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The economic consequences of AIDS mortality in South Africa

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ABSTRACT

We quantify the impact of adult deaths on household economic wellbeing, using a large longitudinal dataset spanning more than a decade. Verbal autopsies allow us to distinguish AIDS mortality from that due to other causes. The timing of the lower socioeconomic status observed for households with AIDS deaths suggests that the socioeconomic gradient in AIDS mortality is being driven primarily by poor households being at higher risk for AIDS, rather than AIDS impoverishing the households. Following a death, households that experienced an AIDS death are observed being poorer still. However, the additional socioeconomic loss following an AIDS death is very similar to the loss observed from sudden death. Funeral expenses can explain some of the impoverishing effects of death in the household. In contrast, the loss of an employed member cannot. To date, antiretroviral therapy has not changed the socioeconomic status gradient observed in AIDS deaths.

1. Introduction

The AIDS epidemic has increased the economic vulnerability of households in many parts of sub-Saharan Africa. AIDS deaths are often preceded by a period of illness, in which household members provide care to those who have fallen ill, and contribute toward their medical expenses (McIntyre et al., 2005). AIDS illness and death also often reduce household income, through the loss of a prime aged worker or through changes in work patterns for prime aged caregivers. In addition, in many parts of Africa, even poor households are expected to host elaborate funerals, adding to the financial burden the household shoulders (Case and Menendez, 2011; Case et al., 2013; Collins and Leibbrandt, 2007).

The economic consequences of AIDS related mortality may differ from those of adult death from other causes for a number of reasons. First, households in which AIDS deaths occur may be systematically different from other households in ways which could affect households' ability to cope with an adult death. Individuals who die from AIDS may also be positively or negatively selected relative to individuals who die from other causes. In addition to these selection issues, there are several other issues related to AIDS deaths that may lead to a differential impact on the household. In contrast with sudden deaths, AIDS deaths are preceded by illness, which on the one hand may deplete household resources but on the other may allow planning to face funeral expenses. HIV is commonly transmitted between spouses and therefore multiple deaths could be more common in households that suffer an AIDS death. If stigma associated with AIDS is present, the household could be less likely to receive financial help from extended family or the community and suffer more after the death. On the other hand stigma could result in smaller funerals reducing the financial burden on households.

Quantifying households' economic vulnerability following an adult death in general, and an AIDS death in particular, serves many purposes. Policy makers need to know, for example, how death affects household functioning. NGOs and other groups who provide services to households where members are HIV positive, and those that have experienced an AIDS death, would benefit from a better understanding of the ways in which such households are vulnerable.

To date, quantification of the impact of an AIDS death on household economic wellbeing has been limited by the quality and quantity of data available. Beegle and De Weerdt (2008) highlight the challenges researchers face. Very few data sets can distinguish AIDS morbidity and mortality from that due to other causes. Households with members who die from AIDS may be systematically different from other households, limiting the usefulness of comparisons between such households. In addition, spillover effects from households in which deaths occur to other households may lead to underestimates of the impact of AIDS deaths, if comparisons are made between households in the same community. While more longitudinal data are becoming available,

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very few datasets cover a long enough period of time to look outside of a narrow window before and after a death occurs.[1]

In this paper, we quantify the economic impact of adult deaths from AIDS, and from other causes, using data that overcome many of these concerns. The Africa Centre for Health and Population Studies began collecting data in January 2000 on the lives of approximately 87,000 people in 11,000 households in Northern KwaZulu-Natal, South Africa. Data are collected twice annually on births, deaths, marriages, residency status and household membership status for each individual under surveillance in the demographic surveillance area (DSA). Verbal autopsies, described in the next section, are performed for every death, allowing us to distinguish AIDS deaths from deaths due to other chronic illnesses and sudden health related or accidental deaths. That these households have been followed since 2000 gives us a wider window to assess the impact of illness and death. In addition, eight rounds of a socioeconomic survey provide markers for household socioeconomic status over the entire period, allowing us to examine outcomes in households in which deaths occur and to compare them both to other households in the DSA, and to their own economic status prior to a death.

We find that households in which members die of AIDS are systematically poorer than other households, measured using household asset indices and self-assessed poverty. However, these households were poorer long before members fell ill with AIDS. The timing of the lower SES observed for these households and their AIDS deaths suggests that the socioeconomic gradient in AIDS mortality is being driven primarily by poor households being at higher risk for AIDS, rather than AIDS impoverishing the households in the survey area. Following a death, households that experienced an AIDS death are observed being poorer still. However, the additional socioeconomic loss following an AIDS death is very similar to the loss observed from sudden death. We investigate possible mechanisms by which death in general leads to relatively lower asset holdings and higher self-assessed reports of poverty for the household, and find that funeral expenses born by the deceased's household can explain some of the impoverishing effects of death in the household. In contrast, the loss of an employed member cannot. We find no evidence that poverty following an adult death is due to the loss of an employed household member and his or her earnings. The scale-up of antiretroviral therapy (ART), late in our study period, has begun to change the age profile of mortality in the DSA, lowering the mortality rate of infants and young children, and that of adults aged 20 to 40. However, we find that adults who die of AIDS in 2008 and 2009—after the scale-up—continue to be drawn systematically from poorer households. To date, ART has not changed the socioeconomic status gradient observed in AIDS deaths.

We begin by introducing the Africa Centre data we use in our analysis, before turning to examine the socioeconomic correlates and consequences of death in the DSA.

2. The Africa Centre for health and population studies

The Africa Centre maintains a database on all individuals who live in, or who are reported to be members of, households that reside in the DSA. A knowledgeable household member reports on current members, whether or not they are resident in a homestead in the DSA at the time of the household interview.[2]

[1] There are a handful of longitudinal studies that examine the impact of adult mortality on household wellbeing in Tanzania (Adhvaryu and Beegle, 2012, Beegle et al., 2008), South Africa (Carter et al., 2007) and Zambia (Chapoto and Jayne 2008, Mahmoud and Thiele, 2013). Only two of these analyses use panels long enough to identify medium and long run effects. None of these can distinguish AIDS deaths from other deaths. Tekola et al. (2008) can distinguish between AIDS deaths and deaths from other causes but their data are from a single cross section collected a few months after the death.

[2] Approximately 30% of members are non-resident at any point in time, with a large fraction of those away having migrated for employment.

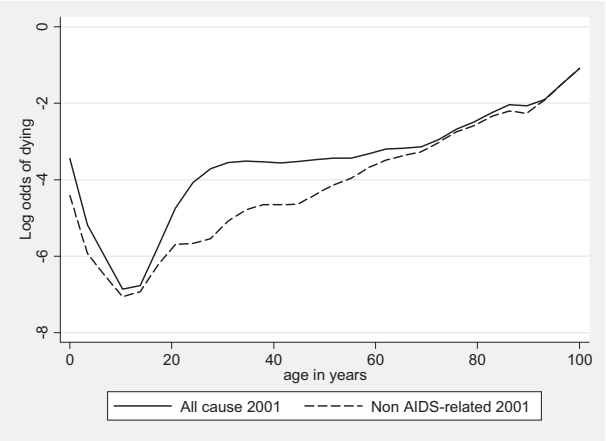

Fig. 1. Log odds of dying by age — all cause and non AIDS-related mortality.

2.1. Verbal autopsies

Upon learning of the death of a household member, a verbal autopsy nurse is sent to interview the deceased's primary caregiver.[3] Symptoms and healthcare seeking behaviors of the deceased are recorded, and sent to two clinicians, who independently assess the information and, where possible, assign a cause of death. Using medical records from local hospitals, the Africa Centre's verbal autopsy data have been validated, and shown to have high sensitivity, specificity, and predictive value for both AIDS and non-AIDS causes of deaths (Hosegood et al., 2004a). Having access to the verbal autopsy data allows us to make distinctions between deaths by cause, which is unusual, and allows us to sidestep concerns about which adults in the field site choose to be tested for HIV.

2.2. Socioeconomic data

Over the period from 2000 to 2011, eight household socioeconomic surveys (HSE) were conducted for all households in the DSA. These occurred in 2001, 2003/04, 2005, 2006, 2007, and annually between 2009 and 2011. In all HSE rounds, information was collected on household ownership of specific assets and members' education. In each round after the 2001 HSE round, information was also collected on households' own assessments of their financial position. We use this information to look at consequences of adult deaths, with a special focus on AIDS deaths.

3. Death in the demographic surveillance area

The impact of the AIDS crisis on the age-mortality profile in the DSA can be seen in Fig. 1, which plots for the year 2001 the log-odds of death from all causes and the log-odds of death from all non-AIDS related causes for all individuals who were being followed by the Africa Centre demographic surveillance system on January 1, 2001. Here the log-odds of death are graphed against the individuals' ages as of January 1st. As is observed in populations globally, the log-odds of non-AIDS related mortality rises approximately linearly with age beyond adolescence (Elo and Preston, 1996, p. 51). The additional deaths in early and middle adulthood attributable to HIV can be seen in the deviation of all-cause mortality from non-AIDS related mortality, which is evident from ages 20 to 60.

In what follows, we analyze the impact of deaths that occurred between 2000 and 2009.[4] Antiretroviral therapy roll-out in this part of KwaZulu-Natal increased markedly in 2008 (Houlihan et al., 2011), which has the potential of changing the age profile and the mean

[3] In order to respect households in mourning, the verbal autopsy visit occurs with a lag of at least 6 months. For details on the protocol, visit http://www.africacentre.ac.za.

[4] Verbal autopsy diagnoses are not currently complete for 2010 or beyond.

Table 1
Deaths by cause in the Africa Centre demographic surveillance area 2000–2009[a].

	Age categories					
	0–5	6–9	10–19	20–29	30–39	40+
Cause of death:						
AIDS	0.365	0.346	0.313	0.585	0.660	0.312
	(0.012)	(0.038)	(0.022)	(0.010)	(0.009)	(0.006)
Sudden death	0.500	0.428	0.508	0.327	0.241	0.340
	(0.012)	(0.039)	(0.024)	(0.010)	(0.008)	(0.006)
Chronic illness	0.074	0.138	0.109	0.037	0.035	0.266
	(0.006)	(0.027)	(0.015)	(0.004)	(0.003)	(0.006)
Unknown cause	0.062	0.088	0.070	0.051	0.064	0.082
	(0.006)	(0.023)	(0.012)	(0.005)	(0.004)	(0.004)
Observations	1739	159	431	2299	3031	5896

[a] Each cell reports the fraction of deaths attributable to a particular cause, for a given age range. Standard errors are given in parentheses.

economic status of individuals who die of AIDS-related illnesses. In the discussion section, we return to examine how the arrival of ART may have changed the economic correlates and consequences of AIDS deaths.

Table 1 presents the number of deaths in the field site, by age category, from January 1, 2000 to December 31, 2009, and the fraction of these deaths by cause for each of six age categories. We have divided deaths into AIDS deaths, deaths from non-AIDS related chronic conditions, and sudden deaths, which are due to accidents (largely homicides and motor-vehicle related deaths) and to the onset of acute health conditions (heart attack and stroke, for example).[5] In this period, children largely died of diarrhea and gastroenteritis, respiratory infections, and AIDS. Almost two-thirds of all adults who died between the ages of 20 and 40 were diagnosed as having died of AIDS.[6] The fraction of adults who died of other chronic illnesses increases from 4% of deaths among adults aged 20 to 39, to 27% of deaths of adults aged 40 or older.

The impact of deaths on the remaining household members may vary by cause, in part because individuals who die suddenly — say, from an accident or a heart attack — generally will not have been in need of care prior to death. In contrast, when household members die of AIDS, or a chronic condition, there may be a period of time prior to death when resources are depleted to pay for care or to provide for those who have fallen ill. In the absence of antiretroviral therapy, survival time for individuals, once they have AIDS, can generally be measured in months (Morgan et al., 2000, 2002).[7] In addition, the characteristics of people who die of a given condition — AIDS, for example — will differ from those of people who die from other causes — say, chronic illness.

Our focus will be on the impact of death on the households' socioeconomic status. We present information on the households under surveillance in Table 2. Approximately 10% of all households report that an adult member died within 12 months prior to an HSE survey, with almost half of the deaths due to AIDS. Households are large, with 8 members on average, of whom just over 5 are resident at any given HSE round. Our measures of economic status will be an asset index constructed using principal component analysis[8] and household survey responses that they are "poor" or "very poor." Our robustness checks show very similar results if instead of the asset index we use the simple sum of assets owned,[9] or if we only use expensive items in our asset sum. On average, a unit increase in the asset index corresponds to an increase of 1.5 assets. Households in the bottom quartile of the asset index own on average 2.4 assets in contrast to those in the top quartile who own 10.4 assets.

We analyze data from 17,814 unique households that may have been observed in up to 8 HSE rounds, for a total of 85,629 household-level observations.

3.1. Sample attrition

Given our reliance on household-level information collected in HSE modules following deaths, we examine the extent to which death causes households to attrite from surveillance — either because the household dissolves, or because it moves outside of the demographic surveillance area and is lost to follow-up. Table A1 presents evidence on this for all households who are present in at least one HSE round between HSE 1 (2001) and HSE 5 (2007).[10] Households present at more than one HSE round in this period will appear multiple times in this sample. We test whether those households who remain under surveillance until the next HSE round, and those who leave surveillance for any reason, are significantly different with respect to household characteristics, including whether a death had occurred in the household in the 12 months prior to the HSE module in which they are observed.

Among households lost to follow-up, 9.4% experienced the death of an adult member from any cause in the year before their households were visited for the HSE round. This is true for 9.9% of households not lost to follow-up. That this difference is not statistically significant can

[5] Verbal autopsies return ICD 10 codes for cause of death. We use these, with a cross walk to ICD 9 codes, and the Chronic Condition Indicator to assign death from a chronic condition. A chronic condition, by definition, is one that lasts longer than a year, and either limits self-care, social interactions or independent living, or requires on-going medical care. See http://www.hcup-us.ahrq.gov/toolssoftware/chronic/chronic.jsp for details. In the remainder of our paper, "chronic conditions" will refer to non-AIDS related chronic conditions.

[6] The last HIV Prevalence, Incidence and Behavior National Survey collected in 2012 indicates that KwaZulu-Natal, where the DSA is located, is the South African province with the highest HIV prevalence, 16.9%. Among the adult population between 25 and 49 years of age, the prevalence is much higher reaching 27.9% (Shisana et al., 2014).

[7] The progression from HIV infection to AIDS takes on average 10 years for people who are not on antiretroviral therapy (ART) but can take decades or never progress to AIDS when taking ART. During this phase of the infection, there are either no HIV symptoms or symptoms are not severe. The short survival time after conversion from HIV to AIDS, in the absence of ART, is similar to the survival time reported in the early stages of the epidemic in developed countries, although it is much shorter than survival in these countries now—three years on average. (http://aids.gov/hiv-aids-basics/just-diagnosed-with-hiv-aids/hiv-in-your-body/stages-of-hiv/) Different factors, such as age, nutrition, genetics, and health care, can affect the duration of the infection stages. Survival time from HIV infection to death may vary between populations, depending on the predominant viral strains in each setting (Lutalo et al., 2007).

[8] We do not have longitudinal data on money metric measures of household economic wellbeing such as per capita income or consumption. While the dynamics of household asset holdings do not fully capture changes in the household financial wellbeing, they are an indication of changes in a household's economic status, and in its ability to cope with shocks. During periods when, on average, households are accumulating assets, a slower rate of accumulation relative to other households identifies those with less financial stability. We follow Filmer and Pritchett (2001) and use principal component analysis to compute weights for an asset index which serves as a proxy of economic status or wealth.

[9] The assets included are ownership of a bicycle, block maker, car, cattle or other livestock, electric stove with oven, electric hot plate, electric kettle, refrigerator or freezer, table and chairs or sofa, gas cooker, kombi/lorry/tractor, radio/stereo, sewing machine, telephone, mobile phone, television, video recorder/DVD player, and wheelbarrow. See Tables 3 to 8 and Appendix Table 4 from our working paper for results using the simple sum of assets owned and details on the distribution of asset ownership. http://www.princeton.edu/~accase/downloads/The_Economic_Consequences_of_Death_in_South_Africa_Working_Paper.pdf.

[10] We stop at HSE5 in order to look forward and see whether the household had attrited before HSE6, which is the last round for which we currently have verbal autopsy data.

Table 2
Household characteristics — HSE 1 to HSE 8.

Fraction of households in which an adult died in the 12 months prior to the current HSE module from:	
All causes	0.096
AIDS	0.046
Other chronic illness	0.015
Sudden death	0.033
Number of household members	7.954
Number of resident household members	5.489
Total household assets	6.584
Self-reports poor or very poor	0.355
Household-level observations	85629
Unique households	17814

be seen in the last column, where the significance of differences between the means presented in columns one and two are noted with asterisks (* for significance at the 10% level, ** for 5%, *** for 1%).[11] Looking at death in the household by cause, we find a small but statistically significant difference in the fraction of households that had an AIDS death, with households who remain under surveillance more likely to have had an AIDS death (5.0% versus 4.2%). Households that will exit before the next HSE round are more fragile than households that remain under surveillance, in that they have fewer members and lower socioeconomic status, measured using an asset index, and self-assessed poverty.

4. Socioeconomic correlates and consequences of AIDS mortality in the DSA

One of the challenges of examining the impact of death on household outcomes is that there are two-way links between economic status on one hand, and individuals' morbidity and mortality on the other. Poorer access to clean water, nutritious foods, and healthy work environments can lead members of poorer households to have higher morbidity and earlier mortality. At the same time, individuals who are too ill to work may stop contributing to household income and may draw down household assets to pay for expensive medical treatments. We can use the longitudinal data from the Africa Centre to examine the timing of illness and death and changes in household assets and self-assessed poverty to examine the mechanisms that link economic status and household adult members' mortality. We start by looking at past and future deaths and comparing households that experienced a death to other households observed in the same HSE round. This first approach allows us to explore possible household selection into experiencing certain types of death and to use the full length of the panel to trace out the timing of changes in household socioeconomic status associated with death. We then use changes between rounds to compare households with their own earlier markers of socioeconomic status. By applying this methodology we take into account selection issues, as the identification of effects is based solely on changes within households. As usual when controlling for fixed effects, measurement error may imply a larger attenuation bias. We use both approaches to obtain as complete a picture of socioeconomic correlates and consequences of mortality due to different causes of death as our unique data allow.

4.1. Households' assets and self-assessed poverty

That households in which an adult member will die of AIDS are poorer well prior to the member's death can be seen in Fig. 2, which presents evidence on the asset index of households which either have in the past, or will in the future, experience the death of an adult member from AIDS or from another cause. Specifically, we run a regression of the form:

$$A_{ht} = \sum_{c} \sum_{\tau=t-[5to6]}^{\tau=t+[5to6]} \beta_{c\tau}\ ind[death = c]_{\tau} + \alpha X_{ht} + u_{ht} \quad (1)$$

where A_{ht} is the asset index for household h in the HSE module collected in year t. The variable $ind[death = c]_{\tau}$ is an indicator that the household experienced an adult death of type c in period τ, where causes c (entered separately) are death from AIDS, death from a chronic illness, sudden death from a known cause, or death from a cause unknown. For each cause of death we include indicators that death occurred between 5 and 6 years before the current HSE module (the coefficient for which is marked as 5 on Fig. 2), between 4 and 5 years ago (4), through deaths that occurred within the past year (0). Analogously, we include indicators that a death from each cause will occur within the next year (−1), one to two years from now (−2), out to deaths that will occur between 5 and 6 years in the future (−6).[12] We also include in this regression a complete set of indicators for HSE round, and the number of household members in each household at the time the household came under surveillance.[13] We allow correlation in the unobservables from the same household observed in different HSE rounds.

The three panels of Fig. 2 present regression coefficients and standard errors for leads and lags of death by cause for AIDS (topmost panel), sudden death (middle panel), and non-AIDS chronic conditions (bottom panel).[14] Relative to other households, on average households that have or will experience an adult death from AIDS have systematically fewer assets. In the years following a death (0 through 5), on average such households have a 0.25 lower asset index (equivalently 0.45 fewer assets) than other households. Households that will experience an adult AIDS death in the future also have significantly fewer assets than other households. This is true even if that death will occur only in 5 to 6 years. Observing uniformly lower asset holdings in households from 1 to 6 years prior to an AIDS death suggests that the lower level of assets in AIDS households prior to death is not due to the household drawing down assets to care for members who become ill, as assets are lower outside the window of time when individuals with AIDS would be alive and in need of support. The asset deficit is smaller before a death than after, but is statistically significant for all indicators of future death. These findings, for AIDS deaths, are consistent with households being poorer prior to the onset of AIDS illness and death, and households becoming even poorer after the death — possibly due to the expense incurred in paying for a funeral.[15] We will return to this in Section 5.

[11] As in Hosegood et al. (2004b), household dissolution is significantly more likely following an adult death. However, household dissolution accounts for a relatively small fraction of households that attrite. Overall, attrition is insensitive to adult death.

[12] We use asset information for all HSE rounds from HSE1 (2001) to HSE8 (2011) to look at the association between current asset position and deaths that occur between 2000 and 2009 (the period for which we have complete verbal autopsy data). At each HSE round, not every household contributes information for all periods in the past and the future. For example, for a household observed at HSE4 (2006), we can document the correlation between current household SES and deaths that occurred up to 6 years in the past. For that household, however, we can only observe the association between current SES and deaths in the future up to 3 years out. When information is missing we assign household zero values, and include an indicator that recognizes that this information is missing at that point for that household. Households may experience multiple deaths. For example, a household observed in June 2006 may have experienced an adult death in August 2004 and will experience another adult death in February 2007. For this household the indicators for deaths one to two years ago and deaths in the next year will be set to one.

[13] Larger households are more likely to experience a death. Larger households also on average own more assets. We include the number of members at the household's first visit to break any mechanical link between assets and death that works simply through household size.

[14] The coefficients and standard errors for Figs. 2 and 3 are presented in Appendix Tables A2 and A3 respectively.

[15] It is also the case that adults who will die of AIDS, and other adults in their households, have completed fewer years of education on average than other adults in the field site. For the youngest adults who die of AIDS, it may be that illness thwarted their education. However, educational deficits are also apparent for adults who die of AIDS in their thirties and forties — decades after they would have completed their schooling. Our working paper http://www.princeton.edu/~accase/downloads/The_Economic_Consequences_of_Death_in_South_Africa_Working_Paper.pdf provides details.

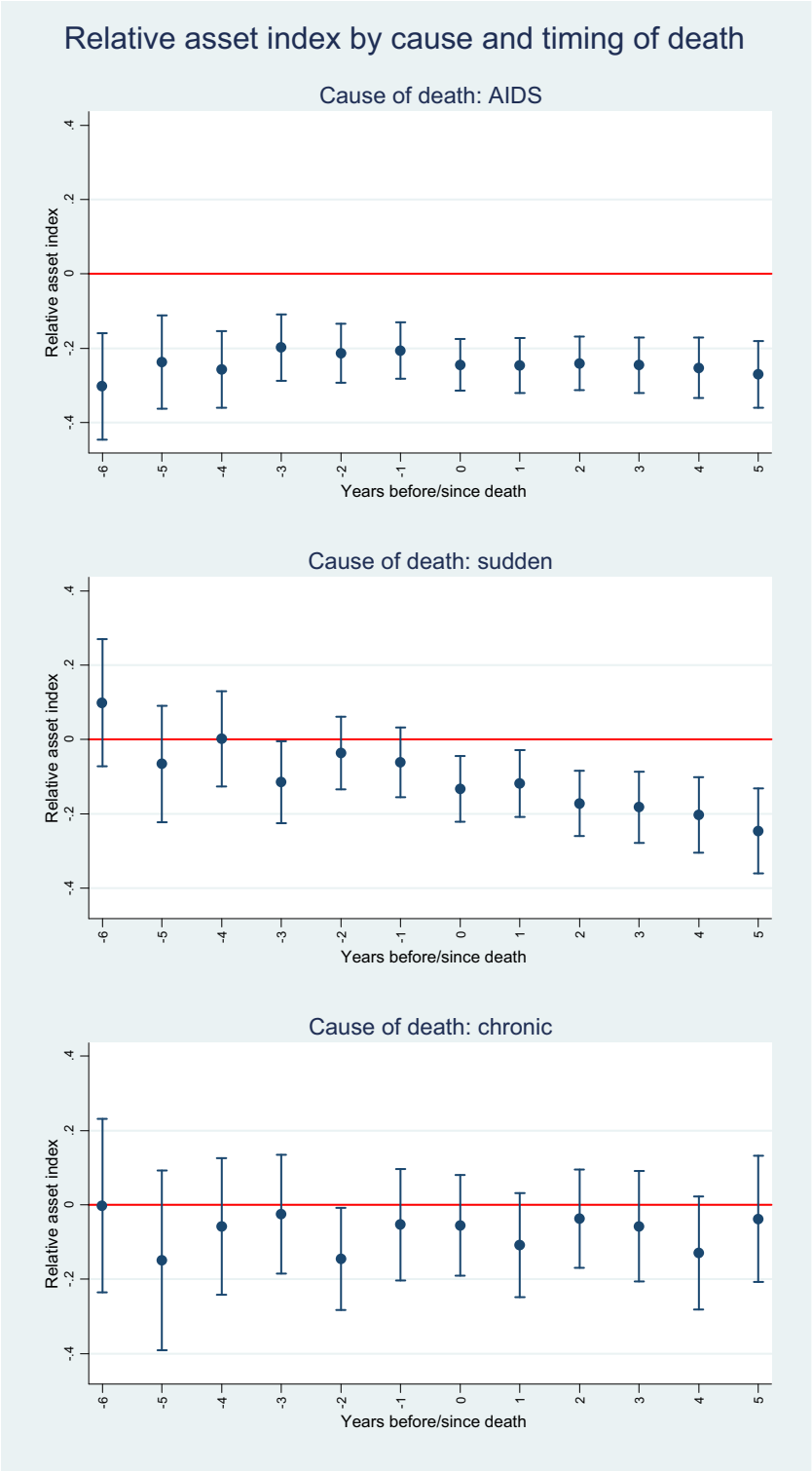

Fig. 2. Relative asset index by cause and timing of death.

The lower asset possession of households following the death of an adult member can be seen for other causes as well. For example, in households where an adult member will die in the future of a sudden death, asset holdings are not significantly different from those observed in other households. This can be seen in coefficients −1 through −6 in the middle panel of Fig. 2. With a sudden death, we expect no feedback from illness to asset depletion prior to the death. However, once a death occurs, such households' asset positions fall significantly below those of other households, with deficits of 0.12 to 0.25 in the asset index (equivalent to 0.2 to 0.4 assets). Over the first decade of the 2000s, the period under study here, on average households accumulated assets. The lower relative position of households experiencing a death comes predominately from the fact that they were not adding to their asset holdings as rapidly as other households.

Table 3
F-statistics and *p*-values on indicators of past or future death by cause.

	Dependent variable:			
	Household assets		Poor or very poor	
	Past death	Future death	Past death	Future death
AIDS	15.48	10.79	19.61	7.46
	(0.000)	(0.000)	(0.000)	(0.000)
Chronic illness	0.72	0.91	2.14	0.52
	(0.631)	(0.485)	(0.046)	(0.762)
Sudden	4.75	1.38	7.30	0.27
	(0.000)	(0.219)	(0.000)	(0.933)
Unknown	1.24	1.00	1.51	1.59
	(0.284)	(0.420)	(0.171)	(0.160)
Observations	78,331	78,331	67,032	67,032

Households that experienced an adult death from a chronic condition are not significantly different from other households in terms of asset accumulation. Members who die from chronic conditions are on average older, and are significantly more likely to have burial insurance. We will return to this below.

F-statistics on the joint significance of indicators for past deaths and future deaths, by cause, are presented in Table 3, and corroborate the evidence in Fig. 2. Households in which a member has or will die of AIDS are significantly different from other households both prior to and after the death. The *F*-statistics and *p*-values for variables 0 through 5 (for deaths in the past) are presented in column 1, and those for variables −1 through −6 (deaths in the future) are presented in column 2. Households in which a member will die of a chronic disease or die a sudden death are not statistically different in their asset index before such deaths occur but, for sudden death, are significantly poorer following the death.[16]

Beginning with the second household economic module (HSE 2, 2003/04), a knowledgeable household member was asked to report on the household's current financial situation, with possible responses being that the household was "Very Comfortable," "Comfortable," "Just Getting By," "Poor," or "Extremely Poor." We use households' responses to this question as a second marker of household socioeconomic status, and run a regression similar to Eq. (1), but with a dependent variable equal to 1 if the household reports that it is "poor" or "very poor," and zero otherwise. Coefficients on leads and lags of death by cause are presented in Fig. 3, and *F*-statistics on death indicators are presented in columns 3 and 4 of Table 3. Households in which an adult member has died or will die of AIDS are significantly more likely to report that they are poor. This is true well before and many years after the death. Households where a member will die a sudden death are no more or less likely to report that they are poor until the death occurs. After a death, they are approximately 5 percentage points more likely to report that they are poor. This persists throughout the period in which we can study them. Households in which a member will die of a chronic condition are not more likely to report poverty prior to the death. However in the first year after the death they are significantly more likely to report that their household is poor — an effect that abates with time.[17] We will present evidence in Section 5 that the less pronounced effect of a funeral on poverty for those households in which someone died from a chronic condition may be due to the financing of the decedent's funeral.

The results presented on past and future deaths in Figs. 2 and 3 compared households that experience a death to other households observed in the same HSE round. We can also use the longitudinal data to compare households with their own earlier markers of socioeconomic status by running household fixed effects regressions of the form:

$$\left[y_{ht} - y_{h,t-1}\right] = \sum_c \delta_c \, ind[death = c, t-(t-1)] + \gamma\left(X_{ht} - X_{h,t-1}\right) + \mu_{ht} \tag{2}$$

where $[y_{ht} - y_{h,t-1}]$ is the change in a socioeconomic outcome (asset index, self-report of poverty) between the current round of HSE data and the data collected in the most recent previous HSE round, and $ind[death = c, t-(t-1)]$ is an indicator that a death from cause c occurred between the HSE rounds. In these regressions, we also include a complete set of HSE round indicators and the number of days that has passed between the two HSE survey rounds.

In the DSA, change in the index of assets between survey rounds is lower on average for households initially observed with a higher asset index. Our results above suggest that the initial asset index is lower for households that will experience an AIDS death. For this reason, we also run regressions that allow more flexibility between past and current asset position. Eq. (2) implicitly restricts the coefficient on the lagged asset index to be equal to one. We relax that constraint in Eq. (3), and examine how the current asset index is associated with death between survey rounds, conditional on previous assets.

$$y_{ht} = \omega y_{h,t-1} + \sum_c \delta_c \, ind[death = c, t-(t-1)] + \gamma\left(X_{ht} - X_{h,t-1}\right) + \mu_{ht}. \tag{3}$$

Results for estimation of Eqs. (2) and (3) are reported in Table 4 with the final two rows showing *F*-statistics for tests of the equality between the AIDS death coefficient and the sudden death and chronic death coefficients. We find that, controlling for the household's previous asset position, an adult death in the household from AIDS or sudden death between survey rounds is associated with a significantly lower asset index in the current HSE round.[18] The magnitude of coefficients for AIDS and sudden death are similar and statistically indistinguishable while AIDS deaths are associated with a significantly lower asset position than are chronic deaths. Similarly, conditional on the household's previous report on poverty, a death between the rounds is associated with a positive and significant increase in the probability of reporting the household is poor or very poor in the current wave for all three

[16] For each of the past and future periods, we tested for equality of the AIDS coefficients with those for sudden and chronic death. For future deaths, four and five out of six coefficients were statistically significantly smaller (in absolute terms) for chronic and sudden deaths respectively. AIDS deaths in the past year and one to two years ago are associated with lower asset indices than sudden deaths. After two years however, the coefficients for AIDS and sudden death are indistinguishable. In five out the six periods for past deaths, AIDS deaths are associated with significantly lower assets than chronic deaths.

[17] For each of the past and future periods, we tested for equality of the AIDS coefficients with those for sudden and chronic deaths. For future deaths, two out of six coefficients were statistically significantly smaller (in absolute terms) for both chronic and sudden deaths. In two out the five periods for past deaths, AIDS deaths are associated with a significantly higher probability of reporting poverty than are chronic or sudden deaths.

[18] We have focused here on the deaths of all adult household members, whether or not they were residents in the DSA. Deaths of non-resident members may have different effects on households, and their impacts may be more heterogeneous — depending on how close the non-resident member was to the household residing in the DSA; whether he or she sent or received transfers from the household prior to death; and whether the DSA household financed the funeral for the non-resident member. We test for differences in the associations between household SES and past and future deaths by residency status. We find no significant difference between the impact of resident and non-resident deaths on household SES. We present these results in Appendix Tables 1 and 2 of our working paper. As we see no significant differences in the patterns for resident members and all members, we continue to examine the deaths of all members.

causes of death.[19,20] AIDS related deaths between rounds are associated with the highest probability of self-reported poverty. The point estimate of 6 percentage points is significantly larger than that for sudden deaths.

From Figs. 2 and 3 it would appear that adult deaths may be associated with continued decline in SES over a period of time. We can further exploit the longitudinal data to investigate whether deaths further in the past continue to have a negative impact on household SES. In Table 5 we present regressions that are an extension of those in the second and fourth columns of Table 4. We now include indicators for death by cause not only for deaths that occurred between the current and previous survey round but also for deaths occurring between one and two, and two and three rounds ago. Conditional on the household's pervious asset index, we find that AIDS related and sudden deaths that occurred between two and three HSE rounds ago continue to be associated with a worsening asset position.

One of the reasons we may expect the consequences of AIDS related deaths to differ from those of death from other causes is that the risks of HIV are likely correlated within households. AIDS deaths may be more likely to be preceded by another death a few years earlier or there may be multiple deaths within the household between HSE rounds. We investigate whether the impact of a death is exacerbated if there had already been a death in the household in the period preceding the previous round. We also examine the impact of multiple deaths in the household between waves by interacting an indicator for more than one death between HSE rounds with our indicators for death by cause. The results in columns 2, 3, 5 and 6 of Table 5 suggest that neither deaths in the period preceding the previous round nor multiple deaths between HSE rounds exacerbate the impact of an adult death above the effect they themselves have had on the household.[21]

5. Discussion

There are many reasons that households may lose ground relative to other households following the death of a member. Additional data collected through the Africa Centre Demographic Surveillance System can help us sort through some of the possible causes.

5.1. Funerals

A household in the DSA may become permanently poorer following the death of a household member in part because of the obligation it faces to bury members in a manner that reflects both the household's status and the member's status within the community. For example, it is generally expected in KwaZulu-Natal that funerals will be larger, the older was the deceased, and that the feast following a man's funeral will involve slaughtering a cow (an expensive proposition), while that following a woman's will involve slaughtering a goat (at lesser expense).[22] Case et al. (2013) use data collected in the DSA on the funeral expenses for the deaths of household members that occurred between January 1, 2003 and December 31, 2005 to document funeral expenditures and financing.[23] Using data collected in the *Illness and Death Survey*, they find that the average cost of an adult funeral is approximately equal to median per capita annual African income during this period. While community, church, and employers often contribute toward the funeral, the deceased household on average paid 90% of the costs associated with the funeral. A quarter of all adults who died in that period had some sort of funeral insurance that paid (primarily) cash to the policy holder's beneficiaries. Policy holders are overwhelmingly old age pensioners, who join a burial society or take out a policy with a funeral parlor or an insurance company at the time they begin to receive their state old-age pension.[24] A quarter of households in the DSA borrowed money (many at usurious interest rates) to bury their dead.

Using data collected in the *Illness and Death Survey*, Table 6 presents descriptive regression results for funeral expenditures and financing. Column one presents coefficients from a regression of total funeral spending (in Rand) on indicators for the cause of death, and indicators for whether the deceased was a prime-aged or pension-aged man or woman. The benchmark characteristics of the deceased, captured by the constant term, are those of a prime-aged woman who died after a chronic illness. On average, a funeral for this type of member cost just over 5000 Rand (8000 Rand in 2012 prices). If she had died of AIDS, approximately 1300 fewer Rand would have been spent on the funeral. This reflects in part the fact, discussed in the previous section, that households in which a member will die from AIDS are poorer well before the death. Relative to a prime-aged woman, 450 extra Rand are spent on average on a pension-eligible woman's funeral, more than 500 additional Rand for that of a prime-aged man, and more than 1800 Rand more are spent on the funeral of a male pensioner—a combination that reflects the status of members by age and sex, and the higher likelihood that a deceased pensioner had funeral insurance.

The relative probabilities of having held funeral insurance prior to death can be seen in column two, where the dependent variable is equal to 1 if the deceased's primary caregiver reports that a funeral policy paid out at death, and is equal to 0 otherwise. Relative to a prime aged woman dying after a chronic illness, prime aged women who die of AIDS are 13 percentage points less likely to have had a funeral policy, and those dying a sudden death are 8 percentage points less likely. In contrast to prime-aged adults, pensioners are highly likely to hold a

[19] The AIDS crisis has resulted in a substantial number of households in the DSA caring for orphans—a role that often falls to the orphans' grandparents. In previous related work using data from the Cape Area Panel Study (Ardington et al., 2010), we document that significant public and private transfers are reported by older adults caring for orphaned children. Perhaps as a result of these transfers, we found no difference in expenditure patterns between older-adult households caring for orphans and other older adult households, and no significant difference in the wellbeing reported by older adults caring for orphans and other older adults. In the Africa Centre study area (Case and Ardington, 2006), we found no significant difference in the school enrolment or attainment of non-orphaned children who were living with maternal orphans relative to non-orphans who were not. While a full assessment of potential spillovers to households caring for orphans is beyond the scope of this paper, we note that in 3.3% of the household transitions analyzed in Table 4, households that did not experience an adult death had a net increase in the number of maternal orphans in the household. As a robustness check we excluded these observations from the regressions shown in Table 4. Our results are unchanged by this exclusion.

[20] Given that we examine deaths and changes in socioeconomic outcomes that occur between the same survey rounds $[t-(t-1)]$, we cannot rule out the possibility that the change in socioeconomic outcomes precedes the death. However, focusing on the impact of deaths between the previous two survey rounds $[(t-1)-(t-2)]$ on changes in socioeconomic outcomes between t and $(t-1)$ will fail to capture any possible changes that occurred closer to the time of the death and before $t-1$. Evidence presented in Table 7 suggests that considerable funeral expenses and associated borrowing play an important role in the impact of deaths on household wellbeing. These consequences of funeral expenses are likely to manifest shortly after the death and are best captured between $t-1$ and t. Nonetheless, we estimate regressions with lagged deaths as a robustness check. Our results are similar although smaller than when we use deaths that occurred between $t-1$ and t. We further explore the effect of deaths between previous survey rounds in Table 5.

[21] Results are consistent when we analyze all adult deaths together, rather than separately by cause.

[22] Cattle in this area sold for approximately 2000 Rand a head in the 2003–2005 period of data collection. This estimate is consistent with other reports for this period. King (2004) reports sale prices for a cow fluctuated between R1500 and R2000 in the former bantustan of KaNgwane, between 2000 and 2002. McCord (2004) reports that sale prices for cows varied from R700 to R3000 in Limpopo in mid-2003. To provide a yardstick against which to measure this sum, we note that in the 2003–2004 HSE2 data collection for the DSA, median total household expenditure per month was 776 Rands.

[23] ACDIS recorded 3728 adult deaths between January 2003 and December 2005. The *Illness and Death Survey* collected funeral information for 84% of individuals who died in that period.

[24] In South Africa, women above the age of 60 and men above the age of 65 are generally eligible for a state old-age pension that, by international standards, is very generous. (The age of eligibility for men has recently been reduced to 60, and we take that into account in our work.) Take up of the pension in the African community is high (upwards of 90%), and we assign pension status to members based on their age eligibility.

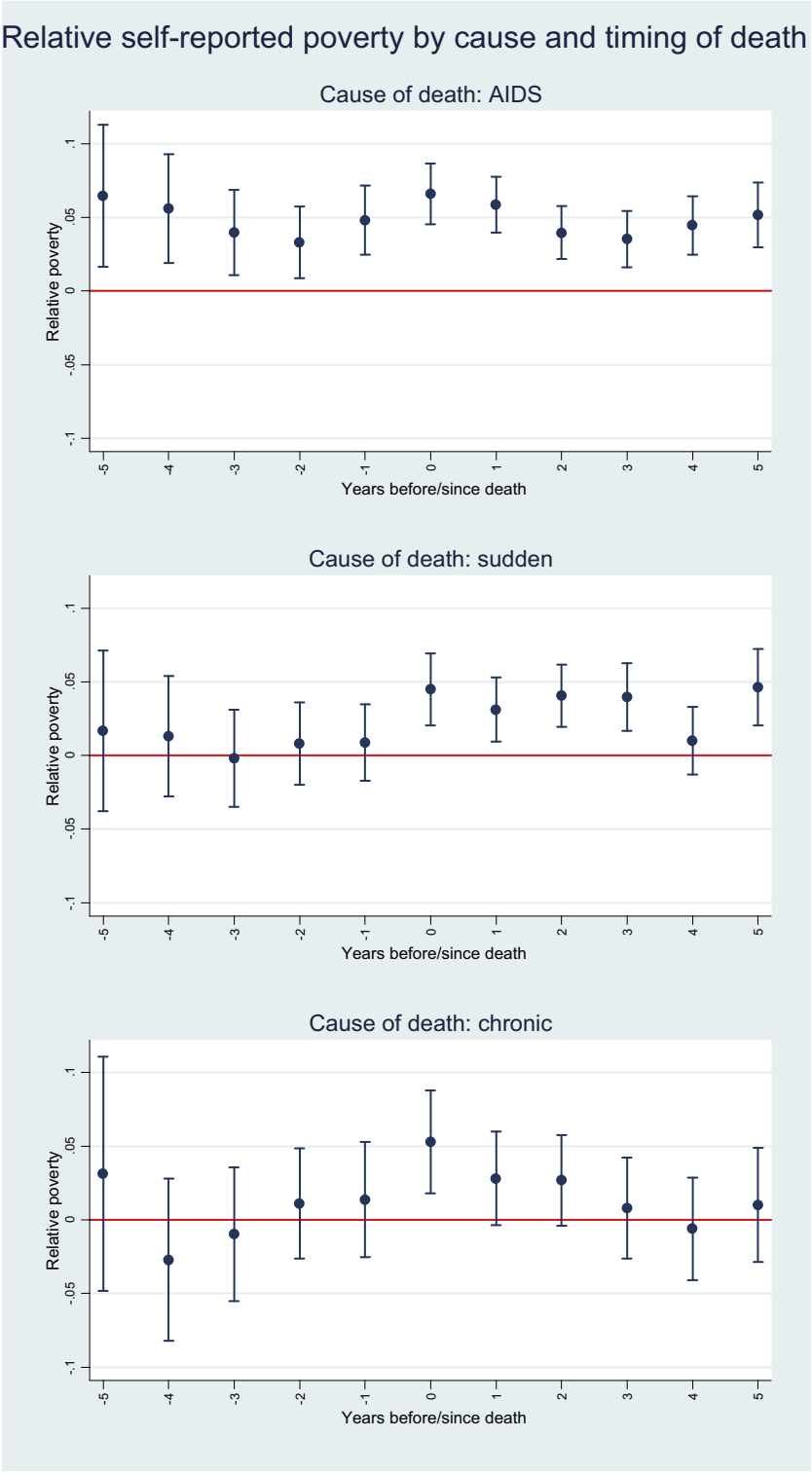

Fig. 3. Relative self-reported poverty by cause and timing of death.

policy: 78 percent of pension aged men (0.300 + 0.482) and 86% of pension aged women who died between 2003 and 2005 held funeral insurance. Even the households of pensioners with burial insurance on average pay positive out-of-pocket expenses for the funeral. On average, 2300 Rand are spent by the household for the funeral of a pension-aged man who held burial insurance, while 800 Rand are spent for pension-aged women with insurance.

Households that do not have the resources on hand to finance an appropriately-sized funeral often borrow money to do so. This can be seen in column three, where the dependent variable is an indicator equal to 1 if the household reports that it borrowed money for the funeral. This occurred in 18% of the funerals observed for prime-aged women when death followed a chronic illness. Borrowing money for a funeral is significantly more likely when the death was due to AIDS (27% versus 18%). On average, then, AIDS deaths are associated with smaller funerals but the funerals are significantly more likely to be funded, at least in part, out of borrowed money. This kind of debt could strain a household's resources well into the future. The funerals

Table 4
Changes in household socioeconomic status following a death[a].

	Change in asset index	Asset index	Change in self-reported poverty	Self-reported poverty
AIDS death between HSE survey rounds	−0.066***	−0.099***	0.031**	0.061***
	(0.026)	(0.024)	(0.014)	(0.010)
Sudden death between HSE survey rounds	−0.071**	−0.072***	0.009	0.022*
	(0.030)	(0.028)	(0.015)	(0.011)
Death from chronic illness between HSE survey rounds	−0.012	−0.006	0.038*	0.034**
	(0.046)	(0.043)	(0.021)	(0.017)
Asset index lagged one HSE round		0.757***		
		(0.004)		
Poverty report lagged one HSE round				0.201***
				(0.006)
Number of observations	44,984	44,984	35,049	35,049
F-statistic (p-value) test of equality between AIDS and sudden death	0.02	0.50	1.11	6.20
	(0.900)	(0.479)	(0.291)	(0.013)
F-statistic (p-value) test of equality between AIDS and chronic death	1.03	3.46	0.07	1.83
	(0.309)	(0.063)	(0.793)	(0.176)

*** p<0.01, ** p<0.05, * p<0.1.
[a] All regressions include indicators for each HSE round, and the number of days since the previous HSE round. Self-reported poverty is an indicator equal to 1 if the household reports it is poor or very poor. p<0.1.

of prime-aged men are larger than those for prime-aged women, and they are almost 5 percentage points more likely to be financed in part with borrowed money. This also leads to the households' financial positions being more fragile in the future.

We can observe the impact of borrowing money and of having held a burial insurance policy on the asset index and self-assessed poverty of households in HSE modules before and after a death that was recorded in the *Illness and Death Survey*. Table 7 presents coefficients from regressions analogous to those presented in Eq. (3) but with indicators that an adult death from any cause occurred between HSE rounds and, for those households with a death, an indicator that the deceased had burial insurance and an indicator that the household borrowed money for the deceased's funeral. (These are set to zero for households where a death did not occur.) We include indicators for which HSE round the observation comes from and control for the time in days between the household's last HSE visit date and its current HSE visit date. In the first four columns, we control for the household's asset index in the previous round, and in the last column, we control for their self-assessed poverty in the previous round. Because we recorded information about funerals from 2003 to 2005, we restrict our analysis of assets held to HSE 2 (2003/04), HSE 3 (2005) and HSE 4 (2006).

As we observed in the previous section, death between survey rounds is negatively and significantly associated with asset holdings on average. Relative to other households with the same asset position in the previous round, households that experienced a death have asset indices that are 0.07 lower when observed following the death.

Table 5
Change in household socioeconomic status and timing of death[a].

	Asset index			Self-reported poverty		
AIDS death between HSE rounds t and t − 1	−0.065**	−0.101***	−0.092***	0.059***	0.062***	0.066***
	(0.031)	(0.027)	(0.027)	(0.011)	(0.011)	(0.012)
Death from chronic illness between HSE rounds t and t − 1	0.013	−0.003	0.016	0.035**	0.034*	0.029
	(0.055)	(0.047)	(0.046)	(0.017)	(0.018)	(0.018)
Sudden death between HSE rounds t and t − 1	−0.080**	−0.071**	−0.079***	0.022*	0.025**	0.028**
	(0.033)	(0.031)	(0.030)	(0.012)	(0.012)	(0.012)
AIDS death between HSE rounds t − 1 and t − 2	−0.053*			0.019*		
	(0.027)			(0.010)		
Death from chronic illness between HSE rounds t − 1 and t − 2	−0.050			0.018		
	(0.047)			(0.016)		
Sudden death between HSE rounds t − 1 and t − 2	−0.040			0.025**		
	(0.031)			(0.011)		
AIDS death between HSE rounds t − 2 and t − 3	−0.051*			0.031***		
	(0.027)			(0.010)		
Death from chronic illness between HSE rounds t − 2 and t − 3	0.038			−0.007		
	(0.049)			(0.017)		
Sudden death between HSE rounds t − 2 and t − 3	−0.068**			0.025**		
	(0.033)			(0.012)		
AIDS death × more than 1 death		0.021			0.001	
		(0.066)			(0.031)	
Sudden death × more than 1 death		−0.017			−0.023	
		(0.077)			(0.035)	
Chronic death × more than 1 death		−0.021			0.011	
		(0.113)			(0.047)	
AIDS death × death between HSE rounds t − 1 and t − 2			−0.036			−0.024
			(0.060)			(0.025)
Sudden death × death between HSE rounds t − 1 and t − 2			0.042			−0.033
			(0.069)			(0.029)
Chronic death × death between HSE rounds t − 1 − nd t-2			−0.143			0.032
			(0.117)			(0.048)
Observations	32,891	44,984	44,984	32,453	35,049	35,049

Columns 1 to 3 include the household asset index in the previous round. Columns 4 to 6 include the household's report of its financial wellbeing in the previous round.
*** p<0.01, ** p<0.05, * p<0.1.
[a] All regressions include the indicators for each HSE round and the number of days since the previous HSE round.

Table 6
Funeral expenses and financing[a].

	Dependent variable:		
	Total funeral expenses	Indicator: deceased had a burial policy	Indicator: household borrowed money to pay for the funeral
Deceased died of AIDS	−1326.96***	−0.128***	0.091***
	(216.67)	(0.025)	(0.026)
Sudden death	−182.47	−0.084***	0.006
	(210.75)	(0.024)	(0.026)
Cause of death unknown	−841.55***	−0.064	−0.059
	(311.98)	(0.036)	(0.038)
Deceased was prime aged male	543.13***	−0.002	0.047***
	(142.13)	(0.016)	(0.017)
Deceased was pension aged male	1841.35***	0.482***	0.008
	(268.53)	(0.030)	(0.032)
Deceased was pension aged female	454.99**	0.560***	−0.037
	(221.00)	(0.025)	(0.027)
Constant	5037.41***	0.300***	0.178***
	(213.97)	(0.025)	(0.026)
Number of observations	3183	3109	3067

*** p<0.01, ** p<0.05, * p<0.1.
[a] Data on funeral expenses and financing are drawn from the *Illness and Death Survey* collected in the Demographic Surveillance Area for deaths that occurred between January 2003 and December 2005.

Table 7
Asset holdings and funeral financing[a].

	Dependent Variable:				
	Household assets				Poor or very poor
Indicator: death in household between survey waves	−0.074**	−0.037	−0.116***	−0.077*	0.059***
	(0.032)	(0.038)	(0.038)	(0.044)	(0.017)
Indicator: death x household borrowed to pay funeral expenses		−0.127*		−0.112*	0.060**
		(0.067)		(0.068)	(0.027)
Indicator: death x deceased had a burial policy			0.155**	0.131*	−0.049*
			(0.067)	(0.068)	(0.027)
Number of observations	17,502	17,468	17,502	17,468	17,022

Columns 1 to 4 include the household asset index in the previous round. Column 5 includes the household's report of its financial wellbeing in the previous round. Data are drawn from HSE2, HSE3 and HSE4. *** p<0.01, ** p<0.05, * p<0.1.
[a] All regressions include an indicator for HSE survey round and days between the HSE rounds.

Reporting that money was borrowed for the funeral is associated with an even weaker asset position for the household, with an additional 0.13 lower asset index reported following the death, relative to other households that experienced a death. However, households that report the deceased had a burial policy experience weakening in their asset position following death. The coefficient on the indicator that the deceased had a policy (0.155) completely offsets the association between death and assets (−0.116). For households that report borrowing money, but also report that the deceased had a funeral policy, death is overall associated with a relatively poorer asset position. The funeral policy more than offsets the coefficient on death, but borrowing still leaves a household vulnerable to reporting a relatively lower asset index than households that were equally positioned in the previous wave. Estimates in column 5, which report on changes in the probability that a household reports it is poor or very poor, are consistent with these results. Overall, bearing the cost of funerals puts households in a weaker socioeconomic position in the DSA, and provides a partial explanation for the results we observed in Section 4.

5.2. Loss of an employed member

An additional mechanism through which death of an adult member could affect household SES is through the loss of earnings of a working member. In Table 8, we test this in two ways. Using data from the *Illness*

Table 8
Employment, earnings and socioeconomic status following a death[a].

	Dependent Variable:					
	Household assets			Poor or very poor		
	HSE 3 & HSE 4		HSE 2–6	HSE 3 & HSE 4		HSE 3–6
Indicator: death in household between survey waves	−0.085*	−0.073**	−0.085***	0.081***	0.070***	0.057***
	(0.049)	(0.035)	(0.022)	(0.019)	(0.013)	(0.009)
Indicator: death × deceased's earning were important to household	0.023			−0.039		
	(0.090)			(0.034)		
Indicator: death × deceased was working when last observed in an HSE round		0.036	0.017		−0.034*	−0.038***
		(0.055)	(0.034)		(0.021)	(0.014)
Number of observations	16,779	18,226	44,543	16,342	17,716	34,948

Columns 1 to 3 include a control for the household asset index in the previous round, and columns 4 to 6 include a control for the household's self-report on poverty in the previous round. Reports that the deceased's earnings were important to the household while he or she was working are drawn from the *Illness and Death Survey*. *** p<0.01, ** p<0.05, * p<0.1.
[a] All regressions include an indicator for HSE survey round and days between the last HSE round and the current round.

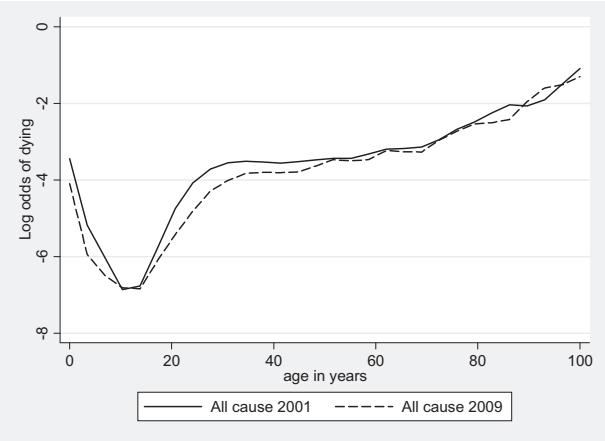

Fig. 4. Log odds of dying by age — all cause mortality in 2001 and 2009.

and Death Study, we investigate whether the household's asset index and self-assessed poverty following a death are significantly related to a primary caregiver's report that, when the deceased was healthy, his or her earnings were important to the household (which is true for 25 percent of adult deaths). In addition, we test whether these markers of economic wellbeing are significantly different from those in other households experiencing a death if the deceased was employed when last seen in an HSE module.[25]

Controlling for the asset index in the previous round, we find that the current index is not significantly associated with either of our measures of employment for the deceased. When controls are not included for previous asset position, employment of the deceased is positively and significantly associated with household asset index: the deceased being employed is itself a marker that the household is better off than other households that experienced a death. This is also reflected in the results reported for self-assessed poverty. Even with a control for self-assessed poverty in the previous round, that the deceased member was working when last seen is negatively and significantly related to the probability of reporting that the household is poor in the current round. The deceased's earnings no longer contribute to the household pot. However, past contributions may protect the household after this member has died. Moreover, conditional on age, we find that employed members are significantly more likely to have had a burial policy, which would defray funeral expenses. It is possible that, taken together, these offset the loss of earnings, leading to an insignificant association between employment prior to death and household future SES.

5.3. ART and household socioeconomic standing

That the arrival in the DSA of antiretroviral theory (ART) is beginning to change the age-mortality profile can be seen in Fig. 4, which returns to the log-odds of dying from all causes — now presented for 2001 and 2009. It is clear from Fig. 4 that death rates at very young ages and in early-middle age have fallen during this period. Although it is still far from being approximately linear in age after adolescence, the movement observable is quite marked. (See Herbst et al., 2009; Herbst et al., 2011 for discussion.)

Has the scale-up of ART begun to change the socioeconomic gradient in AIDS mortality we observed for deaths through the first decade of the 2000s? To explore this question, we re-ran Eq. (1) for all deaths (2000–2009), and included lead and lag indicators that the death in question occurred in the period after ART scale-up occurred in 2008–2009. Panel A of Table 9 presents the *F*-statistics for the coefficients for AIDS deaths in the past and the future in regressions for asset indexes and reports of poverty. We find no evidence, in these first years after ART scale-up, that deaths in 2008 and 2009 are coming from households that are significantly different from households in which deaths occurred earlier in the decade, measured using household asset index. However, with respect to self-assessed poverty, we find that relative to deaths that occurred between 2000 and 2007, those in 2008 and 2009 are drawn from households of higher socioeconomic status (i.e., those with lower self-reported poverty), on average. Panel B of Table 9 shows analogous results for Eqs. (2) and (3). The impact of AIDS-related mortality on the household's asset position does not appear to differ between the periods before and after ART scale-up. AIDS-related deaths in 2008 and 2009 are significantly more likely to be associated with an increase in the probability that the household reports that it is poor than deaths in the earlier period. This difference disappears once we allow for more flexibility between past and current self-reported poverty suggesting that it is driven by the selection evident in Panel A. It is too early to document the long-run effects of ART roll-out, but there is a suggestion, based on the self-assessed poverty results, that it could change the socioeconomic gradient in AIDS mortality. It will be interesting to return to this question once additional years of post-rollout data can be added to the analysis.

6. Conclusions

In the demographic surveillance area, AIDS mortality follows a sharp economic gradient. Households that experienced an AIDS death are poorer than other households long before the death occurred, suggesting that the socioeconomic gradient in AIDS mortality is being driven primarily by poor households being at higher risk for AIDS, rather than AIDS impoverishing the households.

Death in households in the DSA is associated with persistently poorer household socioeconomic status, measured in a variety of ways. Conditional on the household's previous report on poverty, a death between the rounds is associated with a positive and significant increase in the probability of reporting the household is poor or very poor in the current wave for all three causes of death. AIDS related deaths between rounds are associated with the highest probability of self-reported poverty. Controlling for the household's previous asset position, an adult death in the household from AIDS or sudden death between survey rounds is associated with a significantly lower asset index in the current HSE round. Moreover, AIDS related and sudden deaths that occurred between two and three HSE rounds ago continue to be associated with a worsening asset position.

We find that funerals play a role in lowering household SES following a death, especially in those cases in which money was borrowed to pay for the funeral. Households that suffer an AIDS death are less likely to have funeral insurance and more likely to borrow money to face burial expenses. Future analyses on individuals in households that experience a death may shed light on the repercussions of large funerals for individual members' outcomes.

[25] Reports on whether the deceased's earnings were important to the household are only available for deaths covered in the *Illness and Death Survey* (2003–2005). When using this measure of the deceased's employment, we focus on changes in the index of assets and self-assessed poverty measured between HSE2 and HS4. Reports on whether the deceased was working when last observed are available, in principle, in all HSE rounds preceding the death. We report on the latter for both the more restricted period—that is, matching rounds with those available in the *Illness and Death Survey*—and for the whole sample period.

Table 9
Household socioeconomic status and death after ART arrival.

Panel A: *F*-statistics and *p*-values on indicators of past or future death after ART arrival				
	Dependent variable:			
	Household assets		Poor or very poor	
	Past death	Future death	Past death	Future death
All AIDS deaths	14.22	10.39	19.24	10.17
	(0.000)	(0.000)	(0.000)	(0.000)
All AIDS deaths × Indicator[Post-2008]	0.22	0.48	1.18	5.74
	(0.928)	(0.821)	(0.316)	(0.000)

Panel B: changes in household socioeconomic status following a death after ART arrival				
	Change in asset index	Asset index	Change in self-reported poverty	Self-reported poverty
AIDS death between HSE survey rounds	−0.058**	−0.095***	0.015	0.061***
	(0.027)	(0.025)	(0.015)	(0.011)
AIDS death between HSE survey rounds × Indicator[Post-2008]	−0.078	−0.035	0.100***	0.002
	(0.091)	(0.084)	(0.035)	(0.027)
Number of observations	44,984	44,984	35,049	35,049

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Appendix A

Table A1
Household attrition between waves of the HSE module, HSE1 to HSE6.

Among households that			
Fraction of households in which an adult died in the 12 months prior to the current HSE module from	Left surveillance between HSE waves	Remained in surveillance and seen in the next HSE wave	Significance of the difference between households who stayed and left
All causes	0.094	0.099	
AIDS	0.042	0.05	**
Other chronic illness	0.018	0.014	**
Sudden death	0.031	0.034	
Number of household members	4.449	8.454	***
Number of resident household members	2.852	5.875	***
Total household assets	4.14	5.607	***
Asset index	−0.601	0.051	***
Self-reports poor or very poor	0.486	0.428	***
Observations	4499	46354	

Table A2
Coefficients and standard errors for Fig. 2.

Years relative to time of death	Cause of death		
	AIDS	Sudden	Chronic
−6	−0.303***	0.099	−0.002
	(0.073)	(0.087)	(0.119)
−5	−0.237***	−0.066	−0.149
	(0.064)	(0.080)	(0.124)
−4	−0.257***	0.002	−0.058
	(0.053)	(0.065)	(0.094)
−3	−0.198***	−0.115**	−0.025
	(0.045)	(0.056)	(0.082)
−2	−0.213***	−0.037	−0.145**
	(0.040)	(0.050)	(0.070)
−1	−0.207***	−0.062	−0.053
	(0.039)	(0.048)	(0.077)
0	−0.245***	−0.133***	−0.055
	(0.036)	(0.045)	(0.069)
1	−0.247***	−0.118***	−0.108
	(0.038)	(0.046)	(0.072)
2	−0.241***	−0.172***	−0.037
	(0.037)	(0.045)	(0.067)
3	−0.246***	−0.182***	−0.058
	(0.038)	(0.049)	(0.076)
4	−0.253***	−0.203***	−0.129*
	(0.041)	(0.052)	(0.077)
5	−0.271***	−0.246***	−0.038
	(0.046)	(0.058)	(0.087)
Observations	78,331		

Table A3
Coefficients and standard errors for Fig. 3.

Years relative to time of death	Cause of death		
	AIDS	Sudden	Chronic
−5	0.065***	0.017	0.031
	(0.025)	(0.028)	(0.041)
−4	0.056***	0.013	−0.027
	(0.019)	(0.021)	(0.028)
−3	0.040***	−0.002	−0.01
	(0.015)	(0.017)	(0.023)
−2	0.033***	0.008	0.011
	(0.012)	(0.014)	(0.019)
−1	0.048***	0.009	0.014
	(0.012)	(0.013)	(0.020)
0	0.066***	0.045***	0.053***
	(0.011)	(0.012)	(0.018)
1	0.059***	0.031***	0.028*

(continued on next page)

Table A3 *(continued)*

Years relative to time of death	Cause of death		
	AIDS	Sudden	Chronic
	(0.010)	(0.011)	(0.016)
2	0.040***	0.040***	0.027*
	(0.009)	(0.011)	(0.016)
3	0.035***	0.040***	0.008
	(0.010)	(0.012)	(0.018)
4	0.045***	0.01	−0.006
	(0.010)	(0.012)	(0.018)
5	0.052***	0.046***	0.01
	(0.011)	(0.013)	(0.020)
Observations	67,032		

Appendix B. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jdeveco.2014.08.001.

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