Tropical Medicine and International Health doi:10.1111/j.1365-3156.2010.02702.x

VOLUME 16 NO 3 PP 375–378 MARCH 2011

Rates and causes of death in Chiradzulu District, Malawi, 2008: a key informant study

Francesco Checchi[1], Peter Nyasulu[2], Daniel Chandramohan[1] and Bayard Roberts[3]

1 *Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, UK*
2 *Médecins Sans Frontières, French Section, Blantyre, Malawi*
3 *Faculty of Public Health and Policy, London School of Hygiene and Tropical Medicine, London, UK*

Summary In September 2008, we measured all-cause mortality in Chiradzulu District, Malawi (population 291 000) over a 60-day retrospective period, using capture–recapture analysis of three lists of deaths provided by (i) key community informants, (ii) graveyard officials and (iii) health system sources. Estimated crude and under-5-year mortality rates were 18.6 (95% CI 13.9–24.5) and 30.6 (95% CI 17.5–59.9) deaths per 1000 person-years. We also classified causes of death through verbal autopsy interviews on 50 deaths over the previous 40 days. Half of deaths were attributable to infection, and half of deaths among children aged under 5 were attributable to neonatal causes. HIV/AIDS was the leading cause of death (16.6%), with a cause-attributable mortality rate of 1.8 (0.4–3.6) deaths per 1000 person-years.

keywords mortality, cause of death, HIV, AIDS, Malawi, verbal autopsy

Introduction

In countries with inadequate demographic surveillance systems, lack of all-cause and cause-specific mortality data severely restricts the health system's ability to monitor health status and measure the impact of disease control interventions (Setel *et al.* 2007). Chiradzulu District, in Malawi's southern region, is a rural community with high poverty levels and an estimated HIV prevalence of 20% in 2007 (Malawi AIDS Commission, unpublished data). Since 1999, Médecins Sans Frontières has been supporting a district-wide, increasingly decentralized antiretroviral treatment programme, with an active cohort of about 12 000 in August 2008 (Médecins Sans Frontières, unpublished data).

The district was one of four sites in a multi-country evaluation of a method to estimate recent population mortality based on community informants (the informant method). In Chiradzulu, we also investigated causes of death through verbal autopsies (VAs). These consist of illness narratives and structured questionnaires about the decedent's medical history and signs and symptoms prior to death, as reported by next of kin or caregivers (Baiden *et al.* 2007). Here, we report rates and causes of death in Chiradzulu District during July–September 2008.

Methods

Details on the informant method and its validity are reported elsewhere (Roberts *et al.* 2010). Briefly, the method relies on identifying sets of key community informants through rapid qualitative research, and asking these respondents to list recent deaths in their community; households with decedents are then interviewed to establish the demographic characteristics and precise timing of the death, relative to a retrospective period of interest. Available population figures or an ad hoc rapid population estimation study are used to populate the person-time denominator for mortality rate calculation, with the assumption that population size remains constant during the (short) period.

Accordingly, we firstly listed all deaths over a 60-day retrospective period in a spatially representative sample of 96 villages of Chiradzulu District. The list was provided by two sets of key community informants (village headmen or headwomen, and village *fumukazi*, or sage women). For each decedent listed, we established age, sex, circumstances and date of death through a structured questionnaire administered to consenting next of kin and supported by an events calendar.

A VA interview was then carried out on the same day or within a week. VAs were only carried out for deaths over the previous 40 days so as to minimize errors in date recall. We used current WHO VA guidelines and questionnaires (World Health Organization 2007), covering three age groups (<4 weeks; 4 weeks to 14 years; and older than 14 years), translated into Chichewa through group consensus involving a clinician and two non-clinicians and back-translated to verify accuracy.

A Malawian clinician administered questionnaires. Two clinicians analysed questionnaires independently, and a third resolved discrepant cause-of-death classifications. We attributed underlying causes of death using the International Classification of Diseases, version 10 (ICD-10; http://apps.who.int/classifications/apps/icd/icd10online/).

The main aim of the multi-country study was to validate the informant method. To do so, we used a capture–recapture approach that relies on collecting multiple lists of deaths over the same period and analysing the overlap among these lists to estimate the true number of deaths. Capture–recapture provides a best estimate of the true number of deaths in the recall period and is used extensively in epidemiology to evaluate the completeness of reporting and/or the true burden of various diseases (International Working Group for Disease Monitoring and Forecasting 1995). Accordingly, we obtained two additional lists of deaths from alternative sources: (i) chairmen of villages' graveyard committee and (ii) inpatient registers of all health facilities in the district or death reports by health surveillance assistants (community health workers) active in each village. We then applied a Bayesian model averaging capture–recapture technique (International Working Group for Disease Monitoring and Forecasting 1995; Fienberg *et al.* 1999) to the informant method list and these two additional lists so as to estimate the true number of deaths over the 60-day recall period, which we used to compute all-cause mortality rates. We replicated this analysis for children aged under 5.

Simultaneously, we estimated the all-age and under-5-year population of the sampled villages using a combination of residential structure counts (performed in duplicate by independent counters in each village) and a small cluster survey (32 villages selected at random, with two structures per village or cluster) to estimate structure occupancy, defined as the number of people of each age group who spent the previous night within the structure.

We computed mortality rates by fitting Poisson models to the counts of deaths per residential structure, weighted for unequal village sampling probabilities, with the natural logarithm of person-time at risk in the structure as an offset, standard errors adjusted for cluster survey design and confidence intervals derived by bootstrapping. We estimated the HIV/AIDS-attributable mortality rate by multiplying the crude mortality rate by the proportion of deaths investigated by VA that were attributable to HIV/AIDS.

The study was approved by the Ethics Committee of the London School of Hygiene and Tropical Medicine and by the Malawi National Health Sciences Research Committee. All participants provided verbal informed consent.

Results

Data were collected between 26 August and 16 September 2008. Key informants listed 93 deaths (26 among children under 5 years) over the previous 60 days in the sampled villages; 72 (20) were listed by graveyard chairmen, and 44 (11) by health facilities or health surveillance assistants. Using capture–recapture analysis, we estimated 143 (95% CI 123–194) total deaths among all ages and 39 (95% CI 32–96) among those aged under 5 in a population of 54 400 (95% CI 46 700–62 700), of whom 9500 (95% CI 6400–13 600, 17.7%) children under 5 years. This yielded crude and under-5-year mortality rates over 60 days of 18.6 (95% CI 13.9–24.5) and 30.6 (95% CI 17.5–59.9) deaths per 1000 person-years, respectively, with no gender differences.

Over the 40-day period for VA analysis, key informants listed 54 deaths, but because of transport problems, we only did VA interviews for 50, or 64.9% (95% CI 47.2–88.3) of the 77 deaths estimated by capture–recapture to have occurred over this period. Of the 50, 24 (48.0%) were men, 14 (28.0%) children under 5 years, 35 (70.0%) received formal health care for their fatal illness, but only 18 (36.0%) died in a health facility.

Half of deaths were attributable to infectious causes (Table 1). Among children, most were attributable to neonatal causes (≤28 days after birth) and acute respiratory infections. Overall, HIV/AIDS was the leading cause of death (9/50 or 16.6%, 95% CI 3.5–29.5), for an attributable mortality rate over 40 days of 1.8 (0.4–3.6) deaths per 1000 person-years, or 528 (108–1044) HIV/AIDS deaths per year when projected to a census-estimated district population of 291 000 (National Statistics Office of Malawi 2009). Among adults aged 15–59, proportional HIV/AIDS mortality was 7/20 (35.0%).

Discussion

In a rural district of Malawi in 2008, deaths occurred mainly outside health facilities and were mostly attributable to neonatal and infectious causes. HIV/AIDS-attributable mortality among adults, however, appeared lower than elsewhere in Malawi [76% in three rural areas in 1998–2001 (Doctor & Weinreb 2003); 56% in Karonga district in 2005–2006 (Jahn *et al.* 2008)] and southern Africa [30–60% (Adjuik *et al.* 2006; Hosegood *et al.* 2004)], possibly reflecting high coverage of antiretroviral treatment. We may have underestimated HIV/AIDS burden if four tuberculosis and three adult meningitis deaths were in fact HIV-related, although VA interviews did not suggest this. The low contribution of malaria and diarrhoea may reflect pre-rainy season conditions. Generally,

Table 1 Causes of death as assessed through verbal autopsy, by age group and broad category

Underlying cause of death	Children under 5 years (n = 14) n (%‡)	Persons 5 years or older (n = 36)† n (%‡)	All ages (n = 50) n (%‡)	ICD-10 codes
Infectious causes	8 (43.0)	16 (45.2)	24 (48.8)	
Acute respiratory infection	5 (25.9)	0	5 (8.5)	J18.9
Malaria	0	1 (2.0)	1 (1.3)	B54
Diarrhoea	1 (5.0)	0	1 (1.6)	A09
Meningitis	0	3 (9.9)	3 (6.7)	G03.9
Rabies	0	1 (0.7)	1 (4.6)	A82.9
Tuberculosis (not HIV-related)	0	4 (13.9)	4 (9.4)	A15.9, A16.9
HIV/AIDS (includes three HIV–tuberculosis deaths, all among adults)	2 (12.1)	7 (18.7)	9 (16.6)	B23.8, B22.2, B21.0, B20.0
Non-infectious causes	1 (6.1)	13 (27.7)	14 (27.3)	
Cancer	0	5 (10.6)	5 (7.1)	C43.9, C53.9, C22.9, C15.9, C15.9
Cardiovascular disease	0	5 (19.8)	5 (13.3)	I50.0, I67.9, I25.9
Other chronic conditions (asthma in a child; epilepsy, liver cirrhosis, peptic ulcer in older persons)	1 (6.1)	3 (7.3)	4 (6.9)	K74.6, G40.9, J45.9, K27.4
Maternal and neonatal	4 (45.3)	1 (2.7)	5 (16.6)	
Neonatal	4 (45.3)	0	4 (14.8)	P21.9, P10.9, P22.9
Maternal	0	1 (2.7)	1 (1.8)	O72
Injuries	0 (0.0)	3 (6.4)	3 (4.4)	
Accidental	0	2 (5.7)	2 (3.8)	W13, X01
Intentional	0	1 (2.3)	1 (1.6)	Y04
Unclear	1 (5.6)	3 (6.4)	4 (6.2)	R99

†Only one death in the age group 5–14 years (malaria).
‡Percentages are weighted and thus may not correspond to the raw numbers.

inference should be cautious given the small number of deaths investigated.

Our cause-of-death findings rest on the assumption that the proportional mortality among deaths not investigated by VA (35.1% of the estimated total) was the same as in those investigated. While VA studies are typically coupled to retrospective sample surveys or prospective demographic surveillance, under-reporting of deaths is a common problem across these mortality estimation methods (Mathers & Boerma 2010). Our study attempted to explicitly quantify the degree of under-reporting by the informant method and estimate true mortality rates based on multiple sources using capture–recapture. While alternative sources taken individually had limited sensitivity (over 60 days, 50.3% for graveyard chairmen and 30.8% for health facilities or health surveillance assistants: see (Roberts *et al.* 2010), capture–recapture analysis yielded crude mortality estimates that were higher than country-wide projections for 2007 (12.4 per 1000 person-years) (Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat 2008) and similar to those of surveys previously conducted in the southern and central regions of Malawi (see Roberts *et al.* 2010).

In conclusion, this study demonstrates the applicability of a key informant approach (supplemented by capture–recapture analysis) to rapidly generate local overall and cause-specific mortality estimates based on community lists of recent deaths and standard VA interviews. Findings from Chiradzulu District, Malawi, in 2008 suggest a reduced death toll of HIV/AIDS compared to regional estimates but high mortality from neonatal and respiratory diseases.

Acknowledgements

We are grateful to the Chiradzulu District Health Office, other Chiradzulu district officials and Médecins Sans Frontières (in particular Megan McGuire and Ayub Said) for assistance. Dr Siamak Malek (Médecins Sans Frontières) independently reviewed VA questionnaires, and we are grateful for his time. We thank Luciano Mambo, Agnes Mogha, Deborah Namatika and Grey Zachariah for data collection, Oliver Morgan and Mark Myatt for advice, and

Megan Deitchler [Food and Nutrition Technical Assistance project, Academy for Educational Development (AED)] for support. This study was funded by the Office of Health, Infectious Disease, and Nutrition, Bureau for Global Health, United States Agency for International Development (USAID), through both the FANTA-2 Project under the terms of Cooperative Agreement Number GHN-A-00-08-00001-00, and the FANTA Project (1998–2008) under the terms of Cooperative Agreement Number HRN-A-00-98-00046-00, managed by the AED. The contents do not necessarily reflect the views of USAID or the United States Government.

References

Adjuik M, Smith T, Clark S *et al.* (2006) Cause-specific mortality rates in sub-Saharan Africa and Bangladesh. *Bulletin of the World Health Organization*, **84**, 181–188.

Baiden F, Bawah A, Biai S *et al.* (2007) Setting international standards for verbal autopsy. *Bulletin of the World Health Organization*, **85**, 570–571.

Doctor HV & Weinreb AA (2003) Estimation of AIDS adult mortality by verbal autopsy in rural Malawi. *AIDS*, **17**, 2509–2513.

Fienberg SE, Johnson MS & Junker BW (1999) Classical multilevel and Bayesian approaches to population size estimation using multiple lists. *Journal of the Royal Statistical Society*, **162**, 383–405.

Hosegood V, Vanneste AM & Timaeus IM (2004) Levels and causes of adult mortality in rural South Africa: the impact of AIDS. *AIDS*, **18**, 663–671.

International Working Group for Disease Monitoring and Forecasting (1995) Capture–recapture and multiple-record systems estimation II: applications in human diseases. *American Journal of Epidemiology*, **142**, 1059–1068.

Jahn A, Floyd S, Crampin AC *et al.* (2008) Population-level effect of HIV on adult mortality and early evidence of reversal after introduction of antiretroviral therapy in Malawi. *Lancet*, **371**, 1603–1611.

Mathers C & Boerma T (2010) Mortality measurement matters: improving data collection and estimation methods for child and adult mortality. *PLoS Medicine*, **7**, e1000265.

National Statistics Office of Malawi (2009) *2008 Population and Housing Census Preliminary Report*. Zomba.

Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2008) World population prospects: the 2008 revision.

Roberts B, Morgan OW, Sultani MG *et al.* (2010) A new method to estimate mortality in crisis-affected and resource-poor settings: validation study. *International Journal of Epidemiology*, **39**, 1584–1596.

Setel PW, Macfarlane SB, Szreter S *et al.* (2007) A scandal of invisibility: making everyone count by counting everyone. *Lancet*, **370**, 1569–1577.

World Health Organization (2007) *Verbal Autopsy Standards: Ascertaining and Attributing Causes of Death*. WHO, Geneva.

Corresponding Author Francesco Checchi, Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, Keppel Street, London, UK. E-mail: francesco.checchi@lshtm.ac.uk