PUBLIC HEALTH

Mortality rates in displaced and resident populations of central Somalia during 1992 famine

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Famine and civil war have resulted in high mortality rates and large population displacements in Somalia. To assess mortality rates and risk factors for mortality, we carried out surveys in the central Somali towns of Afgoi and Baidoa in November and December, 1992. In Baidoa we surveyed displaced persons living in camps; the average daily crude mortality rate was 16·8 (95% CI 14·6–19·1) per 10 000 population during the 232 days before the survey. An estimated 74% of children under 5 years living in displaced persons camps died during this period. In Afgoi, where both displaced and resident populations were surveyed, the crude mortality rate was 4·7 (3·9–5·5) deaths per 10 000 per day. Although mortality rates for all displaced persons were high, people living in temporary camps were at highest risk of death. As in other famine-related disasters, preventable infectious diseases such as measles and diarrhoea were the primary causes of death in both towns. These mortality rates are among the highest documented for a civilian population over a long period. Community-based public health interventions to prevent and control common infectious diseses are needed to reduce these exceptionally high mortality rates in Somalia.

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Introduction

Refugees and people displaced within their own countries suffer high mortality rates during the early phases of population displacement.[1] Massive population displacements are generally due to war, famine, drought, or a combination of these factors. Displaced populations face health problems compounded by the deprivations that initiated the migration and the lack of public health infrastructure in refugee camps.[2] Malnutrition, crowding, lack of drinking water, and lack of sanitation can lead to intense epidemics with high mortality rates.[3]

Over the past few years, Somalia has suffered from a civil war, which has interrupted farming and destroyed major sources of income for both urban and rural populations. In 1991–92, the Horn of Africa experienced a severe drought, which further diminished food production and led to widespread famine in southern and central Somalia. The famine resulted in massive population displacements to feeding centres in urban areas and to refugee camps in Ethiopia and Kenya. Relief agencies worked in Somalia throughout the period of civil unrest and regular airlifts of food began in August, 1992.

To assess mortality rates, major causes of death, and risk factors for mortality in displaced and resident populations of central Somalia, we carried out population-based surveys in the towns of Baidoa and Afgoi on Nov 20–25 and Dec 5–6, 1992, immediately before the multinational military intervention on Dec 9, 1992.

Subjects and methods

The surveys were designed to assess causes of death in nine central Somali towns by means of a standard thirty-cluster survey design,[4] but conditions were too dangerous for completion of most of the surveys. The study was therefore modified to assess recent mortality by a stratified survey design in two Somali population groups—a camp for displaced persons in Baidoa and the town of Afgoi, which included both displaced persons and long-term residents. There are no reliable census data for Baidoa or Afgoi and population estimates were made by relief agencies working in the towns. People in our survey were taken as displaced persons only if they had moved to their present location during the previous 24 months because of war or famine.

Baidoa, the regional capital of the Bay Region, lies 250 km west of the Somali capital, Mogadishu. The population of Baidoa fell substantially between August and November, 1992, owing to high mortality and emigration, and the estimated population in November, 1992, was between 21 000 and 40 000. Access to the whole town was not possible because it was unsafe, so we surveyed only people in displaced persons camps. Based on hut counts, the number of displaced persons in Baidoa living in temporary camps was estimated to be 5200. The population was divided into seven sections, and a random starting point was selected from the centre of each section. Seven consecutive huts were visited at each starting point (except at one starting point where only five huts could be safely visited), and the head of household in each hut was interviewed by a trained interpreter and one of the study organisers. If the head of household was not available, questions were addressed to another adult living in the household.

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TABLE I—DEATHS AND MORTALITY RATE BY AGE GROUP FROM APRIL TO NOVEMBER, 1992

—	Starting population	No (%) deaths	Mortality rate per 10 000 per day (95% CI)
Baidoa			
≥5 yr	276	86 (31)	13·4 (11·1–15·8)
<5 yr	62	46 (74)	32·0 (27·3–36·7)
All ages	338	132 (39)	16·8 (14·6–19·1)
Afgoi			
≥5 yr	808	62 (8)	3·2 (2·4–3·9)
<5 yr	211	53 (25)	10·4 (8·0–12·9)
All ages	1019	115 (11)	4·7 (3·9–5·5)

The Baidoa figures for displaced persons only, Afgoi for both displaced and resident populations The survey intervals for Baidoa and Afgoi were 232 and 242 days, respectively.

Afgoi lies 40 km west of Mogadishu and had an estimated population of 35 000 in November, 1992. About 1000 displaced persons lived in temporary camps in the town, and others in houses in the town. The town was divided into nineteen sections containing approximately equal numbers of houses; survey starting points were randomly chosen from the centre of each section. Eight consecutive households were interviewed at each starting point. One of the nineteen starting points was in a displaced persons camp, and the other sites were randomly chosen from among the settled population of Afgoi.

An adult in each household was asked to identify all living household members and whether any household members had died between the end of Ramadan (April 3, 1992) and the survey date (232 days for Baidoa and 242 days for Afgoi). Deaths during the 30-day period before the interview were recorded separately. To improve recall accuracy, an interviewee who reported a death was interviewed in detail about the date and circumstances of death.

To determine causes of death, a structured post-mortem interview was done. We first asked an open question about the presumed cause of death and then a series of questions on specific symptoms before death. Five causes of death were assessed—measles, diarrhoeal disease, acute respiratory infection, trauma (both war related and not war related), and maternal death during childbirth. Some common causes of death, such as malnutrition and malaria, were not specified because it is diffcult to determine specific symptoms accurately from post-mortem interviews. Deaths not clearly attributable to one of the specified causes were classified as "other/unknown".

By convention for refugee and displaced person assessments, crude and age-specific mortality rates were calculated as the average daily rate per 10 000 persons during the survey periods with the starting population as the denominator.[5] Each sector in either Afgoi or Baidoa contained about the same number of households; therefore, surveying a fixed number of households in each sector provided a selection proportional to the population within each sector. Confidence intervals for mortality rates were calculated by the normal approximation to the binomial confidence interval method. Risk ratios and 95% CI (Taylor series approximation) were calculated with Epi Info;[6] simple random sampling was assumed. Adjusted risk ratios were calculated for Afgoi participants only by stratification on the basis of residence status by the Mantel-Haenszel method with Robins-Greenland confidence intervals.[7]

Results

In Baidoa, survey data were collected for 338 persons reported to be alive on April 3, 1992, in 47 displaced households. Of these, 62 (18·3%) were children under 5 years. Households in April, 1992, contained an average of 7 members (range 1–16). Between April 3 and Nov 21, 1992, 132 (39%) of the 338 people died; the average crude mortality rate was 16·8 deaths per 10 000 daily (95% CI 14·6–19·1, table I). Displaced children under 5 years old had a disproportionately high mortality rate (32·0 [27·3–36·7] per 10 000 per day). There was no improvement in the overall crude mortality rate in Baidoa for the month before the survey; 17 of 223 persons died in the 30 days before the survey and 115 during the preceding 202 days (crude mortality rate 25·4 [13·8–37·0]) *vs* 16·8 [14·3–19·3] per 10 000 per day).

TABLE II—HOUSEHOLD RISK FACTORS FOR MORTALITY

—	n*	No (%) deaths	Mantel-Haenszel risk ratio (95% CI)*
Household status			
Resident	764	67 (9)	1·0
Displaced in houses	193	28 (14)	1·7 (1·1–2·5)
Displaced in camps	62	20 (32)	3·7 (2·4–5·6)
Livestock ownership			
Yes	36	2 (6)	1·0
No	983	113 (11)	2·5 (0·6–10)
Owns chickens			
Yes	181	10 (6)	1·0
No	838	105 (13)	2·0 (1·0–3·3)
Income from work outside home			
Yes	404	44 (11)	1·0
No	610	71 (12)	1·1 (0·7–1·4)
Male head of household‡			
Absent	144	15 (10)	1·0
Present	709	77 (11)	1·0 (0·6–1·7)
Received general rations in previous 2 wk			
Yes	118	16 (14)	1·0
No	888	98 (11)	0·8 (0·5–1·3)

*April 3, 1992.
†For variables other than household status, adjusted for this factor.
‡Deaths of male heads of household excluded

In Afgoi we collected data for 1019 displaced persons and residents in 152 households who were alive on April 3 (table I). The average number of members of each household in April was 7 (range 1–21). Of the 1019 people, 115 (11%) died between April 3, 1997, and the beginning of the survey (crude mortality rate 4·7 per 10 000 per day [3·9–5·5]). As in Baidoa, children under 5 years old had a higher mortality rate than the rest of the population. Again as in Baidoa, there was no improvement in mortality rate in the month before the survey compared with the previous 212 days (6·2 [3·3–9·1] *vs* 4·5 [3·7–5·4] deaths per 10 000 per day).

We assessed risk factors for mortality among Afgoi participants for the whole 242-day survey period. Although mortality rates were high for all groups, displaced persons were at higher risk of dying than residents, and displaced persons in temporary camps were at highest risk (table II). Overall, 48 (18%) of 255 displaced persons died compared with 67 (9%) of 763 permanent Afgoi residents (risk ratio 2·2, 95% CI 1·5–3·0).

People living in households that owned chickens, a possible indicator of higher socioeconomic status, had a significantly lower risk of dying than people from households without chickens, after adjustment for residence status (table II). The association between lower mortality

TABLE III—CAUSE-SPECIFIC MORTALITY RATES

Cause	Baidoa		Afgoi	
	No (%) deaths	Cause-specific mortality rate*	No (%) deaths	Cause-specific mortality rate*
Measles	33 (25)	4·2	39 (34)	1·6
Diarrhoeal disease	74 (56)	9·4	22 (19)	0·9
Acute respiratory infection	3 (2)	0·4	4 (3)	0·2
Trauma	2 (2)	0·3	9 (8)	0·4
Childbirth	0	..	0	..
Other/unknown	20 (15)	2·6	41 (36)	1·7

*Deaths per 10 000 per day, for April–November, 1992

and ownership of livestock was not significant, perhaps because of small numbers. Other socioeconomic factors did not predict mortality risk.

Measles and diarrhoea together accounted for 81% of deaths in Baidoa and 53% of deaths in Afgoi (table III). Only 2 of 132 deaths in Baidoa and 9 of 115 in Afgoi were directly attributed to war-related trauma. Although malnutrition was not included as a single cause of death in our survey, many deaths were said to be associated with profound oedema, a common terminal symptom of severe protein-calorie malnutrition. These deaths were classified as other/unknown unless specific symptoms were noted.

Discussion

In most countries of sub-Saharan Africa, reported national morality rates are between 20 and 24 deaths per 1000 population per year, equivalent to 0·55–0·65 deaths per 10 000 per day.[8,9] Although displaced persons commonly have higher mortality rates than non-displaced persons,[1] the mortality rates found in our survey are among the highest recorded for civilian populations over a long period.[3,8] Among displaced households surveyed in camps in Baidoa, mortality rates were about thirty times higher than expected in peacetime. Nearly 75% of displaced Baidoa children under 5 years died between April and November, 1992, and the proportion of children under 5 in the displaced population fell from 18·3% to 7·8% during this period. Independent evidence corroborating these mortality rates was obtained from daily records of bodies collected for burial by the Somali Red Crescent Society; between Aug 9 and Nov 14, 1992, 12 255 bodies were collected from both displaced and resident areas of the town.[10] Deaths peaked from late August to early September during simultaneous epidemics of measles and *Shigella dysenteriae* infection.

The survey in Afgoi among both displaced and resident populations may better reflect population-based mortality rates in central Somalia. Mortality rates for the whole Afgoi population were lower than those for displaced persons in Baidoa, but were eight times higher than would be expected for a similar population under non-famine conditions. Our mortality rate is more than double that in Manoncourt and colleagues' mortality survey[11] in the Merca-Qorioley area of central Somalia from April, 1991, to April, 1992. In both surveys displaced persons living in camps were about three times more likely to die than non-displaced residents. With the exception of poultry ownership and residence status, no socioeconomic risk factors assessed were associated with mortality risk in our survey. Since displaced persons may migrate because of pre-existing poor health, nutrition, and socioeconomic conditions, these high mortality rates are likely to be due to poor public health conditions both before and after migration.

The high mortality even among the resident population of Afgoi shows the enormity of the public health disaster in Somalia. There is no evidence that mortality rates improved during the 30 days before the survey in either town despite the continuing relief effort. Lack of security and limited transport hindered effective distribution of food and medicines between August and December, 1992. It is not yet clear whether the recent multinational military intervention will lower mortality through improved relief efforts.

Manoncourt et al[11] found that malnutrition and war-related trauma were the main causes of death in the Merca-Qorioley area in 1991–92, but preventable infectious diseases were the main causes of death in our study in Afgoi and Baidoa This difference may be due partly to differences in the survey instruments used, but it is likely that there has been a real increase in cause-specific mortality due to measles, diarrhoea, and dysentery since April, 1992. Multidrug-resistant *Shigella dysenteriae* has been isolated from patients in Baidoa (S. Toussi, International Medical Corps), and there have been widespread outbreaks of measles in both Baidoa and Afgoi during the past 6 months. This shift in cause-specific mortality may be due to breakdown of public health infrastructure in a setting of widespread malnutrition.

Because of the limitations of our surveys, care should be taken in projecting mortality rates from this study to the whole Somali population. The emigration of healthy people from Baidoa and Afgoi during the survey period would increase apparent mortality rates, whereas deaths of whole families would lead to underestimation of mortality rates. In Baidoa, only the displaced population living in camps was surveyed, and no direct information is available for non-displaced Baidoa residents. Although the Afgoi survey sampled both displaced and non-displaced residents, mortality rates in this town may not be representative of rural areas, towns with intense fighting, or areas without active feeding programmes. Mortality rates for displaced persons may reflect a combination of mortality rates before and after migration, and perhaps should not be taken to indicate mortality after displacement. Other surveys of populations throughout the country are needed so that major public health priorities for Somalia during the post-intervention period can be determined.

The main causes of death in our survey were similar to those found in other famine disaster settings.[1] The highest proportions of deaths were due to two common and preventable conditions, measles and diarrhoeal diseases. Our findings reinforce the need for aggressive prevention and management of common infectious diseases in displaced populations, especially during periods of widespread famine. Mortality can be substantially reduced by establishment of measles immunisation,[12] vitamin A supplementation,[13] and oral rehydration clinics[14] at food distribution and registration centres during refugee operations. In addition to food relief, immunisation and community health worker programmes should have high priority during emergency relief operations to provide prevention and treatment of measles, diarrhoea, malaria, and acute respiratory infections. These programmes have been difficult to implement in Somalia because of the widespread fighting. Finally, high priority should be placed on implementing a simple public health surveillance system to monitor the effect of relief efforts on affected populations.[15,16]

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REVIEW ARTICLE

Fetal nutrition and cardiovascular disease in adult life

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Babies who are small at birth or during infancy have increased rates of cardiovascular disease and non-insulin-dependent diabetes as adults. Some of these babies have low birthweights, some are small in relation to the size of their placentas, some are thin at birth, and some are short at birth and fail to gain weight in infancy. This paper shows how fetal undernutrition at different stages of gestation can be linked to these patterns of early growth. The fetuses' adaptations to undernutrition are associated with changes in the concentrations of fetal and placental hormones. Persisting changes in the levels of hormone secretion, and in the sensitivity of tissues to them, may link fetal undernutrition with abnormal structure, function, and disease in adult life.

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Association between early growth pattern and disease in adults

Two English surveys have indicated that low growth rates in utero and during infancy are associated with high death rates from cardiovascular disease. One of them, of 1586 men born in a maternity hospital in Sheffield during 1907–25, showed that death rates from cardiovascular disease fell progressively with increasing weight, head circumference, and ponderal index (weight/length^3) at birth.[1] In the other, of 5654 men born in Hertfordshire during 1911–30, death rates from coronary heart disease were almost three times higher among those who weighed 18 lb (8·2 kg) or less at age 1 year than among those who weighed 27 lb (12·3 kg) or more.[2]

Examination of men and women in different populations in Britain has shown that low growth rates up to the age of one year are associated with increased prevalence of known risk factors for cardiovascular disease, including blood pressure,[3] and plasma concentrations of glucose, insulin,[4] fibrinogen,[5] factor VII,[5] and apolipoprotein B.[6] These associations parallel those with death rates from cardiovascular disease. The associations are seen in babies who are born small for their gestational age rather than those born prematurely.[1,3] They are found not only among babies with intrauterine growth retardation, defined by birthweight at the lowest centiles, but are also seen in babies of average or even above average weight at birth. Some of the subjects were small at birth in relation to the size of their placentas;[3] others were thin at birth;[1,7] and yet others, though of average birthweight, were short in relation to head size and had below average infant weight gain.[2,5]

Numerous animal experiments have shown that poor nutrition, and other influences that impair growth during critical periods of early life, may permanently affect (programme) the structure and physiology of a range of organs and tissues, including the endocrine pancreas, liver, and blood vessels.[8,9] For example, retardation of intrauterine growth in the guineapig causes life-long elevation of blood pressure.[10]

A simple example of programming in human beings is the permanent deformity of the pelvic bones caused by rickets in infancy. Since different tissues mature during different, often brief, periods of fetal life and infancy, the long-term consequences of altered nutrition depend on its timing and its duration. Consistent with this, different patterns of early growth are associated with different adult abnormalities. For example, those who are thin at birth, as measured by a low ponderal index (weight/length^3), tend to develop the

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