease inhibitors such as trypsin, saponins, etc.) [14]. Dietary fiber increases bulk and satiety and reduces nutrient and energy digestibility and should be limited in diets of malnourished children.

Animal-source foods are recommended for complementary feeding because they provide high-quality protein and bioavailable micronutrients and have low levels of antinutrients and fiber [5]. Products such as lipid-based nutrient supplements often contain relatively more milk and oil and little or no grain, and have lower antinutrient and fiber content than most fortified blended foods.

Inclusion of small amounts of milk products** in a complementary food has been suggested to be beneficial for growth. It appears that intake of cow's milk stimulates insulin-like growth factor 1 (IGF-1) secretion, which has a direct effect on linear growth [15, 16]. Milk also contains high levels of important nutrients, such as calcium, available phosphorus and magnesium, bioactive factors, and proteins that may have growth-promoting abilities [17]. Most products that have shown an impact on growth in children under 2 years of age have contained milk.

Amylase has been used in some products to partially hydrolyze starch, which enables the preparation of products of high energy density, reducing the amount

* Supplementary foods are used in emergency settings when the normal food supply is disrupted and the traditional diet is not available; thus, such foods are often eaten several times a day.

** Lactose intolerance is uncommon among young children. Breastmilk provides about 100 g of lactose per 1,000 kcal and is well tolerated. Ready to use therapeutic foods (RUTF) and F100 provide 40 g of lactose per 100 kcal, and lactose intolerance problems are unusual when these products are given in large quantities to children with severe acute malnutrition. Since a product like Nutributter® has the same lactose content as RUTF but is given in small quantities (20 g a day, instead of up to 200 g per day for a child with severe acute malnutrition), the likelihood of lactose intolerance is low.

of food a child needs to consume to meet energy needs [5]. Special hygiene precautions are needed in the preparation and use of amylase [18].

Products used have been precooked or instant. Use of these products reduces the time needed for preparation and allows caregivers to prepare food for young children more easily. Directions for use include the addition of clean or boiled water or milk, when needed for preparation, to reduce the risk of food contamination.

Fortified blended foods and complementary food supplements have been formulated to be prepared as semisolids or solids (not liquids) so that they are less likely to interfere with breastfeeding and will comply with local and international regulations, including the International Code on Marketing of Breast-Milk Substitutes and subsequent relevant World Health Assembly Health Resolutions [19, 20]. Fortified blended foods and complementary food supplements have been developed to meet many relevant Codex Alimentarius standards [21–23], including hygiene, additives, forms of added vitamins and minerals, and protein quality. However, many complementary food supplements do not meet all relevant Codex standards for supplementary foods [21]; for example, they may contain higher levels of nutrients than suggested by the Codex.

There is a question as to the bioavailability of nutrients in blended foods because of their often high phytate levels and fiber content [5]. For this reason, dehulled legumes and cereals (e.g., corn meal) are preferable. Blended foods that do not contain milk, have a high amount of phytate, have suboptimal micronutrient content (even though fortified), or are bulky and viscous are not optimal for complementary feeding [5].

Micronutrient powders have been developed to conform to the standards set for pharmaceuticals by UNICEF or to guidelines developed by the Sprinkles Global Health Initiative [24] and meet all relevant Codex Alimentarius standards. The Technical Advisory Group on Home Fortification [housed at the Global Alliance for Improved Nutrition (GAIN)] aims to set standards for home fortificants, including micronutrient powders, powdered complementary food supplements, and lipid-based nutrient supplements.

Products reconstituted with water, such as fortified blended cereals, have been formulated to have a low osmolarity (< 300 mOsm/L), which is achieved by keeping sugar levels low [25–27]. Products also have been produced to have a low renal solute load in relation to their energy content, achieved by the exclusion of salt and maintenance of protein levels within the Codex guidelines [23].

There are other types of fortified complementary foods, such as cookies or biscuits and compressed bars, that have been used in emergency feeding programs for young children. Their nutritional content can be made to be similar to that of fortified blended foods or ready-to-use foods. However, there are several disadvantages that have been reported with their use. Some instructions for the use of biscuits are to mix them with water to make porridge [28], but they can instead mistakenly be given to the young child to chew. This can cause a risk of choking (some labels for teething biscuits state to watch the child when she/he eats the biscuit and not allow small pieces to be eaten because of the risk of choking). Use of cookies among young children has been associated with dental caries in Brazil [29]. In Nigeria, two-thirds of children 6 to 18 months of age in one study ate biscuits several times a day [30]. The authors called for health-care workers to find ways to discourage consumption of such foods through health education in order to improve dental health. Additionally, use of a biscuit or cookie does not encourage active and responsive feeding, an important component of the Pan American Health Organization (PAHO)/WHO Guiding Principles for Complementary Feeding of the Breastfed Child [2]. Since numerous biscuits are on the market to be fed as snack foods, there is a concern that caregivers will not differentiate between fortified and nonfortified products or will not identify those containing trans-fatty acids, which are not recommended by the Codex. The promotion of a habit of biscuit consumption could lead to consumption of non-nutritious biscuits rather than healthier traditional foods such as fruits [6].

However, biscuit-making technology could be used to produce products (such as crumbles) that could serve as fortified blended foods or as complementary food supplements and fed to children as semisolid foods or used as home fortificants. When biscuits are used as a short-term measure for reducing the risk of malnutrition under sudden situations of food insecurity or for feeding severely acutely malnourished children, concerns raised above about the use of biscuits for complementary feeding may not all apply [6]. Although there is concern that several vitamins may be destroyed in the baking process, the degradation of vitamins during the baking process can be compensated for by adding additional quantities of vitamins, subject to cost constraints, or by production into compressed bars produced without the need for high heat. Such products are easy to transport and can be especially helpful in emergency settings.

Daily amounts of food provided

The amounts of food provided in successful programs have been low enough to minimize interfering with breastmilk intake. This is essential, because breastmilk plays an important role in the prevention of infection and in providing high-quality macro- and micronutrients.

Table 1 shows the WHO-recommended number of

TABLE 1. Recommendations for feeding frequency (meals or snacks) of complementary foods according to child's age and breastfeeding status and energy needed from complementary foods for breastfed and non-breastfed infants or young children in developing countries [2, 3] , and estimated gastric capacity [20]

Age of child (mo)	Recommended daily feeding frequency (meals or snacks)		Energy needs from complementary foods		Gastric capacity (mL/meal)[a]	
	Breastfed	Not breastfed	Breastfed[b] (kcal/day)	Not breastfed (kcal/day)	Average child	Growth-retarded child
6–8	2–3	4–5	200	600	249	192
9–11	3–4	4–5	300	700	285	228
12–23	3–4	4–5	550	900	345	273

a. Assuming body weights of 8.3, 9.5, and 11.5 kg for well-nourished children and 6.4, 7.6, and 9.1 kg for growth-retarded children among children 6 to 8, 9 to 11, and 12 to 23 months of age, respectively, and gastric capacity of 30 g/kg body weight.

b. Assuming average breastmilk intake

meals or snacks that children should receive daily and the associated amount of energy needed from complementary foods, depending on whether the infant is breastfed or not [2, 3]. Fortified blended foods or complementary food supplements are *not* expected to replace all these meals or snacks.

In order not to reduce breastmilk intake, the total quantity of complementary food provided in successful programs has been less than that suggested in the 1991 Codex standard, which recommended 100 g (with an energy content of 400 kcal in a daily serving) of formulated complementary foods per day (with nutrient levels tied to that amount of energy). **Table 1** shows that 400 kcal exceeds the energy needs from complementary foods of breastfed children 6 to 11 months of age and provides nearly 75% of the needs of a breastfed child aged 12 to 24 months [20], allowing little room for local family foods. Currently, the Codex standards related to complementary feeding are being reviewed to address this issue and others.

Table 2 gives examples of fortified blended foods that have been shown to be effective in enhancing weight or length gain and/or reducing micronutrient deficiencies. The amount of food provided was much less than the Codex recommended level of 400 kcal, and ranged from 140 to 275 kcal per daily serving.

All these products included milk. The Nutrisano papilla was a blend of milk, sugar, and maltodextrin (a cereal-derived product) and contained no legumes. The other two products contained a mixture of soy and rice, or soy, rice, and sesame, both with milk. **Table 2** also lists Codex standards and previous recommendations for complementary foods [4, 21].

The daily serving is the number of grams of food (dry weight) per day for which a specified amount of nutrients is reported. The daily serving is often referred to as the daily ration in feeding programs. **Table 2** shows the amounts of nutrients in one daily serving (or for Favina in Vietnam, each portion) of each product. By knowing the daily serving size, one knows the amounts of nutrients the child would receive if the child consumed the whole serving or ration in one day.

The daily serving or ration may be subdivided into portions, to be given at different times during the day depending on the age of the child or the child's appetite. In Ecuador, a daily serving or ration of 65 g was provided in the national program to be fed in two portions (32.5 g per portion) during the day [8]. In Mexico, a daily serving or ration of 44 g was provided through the national incentive-based welfare system [31]. In contrast, in Vietnam [7], two or three portions per day of 35 g each were recommended, and the products were sold by community volunteers to low-income mothers (**table 2**).

In research studies performed in China, Ghana, and Malawi, fortified complementary food supplements (**table 3**) were given in quantities such as 10 g [32], 20 g [11], 25 g, and 50 g per day [33]. Children receiving 20 to 50 g of nut-based spread were offered 108 to 254 kcal per day.

Amount of food per portion

The volume of a portion depends on the amount of liquid that it contains, which will vary according to the desired consistency and whether or not fat or amylase is added. Prepared final products (either fortified blended foods, or traditional infant cereals combined with a complementary food supplement or micronutrient powder) should be served in volumes below gastric capacity. Young children have small stomachs and cannot eat large quantities at each feeding. Younger children (6 to 8 months) need to consume a less viscous porridge (semisolid but not liquid), whereas older children can be fed a thicker product, requiring less liquid. Brown et al. [27] compiled data on the average amounts (in grams of wet weight) of food eaten at a meal, and found that these ranged from 100 to 230 g for foods of low viscosity for children 6 to 24 months of age. Thus, for some younger children, a whole daily serving or ration may be too much for one feeding, and several portions may need to be fed at different times; but for many, the full daily serving or ration can be consumed easily at one meal.

TABLE 2. Comparison of contents per daily serving of fortified blended foods: Recommendations and examples of products

Variable	Codex [23]		PAHO/WHO Lutter and Dewey [4] per daily serving or ration	Nutrient levels in products and % of WHO/FAO RNIs (age 1–3 yr) for micronutrients) per serving or ration					
	Cereals to be prepared for consumption with milk	Cereals with an added high-protein food to be prepared with water		Mi Papilla (Ecuador) [8]		Nutrisano (Mexico) [31]		Favina (Vietnam) [7]	
Recommendation or product	Recommendation	Recommendation	Recommendation	Product		Product		Product	
Serving size (g dry weight)			50	65		44		2 or 3 portions of 35 g each	
Energy (kcal) per daily serving or ration (e.g., 1 serving or ration fed in 2 portions for Mi Papilla)			220	275		194		140 per portion	
Energy (kcal/g)	Not less than 0.8 kcal /g		4	4.2		4		4	
Protein (g)	The chemical index of the added protein shall be equal to at least 80% of that of the reference protein casein or the protein efficiency ratio (PER) of the protein in the mixture shall be equal to at least 70% of that of the reference protein casein		3–5.5	10		5.8		5.5 per portion	
		Not less than 2 g/100 kcal and not to exceed 5.5 g/100 kcal							
% calories from protein			5.4%–9 %	14.5%		12%		11%	
Fat (g)	Not to exceed 3.3 g/100 kcal	Not to exceed 4.5 g/100 kcal		6		6.6		3.1 per portion	
% calories from fat			26%	19.6%		30.6%		20%	
% calories from added sugar	Not to exceed 7.5 g/100 kcal for added carbohydrate; not to exceed 3.75 g/100 kcal for fructose	Not to exceed 5 g/100 kcal for added carbohydrate; not to exceed 2.5 g/100 kcal for fructose	< 10%	< 10%		7%		15%	
Micronutrients per serving (or portion, for Favina)					% WHO/ FAO RNIs		% WHO/ FAO RNIs		% WHO/ FAO RNIs
Vitamin A (μg RE)		60–180 μg/100 kcal	250	64	16%	400	100%	53.2	13%
Vitamin D (μg)		1–3 μg/100 kcal	1–2					4.1	82%

continued

TABLE 2. Comparison of contents per daily serving of fortified blended foods: Recommendations and examples of products *(continued)*

Variable	Codex [23]		PAHO/WHO Lutter and Dewey [4] per daily serving or ration	Nutrient levels in products and % of WHO/FAO RNIs (age 1–3 yr) for micronutrients) per serving or ration					
	Cereals to be prepared for consumption with milk	Cereals with an added high-protein food to be prepared with water		Mi Papilla (Ecuador) [8]		Nutrisano (Mexico) [31]		Favina (Vietnam) [7]	
Vitamin E (mg)			5	1.8	37%	6	120%		
Vitamin C (mg)			70–140	12	40%	40	133%	28	93%
Thiamine (vitamin B_1) (mg)	No less than 50 µg /100 kcal		0.18	0.21	42%				
Riboflavin (vitamin B_2) (mg)			0.18	0.24	48%			0.1	20%
Niacin (vitamin B_3) (mg)			3.3	2.7	45%			0.5	8%
Vitamin B_6 (mg)			0.22	0.3	60%			0.1	20%
Vitamin B_{12} (µg)			0.26	0.35	39%	0.7	78%	0.1	11%
Folic acid (µg)			41.5	25	17%	50	33%	16.8	11%
Iron (mg)			7–11	5 (ferrous sulfate)	43%	10	86%	10.6	91%
Zinc (mg)			4–5	5 (zinc sulfate)	60%	10	120%	2.2	26%
Copper (mg)			0.2–0.4					0.1	18%
Selenium (µg)			10					2.9	17%
Calcium (mg)		Not less than 80 mg/100 kcal	100–200	120	24%			193	39%
Iodine (µg)			90					7	8%
Vitamin K (µg)								12	80%
Biotin (µg)			1.45						
Choline (mg)			45.9						
Pantothenic acid (mg)			0.35						
Magnesium (mg)			40–60	24	40%			30	50%
Manganese (mg)			0.6					0.5	42%

Phosphorus (mg)			75–100	120	26%				
Potassium (mg)			NA	NA		NA		NA	
Sodium (mg)	Not to exceed 100 mg/100 kcal of the ready-to-eat product					24.5			
Linoleic acid (mg) (omega-6: n-6)		If lipids exceed 3.3 g fat /100 kcal, then the amount of linoleic acid shall be not less than 70 mg/100 kJ (300 mg/100 kcal) and shall not exceed 285 mg/100 kJ (1,200 mg/100 kcal); lauric acid shall not exceed 15% and mysteric acid shall not exceed 15% of total lipid content						1,253	
α-Linolenic acid (mg) (omega-3: n-3)								127	
Ratio of linoleic to linolenic			Between 5:1 and 10:1					9.8: 1	
Instructions						Mix with water (4 spoonfuls of boiled water)			
Recommended portions per day				2		1		2–3	
Ingredients % weight (g/100 g dry weight)				Dried skim milk, soy, rice, oil, sugar		Whole-fat milk, sugar, maltodextrin		Extruded rice (50.7%), dehulled roasted or extruded soybean (21%), sugar (15%), extruded sesame (5.35%), powdered whole milk (5%), calcium phosphate (1.2%), vitamin and mineral premix (0.8%), iodized salt (0.7%), and flavoring (0.25%)	

NA, not available; RNI, recommended nutrient intake

TABLE 3. Comparison of contents per daily serving or ration of complementary food supplement products

Ingredient	Nutributter® tested in Ghana [11]		Spread tested in Malawi [32]		China CDC soy flour [31]	
Type of product	Lipid-based nutrient supplement		Lipid-based nutrient supplement		Soy flour	
Amount (g)	20		25		10	
Energy						
kcal	108		127		44	
kcal/g	5.4		5.1		4.4	
Protein						
g	2.6		3.5		3.9	
% calories from protein	10%		11%		35%	
Fat	7		8.5		1.9	
g	7		8.5		1.9	
% calories from fat	58%		60%		39%	
Added sugar	NA		3.75		0	
g	NA		3.75		0	
% calories from added sugar			12%		0%	
		% WHO/ FAO RNIs		% WHO/ FAO RNIs		% WHO/ FAO RNIs
Vitamin A (μg)	400	100%	400	100%		
Vitamin D (μg)			5	100%	7	140%
Vitamin E (mg)						
Vitamin C (mg)	30	100%	30	100%		
Thiamine (vitamin B_1) (mg)	0.3	60%	0.5	100%		
Riboflavin (vitamin B_2) (mg)	0.4	80%	0.5	100%	0.2	40%
Niacin (vitamin B_3) (mg)	4	67%	6	100%		
Vitamin B_6 (mg)	0.3	60%	0.5	100%		
Vitamin B_{12} (μg)	0.5	56%	0.9	100%		
Folic acid (μg)	80	53%	160	107%		
Iron (mg)	9 (sulfate)	78%	8	69%	6 (NaFeEDTA)[a]	52%
Zinc (mg)	4 (sulfate)	48%	8.4	101%	4.1	49%
Copper (mg)	0.2 (sulfate)	36%	0.4	71%		
Selenium (μg)	10	59%	17	100%		
Calcium (mg)	100	20%	283	57%	385	77%
Iodine (μg)	90	100%	135	150%		
Vitamin K (μg)						
Biotin (μg)						
Choline (mg)						
Pantothenic acid (mg)	1.8	90%	2	100%		
Magnesium (mg)	16	27%	60	100%		
Manganese (mg)	0.08	7%				
Phosphorus (mg)	82	18%				
Potassium (mg)	152					
Sodium (mg)	NA		NA		0	
Linoleic acid (mg) (omega-6: n-6)	1,290				1,000	
α-Linolenic acid (mg) (omega-3: n-3)	290				131	
Ratio of linoleic to linolenic	4.4				7.6	

continued

TABLE 3. Comparison of contents per daily serving or ration of complementary food supplement products *(continued)*

Ingredient	Nutributter® tested in Ghana [11]	Spread tested in Malawi [32]	China CDC soy flour [31]
Instructions	Mix with 15–30 mL of child's food	Feed by spoon	
Servings per day	1	1	1
Ingredients: % weight (g/100 g)	Peanuts, milk, oil, sugar, dried skim milk	28% sugar, 26% peanut paste, 25% dry skimmed milk, 19% oil, and 2% micronutrient powder	Full-fat soy flour

NA, not available; RNI, recommended nutrient intake

a. The soy flour formula has now been changed to a combination of 2.5 mg NaFeEDTA + 2.5 mg ferrous fumarate based on the recommendation of the FAO/WHO Joint Committee on Food Additives [49].

Nutrients

Type 1 nutrients are those whose deficiencies are associated with clinical symptoms; they include, among others, vitamins and the minerals calcium, iron, and selenium [5]. For poor children in developing countries, requirements for type 1 nutrients may be higher than the recommended nutrient intakes (RNIs), which are based on needs of healthy children, because of additional nutrient needs resulting from exposure to environmental stress (pollution, smoke) and infections [5].

Type 2 nutrients are those needed for growth of lean tissues and include sulfur (mostly from protein), magnesium, phosphorus, potassium, and zinc. Except for zinc and, at times, magnesium, the type 2 nutrients have often not been included as fortificants in complementary foods, and this may have reduced the ability of these foods to improve growth in young children [34].

Previously, the number of nutrients used to fortify complementary foods and supplements has ranged from 5 to more than 20. When the focus has been on anemia prevention, fewer nutrients have been used (including iron, zinc, vitamin C, folic acid, and vitamin A) [12]. In vegetarian populations, vitamin B_{12} has sometimes been added. Final formulations of products have been decided upon by taking into account local nutritional problems, costs, technical considerations, and the local regulatory environment [35].

Nutrient recommendation standards

WHO/Food and Agriculture Organization (FAO) RNIs have generally been used in the development of products. The RNIs used were those for children 1 to 3 years of age, even though they are slightly higher in some cases than those for infants 6 to 11 months of age (although the RNI of iron for infants is higher than that for 1- to 3-year-olds).

One conclusion of the Moderate Malnutrition meeting was that "the nutritional requirements of moderately malnourished children probably fall somewhere between the nutritional requirements for healthy children and those of children with severe acute malnutrition during the catch up growth phase" [5]. Golden suggests that, "the composition of the modern diets for treating severe malnutrition (F100 or RUTF) gives an upper limit to the nutrient intakes that are likely to be required by the moderately malnourished or convalescent child living in a hostile environment" [34].

Because low-income children receiving fortified blended foods or complementary food supplements are often malnourished, nutrient standards based on the RNIs may be too low, since they do not take into account the need for replenishment of nutrient stores or catch-up growth [5]. The bioavailability of nutrients is also often limited. Current Codex standards and national regulations, however, may make it difficult to increase nutrient levels above the RNIs.

Nutrient levels

Nutrient levels in products range considerably (**tables 2 and 3**). Some were less than one RNI because nutrients provided in breastmilk were considered in setting the nutrient levels. Thus, some products contained 100% of some RNIs and lower amounts of others. For example, in Ecuador, 80% of the RNIs for iron and zinc; 40% to 60% of the RNIs for vitamin C, the B vitamins, and magnesium; and 15% to 30% of the RNIs for vitamin A, folic acid, calcium, and phosphorus were included. Micronutrient powders normally contained 100% of the RNIs for up to 15 nutrients (**table 4**). Except for zinc, most products did not report on type 2 nutrients, and their content may have been low. However, a significant amount of phosphorus is added in the US Title II fortified blended foods (e.g., corn–soy blend), since tricalcium phosphate and potassium are intrinsic to many cereals and pulses. The participants in the

TABLE 4. Comparison of WHO/FAO RNIs and nutrient composition of micronutrient powders (one serving per day)

Micronutrient	WHO/ FAO RNIs 1–3 yr [36]	UNICEF/WHO/ WFP Multiple Micronutrient Supplement [38, 39]	Sprinkles (Canada) [12]	Vitalita Sprinkles (Indonesia) [40]	Chispitas (Bolivia) [13]
Vitamin A (μg)	400	400	300 (acetate)	375	300
Vitamin D (μg)	5	5	5 (vitamin D_3)	5	
Vitamin E (mg)	5	5	6 (acetate)	6	
Vitamin C (mg)	30	30	30 (ascorbic acid)	35	30
Thiamine (vitamin B_1) (mg)	0.5	0.5	0.5 (mononitrate)	0.5	
Riboflavin (vitamin B_2) (mg)	0.5	0.5	0.5 (riboflavin)	0.5	
Niacin (vitamin B_3) (mg)	6	6	6 (niacinamide)	6	
Vitamin B_6 (mg)	0.5	0.5	0.5 (pyridoxine hydrochloride)	0.5	
Vitamin B_{12} (μg)	0.9	0.9	0.9 (cyano-cobalamin)	0.9	
Folic acid (μg)	150	150	160 (folic acid)	150	180
Iron (mg)	11.6	10 (encapsulated fumarate or other soluble iron)	12.5 (encapsulated ferrous fumarate)	10 (encapsulated fumarate)	12.5 (encapsulated fumarate)
Zinc (mg)	8.3	4.1 (zinc gluconate)	5 (gluconate)	5 (zinc gluconate)	5 (zinc gluconate)
Copper (mg)	0.56	0.56 (copper gluconate)	0.3 (sulfate)	0.6	
Selenium (μg)	17	17			
Iodine (μg)	90	90	90 (potassium iodide)	50	

Moderate Malnutrition meeting [5] emphasized that it is essential to provide all nutrients needed in order to achieve optimal growth and full functional recovery from moderate malnutrition. Products should therefore indicate the nutrient levels for both type 1 and type 2 nutrients (as shown in **tables 2 and 3**).

The upper tolerable nutrient intake level (UL) is defined as the maximum daily intake that is unlikely to pose a risk of adverse health effects in almost all apparently healthy individuals [36]. Sustained intakes above this level should be avoided, but there is a generous safety margin for most nutrients. Although there are no established WHO/FAO ULs for infants 6 to 11 months of age, the Food and Nutrition Board of the Institute of Medicine has suggested ULs for this age group for some nutrients [37]. Most Institute of Medicine ULs for infants are "nondetermined," except for vitamin A, vitamin D, fluorine, iron, selenium, and zinc (for which the UL is less than the RNI for low 15% bioavailability). Only for vitamin D and selenium are the Institute of Medicine ULs for infants 6 to 11 months of age lower than the WHO/FAO ULs for children 1 to 3 years of age, and for these nutrients, the Institute of Medicine ULs are more than 200% of the RNIs.

Golden suggests that for children in developing countries, the RNIs and ULs are too low for many nutrients because of the stressful conditions and poor environments in which they live, as well as the need for catch-up growth [34]. For example, RUTFs or F-100 formula used for treatment of malnourished children include 175 mg/1,000 kcal of magnesium (compared with the RNI of 60 mg and the UL of 65 mg). Magnesium losses are increased with the diarrhea commonly experienced by young children in developing countries. The ULs for magnesium are based on ingestion of supplemental magnesium, not magnesium in food form. Golden suggests that even the 175-mg level may be too low, since the calculations for this amount did not take into account the magnesium that is sequestered in bone during convalescence [34].

It should be noted that the UL for some nutrients is set on the basis of potential nutrient–nutrient interactions, e.g., to avoid causing a deficiency of one nutrient when high levels of another nutrient are consumed (for example, copper and zinc). However, when adequate levels of all nutrients are provided together, such a problem is less likely to occur [34].

In 2008, the American Academy of Pediatrics proposed an increase in the US recommendation for pediatric intake of vitamin D to 400 IU (10 μg) because of suboptimal vitamin D status and decreased exposure to sunlight. Most of the products that have been used in developing countries so far (Sprinkles, fortified complementary foods) have contained less than this, about 200 IU (5 μg) of vitamin D [41].

The inclusion of 100% of the RNIs per daily serving, as is done with most micronutrient powders, helps ensure that children receive all needed nutrients with

TABLE 5. Comparison of WHO/FAO RNIs and ULs per day and F-100/RUTF nutrient levels in 1,000 kcal with two servings of a complementary food or supplement containing 100% of the RNIs per day

Micronutrient	RNI 1–3 yr	UL 1–3 yr[a]	UL 7–11 mo	F-100/RUTF	2 servings or rations/day at 100% of RNI for children 1–3 yr, per serving
Vitamin A (μg)	400	600	600	**1,500**	**800**
Vitamin D (μg)	5[b]	50	25	30	10
Vitamin E (mg)	5	200	NA	22	10
Vitamin C (mg)	30	400	NA	100	60
Thiamine (vitamin B_1) (mg)	0.5		NA	0.7	1
Riboflavin (vitamin B_2) (mg)	0.5		NA	2	1
Niacin (vitamin B_3) (mg)	6	10	NA	**10**	12
Vitamin B_6 (mg)	0.5	30	NA	0.7	1
Vitamin B_{12} (μg)	0.9	None	NA	1	1.8
Folic acid (μg)	150	300	NA	**350**	**300**
Iron (mg)	11.6	40	40	24	23.2
Zinc (mg)	8.3	23–28	NA	22.1	16.6
Copper (mg)	0.56	1	NA	**2.7**	**1.12**
Selenium (μg)	17	90	60	55	34
Calcium (mg)	500[b]	2,500	NA	1,008	1,000
Iodine (μg)	90	200	NA	18	180
Vitamin K (μg)	15[b]		NA	40	30
Biotin (μg)	8		NA	10	16
Choline (mg)	20[b]	1,000	NA	NA	400
Pantothenic acid (mg)	2[b]		NA	3	4
Magnesium (mg)	60	65	NA	**175**	**120**
Manganese (mg)	1.2[b]	**2**	NA	0.7	**2.4**
Phosphorus (mg)	460	3,000	NA	762	920
Potassium (mg)	NA	NA	NA	2,400	NA
Sodium (mg)	NA	NA	NA	454	NA

NA, not available; RNI, recommended nutrient intake; UL, upper tolerable nutrient intake level. Bolded values are those that equal or exceed the UL for ages 1 to 3 years.

a. ULs reported from WHO/FAO [48], except for zinc and magnesium (WHO/FAO [36]) and manganese and phosphorus IOM [37] ;

b Adequate intakes, in: World Health Organization/FAO. Vitamin and mineral requirements in human nutrition [36].

one daily packet of product. This lowers costs and may increase the likelihood of daily consumption. However, products such as fortified blended foods may be eaten by children more than once a day, especially by older children. Including 100% of the RNIs in one serving for younger children could result in older children receiving 200% of the RNIs. This may be a concern for some nutrients. However, participants in the Moderate Malnutrition consultation suggested that levels substantially above the RNI (closer to the levels in F-100 or RUTF) may be needed, so consumption of twice the RNI for most nutrients may not be a problem.

Micronutrient powders contain 5 to 15 nutrients (**table 4**); if twice the RNI is accidentally consumed, only vitamin A, niacin, and copper intakes would be above the ULs. The amount of vitamin A and copper in Sprinkles (Canada) was lowered to less than 100% of the RNI, while levels of the other nutrients were maintained at 100% of RNI values to ensure that children received sufficient amounts.

To assess the implications of consumption of two servings of a product containing 100% of the RNIs, **table 5** compares the RNIs [36], the Institute of Medicine ULs for children 7 to 11 months and 1 to 3 years of age [37], and the levels in F-100 or RUTF per 1,000 kcal [34, 42] with the intakes that would occur if a child were to consume two servings or rations per day (each containing 100% of the RNIs). This scenario would result in intakes above the ULs for magnesium and manganese, in addition to those for vitamin A, niacin, and copper. However, except for manganese, consumption of two servings or rations per day would still provide less of these nutrients than would be consumed by a severely malnourished child given 1,000 kcal per day of F-100 or RUTF.* Although a UL for

* The amount of manganese in RUTF or F-100 is 0.7 mg/1,000 kcal, as compared with the RNI of 1.2 and the UL of 2 mg. The amount of vitamin A in RUTF or F-100 is 1,200 μg, as compared with the RNI of 400 and the UL of 600 μg. The amount of niacin in RUTF or F-100 is 10 mg, as compared with the RNI of 6 mg and the UL of 10 mg. The amount of copper in RUTF or F-100 is 2.7 mg per 1,000 kcal, as

manganese was set by the Institute of Medicine, there were no reports of manganese toxicity. The NOAEL (no observed adverse effects level) was established at 11 mg/day for adults. Including less than 100% of the RNI for manganese in a fortified product is one option for keeping intake levels below the UL, even if a child were to consume two servings per day.

A method has been developed for determining nutrient levels for fortified complementary foods using a micronutrient simulation model that is based on the relative energy requirements for each age group [43]. One of the key components of this method is an expert review of predicted levels of individual nutrients, to assess whether there are concerns regarding potential intakes of levels that exceed the ULs.

In areas where there is high consumption of other fortified foods (such as in Central America, where sugar is fortified with vitamin A), levels of fortification below 100% of the RNI may be appropriate. Also, in populations where both fortified blended foods and micronutrient powders are widely available (as is becoming the case in Bolivia), the levels of nutrients in products may need to be adjusted to account for this.

The conclusions of the 2006 WHO expert consultation on the use of iron in malaria-endemic areas need to be taken into account with respect to the iron content of micronutrient powders or complementary food supplements [44]. The consultation was held after a study in Pemba, Tanzania, found an increase in adverse events (hospital admissions and mortality) among children who were supplemented with iron and folic acid (with or without zinc) in a malaria-endemic area [45]. The conclusions of the expert consultation state that in malaria-endemic areas where malaria control programs, including the use of insecticide-treated nets and vector control, are not optimally implemented and individual screening for iron deficiency is not possible, additional iron can be provided to older infants and young children in fortified blended foods [46]. Although the safety of such blended foods in malaria-endemic areas has not been documented, this approach is likely to avoid the potential adverse effects of a large bolus of iron taken in a single dose, since the iron would be consumed in smaller amounts throughout the day and therefore would be absorbed more slowly. With regard to micronutrient powders or complementary food supplements, which typically provide 1 RNI of iron (10 to 12.5 mg) in a single portion added to a meal, the conclusions state that there is reason to believe that those preparations may be safer than iron supplements, but that they cannot be recommended until this has been demonstrated. Therefore, where malaria control is not well implemented, these products should have lower amounts of iron per single portion or be subdivided into several portions per day. Some have suggested the use of micronutrient powders containing 100% of the RNI for only 60 days within a year [47], whereas others suggest limiting iron to 33% of the RNI at each meal, with three meals a day [K. Dewey, personal communication]. When antifolate antimalarials are used, micronutrient powders should not contain folic acid [47].

Chemical forms of nutrients

The chemical forms of nutrients affect bioavailability, stability, interaction with food, and shelf-life. Cooking also affects the concentrations of certain nutrients, especially vitamins A and C, which are unstable. Some forms of nutrients (e.g., reduced iron) are lower in cost but less well absorbed. **Table 6** gives some of the forms of nutrients appropriate for inclusion on the basis of WHO/FAO guidelines and additional technical guidance.

The Codex Joint Committee on Food Additives states that NaFeEDTA can be used in fortified foods [49].* In 2009, China passed a national food standard for complementary foods that includes the use of NaFeEDTA, as long as the amount does not exceed 3 mg per day. Complementary food supplements (fortified soy flour) in China contain a combination of NaFeEDTA and ferrous sulfate.

Macronutrients

Breastmilk is an important source of high-quality protein, fat (including essential fatty acids), vitamin A, and many other essential nutrients. Therefore, complementary food consumption should not interfere with breastmilk intake. High energy intake from other foods can lead to reduced breastmilk intake and thus potentially have detrimental effects on a child's nutritional

compared with the RNI of 0.56 mg and the UL of 1 mg. During rehabilitation, most children take between 150 and 220 kcal th/kg (630 to 920 kJ/kg) per day [42]. If intake is below 130 kcal th or 540 kJ/kg per day, the child is failing to respond. A child 12 months of age weighing 6.6 kg with a length of 75 cm is severely malnourished on the basis of weight-for-length z-score (−3.78 SD) and should receive 990 kcal of F-100 for recovery, and would receive 150 kcal or more per kilogram until reaching a weight-for-length z-score of –1 SD. Thus, the use of 1,000 kcal of F-100 is an appropriate level with which to compare nutrient levels with the RNIs, since they have been used safely in severely malnourished children.

* "Sodium iron EDTA is suitable for use as a source of iron for food fortification to fulfill nutritional iron requirements, provided that the total intake of iron from all food sources including contaminants does not exceed the PMTDI (provisional maximum tolerable daily intake) of 0.8 mg/kg body weight. Total intake of EDTA should not exceed acceptable levels, also taking into account the intake of EDTA from the food additive use of other EDTA compounds. An Acceptable Dietary Intake of 0–2.5 mg/kg body weight was previously established for the calcium disodium and disodium salts of EDTA, equivalent to up to 1.9 mg/kg body weight EDTA" [49].

TABLE 6. Possible chemical forms of nutrients included in products based on WHO/FAO food-fortification guidelines [48]

Nutrient	Chemical form
Vitamin A	Retinyl acetate or retinyl palmitate or β-carotene
Vitamin D	Ergocalciferol (vitamin D_2) or cholecalciferol (vitamin D_3)
Vitamin E	Acetates of D or DL-α-tocopherol
Vitamin C	L-ascorbic acid
Thiamine (vitamin B_1)	Thiamine mononitrate (preferred for dry products) or thiamine hydrochloride
Riboflavin (vitamin B_2)	Riboflavin
Niacin (vitamin B_3)	Niacinamide
Vitamin B_6	Pyridoxine hydrochloride
Vitamin B_{12}	Cyanocobalamin-diluted form (0.1% or 1%) with 100% active particles, spray-dried form
Folic acid	Pteroyl monoglutamic acid
Iron	NaFeEDTA (subject to Codex limits), encapsulated ferrous sulfate, encapsulated ferrous fumarate[a] and micronized ferric pyrophosphate[b] could also be used, but costs need to be considered
Zinc	Zinc sulfate, zinc gluconate[a] , zinc oxide[c,d]
Copper	Copper sulfate or copper gluconate[d]
Selenium	Sodium selenate, sodium selenite
Calcium	Several forms available; some with higher contents of calcium, such as calcium phosphate and calcium carbonate; soluble organic calcium salts such as calcium citrate. Calcium salts containing well-absorbed anions (such as chloride) should be avoided, as they may induce acidosis[e]
Magnesium	Soluble organic magnesium salts, such as magnesium citrate. Magnesium salts containing well-absorbed anions (such as chloride) should be avoided, as they may induce acidosis[e]
Iodine	Potassium iodate

a. Sprinkles Global Health Initiative and Heinz [24]
b. USAID Micronutrient and Child Blindness A to Z Project [50]
c. Rosado JL. "Zinc and copper. Proposed fortification levels and recommended zinc compounds." [51]
d. In cases where there are interactions due to storage, stabilized forms of minerals should be considered, subject to cost constraints
e. Golden M. "Proposed nutrient requirements of moderately malnourished populations of children." [34]

status and development and increase the risk of illness. Adding nutrient-dense fat sources (such as full-fat soybean flour or whole-milk powder) to enhance the quality of the child's diet has been reported to be beneficial [31, 32]. This is especially relevant for children who are not breastfed, since breastmilk provides the major source of animal protein and fat in the diets of young children in developing countries.

The participants in the Moderate Malnutrition meeting [5] suggested that the protein sources used to feed moderately malnourished children should have a protein digestibility corrected amino acid score (PDCAAS) of at least 70%. Giving lower amounts of proteins with higher PDCAAS may be advantageous, because protein increases the renal solute load. Animal-source foods provide proteins with higher PDCAAS than plant-source foods and thus are beneficial for inclusion in complementary foods. Amino acids containing sulfur (methionine and cysteine) are especially important for linear growth because they are needed for cartilage synthesis [34]. Using plant-based diets to provide large quantities of protein is not ideal, since such diets generally have high levels of antinutrients [5].

Because the typical complementary foods available in developing countries are often limited in fat, essential fatty acids, and high-quality protein, fortified products designed for children in such populations may need to contain higher proportions of these macronutrients than the normal diet to make up for deficits in the other foods consumed. The amount of fat in the total diet is recommended to be at least 30% of energy, but 35% to 45% is considered to be advantageous if the density of micronutrients is adequate [5]. Lipid-based nutrient supplements generally have higher total fat content than fortified blended foods and thus improve fat and essential fatty acid content in the total diet.

Most diets in developing countries are low in α-linolenic acid and have an inappropriately high ratio of linoleic to α-linolenic acid. Foods with high α-linolenic acid content should be promoted [5]. Since emerging evidence suggests that low intake of essential fatty acids is associated with suboptimal growth and development, enhancement of the essential fatty acid content of complementary foods may be beneficial [52, 53]. The use of soy oil, full-fat soy flour, or canola oil is preferable, because they provide both linoleic and α-linolenic acid, whereas corn oil, peanut oil, and palm oil provide primarily linoleic acid.

The 2006 Codex recommended that the level of linoleic acid should not be less than 300 mg per 100 kcal and not exceed 1,200 mg per 100 g of product. The participants at the Moderate Malnutrition meeting

[5] suggested a range of 5:1 to 15:1 ratio of linoleic to α-linolenic acid, although a ratio of less than 5:1 is also likely to be acceptable. Both Nutributter® and the soy flour supplement used in China had more than 1,000 mg of linoleic acid in only 10 to 20 g of food, and the ratio of linoleic to α-linolenic acid was 4.4:1 in Nutributter® and 9.8:1 in the China soy flour.

Summary

Three types of fortified products have been developed for consumption by infants and young children: fortified blended foods, complementary food supplements, and micronutrient powders.

Fortified blended foods that have been successful in improving nutritional status have generally included cereal (or maltodextrin), a nutrient-dense fat source (such as full-fat soy flour or whole-milk powder*), high-quality protein if limited in the diet (5% to 15% calories as protein), milk (whole milk or nonfat milk), and micronutrients.

Complementary food supplements have contained a high-quality protein and a nutrient-dense fat source, a good source of essential fatty acids (e.g., soy, canola, or fish oil), milk, and micronutrients. In some studies, their impacts on growth have been greater than effects seen with fortified blended foods [54, 55] or micronutrient powders [11], but the costs of such products per serving may be higher than the costs of micronutrient powders.

The nutrient levels and types of ingredients vary across different products. The formulations shown as examples in this document were based on available foods, their nutrient contents and costs, and local cultural practices. Until international recommendations are established, these examples may help governments and companies make decisions on types of products, levels and forms of nutrients to include, and composition when designing initiatives for the prevention of malnutrition.

Micronutrient powders contain a mixture of minerals and vitamins that are added to foods in the home or at the point of use to increase the nutrient density of the food to which they are added. There is good documentation of their impact on iron status and some functional outcomes in children 6 to 24 months of age [11]. They are less expensive than other food-based supplements and are also well accepted by families and communities.

There is an urgent need for basic research on the

* Inclusion of whole-milk powder may require special packaging

BOX 1. Summary of characteristics of previously used fortified blended foods and supplements

All products
Instant or precooked
Semisolid or solid
Comply with International Code of Marketing of Breastmilk Substitutes and subsequent World Health Assembly Resolutions

Fortified blended foods

Daily serving size:	20–50 g dry weight
Kcal/g dry weight:	At least 4 kcal/g
Portions per day:	1–3 (larger servings were divided into portions and fed at different times during the day)
Energy:	140–275 kcal per daily serving
Protein:	11%–15% of calories
Fat:	20%–31% of calories

Contained milk and were fortified with micronutrients

Complementary food supplements

Daily serving size:	10–50 g dry weight
Kcal/g dry weight:	4.4–5.4 kcal/g
Portions per day:	1
Energy:	40–250 kcal per daily serving
Protein:	10%–35% of calories
Fat:	39%–60% of calories

Most contained milk and essential fatty acids (ratio of linoleic to α-linolenic acid was generally between 5:1 and 10:1) and were fortified with micronutrients

Micronutrients (for all products and micronutrient powders)
Both type 1 and type 2 nutrients are essential
Bioavailable forms of nutrients

nutrient requirements of infants and young children, harmonization of current recommendations, and better definition of appropriate mineral compounds for use in products for young children. Some key gaps were evident during the preparation of this paper, including the following:

» Recommended amounts of nutrients are uncertain:
  – ULs are generally not available for infants;
  – Because data on usual dietary intakes are not generally available, the appropriate percentage of the RNI per serving to include is unclear;
  – Recommendations based on the average intakes of breastfed children may underestimate the amounts needed by non-breastfed children;
  – Nutrient requirements probably differ for children at risk for malnutrition living in poor environments with high rates of infection, compared with those for healthy children;
» Forms of nutrients differ in bioavailability, cost, and interaction with foods (i.e., suitability for fortification). The recent WHO/FAO guidelines on fortification do not clearly specify which forms of each nutrient should be used and their benefits and costs;
» Information is needed on the best sources of essential fatty acids (fish, algae, soy, rapeseed or canola oil) to be used in such products with respect to costs, availability, and amounts required;
» More data are needed on the value of including milk in such products, especially in relation to the type of milk product (whole, nonfat, whey), costs, and amounts needed to improve child growth.

Conclusions

The three types of products for infants and young children described above have led to improvements in nutritional status in some research studies and program evaluations. **Box 1** summarizes some of the characteristics of each type of product. Fortified blended foods, which are often used in national feeding programs, provide a replacement for less nutritious foods but are generally more expensive than micronutrient powders because they provide macronutrients as well as micronutrients. Fortified complementary food supplements have been shown to influence growth, perhaps because of the essential fatty acids and milk that they contain [11, 54, 55], while also improving micronutrient status. Micronutrient powders have been widely tested and shown to be effective for reducing anemia in large-scale programs [41]. Decisions on which products or which type of product to use will vary, depending on the setting and on the ability of manufacturers to produce high-quality products.

Acknowledgments

We would like to thank André Briend and Zhenyu Yang for their review and comments on this paper. We also thank GAIN for supporting this work for the Ten Year Strategy on Vitamin and Mineral Deficiencies Working Group on Maternal, Infant and Young Child Nutrition.

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New and updated indicators for assessing infant and young child feeding

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Introduction

The World Health Organization (WHO) and partners have released new and updated indicators for assessing infant and young child feeding practices for use in population-based surveys. The indicators reflect current recommendations for appropriate infant and young child feeding and provide important new information on feeding practices in children 6 to 23 months of age.

Simple, valid, and reliable indicators are crucial for tracking progress and guiding investment to improve nutrition and health during the first 2 years of life. In 1991, WHO issued indicators for assessing breastfeeding practices that have since been used widely and have contributed to directing program efforts in many countries [1]. However, a set of indicators that could be used in population-based surveys to assess complementary feeding practices was not available. This limited the understanding of the magnitude and distribution of inadequate feeding practices and hampered progress in the development of effective program responses.

Recognizing this gap, WHO, together with partners from the International Food Policy Research Institute, the Food and Nutrition Technical Assistance Project/Academy of Educational Development, Macro International, the University of California at Davis, the United States Agency for International Development, and UNICEF jointly undertook the effort to develop new and updated indicators to assess infant and young child feeding practices. The work was guided by updated recommendations for the duration of exclusive breastfeeding [2, 3], the Guiding Principles for Complementary Feeding of the Breastfed Child [4], the Guiding Principles for Feeding Non-Breastfed Children [5], and a conceptual framework for identifying potential indicators of complementary feeding [6]. An extensive analysis of infant and young child dietary intake data from 10 sites was performed to assess relationships between dietary diversity and mean micronutrient density adequacy and between feeding frequency and energy intake [7, 8].

The results of this 5-year effort have been recently published [9]. Eight core and seven additional indicators now cover optimal breastfeeding practices and food-related aspects of appropriate feeding practices in children 6 to 23 months of age. New indicators include measures of dietary diversity, feeding frequency, and the consumption of iron-rich or iron-fortified foods. Most indicators can be derived from questions already used in widely implemented surveys, such as Demographic and Health Surveys and UNICEF Multiple Indicator Cluster Surveys. An operational guide to facilitate standardized measurement is under development. The indicators and indicator definitions are summarized in the Annex.

Core indicators

1. Early initiation of breastfeeding
2. Exclusive breastfeeding under 6 months
3. Continued breastfeeding at 1 year
4. Introduction of solid, semi-solid, or soft foods
5. Minimum dietary diversity
6. Minimum meal frequency
7. Minimum acceptable diet
8. Consumption of iron-rich or iron-fortified foods

Optional indicators

9. Children ever breastfed
10. Continued breastfeeding at 2 years
11. Age-appropriate breastfeeding
12. Predominant breastfeeding under 6 months

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13. Duration of breastfeeding
14. Bottle-feeding
15. Milk feeding frequency for non-breastfed children

Data from available Demographic and Health Surveys from 54 countries are currently being analyzed by Macro International to identify baseline values for several of the new indicators. The report will be published by WHO in 2009. Information from 18 African countries using an earlier version of the indicators demonstrated that in 13 countries, less than 30% of children 6 to 23 months of age were fed with solids or semisolids the minimum number of times or more and fed the minimum number or more of food groups, whereas in 14 countries less than 10% of non-breastfed children 6 to 23 months of age received any milk products in addition to being fed solids and semisolids the minimum number of times or more and fed the minimum number of food groups or more [10].

Appropriate infant and young child feeding is critical for child health, development, and survival. The Global Strategy for Infant and Young Child Feeding provides the framework for effective action [11]. In order to assess the situation, target interventions, and populations at risk and to monitor and evaluate progress, feeding practices must be tracked with the use of standard measures. The new and updated indicators provide a sound basis for expanding the necessary information and knowledge, and it is hoped that they will be used widely by countries and partners in efforts to assess progress in public health and toward attainment of the Millennium Development Goals.

Bernadette Daelmans is a staff member of WHO. The author alone is responsible for the views expressed in this publication, and they do not necessarily represent the decisions or policies of WHO. Members of the Working Group and the Steering Team that led the development of the indicators are listed in the document referenced in the Annex.

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Annex

Excerpt from WHO, UNICEF, IFPRI, UC Davis, FANTA, AED, Macro International, USAID *Indicators for assessing infant and young child feeding practices*. Geneva: World Health Organization, 2008 http://www.who.int/child_adolescent_health/documents/9789241596664/en/index.html

Core Indicators

1. **Early initiation of breastfeeding**: Proportion of children born in the last 24 months who were put to the breast within one hour of birth

$$\frac{\text{Children born in the last 24 months who were put to the breast within one hour of birth}}{\text{Children born in the last 24 months}}$$

Notes:

» This indicator is based on historic recall. The denominator and numerator include living children and deceased children who were born within the past 24 months.

» It is recommended that the indicator be further disaggregated and reported for (i) live births occurring in the last 12 months; and (ii) live births occurring between the last 12 and 24 months.

2. **Exclusive breastfeeding under 6 months:** Proportion of infants 0–5 months of age who are fed exclusively with breast milk

$$\frac{\text{Infants 0–5 months of age who received only breast milk during the previous day}}{\text{Infants 0–5 months of age}}$$

Notes:

» This indicator includes breastfeeding by a wet nurse and feeding expressed breast milk. It was, however, thought simpler to retain the term "exclusive breastfeeding" rather than the more precise but cumbersome term "fed exclusively on breast milk".

» This is the first in the series of current status indicators based on recall of the previous day and includes living infants. All indicators that follow, except "children ever breastfed", are also based on recall of the previous day.

» Using the previous day recall period will cause the proportion of exclusively breastfed infants to be overestimated, as some infants who are given other liquids irregularly may not have received them in the day before the survey.

» As with other indicators that are based on current status, exclusive breastfeeding is based on a cross section of children in a given age range, in this case children from birth to just under 6 months of age. It therefore does not represent the proportion of infants who are exclusively breastfed *until just under* 6 months of age and *should not* be interpreted as such. It is generally accepted that the proportion of children who are exclusively breastfed *until just under* 6 months of age is lower than the number derived from the indicator of current status. For example, if there is a linear rate of decline in the proportion exclusively breastfed from 100% at birth to 20% at 6 months, the indicator value for exclusive breastfeeding under 6 months would be 60% (as compared to 20% still exclusively breastfed at 6 months). However, the indicator recommended in this document represents the best option for estimating exclusive breastfeeding and is more sensitive to capturing changes. If there is interest in identifying differences in proportions of infants exclusively breastfed over smaller age ranges, creation of a figure or area graph of feeding practices by age and disaggregation as suggested in the bullet below may provide such information.

» It is recommended that the indicator be further disaggregated and reported for the following age-groups: 0–1 months, 2–3 months, 4–5 months, and 0–3 months.

3. **Continued breastfeeding at 1 year:** Proportion of children 12–15 months of age who are fed breast milk

$$\frac{\text{Children 12–15 months of age who received breast milk during the previous day}}{\text{Children 12–15 months of age}}$$

Notes:

» This indicator includes breastfeeding by a wet nurse and feeding expressed breast milk.

» The title of this indicator on continued breastfeeding reflects an approximation of the age range covered. Because of the age interval, the indicator underestimates the proportion of children breastfed at one year.

» Because the indicator has a relatively narrow age range of 4 months, estimates from surveys with small sample sizes are likely to have wide confidence intervals.

4. **Introduction of solid, semi-solid, or soft foods:** Proportion of infants 6–8 months of age who receive solid, semi-solid, or soft foods

$$\frac{\text{Infants 6–8 months of age who received solid, semi-solid, or soft foods during the previous day}}{\text{Infants 6–8 months of age}}$$

Notes:

- » This indicator is one of the two parts of the previous composite indicator for timely complementary feeding, which also included continued breastfeeding (1).
- » The previous indicator included living infants 6–9 months in the numerator and denominator. A narrower age range has been chosen so as not to include infants first receiving foods as late as 9 months in the numerator.
- » Because the indicator has a very narrow age range of 3 months, estimates from surveys with small sample sizes are likely to have wide confidence intervals.
- » Figures or area graphs of infant feeding practices by age provide additional information and are a useful illustration of the pattern of introduction of solid, semi-solid, or soft foods in the population.

5. **Minimum dietary diversity:** Proportion of children 6–23 months of age who receive foods from 4 or more food groups

$$\frac{\text{Children 6–23 months of age who received foods from} \geq 4 \text{ food groups during the previous day}}{\text{Children 6–23 months of age}}$$

Notes:

- » The 7 food groups used for tabulation of this indicator are:
  - grains, roots, and tubers
  - legumes and nuts
  - dairy products (milk, yogurt, cheese)
  - flesh foods (meat, fish, poultry, and liver/organ meats)
  - eggs
  - vitamin-A rich fruits and vegetables
  - other fruits and vegetables
- » Consumption of any amount of food from each food group is sufficient to “count”, i.e., there is no minimum quantity, except if an item is only used as a condiment.
- » The cut-off of at least 4 of the above 7 food groups above was selected because it is associated with better quality diets for both breastfed and non-breastfed children (8) Consumption of foods from at least 4 food groups on the previous day would mean that in most populations the child had a high likelihood of consuming at least one animal-source food and at least one fruit or vegetable that day, in addition to a staple food (grain, root, or tuber).
- » Results may be reported separately for breastfed and non-breastfed children. However, diversity scores for breastfed and non-breastfed children should not be directly compared, because breast milk is not ‘counted’ in any of the above food groups. Breast milk is not counted because the indicator is meant to reflect the quality of the complementary food diet. As a consequence, this indicator may show ‘better’ results for children who are not breastfed than those who are breastfed in populations where formula and/or milk are commonly given to non-breastfed children.
- » For the same reason, this indicator should not be used to compare populations that differ in prevalence of continued breastfeeding. This caution applies both to comparisons between different sub-populations at one point in time (e.g., urban versus rural comparisons) and the same population at different points in time (e.g., if continued breastfeeding has declined). The composite indicator (# 7 below) captures several different dimensions of feeding and can be used for comparisons across time and between populations with different rates in continued breastfeeding.
- » It is recommended that the indicator be further disaggregated and reported for the following age groups: 6–11 months, 12–17 months, and 18–23 months.

6. **Minimum meal frequency:** Proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more.

The indicator is calculated from the following two fractions:

$$\frac{\text{Breastfed children 6–23 months of age who received solid, semi-solid, or soft foods the minimum number of times or more during the previous day}}{\text{Breastfed children 6–23 months of age}}$$

and

$$\frac{\text{Non-breastfed children 6–23 months of age who received solid, semi-solid, or soft foods or milk feeds the minimum number of times or more during the previous day}}{\text{Non-breastfed children 6–23 months of age}}$$

Notes:

» Minimum is defined as:
  - 2 times for breastfed infants 6–8 months
  - 3 times for breastfed children 9–23 months
  - 4 times for non-breastfed children 6–23 months
  - "Meals" include both meals and snacks (other than trivial amounts), and frequency is based on caregiver report.

» This indicator is intended as a proxy for energy intake from foods other than breast milk. Feeding frequency for breastfed children includes only non-liquid feeds and reflects the Guiding Principles. Feeding frequency for non-breastfed children includes both milk feeds and solid/semi-solid feeds, and also reflects the Guiding Principles for these children.

» It is recommended that the indicator be further disaggregated and reported for the following age groups: 6–11 months, 12–17 months, and 18–23 months of age. Results may also be reported separately for breastfed and non-breastfed children.

7. **Minimum acceptable diet:** Proportion of children 6–23 months of age who receive a minimum acceptable diet (apart from breast milk)

This composite indicator will be calculated from the following two fractions:

$$\frac{\text{Breastfed children 6–23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day}}{\text{Breastfed children 6–23 months of age}}$$

and

$$\frac{\text{Non-breastfed children 6–23 months of age who received at least 2 milk feedings and had at least the minimum dietary diversity not including milk feeds and the minimum meal frequency during the previous day}}{\text{Non-breastfed children 6–23 months of age}}$$

Notes:

» For breastfed children, see indicators 5 and 6 above for "Minimum dietary diversity" and "Minimum meal frequency" definitions.

» For non-breastfed children, see indicator 6 above for definition of "Minimum meal frequency". The definition of "Minimum dietary diversity" is similar to the definition for indicator 5, but milk feeds are excluded from the diversity score for non-breastfed children when calculating "Minimum acceptable diet". This is because milk feeds are considered as a separate and required element for non-breastfed children in this multi-dimensional indicator. Exclusion of milk feeds from the diversity score here avoids "double-counting" of this food group and allows use of this indicator in comparisons – across space and time – between populations with different rates of continued breastfeeding.

» See indicator 15 below for the rationale for at least 2 milk feedings for non-breastfed children.

» It is recommended that the indicator be further disaggregated and reported for the following age groups: 6–11 months, 12–17 months, and 18–23 months of age.

8. **Consumption of iron-rich or iron-fortified foods:** Proportion of children 6–23 months of age who receive an iron-rich food or iron-fortified food that is specially designed for infants and young children, or that is fortified in the home

$$\frac{\text{Children 6–23 months of age who received an iron-rich food or a food that was specially designed for infants and young children and was fortified with iron, or a food that was fortified in the home with a product that included iron during the previous day}}{\text{Children 6–23 months of age}}$$

Notes:

» Suitable iron-rich or iron-fortified foods include flesh foods, commercially fortified foods specially designed for infants and young children that contain iron, or foods fortified in the home with a micronutrient powder containing iron or a lipid-based nutrient supplement containing iron.

» While this indicator assesses a critical aspect of nutrient adequacy of food intake, guidance on how best to operationalize the data collection is difficult to standardize. Further work is being undertaken to develop the questions to allow for its tabulation.

» It is recommended that the indicator be further disaggregated and reported for the proportion of children receiving flesh foods only and the proportion of children who consume some fortified food specially designed for infants and young children that contains iron (with or without flesh foods).

» It is also recommended that the indicator be further disaggregated and reported for the following age groups: 6–11 months, 12–17 months, and 18–23 months of age.

Optional Indicators

Considering the need to limit the number of indicators and quantity of data to be collected to a minimum, it is proposed that the indicators described above are the most critical for population-based assessment and programme evaluation. However, to ensure continuity in monitoring of previously used indicators and recognizing that some programmes may wish to measure additional indicators, the following optional indicators are recommended:

9. **Children ever breastfed:** Proportion of children born in the last 24 months who were ever breastfed

$$\frac{\text{Children born in the last 24 months who were ever breastfed}}{\text{Children born in the last 24 months}}$$

Notes:

» This indicator is based on historic recall. The denominator and numerator include living and deceased children who were born within the past 24 months.
» It is recommended that the indicator be further disaggregated and reported for (i) live births occurring in the last 12 months; and (ii) live births occurring between the last 12 and 24 months.

10. **Continued breastfeeding at 2 years:** Proportion of children 20–23 months of age who are fed breast milk

$$\frac{\text{Children 20–23 months of age who received breast milk during the previous day}}{\text{Children 20–23 months of age}}$$

Notes:

» The title of this indicator on continued breastfeeding reflects an approximation of the age range covered.
» Because the indicator has a relatively narrow age range of 4 months, estimates from surveys with small sample sizes are likely to have wide confidence intervals.

11. **Age-appropriate breastfeeding:** Proportion of children 0–23 months of age who are appropriately breastfed

The indicator is calculated from the following two fractions:

$$\frac{\text{Infants 0–5 months of age who received only breast milk during the previous day}}{\text{Infants 0–5 months of age}}$$

and

$$\frac{\text{Children 6–23 months of age who received breast milk, as well as solid, semi-solid, or soft foods, during the previous day}}{\text{Children 6–23 months of age}}$$

12. **Predominant breastfeeding under 6 months:** Proportion of infants 0–5 months of age who are predominantly breastfed

$$\frac{\text{Infants 0–5 months of age who received breast milk as the predominant source of nourishment during the previous day}}{\text{Infants 0–5 months of age}}$$

Notes:

» As the proportion of infants aged *just less than* 6 months who are exclusively breastfed may be quite low in some populations, the intent of this indicator is to identify infants whose predominant source of nourishment is breast milk, but who also receive other fluids. These include liquids, such as water-based drinks, fruit juice, and ritual fluids. Non-human milk and food-based fluids are not allowed.
» A figure or an area graph of feeding practices by age provides the clearest illustration of various infant feeding practices and when used, can replace this indicator.

13. **Duration of breastfeeding:** Median duration of breastfeeding among children less than 36 months of age

The age in months when 50% of children 0–35 months did not receive breast milk during the previous day

Note:

The population median duration of breastfeeding is the only indicator that requires collection of data on feeding practices in children above 23 months of age and is calculated using current status data among all children less than 36 months of age.

14. **Bottle feeding:** Proportion of children 0–23 months of age who are fed with a bottle.

$$\frac{\text{Children 0–23 months of age who were fed with a bottle during the previous day}}{\text{Children 0–23 months of age}}$$

Notes:

» Information on bottle feeding is useful because of the potential interference of bottle feeding with optimal breastfeeding practices and the association between bottle feeding and increased diarrhoeal disease morbidity and mortality. Bottles with a nipple are particularly prone to contamination. Included in the numerator of this indicator are children less than 24 months of age who received any food or drink from a bottle with a nipple/teat during the previous day (including breast milk), regardless of whether or not the infant was breastfed.

» It is recommended that this indicator be further disaggregated and reported for each of 3 age groups: 0–5 months, 6–11 months, and 12–23 months.

15. **Milk feeding frequency for non-breastfed children:** Proportion of non-breastfed children 6–23 months of age who receive at least 2 milk feedings

$$\frac{\text{Non-breastfed children 6–23 months of age who received at least 2 milk feedings during the previous day}}{\text{Non-breastfed children 6–23 months of age}}$$

Notes:

» Milk feedings include liquid milk products such as infant formula, cow milk, or other animal milk. The specific products to be included need to be defined for each target population, to take into account local milk products that are commonly fed to young children in substantial quantities (e.g., fermented dairy products).

» The minimum of 2 milk feedings was selected based on the following: Average energy intake from breast milk in developing countries is approximately 400 kcal/day between 6 and 11 months and 350 kcal/day between 12 and 23 months (4). For non-breastfed children, the dietary analysis results (8) indicated that 3 milk feedings per day would generally allow for an average intake of milk that is similar to this range (300–400 kcal from milk). Most children will probably not consume more than 180–240 mL of milk per feed, which would be equivalent to ~100–150 kcal/feed if consumed as liquid whole cow milk. Taking the upper end of this range (150 kcal/feed) and a slightly lower "target" for energy intake from milk than is consumed by breastfed children (300 kcal/day), a minimum of 2 milk feedings per day would be needed.

» It is recommended that the indicator be further disaggregated and reported for the following age groups: 6–11 months, 12–17 months, and 18–23 months.