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RESEARCH REPORT

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Background: Case reports of human rights violations have focused on individuals' experiences. Population-based quantification of associations between rights indicators and health outcomes is rare and has not been documented in eastern Burma.
Objective: We describe the association between mortality and morbidity and the household-level experience of human rights violations among internally displaced persons in eastern Burma.
Methods: Mobile health workers in conflict zones of eastern Burma conducted 1834 retrospective household surveys in 2004. Workers recorded data on vital events, mid-upper arm circumference of young children, malaria parasitaemia status of respondents and household experience of various human rights violations during the previous 12 months.
Results: Under-5 mortality was 218 (95% confidence interval 135 to 301) per 1000 live births. Almost one-third of households reported forced labour (32.6%). Forced displacement (8.9% of households) was associated with increased child mortality (odds ratio = 2.80), child malnutrition (odds ratio = 3.22) and landmine injury (odds ratio = 3.89). Theft or destruction of the food supply (reported by 25.2% of households) was associated with increased crude mortality (odds ratio = 1.58), malaria parasitaemia (odds ratio = 1.82), child malnutrition (odds ratio = 1.94) and landmine injury (odds ratio = 4.55). Multiple rights violations (14.4% of households) increased the risk of child (incidence rate ratio = 2.18) and crude (incidence rate ratio = 1.75) mortality and the odds of landmine injury (odds ratio = 19.8). Child mortality risk was increased more than fivefold (incidence rate ratio = 5.23) among families reporting three or more rights violations.
Conclusions: Widespread human rights violations in conflict zones in eastern Burma are associated with significantly increased morbidity and mortality. Population-level associations can be quantified using standard epidemiological methods. This approach requires further validation and refinement elsewhere.

Population-based surveys have demonstrated poor health outcomes in disaster (natural or man-made) settings.[1–3] Instability in these settings often restricts data collection to outcomes such as overall or subpopulation-specific mortality or morbidity,[4 5] and detailed analyses of the effect of confounding or interacting covariate information at the individual, household or community level are rarely possible. Ecological inference concerning the relationship between these observed outcomes and non-measured, non-disease-related characteristics of the setting is common. Such characteristics include direct exposure to active conflict, destruction of health systems, declining access to health care, forced relocation and reduced access to basic necessities.[6 7] While a negative association with health is often concluded, estimates of the magnitude of the association are either not reported or are ecological in nature (e.g. broad temporal[1] or geographical[8] associations).

The reporting of human rights violations (HRVs) has been primarily based on qualitative methods. These investigations provide detailed contextual and anecdotal information regarding specific HRVs, are often placed in a legalistic framework, and are most often utilised for advocacy or for prosecuting perpetrators.[9] This approach has been illustrated on a large scale in various high-profile truth and reconciliation commissions, such as those implemented in South Africa, Guatemala, El Salvador and elsewhere, and under the auspices of United Nations in various tribunals such as the International Criminal Tribunal for Rwanda (ICTR)[10] or the International Criminal Tribunal for former Yugoslavia (ICTY).[11] Classical epidemiological approaches, however, offer an opportunity to extend the examination of HRVs to the population level[12] and can add quantitative strength to the assessment of the impact of these violations on health outcomes. Investigators are increasingly reporting on the prevalence of human rights abuses,[13–17] but rarely have HRVs and health outcomes been concurrently measured in a way that allows for quantification of the relationship.[18–22] When implementing health interventions in settings where HRVs are known to have occurred or are ongoing, an accurate evaluation of the progress of those interventions may require accounting for the impact of violations on measured outcomes.

We have reported elevated mortality risk (infant mortality rate (IMR) and under-5 mortality rate (U5MR) = 122 and 276 per 1000 live births respectively) among communities in eastern Burma confined within the ongoing conflict between the Burmese military junta and ethnic minority groups.[23] The mortality indicators are substantially higher than national estimates for Burma (IMR = 76; U5MR = 107).[24] These estimates were measured through regular household surveys conducted by a network of mobile indigenous health workers (Back Pack Health Worker Team, BPHWT), who provide basic health care and conduct surveillance in eight administrative divisions in eastern Burma (figure 1).

HRVs stemming both from the conflict and from specific policies of the Burmese military regime, the State Peace and

Figure 1 Map of Karen (subdivided) and Karenni states in eastern Burma.

Development Council (SPDC), have been consistently reported and are probably a major contributing factor to poor mental[25] and physical[26 27] health outcomes. These include detention, torture, rape and execution of villagers in resistance areas; systematic destruction of crops, food supplies and livestock; forced labour and military conscription (including of children); and forced relocation.[28–32] By late 2004, there were an estimated 526 000 internally displaced persons (IDPs) in eastern Burma, and at least 240 villages had been destroyed, forcibly displaced or abandoned in the previous 2 years.[33] Since 1992 a Special Rapporteur for Burma has been appointed by the United Nations High Commissioner for Human Rights to report on human rights abuses in the country. Their reports have consistently illustrated a range of violations of rights protected under international conventions for political and civil rights (ICCPR)[34] and economic, social and cultural rights (ICESCR).[35] Furthermore, the treatment of civilian populations living within conflict areas has contravened articles of the Geneva Conventions, in particular Article 3 of Convention IV.[36]

The BPHWT developed an additional module for assessing HRVs on a population level, providing a unique opportunity to quantify the association between HRVs and health outcomes in a conflict zone. We describe this initial effort to use epidemiological tools to examine population-based health and rights associations, suggest modifications towards further improvement, and provide examples of potential applications.

METHODS

Design

Between October and December 2004, BPHWT health workers in conflict zones of the Karen and Karenni areas of eastern Burma conducted retrospective household surveys of vital events and HRVs occurring in the 12 months prior to the interview. The design, implementation and operational method of the BPHWT surveys have been described previously.[23] Briefly, annual village census information was used to construct a sampling frame for the target population (~129 000) spanning eight administrative areas (figure 1). One hundred village-based clusters were selected proportionate to population size, and 20 households within each cluster were selected using systematic interval sampling. Households were defined as a group of people who live in the same house and share meals. If the head of household was unavailable, the next nearest household was selected. The 100 × 20 design was chosen to minimise the data collection burden for each single mobile team and reduce the proportionate impact on overall sample size per lost cluster.

Implementation

Before implementing the survey, an intensive 4-day training workshop was conducted for BPHWT surveyors. The workshop focused on interview techniques, sampling methods, survey questions and relevant case definitions. At each household, surveyors explained the objectives and obtained verbal consent for participation.

The survey included a listing of all household members by age and sex, maternal report of diarrhoea episodes in children during the previous 2 weeks, mid-upper arm circumference (MUAC) for children between 1 and 5 years old, and *Plasmodium falciparum* (a causative agent of malaria) parasitaemia for the respondent using a rapid diagnostic test (Paracheck-Pf® Orchid Biomedical Systems, Goa, India). This rapid test has a higher documented sensitivity (85–94%) and specificity (89–99%) for asymptomatic infection than field microscopy.[37–39] Respondents listed household members who had died during the 12 months prior to the survey. No formal verbal autopsy instrument was used in this setting; respondents of households in which a death had occurred were, however, asked to provide a proximate cause of death.

A final module focused on household exposure to specific potential HRVs during the previous 12 months. Definitions of HRVs included (1) forced labour, being forced to work against one's will; (2) soldier violence – being shot, stabbed or beaten by a soldier; (3) theft or destruction of food supplies (including rice field, paddy, food stores and livestock); (4) injuries from landmines or unexploded ordnance; and (5) forced displacement – being forced to move because of lack of security. Local health leaders developed these questions based on focus group discussions with BPHWT health workers and traditional birth attendants who live and/or work in the communities of the target population. Their informal sharing of experiences living in the context of the ongoing conflict assisted in focusing on prevalent HRVs that could be readily measured and for which a causal pathway to health outcome was plausible. The BPHWT efforts in this module were not intended to strictly adhere to a legal framework for defining those violations; rather, efforts were focused on understanding the exposure of their target population to violations of basic human rights and how these exposures might be associated with the overall health of the community. The working definitions explicitly confined the events to those related to the ongoing conflict and security situation. Furthermore, the above definitions relate directly to rights enshrined in international human rights law: forced labour (ICCPR, Article 8),[34] targeting of non-combatants (Geneva Convention IV, Articles 3 and 27),[36] theft and/or destruction of food supplies and other material goods essential for survival (Protocols Additional to the Geneva Conventions (II), Article 14)[40] and forced displacement or relocation of the civilian population (Protocol II, Article 17;[40] Universal Declaration of Human Rights Article 13[41]). Thus, while the definitions used in the survey were not specifically chosen by the BPHWT to reflect the precise meaning of these legal definitions, their overall aim was to represent the most

common violations occurring in their community that have parallel protection under international law.

Resource and security constraints of the mobile health network required that all survey modules, including all demographic and health data, be confined to a single sheet of paper and without specific individual identifiers. This also restricted the collection of specific morbidity indicators. For example, MUAC was chosen as other measures of malnutrition, such as wasting or stunting, could not be recorded in this setting because the BPHWT workers could not carry weighing scales or length boards. Malaria testing could not be carried out on all individuals: the mobile BPHWT workers carried sufficient diagnostic tests to survey the respondent of each survey, but not children and other adults.

Sample size and analysis

The proposed sample size of 2000 was based on a balance between operational feasibility under security and resource constraints and the BPHWT goal of continued monitoring of the IMR with reasonable precision. The sample size allows for precision of IMR to within 50/1000 live birth (assuming IMR = 150/1000, crude birth rate = 40/1000, mean household size is six persons, overall survey completion rate = 85%, and design effect = 2.0). For estimation of the proportion of households experiencing any given human rights violation, the minimum (absolute) precision is approximately 5%, assuming higher design effects (5.0) for these binary variables.

Overall response rate was estimated at both the cluster and individual household level. Post-sampling weighting was used to account for uneven coverage rates across administrative divisions. Infant (IMR) and under-five (U5MR) mortality rates were estimated as a ratio of deaths to live births, while crude mortality rate (CMR) and age-specific death rates (ASDRs) were estimated as a ratio of all deaths to mid-year population. Population proportions were estimated for morbidity outcomes, including the proportion of respondents testing positive for *Plasmodium falciparum* parasitaemia, prevalence of mild (MUAC $<$ 13.5 cm), moderate ($<$ 12.5 cm) and severe ($<$ 11.0 cm) malnutrition in children (1–5 years), prevalence of diarrhoea episodes during the previous 2 weeks and household-level experience of HRVs in the previous 12 months. Prevalence of the most common HRVs was estimated and simple logistic regression analysis was conducted to compare the odds of various adverse health outcomes between households exposed to one or more HRVs. Individuals were the unit of analysis when data were available (parasitaemia status of respondent, malnutrition status and diarrhoea episodes); deaths and landmine injuries were reported at the household level. For examination of multiple HRVs, Poisson regression models were used for incidence rate data (ASMR and CMR) while logistic regression was used for binary outcomes. All confidence intervals were adjusted for the cluster sampling design. Analyses were conducted with Stata 8.0 (Stata Corp., College Station, TX, USA).

Ethics approval

The survey protocol was approved by local leaders of the Burma Medical Association. The Committee on Human Research of the Johns Hopkins University approved the secondary analysis of the data.

RESULTS

Cluster and household characteristics

The mobile workers conducted a total of 1834 of the target sample of 2000 (92%) household surveys. Response rate was low, however, in Karenni state (58.2%) and Tenasserim division (67.2%), and all overall population-level estimates were adjusted using post-sampling weighting to account for the missing surveys from these areas. Characteristics of the survey sample are summarised in table 1.

The overall male to female ratio was 0.96, but in the 15–25 year age group there was a substantial deficit of males (86 males for every 100 females).

Mortality rates and morbidity

A total of 408 live births and 195 deaths were reported by respondents (table 2).

Of the total deaths, there were 37 among infants (IMR = 89/1000 live births; 95% CI 49 to 129) and 90 child deaths (U5MR = 218; 95% CI 135 to 301). The under-5 age-specific death rate was 49 per 1000 persons (95% CI 32 to 72) and the crude mortality rate was 19 (95% CI 15 to 24). Among both adults and children, the most common reported cause of death was malaria (overall 42%; child deaths 47%; adult deaths 38%). Diarrhoea and acute respiratory infections were the reported cause of death for 22% and 12% of cases respectively. Deaths attributed to violence were few (two from landmines and one from a gunshot wound).

Rapid tests for parasitaemia were conducted in 1739 (95%) of respondents, 1086 (60%) of whom were female; overall 11.2% were positive (table 2). The mean age (standard deviation (SD)) of respondents undergoing malaria testing was 40.1 years (14.8) and this did not differ between individuals testing positive (40.4 years) and negative (40.5 years). Positive status was also not associated with sex of the respondent (males 9.9%, females 12.3%, OR = 0.78 (95% CI 0.49 to 1.24), p = 0.30). MUAC was measured in 1335 of the 1462 children between 1 and 5 years old, and 208 (15.0%) had measurements less than 13.5 cm. Moderate ($<$ 12.5 cm) and severe ($<$ 11.0 cm) malnutrition were found in 2.6% and 1.6% of children respectively. Landmine injuries were reported in 13 households; given the estimated mid-year population of 9746, this represents an approximate risk of 13.3 landmine injuries per 10 000 persons per year.

Violations of human rights

The prevalence of the major categories of HRVs reported by households is shown in table 3.

Over half (52.1%) of respondents reported experiencing one or more HRVs during the previous 12 months. Respondents from 598 (32.6%) out of 1819 households reported forced labour, a quarter (25.2%) reported theft or destruction of their food supply, and 165 households (8.9%) reported forced displacement.

Table 1 Target population, number of clusters and households surveyed, and basic demographic indicators

Sample characteristic	Indicator
Target population	129 000
Number of clusters sampled	100
Number of clusters reached	92
Total households sampled	1834
Response rate	92%
Population sampled	9853
Mean household size*	5.3
Population $<$ 5 years old (%*)	1851 (18.4)
Population $<$ 15 years old (%*)	4446 (44.9)
Population $>$ 65 years old (%*)	217 (2.3)
Male to female ratio (15–25 years*)	0.86
Male to female ratio (15–45 years*)	0.91

*Post-sampling weights applied to adjust means or proportions for reduced response rate.

Table 2 Mid-year population estimates, vital events, mortality rates estimates and prevalence of various morbidities

Mid-year populations		
< 5 years old	1856	
⩾ 5 years old	7890	
Vital events*		
Live births	408	
Infant deaths	37	
Child deaths	90	
Overall deaths	195	
Mortality rates	*Estimate (95% confidence interval*)*	
Infant (IMR)	89 (49 to 129)	
Child (U5MR)	218 (135 to 301)	
Child (ASDR-5)	49 (32 to 72)	
Overall (CMR)	19 (15 to 24)	
Morbidity prevalence	*n*	*Positive (%)*
Plasmodium falciparum positive (respondents only)	1739	216 (11.2)
Children 1–5 years old (n = 1462)		
Malnutrition (MUAC)		
Mild (12.5–13.5 cm)	1335	147 (10.8)
Moderate (11.0–12.5 cm)		36 (2.6)
Severe (< 11.0 cm)		25 (1.6)
Any malnutrition (< 13.5 cm)		208 (15.0)
Child diarrhoea in previous 2 weeks	1830	252 (13.5)
Landmine injuries reported in household	1818	13 (0.8)

IMR, infant mortality rate (infant deaths per 1000 live births); ASDR-5, age-specific death rate under 5 (deaths < 5 per 1000 children < 5); CMR, crude mortality rate (deaths per 1000 population). All vital events are based on 12-month recall period.

Association between human rights violations and health outcomes

The odds of reporting various health outcomes were compared between households exposed and not exposed to the three major categories of HRVs (table 4). Household size did not confound the relationship between exposure status and outcomes reported at the household level; unadjusted odds ratios are presented.

There were substantially increased odds of landmine injuries among households reporting food theft or destruction (OR = 4.55; 95% CI 1.23 to 16.9) or forced displacement (OR = 3.89; 95% CI 1.01 to 15.0). Child deaths were more often reported in households reporting forced displacement (OR = 2.80; 95% CI 1.04 to 7.54) and deaths at any age were more often reported by households that experienced forced displacement or food theft/destruction although the association was statistically significant only for the latter (OR = 1.58; 95% CI 1.09 to 2.29).

Poor nutritional status among children was associated with forced displacement (OR = 3.22 (95% CI 1.74 to 5.76)) and food theft or destruction (OR = 1.94; 95% CI 1.20 to 3.14). The risk of severe malnutrition among children was 5.06 times higher (95% CI 2.81 to 9.08) among households reporting food theft or destruction. The odds of malnutrition among children was significantly higher (OR = 5.88; 95% CI 2.40 to 14.3) in households reporting exposure to both rights violations than in children from households reporting no HRVs.

Forced labour was not associated with mortality. While landmine injuries were more commonly reported in these households (OR = 2.62), this comparison did not reach statistical significance. The risk of child malnutrition was lower among households reporting forced labour (OR = 0.37; 95% CI 0.22 to 0.63).

Crude and age-specific mortality rates, landmine injuries and *Plasmodium falciparum* parasitaemia status were compared across levels of household exposure to HRVs (table 5).

The risk of death among children less than 5 years and the overall mortality risk were substantially higher among families with multiple exposures than in those reporting one or no violations. Landmine injuries were also more often reported in these households (OR = 19.8 (95% CI 2.59 to 151.2)). Furthermore, among families reporting three or more violations, the child mortality risk was 5.23 (95% CI 1.93 to 14.14) times higher than among families not exposed.

DISCUSSION

The infant and child mortality rates estimated here from 2004 survey data are consistent with those estimated from prior surveys in 2002 and 2003,[23] highlighting the health consequences of this humanitarian crisis. The substantial excess mortality risk compared with national estimates in Burma or nearby Thailand (U5MR = 26)[24] is not solely a result of an escalation of conflict during this period. On the contrary, the recall period of this survey coincided with a period of decreased conflict; in early 2004 Karen leaders were actively engaged in ceasefire talks with the Rangoon military regime. Overall, however, the infant, child and adult mortality rates are not significantly different from previous estimates,[23] and the data demonstrate that these communities continue to experience high risk of mortality, infectious morbidity and malnutrition. The preponderance of deaths due to preventable disease rather than direct violent causes parallels similar recent reports.[8 42]

HRVs such as forced displacement and labour, theft and destruction of food supplies, and soldier violence have been reported upon extensively by a wide range of organisations using interviews and other qualitative methods.[31–33] Data presented here provide initial estimates of the extent of these HRVs and supporting evidence for assertions that these HRVs are widespread. Overall exposure to these HRVs was high. More than one-quarter of households reported destruction or theft of

Table 3 Prevalence and cumulative number of various human rights violations reported by family members

Violation	No. of households	No. experiencing violation	Percentage*
Food destruction or theft	1813	472	25.2
Forced displacement	1821	165	8.9
Forced labour	1819	598	32.6
Physically attacked by military	1821	35	2.1
Number of rights violations reported by household			
0	1832	860	47.9
1		703	37.7
2		242	12.8
3		25	1.5
4		2	0.1

*Post-sampling weights applied to adjust means or proportions for reduced response rate.

Table 4 Prevalence of specific health outcomes, by household experience of human rights violation

	Exposed		Non-exposed		Odds ratio (95% confidence interval)
	Total	n (%*)	Total	n (%*)	
Food destruction or theft					
Households reporting					
Infant death	472	6 (1.3)	1341	29 (2.0)	0.68 (0.26 to 1.60)
Child death	472	23 (5.1)	1341	60 (4.3)	1.19 (0.67 to 2.15)
Any death	472	61 (12.5)	1341	120 (8.3)	1.58 (1.09 to 2.29)
Landmine injury	471	5 (1.8)	1335	8 (0.4)	4.55 (1.23 to 16.91)
Individual morbidities					
Respondent	444	77 (16.5)	1274	139 (9.7)	1.82 (1.16 to 2.89)
Plasmodium falciparum positive					
Child diarrhoea (2 weeks)	357	42 (11.5)	1454	209 (14.1)	0.79 (0.51 to 1.22)
MUAC < 13.5 cm	272	58 (23.7)	1088	164 (13.5)	1.94 (1.20 to 3.14)
Forced displacement					
Households reporting					
Infant death	165	4 (2.9)	1656	30 (1.7)	1.72 (0.52 to 5.74)
Child death	165	15 (10.2)	1656	67 (3.9)	2.80 (1.04 to 7.54)
Any death	165	21 (13.6)	1656	160 (8.9)	1.61 (0.75 to 3.42)
Landmine injury	165	4 (2.3)	1655	9 (0.6)	3.89 (1.01 to 15.0)
Individual morbidities					
Respondent *Plasmodium* falciparum positive	164	28 (16.0)	1565	186 (10.8)	1.58 (0.97 to 2.57)
Child diarrhoea (2 weeks)	147	11 (8.5)	1671	238 (13.9)	0.58 (0.27 to 1.26)
MUAC < 13.5 cm	120	42 (32.5)	1248	179 (13.2)	3.22 (1.74 to 5.97)
Forced labour in household					
Households reporting					
Infant death	598	9 (1.5)	1221	25 (1.9)	0.75 (0.32 to 1.79)
Child death	598	27 (4.4)	1221	55 (4.4)	1.01 (0.55 to 1.85)
Any death	598	71 (10.8)	1221	110 (8.6)	1.29 (0.79 to 2.12)
Landmine injury	597	7 (1.3)	1220	6 (0.5)	2.62 (0.71 to 9.61)
Individual morbidities					
Respondent *Plasmodium falciparum* positive	549	81 (13.2)	1178	134 (10.4)	1.32 (0.78 to 2.23)
Child diarrhoea (2 weeks)	550	89 (14.9)	1263	157 (12.5)	1.22 (0.82 to 1.81)
MUAC < 13.5 cm	429	38 (8.3)	933	182 (18.9)	0.37 (0.22 to 0.63)

vital food, crops or livestock, almost 1 in 10 households were forcibly displaced, and almost one-third of households included members who had been forced to work against their will. In addition, while we treated landmines injuries as a health outcome for the main analysis, these can also be considered human rights abuses. One in 50 households reported exposure to violence from combatants, and the annualised rate of exposure to landmine explosions resulting in death or injury was 13.3 per 10 000.

Furthermore, these violations, especially forced displacement and theft and destruction of food supplies, were strongly associated with specific adverse health outcomes such as child and crude mortality, landmine injuries and childhood malnutrition. In these data, forced labour in the household was

Table 5 Mortality risk, landmine injuries and parasitaemia prevalence by cumulative exposure to human rights violations

Mortality rate	No. of deaths	Mid-year population	Deaths/1000	Incidence rate ratio (95% confidence interval)
ASDR-5				
No violations reported	44	970	43	1.00 (– to –)
One violation	26	669	41	0.96 (0.46 to 1.97)
Two or more violations	20	216	95	2.18 (1.11 to 4.29)
CMR				
No violations reported	86	4504	18	1.00 (– to –)
One violation	62	3826	16	0.89 (0.54 to 1.45)
Two or more violations	47	1417	31	1.75 (1.14 to 2.70)
Landmine injuries	Injuries	Households	Proportion (%)	Odds ratio (95% confidence interval)
No violations reported	1	855	0.2	1.00 (– to –)
One violation	4	701	0.6	3.61 (0.47, 27.5)
Two or more violations	8	261	3.1	19.79 (2.59, 151.2)
Plamodium falciparum positive	Positive	Respondents	Proportion (%)	Odds ratio (95% confidence interval)
No violations reported	83	827	8.9	1.00 (– to –)
One violation	82	657	11.3	1.29 (0.73 to 2.30)
Two or more violations	51	253	18.8	2.34 (1.27 to 4.32)

associated with *less* childhood malnutrition, which is difficult to explain. The result, however, may be spurious as this exposure was associated with an increase in crude mortality of 30% and a 2.62-fold increased risk of landmine injuries (although these findings were not statistically significant).

These data were collected in a cross-sectional manner and the observed associations do not establish causality. There are, however, plausible causal pathways between these HRVs and adverse health outcomes. Food insecurity increases the risk of malnutrition and leads to increased foraging and migration, behaviours that might increase risk of landmine injuries and malaria, which has been linked with population movements.[43–45] Forced displacement would similarly increase the risk of death, landmine injuries and malnutrition. These data provide empirical support for the observation that "structural violence"[46] – including violations of basic economic and social rights (right to freedom of movement, labour, food) – might contribute to increased risks of morbidity and mortality in areas of civil conflict. Alternative directionality of these relationships is also possible. No specific data were collected on the timing of the exposure to HRVs, and a number of outcomes statistically related to HRVs may have occurred prior to the exposure. Future efforts to collect data on both HRVs and health outcomes should aim to collect information on a prospective basis or incorporate questions on relative timing of exposures and outcomes into cross-sectional survey instruments.

Further limitations relating to the design and implementation of the survey necessitate cautious interpretation of the population-level estimates. Two areas had a low response rate ($< 70\%$), but the overall response rate was high (92%) and post-sampling weights were used to account for the lowered rate in these two areas. Recall can be problematic, leading to bias in mortality surveys. BPHWT surveyors have been trained to use important dates and/or events to assist the respondent in temporal identification of vital events. The module for assessment of human rights violations could be expanded to allow for a more detailed understanding of the timing, type and number of exposures. In addition, more detailed information on displacement, such as when and why the displacement occurred, distance forced to move and ability/inability to return, need to be explored to more fully capture the relationship between this exposure and health outcomes. Further work on combining individual-level experience of multiple human rights violations is needed for improved exposure measures.

In some cases, deliberate misstatement of exposure to human rights violations is also possible and could bias the results. Respondents might have hesitated to reveal specific information about certain events for fear of exposure to military forces or other authorities. Alternatively, some exposures might have been "false positives", offered by the respondent in the understandable hope that more aid or attention might be forthcoming from the BPHWT workers. We believe this to be unlikely, as the BPHWT workers are themselves trusted members of the community who have a well-understood primary role of providing basic health services.

While these analyses illustrate the potential of quantifying the relationship between exposure to HRVs and health outcomes, further work is required to refine these methods. For example, resource and security constraints of this mobile health network required that all demographic and health data be collected on a single sheet of paper and without specific individual identifiers. This precluded the BPHWT from collecting covariate data such as socioeconomic data on respondents and households, environmental exposures, access to health services (if any) and baseline nutritional status, among others. Such data could have increased understanding of the proximal and distal determinants of health in this setting and more precisely clarified the causal pathway(s) through which these HRVs may affect population-level health outcomes.

Future efforts to measure the population-level impact of HRVs should include a wider range of questions related to specific violations, facilitating a more complete picture of exposure. Principal components analysis might then be utilised to group types of HRVs and provide further understanding of the relationship between HRVs and outcomes. Incorporating qualitative data collection approaches in addition to collection of richer covariate data would help elucidate the specific pathway(s) through which the exposure of individuals, families and communities to rights violations increases the risk of adverse health outcomes. When substantially different population-level experience of degree or types of violations is considered likely across subgroups of a population, samples should be of size sufficient to allow stratified analyses. Increased sample size might also facilitate a more detailed analysis of the correlation between certain human rights violations and improved scales or other similar measures that indicate overall exposure when multiple or concurrent violations occur.

Organisations often focus separately on *either* human rights abuses *or* population-level health indicators. The combined approach illustrated here, however, could be implemented with minimal increases in resources. Integration of both types of data could strengthen advocacy efforts of rights-oriented organisations by bringing a quantitative perspective to the impact of abuses. Similarly, in settings where rights abuses are experienced at a population level, adequate monitoring of public health programmes requires concurrent efforts to assess these exposures.

CONCLUSION

Since November 2005, an additional 27 000 civilians have been displaced in an ongoing offensive against primarily the ethnic Karen by the Burmese military, joining over 500 000 internally displaced persons (IDPs) who had fled from previous abuses and conflict.[47] In 2006 alone, over 200 additional villages were burned to the ground, and there are further reports of forced labour, including as human minesweepers, destruction of food supplies, torture and summary execution committed by SPDC forces against civilians as part of this campaign.[47–49] Under these circumstances, the BPHWT data suggest that long-term, sustainable public health improvements cannot occur without addressing the distal factors that exacerbate poor health outcomes, such as widespread human rights abuses and inability to access health care services.

Given the crisis in Burma, more consideration might be given to supporting and expanding cross-border efforts such as the BPHWT programme. Expanding programmes must go hand in hand with ongoing monitoring and further research into the needs of these neglected populations. Such ongoing monitoring efforts may expand upon the method illustrated here in order to measure the prevalence of human rights violations, to elucidate causal pathways, to quantify the impact of these violations on population-level health indicators and to serve as a tool for short-term assessment of the situation during acute escalations

What is already known on this subject?

- Child and adult mortality rates among internally displaced populations in eastern Burma are high, and many deaths are due to infectious, preventable causes.
- Human rights violations have commonly been reported by rights organisations, but the association between violations and health indicators has not been quantified.

What does this study add?

- These data support qualitative reports of widespread human rights violations occurring within communities of internally displaced persons in eastern Burma.
- Epidemiological tools can be used to quantify the association between human rights violations and population-level health indicators, but further refinement and expansion of the method is necessary.

in conflict. Beyond providing a tool for monitoring of human rights violations, we hope that the development of this approach might assist in advocacy efforts towards the most important overall objective: cessation of these human rights violations.

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