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Premature adult mortality in urban Zambia: a repeated population-based cross-sectional study

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ABSTRACT

Objectives: To measure the sex-specific and community-specific mortality rates for adults in Lusaka, Zambia, and to identify potential individual-level, household-level and community-level correlates of premature mortality. We conducted 12 survey rounds of a population-based cross-sectional study between 2004 and 2011, and collected data via a structured interview with a household head.

Setting: Households in Lusaka District, Zambia, 2004–2011.

Participants: 43 064 household heads (88% female) who enumerated 123 807 adult household members aged between 15 and 60 years.

Primary outcome: Premature adult mortality.

Results: The overall mortality rate was 16.2/1000 person-years for men and 12.3/1000 person-years for women. The conditional probability of dying between age 15 and 60 ($_{45}q_{15}$) was 0.626 for men and 0.537 for women. The top three causes of death for men and women were infectious in origin (ie, tuberculosis, HIV and malaria). We observed an over twofold variation of mortality rates between communities. The mortality rate was 1.98 times higher (95% CI 1.57 to 2.51) in households where a family member required nursing care, 1.44 times higher (95% CI 1.22 to 1.71) during the cool dry season, and 1.28 times higher (95% CI 1.06 to 1.54) in communities with low-cost housing.

Conclusions: To meet Zambia's development goals, further investigation is needed into the factors associated with adult mortality. Mortality can potentially be reduced through focus on high-need households and communities, and improved infectious disease prevention and treatment services.

INTRODUCTION

The adult mortality rate in Zambia is among the highest in the world,[1 2] despite substantial and sustained donor support and government investment over many years in the public sector. Reducing premature adult mortality (defined as a death occurring between 15 and 60 years of age, inclusive) is essential for social and economic development; it also has a direct impact on the well-being of children and adult family members at the individual and population level.[3–5] The high early mortality in Zambia is evidence of the substantial challenges the country has faced as it attempted to reach its targets for Millennium Development Goals 5 (improve maternal health) and 6 (combat HIV, malaria and other diseases).[6]

As with many resource-constrained settings, the absence of a comprehensive vital registration system in Zambia[7] complicates efforts to engage in informed health policy and planning. There is an urgent need to identify alternative sources of data that can provide the information needed to create programmes to reduce adult mortality. In this study, we describe the epidemiological features of adult mortality, using data collected from a multiround cross-sectional, population-based study conducted in Lusaka, the capital city of Zambia, between 2004 and 2011.

METHODS
Setting

Zambia ranks 141 of 187 nations in the United Nations Development Programme

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Strengths and limitations of this study

- Given the absence of a vital registry system, these multiyear population-level data provide insight into adult (age 15–60 years) mortality in Lusaka, Zambia.
- We used a standardised questionnaire, and, over 12 survey rounds, enumerated over 123 000 adults who were residents of households in Lusaka.
- As a household survey, we were unable to validate the reported mortality events.
- As a cross-sectional survey, we are unable to determine whether any of the factors associated with mortality are causal relationships.

2014 Human Development Index.[8] Life expectancy at birth was estimated in 2010 to be 50.8 years in urban areas,[9] with a considerable burden of premature mortality attributable to the high prevalence (14.3%) of HIV infection.[10 11] Lusaka District is an urban area which includes the capital city of Zambia, with an approximate population of 1.7 million people[12] and where the scale-up of free HIV treatment services started in 2004.

Survey sampling and data collection

A description of the methods used to collect household-level and individual-level data has been given previously.[13 14] Briefly, between November 2004 and August 2011 we completed 12 rounds of a population-based household survey in Lusaka District. We stratified the district into 24 communities such that each community corresponded to a distinct health centre catchment area, selected three census enumeration areas within each community, as well as 50 households from each enumeration area. The sampling for each survey round was conducted independently of the other rounds, leading to a potential resampling of households. From each of the 3600 households selected per round, fieldworkers asked a household member to identify the household head or heads. Female household heads were preferentially selected for the study interview, under the assumption that they were more likely to accurately recall household membership and deaths.

Interviewers and participants completed all study procedures in English, Nyanja or Bemba. After explaining the aims of the study, an interviewer obtained written informed consent and then orally administered a structured questionnaire. The respondent was asked to enumerate all persons who lived in the household during the past 12 months, and to report the age and sex, and the timing and perceived primary cause of any death, for each individual. The questionnaire also contained sections on the household head's: demographic characteristics; asset ownership and domicile characteristics; health service access; HIV-related knowledge, attitudes and practices; functional status and availability of social support; and patterns of migration over the past 12 months. Owing to resource constraints, we were unable to conduct a verbal autopsy interview to verify cause of death. On the basis of guidance from our local ethics committee, we did not enquire about individual respondent HIV status. In conjunction with the timing of each survey round, we categorised each household based on their location within communities with clinics that provided HIV care and treatment. We also included an antenatal HIV prevalence measure for the communities, using data collected from a contemporaneous study of services for prevention of mother to child transmission of HIV in Lusaka District.[15]

Statistical analysis

The primary objective of this report was to describe the epidemiological features of adult mortality in Lusaka District. We first described the characteristics of the respondent household heads. Second, we described the total number of mortality events, survival time, age, sex and reported primary causes of death for all of the household members aged 15–60 years. Third, we plotted the observed mortality rate by age for men and women against the predicted mortality rates in a reference population (West Model) with a similar under-five mortality rate to Lusaka. The West Model represents the most widespread pattern of mortality among the global mortality patterns characterised by Coale and Demeny[16] and is intermediate to the other patterns. Fourth, we estimated the trend in adult mortality by fitting a Poisson regression model, with chronological time serving as the independent variable to calculate a mortality rate ratio. We also assessed whether the mortality trend was different between males and females by subsequently adding sex into this model as an interaction term. Next, we used separate Poisson regression models to estimate the sex-specific, community-specific and overall mortality rates. We also calculated the sex-specific, community-specific and overall conditional probabilities of dying between ages 15 and 60 ($_{45}q_{15}$).

Finally, we estimated the relative risk of dying by individual-level, household-level and community-level factors. For this investigation, we reported the results from two stages of regression analysis. In stage 1, we used a univariable Poisson regression model for each factor and reported the mortality rate ratio and 95% CI for each factor. In stage 2, we used a conceptual model (figure 1) following the modelling approach for multi-level regression described by Victora et al as follows: we
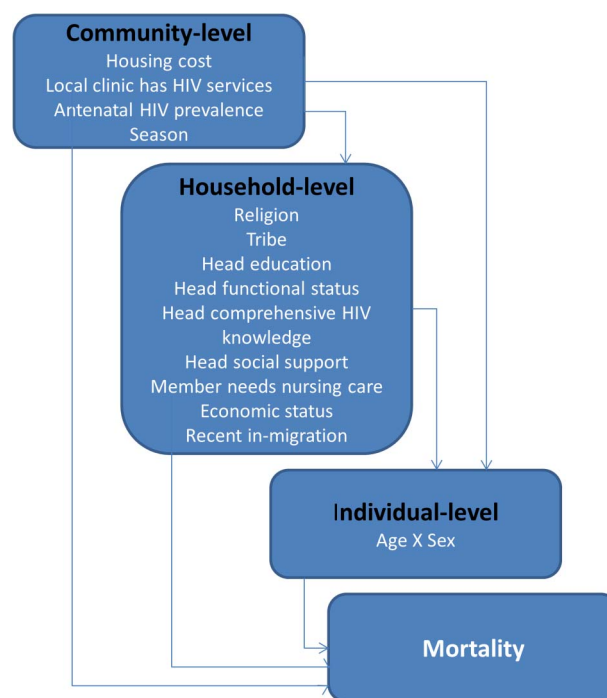

Figure 1 Conceptual framework for analysis of individual-level, household-level and community-level correlates of adult mortality.

entered all of the individual-level variables into a Poisson regression model, then all of the household-level variables, and finally all of the community-level variables. Between steps, we removed any variables with insufficient evidence of an association with mortality (p>0.1).[17] Regardless of their association, we planned a priori to retain sex-specific age group strata in the final regression model. The final model provides estimates of the association of community-level factors (excluding any mediating effects from the household-level and individual-level factors), household-level factors (excluding any potential confounding from community-level factors and excluding any mediating effects from individual-level factors), and individual-level factors (excluding any potential confounding from community-level and household-level factors) with mortality. For all Poisson models, we used mortality (0=alive, 1=died) as the dependent (Y) variable, and entered the household member's survival time in months as an offset. We adjusted all of the regression-derived figures reported here for the complex sampling design; we calculated SEs and the corresponding 95% CI using Taylor series linearisation.[18]

We defined key community-level, household-level and individual-level measures as follows. We used the Zambia Central Statistical Office reports to classify communities as being high, medium and low socioeconomic status areas.[19] We created categories for the open-ended responses to questions on religious and tribal identity. From the household head's description of his or her functional status, we created a binary measure of 'healthy' and 'sick/bedridden/other'. To create an economic status score for the household, we used the first factor of a principal components analysis which included binary measures of 16 household assets, and indicator measures of floor type, toilet type, cooking fuel, water source and size of residence. The normalised resulting Z-score for each household is an estimate of its economic position among all households in the study.[20] A household head who correctly answered a set of five questions about HIV was determined to have 'comprehensive knowledge of HIV', as per the definition used in the 2007 Zambia Demographic and Health Survey.[21] In order to split each household member's exposure in the last year between their current and previous ages, we randomly imputed exact dates of birth based on current age and date of interview. We also divided each adult's survival time during the past 12 months between three seasons (hot wet from December to March, cool dry from April to August and hot dry from September to November). We completed statistical analysis using Stata/IC V.13 (College Station, Texas, USA).

All survey respondents provided written informed consent.

RESULTS
Between November 2004 and August 2011, we completed 12 rounds of the household survey and collected data from 43 200 households overall. Of the 43 200 households, 2650 (6.1%) were replacement households because the head could not be contacted and 1088 (2.5%) were replacement households because the originally selected head declined to participate. At least one resident aged between 15 and 60 years was residing in 43 064 of these households. The household heads who provided data were mostly (88%) women, had a median age of 30 years (IQR 25–38), and had completed a median of 9 years of formal education (IQR 7–12). The household heads were primarily members of Protestant (36%), Pentecostal (27%) and Catholic (20%) religious denominations, and were mostly members of Bemba (38%), Nsenga (34%) and Tonga (20%) tribal groups.

In sum, the household heads enumerated 123 087 household members aged between 15 and 59 years. Collectively, these members had a median age of 27 years (IQR 21–35), and 54% were female. The household heads reported 1600 deaths and 122 954 person-years of survival time among household members. Slightly more than half (54%) of the household members who died were men, with a median age of death of 33 years (IQR 26–40). The most common reported causes of death for males were tuberculosis (25%), malaria (17%), HIV/AIDS (12%) and car accidents (8%). For women, the most common reported causes of death were tuberculosis (24%), HIV/AIDS (16%), malaria (16%) and diarrhoea (3%). Another 2.5% of deaths among women were attributed to complications of childbirth.

Figure 2 is a plot of age-specific death rates among men and women, compared to the rates expected in a reference population with under-five mortality rates similar to those observed in Lusaka District. These mortality schedules reveal that while the mortality of the oldest adults in Lusaka was generally elevated in comparison to the West Model, the death rates of younger adults were particularly higher than predicted.

The sex-specific, community-specific, and overall mortality rates, and $_{45}q_{15}$ are shown in table 1. The mean adult mortality rate across all survey rounds was 14.1/1000 person-years, which did not appear to vary over time (mortality rate ratio 0.98, 95% CI 0.95 to 1.01, p=0.20); the mortality trend over time did not appear to be modified by sex (P-interaction=0.728). The mortality rate was 16.2/1000 person-years for men and 12.3/1000 person-years for women. The conditional probability of dying between ages 15 and 60 ($_{45}q_{15}$) was 0.626 for men and 0.537 for women. On the community level, the lowest mortality rate was observed in Civic Centre (7.5 deaths/1000 person-years and $_{45}q_{15}$=0.371), and the highest mortality rate was observed in Kalingalinga (20.6 deaths/1000 person-years and $_{45}q_{15}$=0.753).

Results from regression modelling of individual-level, household-level, and community-level factors and mortality are shown in table 2. In the final multivariable model, we observed that, relative to residents of high-
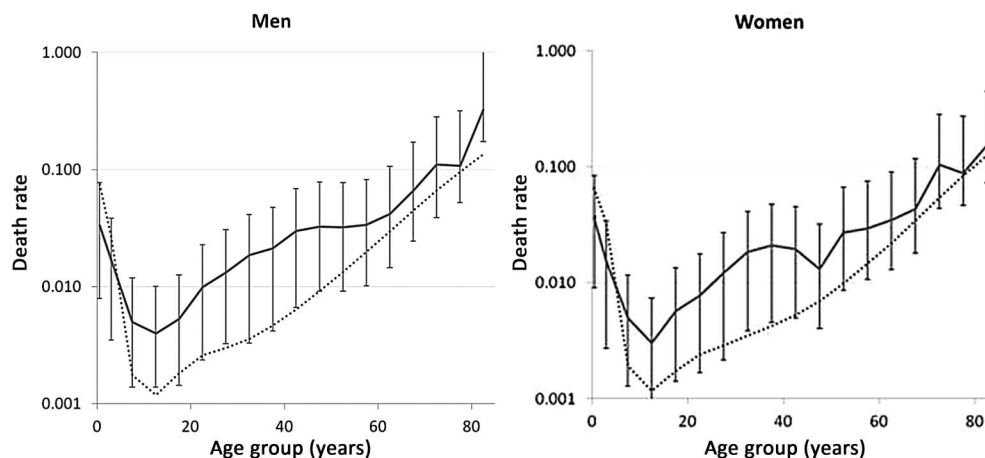
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Figure 2 Death rate by age for men and women in Lusaka District, Zambia, 2004–2011. The thick solid lines are the observed death rates, the vertical lines are the 95% confidence intervals for the observed death rates. The dotted lines represent the expected death rates according to the West series of model life tables.[16]

cost housing communities, the mortality rate was 11% higher in medium-cost housing communities and 28% higher in low-cost housing communities. Relative to the hot-dry season (September–November), the mortality rate was 35% higher in the hot-wet season (December–

March) and 44% higher in the cool-dry season (April–August). The mortality rate was 6% lower for every year increase in the household head's education and 19% higher when the household head did not have comprehensive knowledge of HIV. Also on the household level,

Table 1 Adult mortality rates and mortality probabilities in Lusaka District, Zambia, 2004–2011

Stratum (housing cost[19])	Mortality rate	95% CI	$_{45}q_{15}$	95% CI
Bauleni (LC)	13.4	10.4 to 17.3	0.552	0.430 to 0.681
Chainda (LC)	17.7	14.3 to 21.9	0.751	0.641 to 0.849
Chawama (LC)	14.6	11.4 to 18.6	0.676	0.540 to 0.806
Chazanga (LC)	15.0	11.3 to 19.9	0.640	0.508 to 0.770
Chipata (LC)	13.0	9.8 to 17.3	0.601	0.482 to 0.724
George (LC)	16.7	12.5 to 22.2	0.605	0.495 to 0.717
Kalingalinga (LC)	20.6	15.9 to 26.8	0.753	0.636 to 0.856
Kanyama (LC)	17.7	13.7 to 22.9	0.630	0.530 to 0.730
Kaunda Square (LC)	13.3	10.0 to 17.6	0.550	0.444 to 0.663
Lilayi (LC)	16.0	13.6 to 18.9	0.606	0.492 to 0.722
Mandevu (LC)	16.5	12.7 to 21.6	0.633	0.514 to 0.752
Matero Main (LC)	16.0	10.9 to 23.5	0.630	0.521 to 0.738
Matero Ref (LC)	14.0	11.6 to 16.8	0.517	0.415 to 0.627
Mtendere (LC)	10.8	8.0 to 14.5	0.532	0.401 to 0.675
Ngombe (LC)	11.8	8.7 to 16.0	0.425	0.320 to 0.548
Chainama (MC)	9.9	7.7 to 12.6	0.453	0.339 to 0.585
Chelstone (MC)	10.1	7.3 to 13.8	0.485	0.385 to 0.595
Chilenje (MC)	9.6	7.5 to 12.3	0.449	0.343 to 0.570
Kabwata (MC)	11.3	8.9 to 14.4	0.536	0.426 to 0.654
Kamwala (MC)	10.9	7.0 to 17.0	0.503	0.387 to 0.632
Civic Centre (HC)	7.5	5.3 to 10.6	0.407	0.294 to 0.545
Makeni (HC)	12.0	9.2 to 15.7	0.617	0.479 to 0.756
Railways (HC)	8.4	5.9 to 11.9	0.371	0.256 to 0.516
State lodge (HC)	9.1	5.0 to 16.4	0.493	0.364 to 0.638
All men	16.2	14.8 to 17.8	0.626	0.582 to 0.665
All women	12.3	11.2 to 13.5	0.537	0.474 to 0.593
Lusaka District	14.1	13.1 to 15.2	0.585	0.547 to 0.619

$_{45}q_{15}$=Probability of death for 15-year-olds before 60th birthday.
Mortality rate and 95% CIs are per 1000 person-years.
HC, high-cost housing; LC, low-cost housing; MC, medium-cost housing.

Table 2 Individual-level, household-level and community-level correlates of adult mortality in Lusaka District, Zambia, 2004–2011

Level Factor	Stage 1: univariable models		Stage 2: final multivariable model	
	MRR	95% CI	aMRR	95% CI
Community				
Housing cost				
Low	1.64	1.38 to 1.94	1.28	1.06 to 1.54
Medium	1.10	0.91 to 1.34	1.11	0.91 to 1.35
High	1.00		1.00	
Local clinic offers antiretroviral therapy				
No	1.00			
Yes	1.11	0.98 to 1.25		
HIV prevalence (%)	1.01	1.00 to 1.03	1.02	1.00 to 1.03
Season				
December–March (hot/wet)	1.36	1.15 to 1.61	1.35	1.14 to 1.60
April–August (cool/dry)	1.44	1.22 to 1.71	1.44	1.22 to 1.71
September–November (hot/dry)	1.00		1.00	
Household				
Religion				
None	1.45	0.78 to 2.68		
Pentecostal	1.00			
Protestant	1.20	1.02 to 1.43		
Catholic	1.13	0.94 to 1.36		
Other	1.00	0.85 to 1.31		
Tribe				
Bemba	1.00			
Tonga	1.12	0.94 to 1.33		
Nsenga	1.16	1.00 to 1.34		
None/other	1.01	0.77 to 1.32		
Head's education (years)	0.93	0.92 to 0.94	0.94	0.93 to 0.96
Head's functional status				
Healthy	1.00		1.00	
Sick/bedridden/other	1.36	1.24 to 1.49	1.19	1.07 to 1.32
Head's comprehensive knowledge of HIV				
No	1.33	1.17 to 1.52	1.19	1.04 to 1.36
Yes	1.00		1.00	
Head's social support				
Very satisfied	1.00		1.00	
Somewhat satisfied	1.05	0.91 to 1.23		
Somewhat dissatisfied	1.19	0.99 to 1.44		
Very dissatisfied	1.32	1.08 to 1.63		
Household member currently needs nursing care				
No	1.00		1.00	
Yes	2.32	1.86 to 2.91	1.98	1.57 to 2.51
Economic status (Z-score)	0.85	0.80 to 0.90		
Recent in-migration				
No	1.00			
Yes	0.78	0.62 to 0.98		
Individual				
Male age group (years)				
15–19	1.00		1.00	
20–24	1.88	1.22 to 2.88	1.91	1.24 to 2.93
25–29	2.50	1.68 to 3.72	2.60	1.74 to 3.88
30–34	3.52	2.40 to 5.16	3.70	2.52 to 5.43
35–39	3.99	2.70 to 5.89	4.16	2.82 to 6.15
40–44	5.66	3.77 to 8.51	5.99	3.98 to 9.01
45–49	6.18	3.95 to 9.69	6.25	3.99 to 9.80
50–54	6.11	3.84 to 9.74	5.99	3.76 to 9.56
55–59	6.43	3.91 to 10.57	5.98	3.63 to 9.86

Table 2 Continued

Level	Stage 1: univariable models		Stage 2: final multivariable model	
Factor	MRR	95% CI	aMRR	95% CI
Female age group (years)				
15–19	1.09	0.70 to 1.69	1.12	0.72 to 1.74
20–24	1.46	0.98 to 2.20	1.52	1.01 to 2.29
25–29	2.32	1.59 to 3.37	2.46	1.69 to 3.58
30–34	3.48	2.36 to 5.13	3.54	2.40 to 5.23
35–39	3.97	2.66 to 5.92	4.07	2.72 to 6.08
40–44	3.70	2.39 to 5.73	3.71	2.40 to 5.74
45–49	2.48	1.52 to 4.04	2.37	1.45 to 3.88
50–54	5.12	3.15 to 8.34	4.68	2.86 to 7.64
55–59	5.54	3.20 to 9.58	4.83	2.78 to 8.40

aMRR, adjusted mortality rate ratio; CI, confidence interval; MRR, mortality rate ratio.

the mortality rate was nearly two times higher among residents of households where a current member was in need of nursing care.

DISCUSSION

Over the study period, the conditional probabilities of mortality for men ($_{45}q_{15}$=0.626) and women ($_{45}q_{15}$=0.537) were higher than expected. In addition to the high mortality rates, there were substantial variations in mortality between sexes, communities and seasons. Household heads attributed diseases of infectious origin as the primary causes of death for the adults in their households. Given the absence of a vital registry system —and in a district where 37% of deaths occur at home[22]—these multiyear population-level data provide an important insight into adult health in Lusaka. This analysis builds on previous work on the population-level mortality trends in Lusaka District,[13] which found a modest but non-significant reduction in all-cause mortality between 2004 and 2011.

We did not detect a change in the mortality rates for men or for women in Lusaka District. Adult mortality trend data from other studies conducted between the 1990s and 2010s are inconsistent, with increasing trends for men and women reported by the Global Burden of Disease Study and decreasing trends reported by the Demographic and Health Surveys and the WHO.[1 2 23] Until a vital registration system is put into place, these contrasting figures justify closer monitoring of mortality in Zambia, such as with a demographic surveillance system or burial surveillance, both of which have been used successfully in sub-Saharan Africa.[24–27]

Despite the intensive scale-up of antiretroviral therapy (ART) in this area of high HIV prevalence, we observed unexpectedly high mortality among adults, and particularly among younger adults between 20 and 40 years of age. A cohort study of adults conducted before ART scale-up in a community in urban Zambia found that 74% of the premature mortality was attributable to HIV.[11] Yet, in spite of ART coverage increasing from 30% in 2005 to over 80% in 2008,[28] we observed a

'bump' in the West Model, which is consistent with the pattern observed in areas with high HIV prevalence prior to ART scale-up.[29] While ART coverage is high, there is evidence that ART retention in Lusaka is low,[30 31] which has been shown in mathematical models to attenuate the impact of an ART programme on population-level mortality.[32–34]

This observation makes it less likely that there was a decrease in HIV mortality which was offset by increases in other causes of death, resulting in the lack of evidence for any trend in mortality. The trend in population-level mortality remains uncertain in Zambia. These data from Lusaka indicate a need for further attention to the health of adults and the drivers of their mortality, with particular attention to the initiation and retention of patients in the ART programme.

We observed a substantial variation in mortality rates between communities. For example, the probability of a 15-year old dying before reaching age 60 was twice as high in Kalingalinga ($_{45}q_{15}$=0.753), a low-cost housing community, as in Civic Centre ($_{45}q_{15}$=0.371), a high-cost housing community. These findings are consistent with morbidity figures from the Zambia Living Conditions Surveys of 2010, in that 12.2% of the residents of urban low-cost housing communities reported injury or illness in the past 2 weeks, compared with 8.6% of the residents of high-cost housing communities.[12] Furthermore the $_{45}q_{15}$ in low-cost housing communities appears to be only modestly lower than an estimate of 0.778 made in similar communities in Lusaka in 1995.[10] Since the illness figures for both urban low-cost and high-cost housing areas in Zambia have increased from 2006,[12] meeting UN mortality reduction targets for Zambia— from 0.618 in 2000–2005 to 0.306 in 2010–2015[35]—may not be feasible. Meeting this goal will necessitate a particular focus on the low-cost housing areas, so that the morbidity and mortality gaps between different communities can be closed.

We note that the association between housing cost at the community level and mortality remained significant in the final multivariable model, an association which was independent of the community-level HIV

prevalence. In contrast, household-level socioeconomic status was dropped from the model even before inclusion of the community-level housing-cost variable. This suggests a community-level effect on mortality that is independent of a household-level effect. Many low-cost housing communities in Lusaka have inadequate access to improved drinking water and sanitation facilities, poor infrastructure, and elevated exposure to infectious agents,[36] all of which are deleterious to health. Since over a quarter of Zambia's population resides in urban low-cost housing areas,[19] substantial progress in reducing mortality and improving equity can be achieved through additional focus on the risk factors for mortality in low-cost housing communities.

We found that the top three causes of death for men and women were infectious diseases (ie, tuberculosis, HIV and malaria). Other studies provide supporting evidence that tuberculosis, HIV and malaria remain the primary threats to adult health in Zambia.[22 37] Since treatment services for all three infections are available at essentially no cost, other barriers to care—such as those relating to the known challenges with treatment initiation and retention[31 38] and stigma—must be explored.

In our analysis, the mortality rate was higher for residents of households where the head did not demonstrate comprehensive knowledge of HIV. This finding was independent of the positive association between household head educational attainment and mortality. These households may be characterised by lower levels of health literacy and household-level health promotion activity, and reduced contact with HIV sensitisation campaigns (which may itself be a proxy for healthcare access). It is worth re-emphasising that the household heads in this study were predominantly female and that there may be a different relationship between comprehensive knowledge of HIV and mortality for those living in male-headed households. The positive association between a member needing nursing care on the date of the interview and mortality may be a form of reverse causation, as the household member's death had to precede the data collection for the study's interview. When a household member dies, the health status of surviving household members is affected, either through direct means (eg, transmission of infection) or indirect means (eg, loss of income or a caregiver). The association between the low functional status of the household head and mortality is likely to be of a similar nature. These latter two findings support the idea of a household-level effect of illness. Future health programmes can explore how the entire household can be supported once any one individual has a negative health event.

There are important limitations to consider when interpreting these results. We were unable to capture information about households which disbanded after the death of a head, which is a potential source of bias for household-based samples.[39] This could in turn lead to an underestimation of the mortality rates, and an unquantifiable bias for the correlates of mortality. We could not verify the cause of death and, as a result, certain stigmatised causes of death (eg, HIV) or more medically complex causes (eg, ischaemic heart disease) may be under-reported, while others such as malaria may be over-reported. Finally, there may be important associations between specific risk factors and mortality that are modified by age or gender that we did not specifically investigate here.

Our inability to verify the cause of death also limits our ability to further explore the finding that mortality varies highly by season. We found that relative to the hot dry season (September–November), mortality was 35% higher in the hot wet seasons (December–March) and 44% higher in the cool dry seasons (April–August). This pattern is more consistent with a highly prevalent acute infectious disease such as malaria. Future research, using verbal autopsy methods, can consider whether individual causes of death vary within and across years.

In low-income countries such as Zambia, where a comprehensive vital registration system is not in place, repeated population-based surveys offer a means of assessing the overall health of and trends in the population. The results of such surveys allow for identification of the persons and geographic communities with a greater need for health services, and thus can lead to a more efficient allocation of scarce resources. In Lusaka District, we found evidence that the targeting of certain communities (eg, those with low-cost housing and/or lower penetration of HIV services) and intensifying health promotion activities during certain seasons could more efficiently reduce all-cause adult mortality. The mechanisms by which these factors are on a pathway to increased mortality risk, however, require further investigation.

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Data sharing statement No additional data are available.

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