Responding to nutritional crises in Niger: research in action in the region of Maradi

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Introduction

1 Despite recent developments and efforts to address childhood malnutrition and its determinants, eradicating world hunger and childhood malnutrition has become an evasive task. While the prevalence of malnutrition worldwide declined from an estimated 878 million in the early 1970s to 825 million in the mid to late 1990s, from this point onward estimates increased dramatically from 857 million in early 2000 to a peak of 1.02 billion in 2009. This suggests an increase of approximately 195 million since the late 1990s. All the while, the world has been producing enough food to feed everyone worldwide over the last four decades.

2 Child malnutrition continues arguably to be the biggest threat to the public health and social system worldwide. From a public health perspective, malnutrition constitutes the single biggest contributor to under-five mortality, and current data suggest that mortality due to malnutrition accounts for 58% of total mortality. Malnutrition-related deaths have been increasing annually since the 1960s, and available annual trend analyses indicate an increased rate of malnutrition-related deaths; with malnutrition-related deaths in under-fives estimated at 6 million children per year. Malnourished children are prone to serious childhood illnesses and stunted physical and mental development. Child malnutrition has also a negative effect on education attainment and economic productivity. Compared to malnourished children, well-nourished children are more likely to complete school, to achieve better school grades, earn more money as adults, and more likely to have well-nourished children themselves. Children who are stunted the first two years of life have been found to have lower cognitive test scores, delayed enrolment, higher absenteeism and more class repetition compared with non-stunted
children. Haddad and Bouis (1990) estimated a 1.4 % reduction in productivity for every 1 % decrease in height and 1 % reduction in productivity for every 1 % drop in iron status. Although the above is well-known, addressing childhood malnutrition, particularly in crises, has been and remains challenging. Preventive and curative strategies are of the utmost importance during chronic or acute nutritional crises, defined as slow-onset crises such as drought, crop failure or economic crises, which may erode livelihoods and undermine food supply thereby leading to vulnerabilities of households to meet their food needs.

With a total population of about 14 million and 70 % of the population living on less than US$ 1 per day, Niger routinely ranks at the bottom of UNDP’s Human Development Index list. Growing at an annual rate of 3.3 %, with an aggregate fertility index of 7.5, the population relies on subsistence agriculture, which covers 30 % of needs. Low education levels, poverty, malnutrition and limited access to drinking water and basic sanitation have led to health indicators being well below minimum international standards. Gender imbalances favoring men exist in key areas of representation in decision-making processes, education, employment, and access to health services further aggravating disparities. Household food production is linked to rain-fed agriculture, where staple crops such as millet and sorghum are harvested once per year from September to October.

Each year, the decrease in food quantity and quality experienced in the months preceding the harvest (August to October) is associated with an increase in wasting among children under 5 years. The extension of the period between the depletion of stored food and the new harvest, or the “hunger gap”, usually necessitates additional assistance. The timing and duration of the hunger gap varies from year to year depending on the timing and duration of the annual rains in addition to more complex market factors. Maradi, located in the south-central part of the country bordering Nigeria, is considered the “bread basket” of the country due to high crop yields but has some of the highest rates of malnutrition in the country. This was particularly dramatic in 2005, when millet prices reached levels inaccessible to large segments of the population. In 2005, public health facilities and nongovernmental organizations (NGOs) reported 274,959 malnutrition cases, of which 73,080 were acute and 201,879 moderate malnutrition cases. Subsequent to the crisis in 2005, two major developments occurred in response to nutritional crises: a change in the definition of malnutrition and uptake of new treatment and prevention options.

Here, some of the barriers and innovations with respect to these two developments in responding to nutritional crises are described via a series of studies conducted in the region of Maradi, Niger. These studies were conducted over a 10-year period and illustrate the evolution in emergency programming as well as the perception of malnutrition in a high burden setting. This paper is not a comprehensive review of the published and grey literature, but rather, using selective illustrative studies, a description of how research played a role in the nutritional programming landscape in Niger. Although introduction of the WHO Growth Standards, ready-to-use foods and community-based care have transformed treatment of malnutrition, preventive strategies continue to be the subject of debate within the scientific and programming communities.
Defining Malnutrition

The diagnosis of acute malnutrition is based on anthropometric and clinical assessment, and its prevalence in children under five years can be used to benchmark the severity of the nutritional situation in settings where a suspected nutritional crisis is ongoing. Acute malnutrition (wasting) or chronic malnutrition (stunting) are classified based on severity. Mid-Upper Arm Circumference (MUAC) and Weight-for-Height Z-score (WHZ) are the indicators used to classify a child with wasting. Severe Acute Malnutrition (SAM) is defined by a weight-for-length/weight-for-height Z-score [WHZ] < −3; and/or mid-upper arm circumference [MUAC] < 11.5 cm and/or bipedal edema. Moderate Acute Malnutrition (MAM) is defined as −3 ≤ WHZ < −2 and/or 11.5 ≤ MUAC < 12.5 cm. Global Acute malnutrition (GAM) is the sum of MAM and SAM at population levels. Stunting is defined by a Length/Height for Age Z-Score ([LAZ]) < -2 for stunting and LAZ< -3 for severe stunting. In 2006, the World Health Organization (WHO) introduced the WHO Child Growth Standards (WHO standards) for assessing the growth and development of children less than sixty months of age in April 2006. The WHO standards were developed using data from a multicenter international study and, as a standard rather than a reference, describe how children should grow under optimal conditions. They were developed to replace the National Center for Health Statistics (NCHS)/WHO growth reference (NCHS reference) and represent a significant move forward in the understanding and measurement of the nutritional status of children.

The NCHS population was the reference most commonly used in national programs for individual growth monitoring and population-based estimates of child malnutrition and in emergency settings to determine admission to and discharge from feeding programs. Given important differences in the diagnosis of malnutrition when the same criteria are applied with the NCHS reference and the WHO standards, greater clarity on the implications of introducing the WHO standards for ongoing and new nutrition programs was needed. Findings in this area were all the more important as decisions about recommended indicators may have a major impact on costs and number of children included in programs.

Some of the first studies exploring the implications of the shift in the “definition” of malnutrition were conducted in Niger. One of these aimed to assess the implications of introducing the WHO standards on common treatment outcomes. Using data collected in a home-based malnutrition treatment program, differences in weight gain, duration of treatment, recovery from malnutrition, mortality, loss-to-follow-up and need for inpatient care of children that would be included in severe malnutrition treatment programs if the WHO standards were applied, as compared to the NCHS reference were analyzed.

Compared with children who would be included in malnutrition treatment programs according to the National Center for Health Statistics (NCHS)/WHO growth reference (NCHS reference) and percent of the median criterion, children who would be included according to the WHO standards and Z score criterion had shorter durations of treatment, greater recovery and less death, defaulting and need for inpatient care. These children were younger and had higher WHF Z scores on admission than those included with the NCHS reference. Patterns remained after adjustment for differences in child age and sex.
No child included by the NCHS reference and percent of the median criterion was excluded by the WHO standards and Z score criterion.

Important differences exist in the treatment outcomes of children that would be included in emergency feeding programs with the WHO standards, compared to the NCHS reference. Introduction of the WHO standards and the Z score criterion expanded programs to include children who are younger but less severely malnourished. Identified at earlier stages in the progression of malnutrition, these children have fewer medical complications requiring inpatient care and are more likely to experience favorable discharge outcomes. Although the new WHO standards required organizations to increase their treatment capacity, they are a practical tool for the early diagnosis and effective treatment of severe acute malnutrition in children.

Subsequently, the relationship between anthropometric status at admission, according to each of these references, and risk of death in moderately or severely malnourished children admitted to the MSF nutritional program in Maradi was analyzed. We compared the sensitivity and specificity of weight for height (WH), expressed as Z scores (WHZ) or percentage of the median (WH %), using WHO growth standards or NCHS reference. We also assessed the use of the mid-upper arm circumference (MUAC) as an indicator for mortality risk. We analyzed data from 64,484 children aged 6-59 months admitted with malnutrition (<80 % WH % (NCHS) and/or MUAC<110 mm and/or presence of edema) in 2006 into the Médecins Sans Frontières (MSF) nutritional program in Maradi, Niger. Sensitivity and specificity of weight for height (WH) in terms of Z score (WHZ) and percentage of the median (WH %) for both WHO standards and NCHS reference were calculated using mortality as the gold standard. Sensitivity and specificity of mid-upper arm circumference (MUAC) was also calculated. The receiver operating characteristic (ROC) curve was traced for these cutoffs and its area under curve (AUC) estimated. In predicting mortality, WHZ(NCHS) and WH %(NCHS) showed AUC values of 0.63 (95 %CI : 0.60 – 0.66) and 0.71 (0.68 – 0.74), respectively. WHZ (WHO) and WH % (WHO) appeared to provide higher accuracy with AUC values of 0.76 (0.75 – 0.80) and 0.77 (0.75 – 0.80), respectively. The relationship between MUAC and mortality risk appeared to be relatively weak, with AUC = 0.63 (0.60 – 0.67). Analyses stratified by sex and age yielded similar results. These analyses highlight that in this population of malnourished children, WHO standards are a more accurate indicator to predict mortality risk than the NCHS reference.

Along with others from different contexts as well as others in Niger, these studies contributed to the appropriation of the WHO Growth Standards within Niger and brought awareness to the benefits of recognizing malnutrition in its early stages. Today, ten year on, additional work has been conducted on further simplifying programming and incorporating other “diagnostic” tools. Use of the MUAC as both entry and exit criteria, as well as for screening, is perhaps the next change in nutritional programming. The MUAC, as a simple and easy to use tool, is portable and allows for children to be assessed in a variety of contexts without the use of a measuring board or scale. Ongoing research explores the trade-offs in the use of MUAC alone or combination with measures of weight and height to both screen and admit and discharge children from treatment.
Treatment and Prevention

13 Ready-to-use-therapeutic-foods (RUTF) transformed the treatment of child malnutrition. These energy-dense micronutrient spreads often made of peanuts, oil, sugar, and milk powder have been shown effective in the treatment of severe wasting in children and have made large-scale community-based care and treatment possible\textsuperscript{16,17}. However, as the treatment of wasting can be expensive and difficult to provide on a large-scale in resource-limited settings, complementary strategies for the prevention of wasting became increasingly important to consider as treatment strategies improved and program coverage increased. However, at the time of the 2005 crisis, the effectiveness of RUTF in the prevention of wasting had not yet been evaluated.

14 As a result, in 2006, the first randomized trial of the use of RUTF in prevention was conducted\textsuperscript{18}. The objective was to evaluate the effect of a 3-month distribution of RUTF on the nutritional status, mortality and morbidity of children 6 to 60 months of age. Villages were randomized to intervention and to no intervention. Villages were visited monthly from August 2006 to March 2007. All children in the study villages between 6 and 60 months of age were eligible for recruitment. The intervention consisted of a monthly distribution of one packet per day of RUTF (500 kcal / day) to each eligible child along with a comprehensive free-of-charge primary care package for all children. We found a protective effect of the intervention on WHZ change and a significant reduction in the incidence of wasting and severe wasting. The adjusted overall effect of the intervention on WHZ change was 0.22 Z (95% CI: 0.13, 0.30) over 8 mo. The intervention resulted in a 36% (95% CI: 17% - 50%) reduction in the incidence of wasting and a 58% (95% CI: 43% - 68%) reduction in the incidence of severe wasting. There was a non-significant 49% reduction in mortality associated with the intervention.

15 The acceptability and effectiveness of RUTF in both prevention and treatment led to the development of a variety of new, targeted ready-to-use spreads, including ready-to-use-supplementary-foods (RUSF). RUSF were developed to serve as a supplement to traditional complementary foods and were specifically designed with the prevention of malnutrition among children aged 6 to 36 months in mind. Compared to RUTF, which provide large quantities of energy and the micronutrients needed by children with severe wasting, RUSF provide lower energy and the recommended daily allowance of micronutrients when combined with the local diet in a small daily dose of spread. RUSF formulations developed for use in prevention, rather than treatment, and the lower cost relative to RUTF contributed to an increasing interest in the use of RUSF within nutritional programs. Similarly, targeting of younger children also focused the use of these tools.

16 As a follow-up to the RCT conducted in 2006, we explored the effectiveness of RUSF supplementation compared to RUTF supplementation. In this trial, children aged 6 to 36 months in 12 villages of Maradi received a monthly distribution of RUSF (247 kcal / 3 spoons / day) for 6 months or RUTF (500 kcal sachet / day) for 4 months\textsuperscript{19}. We compared the incidence of wasting, stunting, and mortality among children receiving preventive supplementation with RUSF vs. RUTF. The effectiveness of RUSF supplementation depended on receipt of a previous preventive intervention. In villages where a preventive supplementation program was previously implemented, the RUSF strategy was associated with a 46% (95% CI: 6% to 69%) and 59% (95% CI: 17% to 80%) reduction in wasting.
and severe wasting, respectively. In contrast, in villages where the previous intervention was not implemented, we found no difference in the incidence of wasting or severe wasting by type of supplementation. Compared to the RUTF strategy, the RUSF strategy was associated with a 19% (95% CI: 0% to 34%) reduction in stunting overall.

Follow-up studies stemming from the initial RCT have aimed to address interventions and their sustainability in the context of recurrent nutritional crises as well as contribute to the ongoing monitoring of these distributions. In 2010, an observational cohort was the first to show a reduction in mortality linked to the distribution of RUSF. The results of this study show that distributions including an RUSF for children 6 to 23 months and a family protective ration had a modest but positive effect on prevention of wasting and anthropometric status. Importantly, deaths were halved for those who received the supplements compared to those who did not.

Although ready-to-use foods and community-based care transformed treatment of malnutrition, preventive strategies continue to be the subject of debate. UNICEF and WFP recommend preventive large-scale distributions of specialized nutritious foods targeting young children during the hunger gap. Options for large-scale preventive distributions include fortified blended flours, ready-to-use foods and direct cash transfer either alone or in combination with family protective rations. Cash transfers aim to strengthen food security for vulnerable households by giving families enough purchasing power to consume an adequate and balanced diet, maintain a good standard of hygiene, access health services, and invest in their own means of food production in addition to their children’s growth and development. Programs of some international agencies and organizations rely exclusively on cash transfer and do not distribute food supplements, and some donors express a preference for cash transfers, not only to support livelihoods, but also to improve nutrition. While conditional cash transfer to vulnerable households has shown a long-term positive impact on growth and on malnutrition-related mortality in children under five, especially in Latin America, there is little conclusive evidence that cash transfer has a direct effect on preventing malnutrition.

A large-scale pragmatic randomized trial examining an array of large-scale prevention strategies over an 18-month period was recently completed in 48 villages in the region of Maradi. Seven strategies were assessed: monthly distributions of supplementary food, (CSB++, or two different RUSFs) for children, with or without household support: either cash (38 € per month) or food. An additional arm includes a cash transfer of 42 € per month to all households with a child in the target group. Anthropometric and clinical data are collected monthly. All children have access to the same primary health care programs. Endpoints include wasting, severe wasting and mortality. Mortality events include all reports in which the cause of absence from surveillance visits was reported to be death by a family member.

At 5-months of follow-up, strategies involving a food supplement plus cash transfer all showed reduced incidence of wasting compared to the cash only arm during the period overlapping the hunger-gap. Incidence of MAM was twice lower in the strategies receiving a food supplement combined with cash compared with the cash-only strategy or with the supplementary food only groups. Over the 18 months of follow-up, although analyses are on going, incidence of MAM and SAM were comparable among groups supplemented with nutritious foods, but preventive effects on incidence and prevalence of stunting remained elusive. Distribution of nutritious supplementary foods to young
children in conjunction with household support should remain a pillar of emergency nutritional interventions, but are likely to remain

Discussion

The studies illustrated here addressing two changes in nutritional programming in Niger highlight ongoing difficulties and innovations. It is important to note that the studies reviewed here have limitations. First, this is not a review of the literature, but rather the presentation of research conducted in a specific context addressing specific questions and conducted by a multi-disciplinary research group embedded in the humanitarian landscape. As such, participants in these studies all benefited from care provided by Epicentre, Médecins Sans Frontières and the Nigerian NGO FORSANI in collaboration with the Ministry of Health of Niger. High coverage of comprehensive, free pediatric primary care in functional health structures (including TFP) guaranteed timely care for all enrolled children who were ill and/or became malnourished. Therefore, the effect size of the interventions discussed here may be different in a setting with less access to comprehensive primary care. Second, we did not collect data on all possible factors that could have influenced the incidence of malnutrition and mortality in all of the studies reviewed here. The multi-factorial determinants and multiple causal pathways mean that these studies do not capture the complex dynamics of malnutrition, but rather aim to provide information, which can be used for programming purposes. Third, outcomes of nutritional interventions and programs like these are highly dependent on the health and socio-economic environment of the study area. In this study setting in Niger, many therapeutic nutritional programs and large-scale distributions of nutritious foods have been implemented in the area over the past decade. Perhaps relatedly, caretakers routinely report high acceptability of both programs and distributions.

Although progress has been made in terms of the diagnosis of malnutrition per se as well as the tools available for prevention and treatment, some of which are discussed here, recurrent nutritional crises continue and financial resources are limited. Ensuring the conduct of studies exploring supplementary foods, cash and other modalities as well as continued work on screening and programmatic tools for prompt and accurate evaluation of children are essential given the high burden. Although the studies reviewed here present unique methodological challenges, and are only a small part of the body of literature, without them, the evidence-base to drawn on for operational guidance would have and will continue to remain sparse.

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NOTES


ABSTRACTS

Despite developments to address childhood malnutrition and its determinants, eradicating childhood malnutrition remains evasive. From a public health perspective, malnutrition constitutes the single biggest contributor to under-five mortality. With a total population of about 17 million and 70% living on less than US$ 1 per day, Niger routinely ranks at the bottom of development indices. Household food production is linked to rain-fed agriculture, where staple crops such as millet and sorghum are harvested once per year. Each year, the decrease in food quantity and quality in the months preceding the harvest (August to October) is associated with an increase in wasting among children, known as the “hunger gap.” Maradi, located in the south-central part of the country has some of the highest rates of malnutrition in the country. This was particularly dramatic in 2005, when millet prices reached levels inaccessible to large
segments of the population. Subsequent to the crisis in 2005, two major developments occurred in response to nutritional crises: a change in the definition of malnutrition and uptake of new prevention options. This paper discusses some of the barriers and innovations with respect to these two changes via a series of studies conducted in the region.

INDEX

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