Original article

Mortality Decreases among Young Adults in Southern Central Ethiopia

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Abstract

Background: Despite the anticipated high impact of HIV and AIDS among young people, AIDS related mortality is not well documented because of the lack of death registration systems in Ethiopia. The objective of this analysis was to investigate the trends in mortality among young adults (aged 10-24 years) in the era of the AIDS epidemic.

Methods: We analyzed data for young adults aged between 10-24 years using the Butajira Rural Health Programme (BRHP) open cohort database. The study covers 1 urban and 9 rural communities, which were initially randomly selected from the Butajira district. The BHRP database covers the period 1987-2004, recording vital events and migration at the household level after an initial baseline census in 1987, using village-based data collectors. The data included 34,150 young people who contributed a total of 248,154 person years.

Results: In the 18-year follow-up period, 1,030 young adults died, giving an age-specific crude mortality rate of 4.2 per 1,000 person-years. The trends of mortality in this population declined from 6 per 1,000 person-years in 1987-1989 to less than 2 per 1,000 person-years in 2002-2004. Deaths due to HIV were recorded at a rate of only 0.02 per 1,000 person-years, according to causes of death reported by family care givers. A multivariate regression model showed that young adults from the rural highlands and lowlands had a higher risk of death (adjusted rate ratios 1.99 [1.40-2.83] and 2.58 [1.82-3.66] respectively) than young urban adults, even after adjusting for water source, literacy and housing type. The earlier cohorts (1987-1989 and 1990-1994) had higher risks of mortality than the latest cohort (1999-2004) - (adjusted rate ratios 1.91 [1.59-2.29] and 2.03 [1.75-2.35] respectively).

Conclusion: A remarkable decline in mortality was observed in this population with little sign of excessive HIV/AIDS-related mortality appearing during this 18-year period. However, the occurrence of AIDS-related deaths in the latter part of the study period suggests appropriate interventions to counter the developing HIV epidemic are justified. [*Ethiop.J.Health Dev.* 2008;22;(3):218-225]

Background

Mortality data are scarce in developing countries mainly because of the lack of death registration systems (1). Population censuses complemented by sample surveys have been the major methods of tracking population dynamics in sub-Saharan Africa (2). The need for reliable data has become more important in the era of the HIV and AIDS epidemic, for which priority setting requires precise data on mortality (3).

The natural history of HIV infection and AIDS-related mortality has been studied in a variety of African settings (4-7) with mortality rates depending on infection rates and the availability of antiretroviral therapy, which, if delivered successfully, prolongs the period between infection and death.

In Ethiopia, young people are most affected by the HIV pandemic. A study conducted in Butajira showed a prevalence of 5.4% among antenatal attendees aged 15-19 years (8). According to the 2005 AIDS report for Ethiopia, the prevalence of HIV among antenatal attendees aged 15-24 was 5.6% (9). The prevalence of HIV infection has recently been adjusted, however, mainly because of better population-based surveys. The 2005 Ethiopian Demographic and Health Survey (DHS) report showed the prevalence among young adults aged 15-24 to be 0.7% - 2.1% in urban areas and 0.4 % in rural areas (10). This later population-based survey suggests that earlier estimates based on antenatal surveys were too high, mainly because the antenatal surveillance sites were not representative of the general population. Reported AIDS-related mortality is low, however, because most deaths occur at home in Ethiopia, as in other developing countries, without certification as to cause.

In 2006, an Ethiopian Ministry of Health AIDS report estimated that AIDS accounts for 34% of all the deaths of young people aged 15-49 years (9). A community-based verbal autopsy conducted at the BRHP in 2000 attributed 8.5% of all deaths in the highlands, 4.8% in the lowlands and 11.3% of all deaths in the urban areas to AIDS (11). A cemetery-based study conducted in Addis Ababa indicated an increase in the mortality rate for women aged 20-24 years from 2.1/1000 in 1984 to 3.3/1000 in 2001(12).

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Population-based information is the most reliable method of estimating mortality in the absence of civil registration, if the information is collected prospectively and continuously (13). The Butajira rural health programme (BRHP) is one of the population-based demographic and health surveillance sites (DSS) in Ethiopia which as followed an open cohort since 1987 (14, 15).

The objective of this analysis was to investigate levels and trends of mortality among young adults aged 10-24 in the era of the AIDS epidemic.

Methods

Study area: This study was conducted in Butajira, Meskan and Mareko district, situated 130 km south of Addis Ababa. The area has a diversified topography, with the study population living in three geographical areas: rural lowlands (areas less than 2000 meters above sea level), rural highlands (areas 2000 meters or more above sea level) and urban. The urban town Butajira is situated in the highlands.

A new asphalted road between Butajira and Addis Ababa has facilitated business and communications. Starting in 2002, a public hospital staffed by general practitioners, a gynaecologist and a surgeon provides services to the district (16). In addition, private and NGO health institutions, including one hospital, serve the population (17).

***Study design*:** The study design is a prospective open cohort using the Butajira Rural Health Programme (BRHP) database.

Nature of the Butajira cohort: The BRHP was launched after a random selection of 9 of 82 rural peasant associations (PAs-the smallest administrative unit in rural Ethiopia) and one of four urban kebeles (the smallest administrative unit in urban Ethiopia) in the district. At the beginning of the programme in April 1986, a census with mapping and numbering of all houses was done. The baseline population in selected kebeles in January 1, 1987 was 28,614 people with a male to female ratio of 94/100. Half of the population was under 15 years of age, while 45% were aged 15-59 years (14, 18). The database was updated by regular registration of vital and migratory events such as births, deaths, marital status, new households, emigration and immigration to the study site, and moves within the study area. The surveillance system works as an open cohort - people may enter and leave the area at any time. This movement is tracked by the surveillance system, which makes the calculation of individual person-time possible (14).

The data were initially collected monthly, and have been collected quarterly since 1999. Trained high school graduates living in the villages collect the information. Having village-based data collectors makes identifying and reporting of events easier. The data collected by the village enumerators is routinely checked by supervisors and researchers. The death registration form used for this study includes questions about 20 possible causes of deaths including communicable and non-communicable diseases as reported by care givers and family members (14). Diseases which are not mentioned in this form are mentioned as other causes.

During the early 1990s, the BRHP demographic surveillance site (DSS) faced several difficulties concerning continuous data collection and quality control, because of war and a change in government. In addition the untimely death of the project leader in 1992 created a gap in the data quality control. To address this problem a new census was done in 1995. Comparison of the database compiled from the regular surveillance and the re-census showed some inconsistencies that were corrected (19). In 1999, the census was repeated for quality control purposes. Unfortunately, some missed data for those who died could not be collected during the repeat census. Therefore, we lack information on marital status for 628 of the deaths, religion for 137 of the deaths, land size for 144 of the deaths and number of oxen for 192 of the deaths.

Study participants: In the 18-year follow-up period from January 1st 1987 to December 31st 2004, 97,452 individuals contributed 715,743 person-years. Among these, 34,150 young adults aged 10-24 years contributed 248,154 person years. In this study, all persons aged 10-24 years who were in the BRHP cohort at any time between 1st January 1987 and 31st December 2004 were included.

Data management and analysis: Data were stored in a specially developed dBase IV application. We used the Cohort programme (Umeå University, Sweden) to calculate mortality rates from person time to assess trends, causes of mortality and compare mortality between male and female (20). We used Poisson regression (Stata 10) to analyse risk factors for death (21). Factors in the regression model included period, source of water, literacy, type of house, sex, residential area and age. Similar risk factors were used in other studies in the study area (15). Interaction was tested and no important interaction term was found.

Ethical clearance: Ethical clearance was obtained from the National Ethical Review Committee in Ethiopia, and by the Universities of Addis Ababa and Bergen.

Results

During the 18-year study period from 1987 to 2004, 1,030 young adults aged 10-24 died, giving a crude mortality rate of 4.2 per 1,000 person–years (PY). Males comprised 52% of all young adults who died during the

observation period. Young adults living in the lowlands had higher mortality rates (5.5 per 1000 PY) than those living in the rural highlands (4.2 per 1,000 PY) and in urban areas (1.82 per 1,000 PY). Young men had a higher mortality rate (4.4 per 1,000 PY) than young women (3.9 per 1,000 PY). Mortality in this population has decreased from 5.9 per 1,000 PY at the beginning of the study (1987) to 2.7 per 1,000 at the end of the study (2004) (Table 1).

Table 1: **Mortality rates of young adults aged 10-24 by demographic factors, Butajira, Ethiopia (1987-2004) (248,154 person-years observed)**

Variable	Number of deaths	Percent	Person years	Incidence/1000
Sex				
Female	496	48.15	126,673	3.9
Male	534	51.85	121,481	4.4
Age				
10-14	419	40.39	98,686	4.3
15-19	344	33.20	85,202	4.0
20-24	267	26.41	64,266	4.2
Residence				
Urban	97	9.42	53,246	1.8
Rural high land	457	46.21	107,954	4.2
Lowland	476	44.37	86,954	5.5
Marital status				
Never married	326	31.65	107,980	3.0
Married	56	5.44	24,301	2.3
Single/(DWS)*	20	1.94	2,092	9.6
Unknown	628	60.97	113,781	5.5
Religion				
Orthodox Christian	181	17.57	51,114	3.5
Muslim	695	67.47	179,921	3.9
Other Christians	17	1.65	5,253	3.2
Unknown	137	13.31	11,866	11.5
Literacy				
Literate	789	76.6	192,168	4.1
Illiterate	241	23.4	55,986	4.3
Period				
1987-1989	168	16.31	28,512	5.9
1990-1994	358	34.76	57,901	6.2
1995-1998	216	20.97	53,616	4.0
1999-2004	288	27.96	108,125	2.7

* DWS = divorced, widowed or separated

Comparison by gender and area showed that the risk of dying was higher among rural lowland and highland men and women than urban residents (Figure 1). The sex differential in mortality was most pronounced in the rural lowlands, particularly in the earlier periods. During the 18 years of follow up, the overall mortality rate declined from 6 per 1,000 PY to less than 2 per 1000 PY.

The leading perceived causes of death were malaria (0.85 per 1,000 PY), diarrhoea (0.5 per 1,000 PY) and tuberculosis (0.36 per 1,000 PY). Other causes account ed for 1.25 deaths per 1,000 PY and unknown causes for 0.39 deaths per 1,000 PY, as reported by family care givers. The risk of dying from HIV was only 0.02 per 1,000 PY (Table 2).

Although mortality from malaria and diarrhoea showed periodic variation, their importance as causes of death declined (Figure 2). All reported HIV/AIDS-related deaths occurred during the later periods.

A Poisson regression model, taking into account sex, age, literacy, source of water, type of house and period, showed that young adults living in the rural lowlands and highlands had higher risks of death (adjusted rate ratios [with 95% confidence intervals] 2.58 [1.82-3.66] and 1.99 [1.40-2.83]) than urban young adults. Mortality rates were significantly higher in the earliest cohort (1987-1989 and 1990-1994) than the 1999-2004 cohort (adjusted rate ratios 1.91 [1.59-2.29] and 2.03 [1.75-2.35]). Males died at a slightly higher rate than females (adjusted rate ratio 1.13 [0.99-1.27]) but the difference was not significant. Age group and literacy were not appreciably associated with mortality rates, while source of water and type of house (large circular, small circular and non-circular) showed complex relationships with residential area (Table 3).

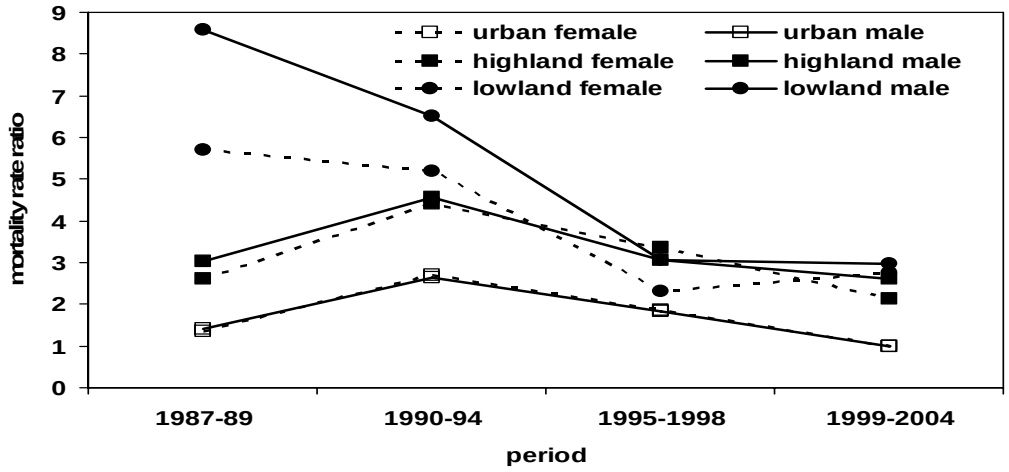

Figure 1: **Gender differentials of mortality among young people aged 10-24 years, adjusted for age group, literacy, source of water and housing type, with urban female deaths in 1999-2004 as the reference group, in Butajira, Ethiopia 1987-2004**

Table 2: **Causes of mortality, as reported by family members, among young adults aged 10-24 years in Butajira from 1987-2004**

Disease	Number of deaths	Person years	Incidence/1000
Malaria	213	248,154	0.85
TB	90	248,154	0.36
Meningitis	38	248,154	0.15
Pneumonia	48	248,154	0.19
Diarrhoea	125	248,154	0.50
Heart disease	25	248,154	0.10
Other causes	311	248,154	1.25
Pregnancy related	12	126,673	0.10
Maternal death	5	126,673	0.04
HIV	4	248,154	0.02
Accident	24	248,154	0.10
Unknown	97	248,154	0.39

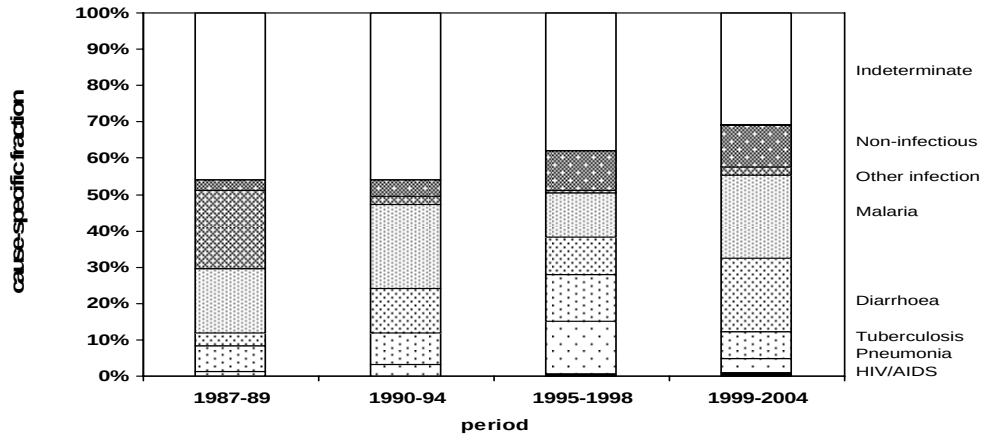

Figure 2: Trends **in cause-specific fractions of mortality as reported by family members among young adults aged 10-24 years, in Butajira, Ethiopia**

Table 3: **Poisson regression showing mortality rate ratios adjusted for background factors among young adults aged 10-24 in Butajira for the period 1987-2004.**

Factors/ Variables	Deaths	Person years	Unadjusted rate ratio (95% CI)	Adjusted rate ratio (95% CI)
Sex				
Male	534	121,481	1.12 (0.99-1.27)	1.13(0.99-1.27)
Female	496	126,673	1.00	1.00
Age group				
10-14	416	98,686	1.06 (0.91-1.23)	0.99 (0.85-1.15
15-19	342	85,202	0.99 (0.85-1.16)	0.94(0.80-1.10)
20-24	267	64,266	1.00	1.00
Residential area				
Highlands	457	107,954	**2.32 (1.86-2.89)**	**1.99 (1.40-2.83)**
Lowlands	476	86,954	**3.00 (2.11-3.31)**	**2.58 (1.82-3.66)**
Urban	97	53,246	1.00	1.00
Literacy				
Illiterate	241	55986	1.05 (0.91-1.21)	1.03 (0.89-1.18)
Literate	789	192168	1.00	1.00
Source of water				
Other sources	948	201,915	**2.64 (2.11-3.31)**	**1.51 (1.07-2.14)**
Piped	82	46,239	1.00	1.00
Type of house				
circular 4-7m radius	446	91,298	**1.44 (1.24-1.68)**	**0.80 (0.68-0.96)**
circular <3m radius	323	79,385	**1.21 (1.03-1.42)**	**0.69 (0.57-0.82)**
non-circular	261	77,471	1.00	1.00
Period				
1987-1989	168	28,512	**2.03 (1.69-2.44)**	**1.91 (1.59-2.29)**
1990-1994	358	57,901	**2.10 (1.82-2.44)**	**2.03 (1.75-2.35)**
1995-1998	216	53616	**1.25 (1.03-1.51**	1.21 (1.00-1.47)
1999-2004	288	108,125	1.00	1.00

Discussion

Our data suggest a decline in mortality of young adults in rural Butajira during the period under consideration (1987-2004). High mortality was associated with living in the rural areas, particularly in the lowlands, those who used un-piped water source and the earliest cohorts.

Exclusion of some important background factors like marital status in the regression model because of missed data represents a limitation of this study. Lack of validated causes of death is another limitation. The decline in mortality rates in this population was particularly marked in the later periods, and in a database of this kind, accumulated over many years, it is difficult to get a dataset without limitation. For example, this latter steep decline could be explained by weaker data supervision, preceding the first re-census in 1995 (19); however any missed deaths have always been incorporated into the database retrospectively when discovered. Fottrell showed that the effect of random errors in these DSS data had little effect on mortality analyses (22). It was also clear that there were heavily confounded relationships between area of residence and water supply and type of house. However, the multivariate regression model used suggests that there was a persisting effect of rural residence even after adjusting for these confounders.

The crude mortality rate among young people aged 10-24 in the study area (4.2 per 1,000 PY) is in agreement with mortality estimates of 2-5 per 1,000 PY for the HIV-uninfected population of the same age group in developing countries (7). During the early part of the study period (1987-1989), the crude mortality rate was higher (5.9 per 1,000 PY) and declined to 2.7 per 1,000 PY for the years 1999-2004. The mortality rate for people with AIDS in this age group, based on the estimation for developing countries by Porter et al., was between 25 per 1,000 and 45 per 1,000 for those in their teens and 70-120 per 1,000 for those in their twenties (7). Comparing our results with these estimates, the overall mortality incidence in our study population is probably below the levels at which one might suspect elevated AIDS-related mortality.

The latest DHS report of Ethiopia showed, for SNNPR, a low prevalence of HIV (0.2%) among the general rural population (23) and a prevalence of 0.4 among rural youth 15-24 years of age (10). This low prevalence suggests that AIDS-related mortality in our study group should also be low, despite less than universal access to treatment.

A behavioural analysis found that youth in the study area were not likely to engage in premarital sex - most initiate sex within marriage (24). The same study also indicated that married women were vulnerable to HIV because of the promiscuity of their husbands (24), as has been shown by other studies (25, 26). Our study, however, found slightly lower mortality for women than men, which is also consistent with relatively low levels of AIDS mortality in the area.

In 2000, an HIV sero-prevalence study conducted in the same area among antenatal attendees aged 15-19 and 20-24 showed a prevalence of 5.4% and 2.7% respectively (8). A recent study conducted in the same area using verbal autopsy among adults aged 20 years and above attributed 11% of death in urban areas and 3.7% of the deaths in rural areas due to AIDS (27). Few cases of AIDS mortality, however, were reported even by the end of the study period by family care givers in our study. Lack of reporting of AIDS as a cause of death by care givers could be attributed to lack of knowledge about the disease or a lack of willingness to report it. Family members are likely to report opportunistic infections like TB or diarrhoea rather than AIDS as the cause of death. Studies from other African countries have shown findings consistent with this possibility (28). Limited reporting of AIDS as a cause of death could also be related to the stigma associated with the disease.

The lowland residents encountered the highest mortality rates, and malaria was the most common of the family-reported causes of deaths in our study. In the lowlands of Ethiopia, malaria is characterised by erratic epidemics, and its burden on the health of the population is immense (29). A verbal autopsy conducted among adults aged 20 years and above in the area showed that malaria caused 13% of deaths (30). In our study, the peaks in malaria deaths occurring in 1990 and 1999 reflected malaria epidemics during those years (31), while the spike in diarrhoea deaths in 1999 could be explained by the 1999 food insecurity in the area.

Malaria is preventable through public health efforts and through curative care at the community level (32). The hospital records from the last five years (2002-2006) suggest that malaria was the main cause of hospital admissions (16). The recent decline in mortality of this population could be related to the improved health services in the area. A study that analyzed the BRHP data for the general population indicated that survival was associated to improved socio-economic conditions and the effect of health services in the area (15).

Conclusion

The declining trend in mortality in the 10-24 years age group is consistent with low AIDS-related mortality in this population. However, since the few AIDS-related deaths that were recorded occurred in the later periods of this study, there is a clear need for HIV-related health interventions within this population. Timely interventions among the youth could curtail to curve the spread of HIV among the general population.

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