Malnourished children and supplementary feeding during the war emergency in Guinea-Bissau in 1998–1999

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ABSTRACT

Background: Supplementary feeding programs (SFPs) are intended to mitigate the deterioration of nutritional status and the increase in mortality among malnourished children.

Objective: We investigated the effect of an SFP on malnourished children in Guinea-Bissau who were returning to their homes after having been displaced within the country because of war in 1998–1999.

Design: The effect of the war on the nutritional status of children aged 6–59 mo who were present in Bissau sometime from September 1998 to June 1999 was evaluated by comparing the mortality and the prevalence of malnutrition with the values expected had the war not occurred and by comparing the severity of malnutrition in malnourished children before and during the war. The quality of the SFP was also evaluated. Children with midupper arm circumference < 130 mm were provided weekly medical consultations and supplementary feeding until recovery.

Results: The degree of malnutrition did not increase during the war. The prevalence of malnutrition increased with the start of the war but then decreased. The mortality of malnourished children did not increase during the war. Seventy-four percent of the referred children received treatment; of those, 1% died, 67% recovered, and 32% abandoned treatment. Compliance was 89%. The recovery rate was 13.1 · 1000 −1 · d −1, and the median time to recovery was 48 d. Better compliance was associated with shorter time to recovery.

Conclusions: Our findings may be biased by changes in the cultural and socioeconomic background of the malnourished children. However, 3 different analyses indicated a beneficial effect of the SFP. Thus, the home-based SFP probably prevented nutritional deterioration during the war in Guinea-Bissau.

KEY WORDS Malnutrition, supplementary feeding, mortality before 5 y of age, war, complex emergency, socioeconomic position, observational study, sub-Saharan Africa

INTRODUCTION

Malnutrition is a major health problem in a humanitarian emergency because it increases vulnerability to severe diseases, and growing children are particularly vulnerable to its consequences (1–4). The prevalence of malnutrition in nonrefugee populations in Africa is expected to be between 5% and 8% (5). For children aged <5 y, the prevalence of malnutrition among persons displaced within their own country [i.e., internally displaced persons (IDPs)] has been found to be between 25% and 50%, and in camp settings, the prevalence has been as high as 75% (6). During the famine in Ethiopia in 2000, the prevalence of wasting was 29.1% among children aged 6–59 mo in a non-camp setting with a mixture of displaced and residential persons (7). The prevalence of malnutrition, which often increases after food-coping mechanisms begin to fail, is a late indicator of famine (8). Households headed by women are at higher risk of malnutrition in emergency situations (9).

Weight-for-height is the recommended index in nutritional assessments and is recommended as the most reliable measurement of acute malnutrition in famine and emergency situations (10–12). Midupper arm circumference (MUAC) is a relatively simple index, but with a fixed cutoff, it ignores age-related changes. Compared with weight-for-height, MUAC has a sensitivity of 24.6% and a specificity of 94.8% (2). MUAC appears to be a better predictor of childhood mortality than is weight-for-height (13–16).

In rural Guinea-Bissau, supplementary feeding of nonhospitalized, severely malnourished children reduced their mortality by 25% and had a beneficial effect on growth (17). The quality of supplementary feeding is reflected in recovery, death, and average length of treatment (18). Minimum standards for coverage, recovery, and mortality have been proposed (4, 19). Satisfying requirements for recovery is an indicator of the quality of the program but gives no information on the nutritional status of the population (18).

During the war, the Bandim Health Project (BHP) offered supplementary feeding and treatment to malnourished children aged 6 mo to 5 y in the project area. In connection with weekly consultations, the caretakers of malnourished children were provided with a prepared dietary supplement and tablets for daily micronutrient supplementation.

Childhood mortality and prevalence of malnutrition increase for refugees and IDPs, but the effect on returning IDPs has not
been reported before. We compared the prevalence of malnutrition and mortality in malnourished children during the war with that before the war to investigate how a supplementary program for nonhospitalized children affected growth, recovery, and degree of malnutrition in the community.

SUBJECTS AND METHODS

Emergency situation

From June 1998 to May 1999, Guinea-Bissau experienced an armed conflict between a military junta, which was backed by most of the national army and the general population, and the President, who was supported by troops from the 2 neighboring countries, Senegal and Guinea-Conakry (20–22). In May 1999, government troops surrendered to the junta.

There were several periods of fighting (6 July–26 August and 9 October–1 December 1998 and 30 January–15 February and 6–7 May 1999). Fighting was most intense in the capital, and the residential areas of Bissau were exposed to heavy shelling during the periods of fighting. By the end of 1998, 196 000 persons were internally displaced, and 6600 had left the country (23). By the end of 1999, 265 000 IDPs had returned, and of 7100 refugees who had left the country, 5300 had returned (24). Camps never became a prominent feature of the emergency in Bissau; displaced people moved in with relatives or strangers in the rural areas. As soon as people believed the cease-fire would hold, they started returning to the capital. During the emergency, the public health systems did not function, but the central hospital, which was supported by humanitarian aid, continued to receive patients. Most other public services did not function. Less money was available because salaries were not paid, and the market was limited. Humanitarian aid provided a limited proportion of the missing food, and although there was no real hunger, the situation was difficult.

The Bandim Health Project and humanitarian assistance

The BHP maintains a longitudinal, demographic surveillance system in 4 suburbs of Bissau: Bandim I, Bandim II, Belem, and Mindara. The project covers around 16% of the population in the capital, Bissau. As part of the routine registration system, all houses are visited monthly to identify new pregnancies, births, and deaths. Reported deaths are subsequently confirmed in an interview, and the perceived cause of death is registered. Field assistants visit children under 3 y of age at home every 3 mo to monitor nutritional status, breastfeeding, hospitalizations, and immunizations.

During the war, BHP took responsibility for humanitarian aid activities by providing medicine and distributing food to IDPs. When the population returned to Bissau, BHP followed, continued providing medicine to health centers in the project area, and organized food distribution when stocks were available. Beginning in October 1998, the project organized vitamin A supplementation for children below 5 y of age. In addition, from January 1999, permethrin-impregnated bed-nets were distributed to pregnant women and children below 2 y of age, and from September 1998, supplementary feeding was established for malnourished children (see below). For humanitarian assistance, the routine home visits were extended to children under 5 y of age.

Supplementary feeding of malnourished children

Supplementary feeding and medical treatment of undernourished children below 5 y of age started on 1 September 1998 at the health center in the BHP area and continued until March 2000. Children who were observed by field assistants to have an MUAC < 130 mm were referred to the Bandim Health Centre. At the health center, all children had MUAC, weight, and height measured and were examined by a Guinean physician. Medical conditions were treated, and all malnourished children received dietary supplementation. Medicine and supplementary feeding were provided for 7 d, and caretakers were instructed to return in 1 wk for the children to be reexamined and receive supplementary feeding for another week. Supplementary feeding continued until the children recovered (MUAC ≥ 130 mm).

The caretaker of each child was supplied with micronutrient tablets and flour mix in an amount corresponding to 6500–8700 kJ/d, which was well above the recommended minimum supplementation of 4200–5040 kJ/d (1000–1200 kcal/d) (12). The caretaker was instructed to prepare the gruel ≥ 3 times/d and to feed it to her child 6 times/d. The energy intake was not restricted, and although the supplement was intended for the child only, the caretaker was allowed to serve leftovers to other children in the family. The caretaker was told that the child was fine if he or she was eating only the supplied millet gruel but that she was allowed to supplement the gruel with her own food as well; the caretaker was also instructed to continue breastfeeding. Furthermore, the caretaker was asked to give the micronutrient tablet once a day; the amount of micronutrients per tablet equaled approximately one recommended daily allowance.

Dietary treatment

On the basis of results from a previously conducted dietary survey (25), millet gruel was chosen for the therapeutic feeding. This was a modified traditional weaning food, which was locally produced and had shorter shelf life than did commercially prepared products. Millet seeds were pounded into flour and mixed with fresh eggs, fresh bananas, and margarine in a pot over a fire. Subsequently, this mixture was dried in the sun or in a pot over a fire, pounded again, and sieved. To this very dry flour mix were added full-strength milk powder and sugar, and the mix was then stored in a refrigerator at a maximum temperature of 5 °C until distribution. After distribution, the mix could easily be kept at ambient temperature in a closed plastic container for 1 wk without spoiling. The flour mix was added to water and boiled for 15 min to further ensure that there would be no problems of household food safety. The dietary requirements for catch-up growth were set to an energy density of 3.8 kJ/mL with 8.7% of the energy from protein (26). The gruel was modified to fit these criteria by the addition of full-strength milk powder and an increase in the content of sugar and margarine (25). In a previous controlled, community-based, intervention study of persistent diarrhea (27), the gruel was found to be associated with short- and long-term weight gain and long-term improvement in linear growth.

Study populations

The study was based on 3956 children aged 6–59 mo who were seen at home in the study area between 1 September 1998 and 31 May 1999. Four hundred thirty-three (10.9%) children were registered as being malnourished (MUAC < 130 mm) at
least once, and of these, 247 (57.0%) received supplementary feeding and medical treatment. Children were censured at death, permanent movement out of the area, attainment of 5 y of age, or 31 May 1999, whichever came first. We cannot know the nutritional status of a child who was absent at a home visit; thus, only time from a home visit at which the nutritional status was registered was attributed to the child. Nutritional status of a child changes over time. The interval between home visits was normally 3 mo. Thus, we censored information about nutritional status after 90 d if a new visit and examination of arm circumference had not been conducted within this period. Deaths due to acts of war or accidents, as reported in a cause-of-death interview, were censored.

**Study design**

We used different designs to examine the effect of war and supplementary feeding on the nutritional status of the community.

**Malnutrition status of the study population**

We evaluated the effect of war on the nutritional status of the study population in 2 different designs. First, we investigated how children aged 6–35 mo were affected; we compared observed monthly prevalence rates of malnutrition during the war with expected prevalence rates. Second, to investigate changes in the severity of malnutrition among malnourished children, we compared mean MUAC before and during the war.

The nutritional status of the children was known only when they were present in Bissau. Migration patterns were different during the war; more time was spent outside Bissau due to periods of fighting. Families with good conditions might have been the first to return to Bissau. Alternatively, families with malnourished or sick children might have returned to Bissau more quickly, as knowledge about the better availability of treatment in Bissau circulated among the IDPs in the interior of Guinea-Bissau. Thus, to explore the potential bias in those who came back first, we compared the cultural and socioeconomic risk factors of malnourished children before and during the war.

As we know only the nutritional status of the children present at the last home visit, the effect of the war was examined by using only the children who were present in Bissau. Before the war, the routine surveillance included children up to 3 y of age, and our comparisons are therefore restricted to children aged 6 mo to 3 y.

**Supplementary feeding and treatment**

The quality of the supplementary feeding and treatment program was compared with the Sphere Project’s minimum standards in disaster response (4). The supplementary feeding was performed in an urban area with <2 h return walk. Thus, coverage should have been >90%, and during treatment, the numbers of deaths, recovered, and abandoned should have been <3%, >75%, and <15%, respectively. In addition, we evaluated compliance.

**Statistical methods**

The expected monthly wartime prevalence of malnutrition and mortality associated with malnutrition was estimated by using time series methods to forecast prewar data (January 1995 to May 1998) into wartime (June 1998 to May 1999). We used 2 classes of log-transformed time series models to account for trends, epidemics, and seasonal variations, the latter as either piecewise constant terms or cyclic functions. The variance was modeled with an underlying Poisson process with overdispersion or with an underlying Gaussian process including the monthly estimation SE in the variance. The best forecasting capacity was obtained when the monthly estimation error was included in the variance, either multiplicatively as overdispersion in a Poisson regression or additively in a Gaussian regression. The model residual error in both regressions may express autocorrelation.

The forecasting capacity of the time series models was evaluated on the basis of their ability to predict prevalence or mortality in the year before the war. We found that a Gaussian regression with no trend and quarterly constant seasonal variation was the best model for forecasting the prevalence of malnutrition the year before the war. Mortality rates the year before the war had the best prediction in a Poisson regression with no trend and a 12-mo cyclic seasonal variation. A more detailed description of the methods is available from the authors.

We used 4 cultural and socioeconomic indicators (ethnicity, suburb, schooling of mother, and type of roof) that are associated with childhood survival to construct an index. The index was defined as the sum of positive values [ie, not(Pepel) + not(Bandim) + mother had any schooling + roof was solid]. Because the 2 index groups 0 and 4 were small, they were grouped with index groups 1 and 3, respectively. Missing values were treated as negative values.

The expected wartime prevalence and mortality rates were forecasted for each cultural and socioeconomic index group. These rates were then assembled every month during the war into one rate weighted by the distribution of persons (prevalence) or observation time (mortality rates) in each index group.

Indexes ($z$ scores) of anthropometric status were calculated by using a SAS program that was based on the year 2000 growth charts from the Centers for Disease Control and Prevention (CDC) and was downloaded from the CDC website on 26 September 2002 (Internet: www.cdc.gov/nccdphp/dnpa/growth-charts/sas.htm). Analysis was performed by using SAS release 8.02 (SAS Institute Inc, Cary, NC).

**RESULTS**

**Malnutrition status of the study population**

The distributions of malnourished children present in Bissau before and during the war did not differ with respect to age and type of household (Table 1). However, there were significant differences with respect to ethnicity, district, mother’s schooling, and quality of roof. Values of a cultural and socioeconomic index based on these 4 factors differed significantly between the children present during the war and all children present in Bissau from 1 January 1995 to 31 December 1999 (Table 1).

The prevalence of malnutrition among children 6–35 mo of age before the war (January 1995 to May 1998) was 7.5%, and quarterly constant prevalence ratios (8.5% in February–April, 6.5% in May–July, 6.7% in August–October, and 8.4% in November–January) were the best adjustment for calendar-time variation. The observed and expected prevalence of malnutrition and the ratio of observed to expected prevalence from September 1998 to May 1999 are shown in Figure 1. In December 1998, the observed prevalence was significantly elevated in comparison with the expected prevalence. A decrease in the observed prevalence of malnourished children began in January 1999.
The mortality rate for malnourished children 6–35 mo of age did not show any calendar-time trend before the war; the best adjustment for calendar-time variation was a 12-mo cyclic fluctuation varying from 2.7 to 5.7 around 3.9 deaths \(\cdot\) 10 000 children \(\cdot\) d\(^{-1}\). During the intervention period, observed mortality rates relative to the expected rates, adjusted for the cultural and socioeconomic distribution observed during the war, showed some variation but were never significantly elevated (Figure 2).

The severity of malnutrition among the malnourished children, which was measured as mean MUAC, in the 3 prewar September-to-May periods was 122 mm (95% CI: 122, 122 mm; \(n = 2198\)). The mean MUAC during the war was the same: 122 mm (95% CI: 121, 123 mm; \(n = 470\); \(P = 0.43\)) (adjusted for repeated measurement and controlled for cultural and socioeconomic index and season).

**Supplementary feeding and treatment**

Of the 433 children registered as being malnourished, 5 died and 84 recovered without supplementary feeding or medical treatment (Figure 3). Ninety-four children were eligible for supplementary feeding at the end of the study (31 May 1999). Two hundred forty-seven children received supplementary feeding and medical treatment. Twenty-seven children were still under treatment when the study ended, 2 of the children had died \(\{0.9%\}2/(24727)\), 148 (67%; 95% CI: 61%, 73%) had recovered, and 70 (32%; 95% CI: 26%, 38%) had abandoned treatment (Figure 3). All children with an MUAC < 130 mm at the 3-mo home visits were referred for treatment. Coverage, which was expressed as the percentage of children who were referred for treatment and were actually included in the supplementary feeding program, was 74% \([247/(433 - 94 - 5)]\).

In the community surveillance, the mean MUAC of the children enrolled in the supplementary feeding program was 121 mm (95% CI: 120, 121 mm), whereas the mean MUAC of the children who did not receive treatment was 124 mm (95% CI: 123, 125 mm) \((P\) for equal values < 0.01; controlled for age and

![FIGURE 1](https://example.com/figure1.png)

**FIGURE 1.** Monthly prevalence of malnutrition (midupper arm circumference < 130 mm) and monthly ratios of observed to expected prevalence of malnutrition in children aged 6–35 mo during the war in Guinea-Bissau in 1998–1999. The supplementary feeding program took place from 1 September 1998 to 31 May 1999. In the left panel, the expected values were standardized to the cultural and socioeconomic distribution of the children during the war. In the right panel, values were adjusted for the cultural and socioeconomic distribution of the children during the war. Solid lines represent mean values, and dashed lines represent 95% CIs.
season). Treatment compliance measured as days receiving supplementary feeding relative to days registered in treatment was 89% (Table 2).

The recovery rate for those receiving treatment was 13.1 \cdot 10^{-3} \text{, d}^{-1} (Table 3). The median time to recovery for treated children was 48 d (95% CI: 34, 72 d), and better compliance was associated with a shorter time to recovery (compliance \leq 50\%, 101 d; compliance between 50\% and 75\%, 58 d; compliance > 75\%, 28 d; P for equal values < 0.01; controlled for initial MUAC).

When included in the supplementary feeding and treatment program, 80\% of the children (6–59 mo of age) were wasted, and 46\% were stunted. The median MUAC was 122 mm (Table 4). When receiving supplementary feeding, the children had an MUAC growth rate of 0.78 mm/d and gained 4 g/d in weight (Table 3). The association between previous growth and the probability of returning was investigated by comparing the previous growth of those who showed up with that of those who did not show up after 8 d. We found no association dependent on the last 8-d period or the total preceding treatment (both P = 0.84).

DISCUSSION

In emergency situations, the prevalence of malnutrition and mortality among malnourished children tends to increase. In comparison with the expected prevalence for children aged 6–35 mo who were present in Bissau and after adjustment for the socioeconomic composition of the war population, the prevalence of malnutrition increased initially; however, from January 1999, the prevalence of malnutrition decreased among children present in Bissau. The mortality of malnourished children 6–35

FIGURE 2. Monthly mortality rates and monthly ratios of observed to expected mortality in malnourished children aged 6–35 mo during the war in Guinea-Bissau in 1998–1999. The supplementary feeding program took place from 1 September 1998 to 31 May 1999. In the left panel, the expected values were standardized to the cultural and socioeconomic distribution of the children during the war. In the right panel, values were adjusted for the cultural and socioeconomic distribution of the children during the war. Solid lines represent mean values, and dashed lines represent 95\% CIs.

FIGURE 3. Schematic diagram of the 433 malnourished children aged 6 mo to 5 y who participated in the study during the war in Guinea-Bissau in 1998–1999. The supplementary feeding program took place from 1 September 1998 to 31 May 1999. Numbers in parentheses indicate subjects who were still eligible for treatment or were receiving supplementary feeding and treatment at the end of the study. Numbers in brackets indicate subjects who were censored because they permanently moved out of the study area or reached 5 y of age before recovery or death. Two children receiving supplementary feeding and treatment permanently moved out of the study area and were censored at day zero as having abandoned treatment. MUAC, midupper arm circumference.
mo of age during the war showed some variation but was similar overall to the expected mortality. We presumed an increased mortality for malnourished children and an increased prevalence of malnutrition, but we found no increase, which suggests either a beneficial effect of supplementary feeding or a differential return of malnourished children during the war. The cultural and socioeconomic risk factors of malnourished children before and during the war were different with respect to ethnicity, district, and educational-economic status, and this may have introduced selection bias. Bissau is in the homeland of the Pepel ethnic group, and it may have been easier for Pepes to return to the city than for other ethnic groups, who had fled further away. The mortality of Pepes is normally higher than that of other ethnic groups; thus, more Pepes present in Bissau during the war would imply increased mortality. However, the increased percentage of educated mothers, families with better housing quality, and families living in districts with lower prewar childhood mortality may have had the opposite effect. We adjusted the expected prevalence and mortality rates to reflect the distribution of socioeconomic risk factors in the population. This would reduce the bias due to a changed composition of the population during the war. However, we cannot separate the total effect of other interventions and the warfare, and the study was too small to control for all possible confounders. Nevertheless, during the intervention, we observed a decreasing prevalence of malnutrition, which strengthens the possibility that the supplementary feeding program had a beneficial effect.

The supplementary feeding program fulfilled the minimum standards in disaster response for death during treatment, and all undernourished children were included. If this is interpreted as coverage, the program did poorly. However, the program was interrupted several times due to small outbreaks of fighting in the capital, and many mothers and their children fled on such occasions. Once a malnourished child had entered the treatment program, compliance was 89%. With the nonhospitalization setup of the program, it could be expected that returning depended on previous growth during treatment. We found no such association. This and the relatively high compliance indicate a high commitment to the program, which was seriously interrupted only by occasional outbreaks of fighting.

The supplementary feeding program included medical treatment, which may also have affected growth. We cannot distinguish between the effects of medical treatment and supplementary feeding, but time to recovery decreased with compliance, which suggests that the supplementary feeding also contributed to better growth. Taking into account the nonhospitalization of the treated children, this suggests a benign effect of the supplementary feeding intervention.

Given the nonexperimental character of humanitarian aid, there is no way of knowing the exact effect of supplementary feeding. The comparisons could be residually biased because of changes in the ethnic and educational-economic distribution of the malnourished children, because of other interventions during the war, or because of the size of the study. However, excluding this bias, 3 different analyses provided results that would be consistent with a beneficial effect of the program. First, contrary to expectations, we found that the prevalence of malnutrition decreased during the war after the expected initial increase. Second, the severity of malnutrition among the malnourished children did not increase. Third, we did not find an increased mortality among the malnourished children during the war. Supplementary feeding may have been the main cause of this lack of expected deterioration in nutritional conditions. We believe that supplementary feeding had a beneficial effect on individual growth and recovery and prevented an increase in malnutrition in the community. Thus, supplementary feeding should be

### TABLE 2

<table>
<thead>
<tr>
<th>Age (mo)</th>
<th>6–11</th>
<th>12–23</th>
<th>24–35</th>
<th>36–59</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days receiving treatment</td>
<td>16 (8, 34)</td>
<td>18 (8, 26)</td>
<td>21 (8, 31)</td>
<td>16 (8, 39)</td>
<td>16 (8, 34)</td>
</tr>
<tr>
<td>Days registered in treatment</td>
<td>21 (8, 54)</td>
<td>28 (12, 87)</td>
<td>27 (9, 76)</td>
<td>22 (8, 43)</td>
<td>25 (8, 64)</td>
</tr>
<tr>
<td>Compliance (%)</td>
<td>95 (80, 100)</td>
<td>88 (55, 100)</td>
<td>78 (47, 100)</td>
<td>91 (73, 100)</td>
<td>89 (59, 100)</td>
</tr>
</tbody>
</table>

1 All values are medians; quartiles in parentheses. n = 247. The supplementary feeding program took place from 1 September 1998 to 31 May 1999.
2 Compliance = 100 x days receiving treatment/days registered in treatment.

### TABLE 3

<table>
<thead>
<tr>
<th>MUAC at start of treatment (mm)</th>
<th>&lt;115</th>
<th>115–125</th>
<th>126–130</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery ($\cdot 1000^{-1} \cdot d^{-1}$)</td>
<td>5.9 (3.7, 9.6)</td>
<td>11.3 (9.0, 14.3)</td>
<td>28.7 (22.2, 37.2)</td>
<td>13.1 (11.1, 15.4)</td>
</tr>
<tr>
<td>Growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MUAC (mm/d)</td>
<td>2.09 (1.29, 5.47)</td>
<td>0.67 (0.46, 0.89)</td>
<td>0.43 (0.25, 0.60)</td>
<td>0.78 (0.31, 1.25)</td>
</tr>
<tr>
<td>Weight (g/d)</td>
<td>8 (5, 10)</td>
<td>2 (1, 4)</td>
<td>0 (~3, 3)</td>
<td>4 (3, 5)</td>
</tr>
</tbody>
</table>

1 All values are ¯; 95% CI in parentheses. The supplementary feeding program took place from 1 September 1998 to 31 May 1999. MUAC, midupper arm circumference.
REFERENCES


