ⓦ Health programmes and policies associated with decreased mortality in displaced people in postemergency phase camps: a retrospective study

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Summary

Background An estimated 35 million people have been displaced by complex humanitarian emergencies. International humanitarian organisations define policies and provide basic health and nutrition programmes to displaced people in postemergency phase camps. However, many policies and programmes are not based on supporting data. We aimed to identify associations between age-specific mortality and health indicators in displaced people in postemergency phase camps and to define the programme and policy implications of these data.

Methods In 1998–2000, we obtained and analysed retrospective mortality data for the previous 3 months in 51 postemergency phase camps in seven countries. We did multivariate regression with 18 independent variables that affect crude mortality rates (CMRs) and mortality rates in children younger than 5 years (<5 MRs) in complex emergencies. We compared these results with recommended emergency phase minimum indicators.

Findings Recently established camps had higher CMRs and <5 MRs and fewer local health workers per person than did camps that had been established earlier. Camps that were close to the border or region of conflict or had longer travel times to referral hospitals had higher CMRs than did those located further away or with shorter travel times, and camps with less water per person and high rates of diarrhoea had higher <5 MRs than did those with more water and lower rates of diarrhoea. Distance to border or area of conflict, water quantity, and the number of local health workers per person exceeded the minimum indicators recommended in the emergency phase.

Interpretation Health and nutrition policies and programmes for displaced people in postemergency phase camps should be evidence-based. Programmes in complex emergencies should focus on indicators proven to be associated with mortality. Minimum indicators should be developed for programmes targeting displaced people in postemergency phase camps.

Introduction

At the end of 2000, an estimated 35 million people had been displaced[1] by complex humanitarian emergencies affecting civilian populations. Such emergencies arise from a combination of war or civil strife, food shortages, and population displacement that generally results in significant excess mortality. During the emergency phase of a complex humanitarian emergency, which is defined as having a crude mortality rate (CMR) of one or more deaths daily per 10 000 people, mortality rates in displaced people are at least double predisplacement baseline levels.[2,3] Most deaths result from preventable and treatable infections, often exacerbated by malnutrition, caused mainly by diarrhoeal disease, respiratory tract infections, measles, and malaria.[2,4] To reduce this excess mortality rapidly, humanitarian organisations prioritise their relief programmes toward the provision of adequate shelter, water, sanitation, food, and public health and curative health programmes. Many populations affected by complex humanitarian emergencies have been displaced for long periods, living relatively settled lives—this postemergency phase is defined as having a CMR of less than one death daily per 10 000 people.[2–4] In this article, we use the term displaced people to refer both to refugees who have crossed international borders and to people who have been displaced from their homes but remain within the internationally recognised borders of their countries.

The Sphere project describes minimum standards for providing basic services to displaced populations in the emergency phase of complex humanitarian emergencies.[3] The project evolved from a growing recognition among donors, aid agencies, and recipients that humanitarian assistance needed to become more professional, effective, and accountable.[5,6] These minimum standards were based on scientific data if available or on consensus between experts. Data for service delivery and health outcomes in complex humanitarian emergencies are increasingly being gathered as donors and humanitarian organisations recognise the need to assess interventions to develop an evidence base for policies and programmes.[7] However, data have mainly been obtained from the acute phase of complex emergencies, in which excess mortality as well as political interest, media attention, and funding is greatest.[4] The postemergency phase has been little studied, and no comprehensive programme guidelines exist for this phase.

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Our results are part of a large study assessing the magnitude and causes of morbidity and mortality in displaced people in postemergency phase camps. We aimed to identify associations between age-specific mortality and health indicators in displaced people in postemergency phase camps, and to describe programme and policy implications for governments, UN agencies, and humanitarian organisations working during the postemergency phase. We also aimed to start a dialogue on minimum standards for displaced people during the postemergency phase of complex humanitarian emergencies.

Methods

Population

From November, 1998, to March, 2000, we visited 52 camps for displaced people in seven countries. Our inclusion criteria for camps were: displaced people were residing in the camp during the postemergency phase; stable camp population size, defined as less than 5% change in population size during the 3 months before data collection; camp population at least partly dependent on outside organisations for food aid and health care; and functioning health-information system, defined as those maintained by health organisations that recorded morbidity and mortality in their health-care units and produced a monthly report. We created a list of countries in which displaced people were living in postemergency phase camps from databases from the UN High Commissioner for Refugees (UNCHR) and international non-governmental organisations (NGOs). Eligibility of camps was established from discussions with responsible NGOs and from assessments of their monthly reports. We sought permission from the host government, UNHCR, and responsible NGOs to visit eligible camps. The ethics review boards at the Centers for Disease Control (CDC) and Johns Hopkins University reviewed and approved the research study proposal.

Procedures

We obtained 3-months' retrospective mortality data and data for preventive and curative health programmes implemented by NGOs. We used a standardised data collection form for every camp. Mortality rates have been reported as monthly deaths per 1000 people in the postemergency phase. We calculated CMRs by dividing the number of deaths in the 3-month period by the midpoint population size, and have reported CMRs as total monthly deaths per 1000 people.

Mortality rates in children younger than 5 years (<5 MRs), defined as monthly deaths in children younger than 5 years per 1000 children younger than 5 years, were calculated by dividing the number of deaths in children younger than 5 years in the 3-month period by the midpoint population size for children younger than 5 years. We obtained official monthly population figures for every camp from UNHCR and NGOs. Midpoint population was established by use of the 2nd month of the 3-month period.

We analysed records of every death from lists from health clinics, referral hospitals, graveyard workers, and community health workers. Information was supplemented by interviews and discussions with key informants such as camp health staff, and camp and community leaders, then compared with monthly NGO reports. We constructed a record of every death, which included decedent's sex, cause of death, age at time of death, and household location, to enable removal of any duplicate reports. We compared our record of deaths with other data sources and crossreferenced data. Cause of death was recorded from hospital records if possible. If the person had not died in a hospital, cause of death was established by community health workers by interviewing the decedent's family.

We used a hierarchical approach to resolve discrepancies between data sources: written records were prioritised over oral communication, and health-care records over all other records. Organisations in 39 (75%) of 52 camps used standard case-definitions of disease derived from those used by Médecins Sans Frontières or WHO.[8,9] Detailed methods of mortality investigation used in this study have been published.[10]

For every camp, we used the percentage of female people and of people younger than 5 years to adjust for age and sex differences. We also adjusted for camp population size. Because mortality has a seasonal pattern in most countries, though patterns vary by cause and region,[11] we recorded the season in every camp and adjusted data accordingly. The season in which data was obtained was categorised by the health professionals in every camp; seasons fell into three broad categories: cold, wet, and dry. Other independent variables were those found or thought to affect mortality in complex humanitarian emergencies.[2–4,8,12] Variables were divided into four categories: shelter and site planning, water and sanitation, food and nutrition, and health care.

Distance from camp to border for refugees or to area of conflict for internally displaced people was provided by government officials and recorded in km. UNHCR or NGOs provided population figures for camps. Population density was measured by covered area, defined as the space covered by a household's dwelling divided by the number of people living in the dwelling. Site space was defined as all land used by camp residents, including infrastructure and agriculture. Time to referral hospital was provided by health staff, and was defined as the mean time from camp to referral hospital by use of the most common method of transport.

Water consumption in daily litres per person was calculated by dividing the daily quantity of water supplied to the camp by the total number of people. The daily quantity of water supplied was generally established by measurement of the amount of water needed to replenish the main water distribution points in the camp. Data for the number of functioning latrines were provided by the NGO responsible for water and sanitation.

Quantity of food aid in kilojoules showed the amount of food distributed but not necessarily the amount consumed by displaced people. Food-coping mechanisms were defined as the presence of gardens or livestock in most households in the camp, established by visual inspection and reports from camp leaders. Global acute malnutrition was defined as weight-for-height measurements of less than 80% of median or less than –2 z scores, derived from the National Center for Health Statistics, CDC, and WHO reference populations.

Local health workers were defined as all doctors, nurses, and clinical officers from the displaced population or host country working in the camp. Referral rates were defined as the monthly number of documented recommended referrals by camp health staff to a referral hospital located outside of the camp per 1000 people. Mean incidence of diarrhoeal disease,

respiratory tract infection (upper and lower tract disease), and malaria were obtained from outpatient department registers in camp clinics. Camps with a basic laboratory were defined as any camp with a laboratory in which blood smears could be analysed for malaria or sputum for tuberculosis with a microscope.

Data for independent variables were obtained from the organisations responsible for relevant programmes in the camps. We attempted to confirm these data by interviews with camp leaders, health-care workers, women's groups, and other organisations working in camps. Whenever possible, we categorised variables according to the recommended minimum standard in the Sphere project. For instance, Sphere recommendations include one home visitor for every 500–1000 people,[3] so we divided the community health worker variable into three categories: one worker for more than 1000 people, one worker for 500–1000 people, and one worker for less than 500 people. If no Sphere standard existed, we categorised variables in accordance with a logical division of the variable (ie, population size by 10 000 increments) or by a division that would allow for a roughly equal number of camps in every category (ie, disease rates). Although the World Food Programme (WFP) and WHO recommend that people have access to at least 8791 kJ (2100 kcal) per person daily, few postemergency phase camps received that amount, so we categorised the food distribution variable into less than or at least 7535 kJ (1800 kcal) per person daily.

Statistical analysis
We did descriptive and bivariate analyses with SPSS version 9.0. Multivariate Poisson regression was used to analyse mortality rates by use of SAS version 8.1. All regression analyses included an adjustment for overdispersion. Overdispersion occurs if the variability in data exceeds that expected with a Poisson distribution, and, thus, adjustment is necessary to obtain correct standard errors and p values. p values are based on likelihood ratio χ^2 statistics. A type-3 analysis in which all variables were simultaneously adjusted for all other variables in the analysis was used. Rate ratios were also simultaneously adjusted for all other variables in the analysis.

Role of the funding source
The sponsors of the study had no role in study design, data collection, data analysis, data interpretation, writing of the report, or in the decision to submit the paper for publication.

Results
From November, 1998, to March, 2000, we surveyed 52 of around 80 eligible camps for displaced people during the postemergency phase in seven of 11 countries (table 1). We were unable to visit all camps that met our inclusion criteria because of logistical constraints or lack of government or NGO authorisation. We completed six 6–8-week field trips to the following countries: Azerbaijan (seven camps), Ethiopia (11), Myanmar (three), Nepal (seven), Tanzania (eight), Thailand (five), and Uganda (11). Results for one camp in Tanzania with Congolese refugees were excluded because of missing data. Therefore, we included 51 postemergency phase camps.

We identified 770 deaths, 322 of which were children younger than 5 years, in 678 296 people in the 51 camps during 153 camp-months. Mean CMR was

	Met inclusion criteria		Included in study*	
	n camps	n people	n camps	n people
Azerbaijan	7	19 200	7	19 200
Central African Republic	1	55 000	0	..
Djibouti	2	22 000	0	..
Ethiopia	12	250 000	11	238 220
Ghana	2	15 000	0	..
Kenya	4	173 600	0	..
Myanmar	3	7700	3	7700
Nepal	7	98 100	7	98 100
Tanzania	9	331 500	7	171 021
Thailand	About 20*	>150 000	5	30 176
Uganda	13	>120 000	11	113 879

Three camps (108 600 people) met inclusion criteria but were not included because approval was not received from NGO or government. *We did not assess all camps because of logistical constraints.

Table 1: **Countries with displaced persons' camps that met inclusion criteria**

0·4 monthly deaths per 1000 (range 0–0·8, 95% CI 0·3–0·4); and mean <5 MR was 0·9 monthly deaths per 1000 (range 0–2·7, 95% CI 0·7–1·1).

Table 2 shows camps categorised by independent variables and Sphere minimum standards for the emergency phase where applicable. No camp had existed for less than 1 year, and eight (16%) had existed for more than 10 years. Eighteen (35%) camps were less than 50 km from the border or area of conflict. 12 (24%) camps had less than 15 L of water daily per person and 16 (31%) had at least 20 people per latrine. 32 of 51 camps (63%) met the minimum recommendation of less than 2000 people per local health worker and 1000 or fewer people per community health worker.

Table 3 shows the results of the multivariate analysis for all independent variables. The percent female population compared with the total population had a rate ratio of 1·02 (95% CI 0·94–1·09) with a p value of 0·68 for the CMR and a rate ratio of 1·03 (95% CI 0·89–1·21) with a p value of 0·67 for the <5 MR. The percent population under 5 years compared with the total population had a rate ratio of 1·13 (95% CI 1·04–1·23) with a p value of 0·002 for the CMR. In a comparison of the camps, lower CMRs and <5 MRs were associated with camps that had existed longest and had the most local health-care workers per person. Lower CMRs were associated with camps located furthest from the border or conflict area—eg, camps less than 10 km from the border or conflict area had nearly ten times the CMRs of camps located at least 50 km from the border. Lower CMRs were associated with time to reach referral hospital, but the direction of the association was not consistent. Lower <5 MRs were associated with camps that had high per person water supply and low rates of diarrhoeal disease. For instance, camps that received 15 or 15–20 L of water per person daily had five times the <5 MRs than camps that received more than 20 L per person daily. The goodness of fit for CMR data was χ^2 of 28·7 (17 degrees of freedom) and 31·6 (18) for <5 MR.

Three variables were not included in the analysis because data were not available for all camps; however, they aid interpretation of the results of the regression analysis. Population density is important in analysis of the effects of population size on mortality.[13,14] Mean covered area per person was 7·0 m² (95% CI 4·2–9·5, n=34 camps) and mean site space per person was 3687 m² (192–7183, n=33 camps). Increased prevalence of acute malnutrition is associated with increased mortality.[15] 39 camps had data on global acute

malnutrition, of which 28 had used percent median, with the following results: mean of 8·3% (SD 6·2), median of 6·5% (range 0–23·0). 11 camps had used z scores, with the following results: mean of 4·3% (4·0), median of 2·8% (1·0–15·4). Injury-specific morbidity and mortality rates can be associated with the distance of a camp from the border or conflict area. Increased incidence of injury-specific morbidity was associated with camps closer to borders or conflict areas (rate ratio 0·995, 95% CI 0·992–0·9998, p=0·008). Trauma-specific mortality rates were not associated with distance to border or conflict area (1·004, 0·997–1·011, p=0·242); however, only 11 of the 51 camps reported any deaths from trauma.

Variable	Mean (range)	Categorisation	n camps
Demographics and climate			
Age of camp (years)	5·7 (1·1–17·5)	<3	14 (27%)
		3 to <6	16 (31%)
		≥6	21 (41%)
Population size	13 301 (836–40 474)	≥20 000	11 (22%)
		10 000 to <20 000	17 (33%)
		<10 000	23 (45%)
Children <5 years	16% (5–26)	N/A	N/A
Women	50% (41–60)	N/A	N/A
Season	N/A	Rainy	21 (41%)
		Cold	8 (16%
		Dry	22 (43%)
Site and shelter planning			
Camp distance to border or conflict (km)	83 (0–260)	<10	8 (16%)
		10 to <50	10 (20%)
		≥50*	33 (65%)
Time to referral hospital (min)	68 (5–300)	≥120	8 (16%)
		60 to <120	17 (33%)
		30 to <60	16 (31%)
		<30	10 (20%)
Water and sanitation			
Water quantity (L/person/day)	27 (5–80)	<15	12 (24%)
		15 to 20*	12 (24%)
		>20*	27 (53%)
n people per functioning latrine	18 (3–136)	≥20	16 (31%)
		10 to <20*	20 (39%)
		<10*	15 (29%)
Food and nutrition			
Food distribution (kJ/person/day)	7113 (1168–9211)†	<7535‡	27 (53%)
		≥7535§	24 (47%)
Food-coping mechanisms (gardens, livestock)	N/A	Neither	7 (14%)
		Either	12 (24%)
		Both	32 (63%)
Health care			
n people per local health worker	2057 (239–6790)	≥2000	19 (37%)
		1000 to <2000*	17 (33%)
		<1000*	15 (29%)
n people per community health worker	1095 (304–2369)	>1000	19 (37%)
		500 to 1000*	17 (33%)
		<500*	15 (29%)
Referral rate (per 1000 people/month)	3 (0·02–70)	Low (<0·5)	31 (61%)
		Moderate (0·5 to <2·0)	14 (28%)
		High (≥2·0)	6 (12%)
Incidence of malaria (per 1000 people/month)			
Total	48 (0–325)	High (≥50)	15 (29%)
		Moderate (1 to <50)	18 (35%)
		Low (<1)	18 (35%)
Children <5 years	78 (0–463)	High (≥100)	16 (31%)
		Moderate (1 to <100)	19 (37%)
		Low (<1)	16 (31%)
Incidence of respiratory tract infection (per 1000 people/month)			
Total	56 (8–258)	High (≥50)	17 (33%)
		Moderate (25 to <50)	17 (33%)
		Low (<25)	17 (33%)
Children <5 years	166 (20–772)	High (≥160)	18 (35%)
		Moderate (60 to <160)	15 (29%)
		Low (<60)	18 (35%)
Incidence of diarrhoea (per 1000 people/month)			
Total	14 (2–70)	High (≥15)	18 (35%)
		Moderate (7 to <15)	16 (31%)
		Low (<7)	17 (33%)
Children <5 years	52 (5–187)	High (≥55)	17 (33%)
		Moderate (25 to <55)	17 (33%)
		Low (<25)	17 (33%)
Basic laboratory facilities	N/A	No	14 (28%)
		Yes	37 (73%)

N/A=not applicable. *Minimum standards for emergency phase:[3] site is located at a safe distance from possible external threats to physical security, usually not less than 50 km (p 199); water supply should be at least 15 L per person per day at point of collection (p 30); maximum of 20 people per toilet (p 36); for about 10 000 people should have 2–5 qualified health workers (p 252); and one home visitor for 500–1000 population (p 252). †1718 (279–2200) kcal. ‡<1800 kcal. §≥1800 kcal.

Table 2: **Independent variables assessed**

Mean measles immunisation coverage for children younger than 5 years was 87% (95% CI 82–92; n=46). Only one death was suspected as being caused by measles, therefore, measles vaccination coverage was not included as a variable in our analysis.

Discussion

Our results support some policies and programmes that are already being implemented, such as provision of a minimum quantity of water and an emphasis on diarrhoeal disease prevention and treatment.

Variable	Crude mortality rate (95% CI)	p	Under 5 mortality rate (95% CI)	p
Demographics and climate				
Age of camp (years)				
⩾6	1·00	0·01	1·00	0·04
3 to <6	1·45 (0·50–4·22)	··	0·28 (0·06–1·34)	··
<3	3·24 (1·14–9·24)	··	1·18 (0·28–4·92)	··
Population size				
<10 000	1·00	0·27	1·00	0·50
10 000 to <20 000	0·69 (0·38–1·28)	··	1·61 (0·61–4·26)	··
⩾20 000	0·57 (0·29–1·14)	··	2·08 (0·59–7·38)	··
Season				
Dry	1·00	<0·001	1·00	0·01
Cold	12·20 (2·62–56·76)	··	22·04 (3·10–156·69)	··
Rainy	1·07 (0·57–2·00)	··	0·91 (0·22–3·84)	··
Site and shelter planning				
Distance of camp to border or conflict (km)				
⩾50	1·00	0·001	1·00	0·17
10 to <50	3·68 (1·71–7·90)	··	3·00 (0·78–11·53)	··
<10	9·69 (1·11–84·39)	··	6·12 (0·49–76·02)	··
Time to referral hospital (min)				
<30	1·00	··	1·00	··
30 to <60	0·32 (0·16–0·66)	··	0·74 (0·24–2·27)	··
60 to <120	0·73 (0·26–2·07)	··	0·20 (0·04–0·97)	··
⩾120	1·47 (0·52–4·16)	0·02	0·33 (0·04–2·98)	0·22
Water and sanitation				
Water quantity (L/person/day)				
>20	1·00	0·76	1·00	0·03
15 to 20	1·12 (0·57–2·21)	··	5·24 (1·49–18·49)	··
<15	1·30 (0·60–2·84)	··	5·31 (1·46–19·35)	··
n people per functioning latrine				
<10	1·00	0·07	1·00	0·46
10 to <20	0·38 (0·12–1·20)	··	0·48 (0·13–1·84)	··
⩾20	0·86 (0·36–2·02)	··	0·73 (0·20–2·70)	··
Food and nutrition				
Food distribution (kJ/person/day)				
⩾7535*	1·00	0·94	1·00	0·80
<7535*	1·03 (0·48–2·19)	··	0·81 (0·17–3·97)	··
Food coping mechanisms (gardens, livestock)				
Both	1·00	0·35	1·00	0·10
Either	2·46 (0·70–8·63)	··	0·17 (0·03–0·91)	··
Neither	2·20 (0·57–8·47)	··	0·12 (0·01–1·35)	··
Health care				
n people per local health worker				
<1000	1·00	0·01	1·00	0·02
1000 to <2000	2·32 (1·00–5·41)	··	3·71 (0·79–17·36)	··
⩾2000	5·44 (1·65–17·87)	··	13·48 (1·89–96·19)	··
n people per community health worker				
<500	1·00	0·09	1·00	0·07
500 to 1000	99·80 (0·87–11509·18)	··	5·09 (0·20–132·41)	··
>1000	39·39 (0·64–2423·82)	··	1·29 (0·06–25·93)	··
Referral rate (per 1000 people/month)				
High	1·00	0·78	1·00	0·68
Moderate	0·98 (0·46–2·06)	··	1·01 (0·28–3·69)	··
Low	0·75 (0·27–2·03)	··	0·61 (0·16–2·36)	··
Incidence of malaria (per 1000 people/month)				
Low	1·00	0·15	1·00	0·47
Moderate	1·68 (0·85–3·33)	··	2·43 (0·54–10·85)	··
High	2·08 (0·69–6·22)	··	1·18 (0·23–6·08)	··
Incidence of respiratory tract infection (per 1000 people/month)				
Low	1·00	0·08	1·00	0·24
Moderate	0·53 (0·15–1·87)	··	2·20 (0·58–8·36)	··
High	7·02 (1·30–37·99)	··	4·39 (0·60–32·18)	··
Incidence of diarrhoea (per 1000 people/month)				
Low	1·00	0·08	1·00	0·01
Moderate	1·77 (0·80–3·91)	··	0·49 (0·13–1·88)	··
High	3·29 (1·11–9·76)	··	2·63 (0·43–16·01)	··
Basic laboratory				
Yes	1·00	<0·0001	1·00	0·01
No	0·12 (0·04–0·37)	··	0·13 (0·02–0·82)	··

*1800 kcal.

Table 3: **Multivariate analysis of the effect of independent variables on age-specific mortality rates**

Additionally, we have identified factors whose importance has not been sufficiently prioritised, such as the number of local health-care workers per person and the distance that camps are situated from a border or area of conflict. Health and nutrition policies and programmes for displaced people in postemergency phase camps should be evidence-based. Programmes in complex emergencies should focus on indicators proven to be associated with mortality. Humanitarian organisations often provide similar services in the emergency and postemergency phases of complex humanitarian emergencies, despite increasing evidence and consensus that needs differ between phases.[16] Because the postemergency phase is more stable and mortality rates are much lower than in the emergency phase, minimum health and programme standards and indicators should be modified and others added, comparable with those defined in the Sphere project.[17]

Insecurity in camps for displaced people increases if camps become zones of military activity, violence, and crime.[18] 50 km is generally accepted as the minimum distance that camps should be situated from the border.[3,12] Our results support this recommendation and show an association between increased trauma morbidity in camps situated closer to the border or area of conflict than in those situated further away. Governments and UNHCR should establish or relocate camps as far away from external threats as possible; relocation has been done successfully in Thailand, Uganda, Kenya, and Guinea.[18–20]

Recommendations for maximum camp size range from 20 000[12] to 50 000 people.[13] In Ethiopian postemergency phase refugee camps in Sudan, camp population size (range 1000–10 000 people) and <5 MR were positively correlated ($R=0·76$).[21] We did not note such an association, possibly because our study lacked power. Furthermore, the mean area of covered and total site spaces in the camps in our study were much larger than the Sphere project's minimum recommendations, and might be important factors[14] to consider when planning sites.

No camp had an operating theatre in which lifesaving surgery, such as repair of a ruptured bowel or caesarian section, was possible. Time or distance to referral hospitals can affect maternal mortality and obstetric intervention rates.[22,23] The direction of the association between times to referral hospitals and CMR was not consistent in our study; however, study power was low.

Increased water supply was associated with decreased <5 MRs. Improved water supply, sanitation, or both are associated with reduced mortality in non-displaced populations in developing countries, especially in children.[24] Sphere recommendations include at least 15 L per person daily of water for drinking, cooking, and personal and domestic hygiene during the emergency phase of a complex humanitarian emergency.[3] However, in the postemergency phase, displaced people need water for more than just survival as they return to aspects of settled lifestyles, such as agriculture, livestock, and building. Provision of more than 20 L per person daily of water was associated with lower mortality rates in children, hence the minimum standard for water supply might need to be higher than 20 L in the postemergency phase. A blanket recommendation is unlikely to be suitable for all geographic areas since the availability of water differs between regions.

We did not see an association between the number of functioning latrines and mortality. However, overall sanitation facilities were of a good standard and water quantity was sufficient in most camps. Furthermore, our study might have lacked the power to show such an association.

Quantity of food aid was not associated with mortality. Agencies responsible for providing food aid reported having reduced the quantity delivered to most camps in the study because of funding constraints, or after household food economy analyses had shown that communities had developed sufficient food-coping mechanisms, or both. We are not suggesting that food aid is unimportant in postemergency camps; however, the WFP/WHO recommendation of 8791 kJ (2100 kcal) per person daily in the emergency phase seems unnecessary in most postemergency phase camps. If a displaced population has developed food-coping mechanisms, distribution of smaller quantities of food might be appropriate. Food-coping mechanisms need to be assessed by household food economy methods for individual camps. Although we were unable to include the rate of acute malnutrition in our analysis, it was low for most camps and we do not think that its inclusion would have affected our results.

Diarrhoeal disease, which is a substantial cause of morbidity and mortality in developing countries,[25] has a high incidence in complex humanitarian emergencies because of overcrowding and poor environmental conditions.[2] In our study, increasing incidence of diarrhoeal disease was associated with increasing CMRs and <5 MRs. During the postemergency phase, as in the emergency phase, humanitarian organisations should prioritise prevention of diarrhoeal disease, control measures, and proper treatment.

Difficulties with case definitions and diagnoses by health-care workers in many postemergency phase camps prevented disaggregated reporting of diarrhoeal disease as bloody or watery, and respiratory tract infections as lower or upper tract disease. Furthermore, malaria diagnosis in nearly all camps was syndromic rather than laboratory based, and thus was sensitive but not specific.[26] Non-specific diagnoses and lack of power in our study might have been why neither respiratory tract infections nor malaria were significantly associated with mortality. Improvements in the clinical skills of health-care workers and use of laboratory tests could help improve the specificity of diagnoses.

Measles mortality is high in displaced children in densely populated emergency-phase camps, thus a measles vaccination campaign and vitamin A distribution is a top priority at the beginning of a complex humanitarian emergency.[8,27,28] The low rate of measles deaths in our study showed that these campaigns and routine vaccination programmes seem to be successful in postemergency phase camps.

Camps that lacked basic laboratories were associated with decreased mortality rates. However, since the type of tests available varied between laboratories, and the type and quantity of tests ordered by health-care workers varied within and between camps, this result is difficult to interpret.

We noted an association between increased provision of qualified local health-care and community health workers with decreased CMRs and <5 MRs. A consensus between international humanitarian organisations, taking into account budgetary constraints, will be necessary to establish optimum staff levels in postemergency camps. Current Sphere recommendations should be reassessed, since it is likely that more health workers are needed in an emergency rather than a postemergency phase camp.

Our study has several limitations. Underestimation of deaths and overestimation of camp populations might have led to underestimated mortality rates. We attempted to reduce this difficulty by restricting the reporting period to 3 months before the camp visit to allow for thorough collection and verification of data and to reduce recall bias; in fact, we identified 20% more deaths than the health organisations had reported.[10] Both factors would probably have occurred in the same direction for most camps, thus reducing potential biases in the analysis.

A longer data collection period would have improved the precision and inclusiveness of our mortality estimates in camps that had small populations, and kept the effects of seasonal variation to a minimum. We accounted for this limitation by adjusting data for type of season and camp population size, and by using Poisson regression instead of a weighted linear regression, which allowed for relatively rare events, such as death.

Independent variables that might affect mortality rates, such as religious or cultural beliefs, were not included in the model because they were difficult to quantify. Despite including 51 camps, our sample size, and thus, study power, was small. Selection bias might have occurred since we were unable to visit all camps that met our inclusion criteria. However, we obtained at least 3 months' data from monthly and yearly NGO reports for ten eligible camps that we did not visit in Tanzania, Kenya, and Thailand. The reported mean CMRs of these camps (0·3 monthly deaths per 1000 people [95% CI: 0·3–0·4]) were of a similar magnitude to CMRs of included camps. Thus, we conclude that the mortality rates in the camps we surveyed were representative. The camp that we excluded from the analysis had similar independent variables and mortality rates as included camps.

Our conclusions apply only to postemergency phase camps that met the inclusion criteria. Some displaced populations, such as Afghan, Palestinian, Liberian, and Sierra Leonean refugees, have existed for so long, or are so integrated with the local community, that they no longer rely on outside food aid or health care, and hence, were not included in our study. Analysis of data from some of these populations show they have mortality rates similar to those of the camps in our study.[20,29]

Most research on complex humanitarian emergencies has focused on the emergency phase. Research is needed to establish evidence-based policies and programmes with the objective of reducing mortality in displaced people living in post-emergency phase camps. Sphere standards describe indicators and minimum standards for the emergency phase of complex humanitarian emergencies, but a comprehensive and practical set of minimum standards for key indicators needs to be developed for displaced people in postemergency phase camps. Further research would best be undertaken with a prospective study design.

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