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Mortality in South Africa – socioeconomic profile and association with self-reported health

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Abstract

This paper exploits the first two waves of NIDS to describe the socioeconomic profile of mortality and to assess whether self-rated health status is predictive of mortality between waves. Mortality rates in NIDS are in line with estimates from official death notification data and display the expected hump of excess mortality in early and middle adulthood due to AIDS, with the excess peaking earlier for women than for men. We find evidence of a socioeconomic gradient in mortality with higher rates of mortality for individuals from asset poor households and with lower levels of education. Consistent with evidence from many industrialized countries and a few developing countries, we find self-rated health to be a significant predictor of two year mortality, an association that remains after controlling for socioeconomic status and several other subjective and objective measures of health.

Keywords

mortality; self-rated health

1. Introduction

There is an extensive literature documenting both the socioeconomic gradient in mortality (Cutler et al 2006) and the relationship between self-rated health and mortality (see Idler and Benyamini 1997 and DeSalvo et al. 2005 for reviews) in developed countries. However, within country evidence on these relationships in developing countries is relatively scarce. These gaps exist largely due to the requirement for longitudinal data to examine the socioeconomic profile of mortality and the association between mortality and self-rated health at the household and individual level.

Self-reported health has consistently been shown to have strong predictive power for subsequent mortality in developed countries, even after controlling for a variety of indicators of health and socioeconomic status. This single question is easy to collect, low cost, and readily understandable. It has been “routinely used in allocating health service funding, adjusting for ‘need’ in studies of social inequality in access to medical care, in assessing and monitoring inequalities” (O’Reilly and Rosato 2010:1011), and in identifying vulnerable target groups for health interventions (Ng et al. 2012).

Despite the robust association between self-reported health and mortality, a number of studies have documented differences in perception and reporting of health between cultures and across socioeconomic groups within developed countries (Burström and Fredlund 2001, O'Reilly and Rosato 2010, Quesnel-Vallée 2007). This evidence of the potential modifying effect of culture and socioeconomic status on the relationship between self-reported health and mortality motivates the need to investigate this association within each specific context. This is particularly salient for developing countries, where individuals tend to have less access to information about their health and where deaths from infectious diseases and injuries are more common (Frankenberg and Jones 2004). In sub-Saharan Africa, high AIDS-related mortality may modify the association between self-reported health and mortality (Olgiati et al. 2012).

The relationship between self-rated health and mortality in the developing world is not well-established with only limited evidence from a handful of countries (see Frankenberg and Jones 2004 and Ng et al. 2012 on Indonesia, Yu et al. 1998 on China, Hirve et al. 2012 on India and Lima Costa et al. 2011 on Brazil). Apart from the first paper, these are all localized studies and restricted to samples of older adults. To our knowledge, the only African study was conducted among a non-random subsample of 15 to 54 year olds who had consented to HIV testing in a demographic surveillance area in rural northern KwaZulu-Natal (Olgiati et al. 2012).

Similarly, the strong inverse relationship between socioeconomic status and mortality observed within developed countries is not well documented in developing countries (de Walque and Filmer 2013). A lack of vital registration systems and longitudinal data has made it difficult to quantify the socioeconomic gradient in mortality, an important indicator of health disparities in these countries. In contexts where HIV/AIDS is a major contributor to mortality, research suggests the gradient may be modified or even absent. For example, in an analysis of several countries in Africa, Fortson (2008) finds evidence of a positive education gradient in HIV infection while estimates of the wealth gradient in HIV vary substantially across countries.

In a recent study, De Walque and Filmer (2013:19) analysing Demographic and Health Survey data from 33 sub-Saharan African countries and find that the education gradient in mortality “has sharpened over time in countries with high HIV prevalence”. They are, however, constrained by the cross-sectional nature of their data to using the current socioeconomic status of living siblings as a proxy for the socioeconomic status of the deceased. Their measures of socioeconomic status are also limited to an indicator of some primary education and rural/urban location. Using longitudinal data from a demographic surveillance site in rural KwaZulu-Natal, Ardington et al. (2012) investigate the socioeconomic correlates and consequences of death by cause and find that individuals who will die of AIDS have less education and come from poorer households. At a national level, South African official death notification data provides the basic demographic characteristics of the deceased but the vital registration system does not collect socioeconomic information¹ or measures of health prior to death.

This paper takes advantage of the first two waves of the National Income Dynamics Study (NIDS), South Africa's first nationally representative panel study, to describe the socioeconomic profile of mortality and to assess whether self-rated health status is predictive of mortality between waves. The longitudinal data allow us to directly observe the socioeconomic status of individuals who die between waves of the survey. We exploit the

¹Data on education and occupation are collected but are missing for 55% of those aged 6 and older and 76% of those aged 15 and older respectively.

rich data from NIDS to explore multiple dimensions of socioeconomic status. To our knowledge, this is first nationally representative study to assess the relationship between self-rated health status and mortality in Africa.

Mortality rates in NIDS are in line with estimates from death notification data and display the expected hump of excess mortality in early and middle adulthood due to AIDS. We find evidence of a negative association between socioeconomic status – measured using individuals' education and household asset holdings – and mortality. Poor and fair self-reported health are predictive of mortality between the waves, an association that remains after controlling for several other measures of health and socioeconomic status.

This paper is organised as follows. In the next section, we begin by examining the level of mortality in the panel and the characteristics of the deceased. We then investigate the socioeconomic profile of mortality in South Africa. In section 3, we focus on whether self-reported health is predictive of mortality and consider the association between other indicators of health and subsequent mortality. The final section concludes.

2. Mortality in NIDS

2.1 Death rate

We begin our analysis by focusing on mortality rates and the characteristics of those who died between the first and second waves of the panel. NIDS was designed as a panel of all individuals who were resident in a participating household in Wave 1. The aim was to follow these continuing sample members (CSMs), re-interviewing them every two years. Table 1 presents the status at the second wave in 2010 of the 28247 CSMs from the first wave in 2008². At Wave 2, three quarters were successfully interviewed, 5.26% were not successfully interviewed but were established to be alive through the household roster, 16.7% have an unknown vital status (due largely to the entire household not being located or refusing to participate in Wave 2) and 3.15% had died. This represents a weighted mortality rate of 2.70% (95% CI 2.36%–3.04%) which rises to 3.34% (95% CI 2.92% – 3.76%) if we exclude those whose vital status is unknown. Using death notification data, Statistics South Africa (Stats SA) calculated the crude death rate per 1000 population to be 13 and 12 in 2008 and 2009 respectively (Stats SA 2011). Based on these rates, we would expect 2.6% of the sample to have died during the two years between NIDS waves.

There are several reasons why the NIDS death rate estimate may be slightly higher than those from official death notification data. Firstly, we do not know the vital status of a substantial portion of continuing sample members from Wave 1. Evidence presented below suggests that the death rate amongst this group could be lower than among those whose vital status is known. Second, late registrations and non-reporting of deaths result in Stats SA under-reporting deaths. Finally, Stats SA's crude death rates are calculated using the mid-year population estimates and NIDS death rates rely on weights that adjust for differential sampling probabilities and non-response. The various assumptions underlying the mid-year population estimates and the calculation of NIDS weights could both contribute to differences in death rates between NIDS and Stats SA.

2.2 Demographic and socioeconomic profile of mortality

The age-pattern of mortality in NIDS is investigated in Figure 1. The top panel of Figure 1 shows the age distribution of the full Wave 1 sample and of the 889 individuals who died

²Around 89% of these CSMs were successfully interviewed in Wave 1. A proxy interview was collected for an additional 6% of CSMs.

following the Wave 1 interview. As expected, deaths are disproportionately concentrated among very young children and older people. A comparison of the age distribution of the deceased in NIDS with the death notification data from Stats SA looks reasonable, although the number of deaths of children under the age of two is substantially lower in NIDS than in the death notification data. The bottom panel of Figure 1 presents the log odds of dying by age at Wave 1 separately for females and males. In most settings, the log odds of dying increase linearly with age in adulthood (Deaton 2003). The NIDS data show the typical decrease in mortality after early childhood and then roughly linear increases from age 15 onwards, but also exhibit a distinct hump between the ages of 20 and 40. This is in line with other South African datasets that show excess mortality in early- to middle-adulthood associated with the AIDS pandemic. The hump of excess mortality clearly peaks about five years earlier for women than for men. This is consistent with HIV prevalence peaking around five years later for men (Karim et al. 2010, Rehle et al. 2007). Overall, female deaths account for 47.9% of all deaths in NIDS, a percentage exactly in line with Stats SA's estimates. It is clear that the gender gap in mortality rates differs over the life cycle. We will return to explore this in more detail in Table 3.

Table 2 presents weighted means for a range of demographic, socioeconomic and health variables measured at Wave 1 by the CSM's vital status at Wave 2. In our analyses, we focus both on the full sample and the subsample of those aged 20 and older, for whom we have data on a range of self-reported health conditions and behaviours together with measured height, weight and blood pressure³. Asterisks in columns 2 indicate whether differences in means between those who were still alive and those who had died by Wave 2 are significant at the 1% (***), 5% (**) and 10% (*) level. Similarly, asterisks in column 3 indicate significant differences between those who were still alive and those whose vital status is unknown at Wave 2. A quick look at Table 2 reveals stark differences between those whose vital status at Wave 2 is unknown and those who were still alive along a range of dimensions. Those with unknown vital status were substantially more likely to be white, male, reside in an urban area and come from smaller households with higher per capita expenditure and level of assets. In contrast, individuals who died between waves lived in households with significantly fewer assets than those who were still alive. Amongst individuals aged 20 and older, compared to those who are still alive, individuals whose vital status is unknown and those who had died had, on average, 1.1 years more and 1.8 years less education respectively. Adults who died were significantly less likely to be married and more likely to be widowed than those adults known to still be alive.

In Wave 1, respondents were asked to describe their health over the past 30 days as either excellent, very good, good, fair or poor. Responses were coded from 1 for excellent to 5 for poor. We construct dichotomous indicators of the five health categories. Compared to those known to be alive, individuals who died between waves were significantly less likely to report very good or excellent health and significantly more likely to report fair or poor health. In contrast, those whose vital status is unknown report significantly better health. For example, the percentage of individuals reporting poor health is 4.7% for those known to be alive, 17.1% for those who died between waves and 2.9% for those whose vital status is unknown.

In addition to the question about general health status, the NIDS adult questionnaire asked detailed information about chronic conditions and various health-related behaviours. For individuals aged 20 and older, we present means for a range of measured and observed health indicators. Respondents were asked whether they had ever been told by a health

³The adult questionnaire is administered to all individuals aged 15 and older. We selected age 20 as our cut off as this is the minimum age for the WHO body mass index categories. All our results are robust to cut-offs of 15 or 18 years of age.

professional that they had any of the following chronic conditions: Diabetes, Tuberculosis, High blood pressure, Stroke, Asthma, Heart condition and Cancer. The survey also asked whether respondents had experienced any of a list of 24 symptoms and illnesses in the 30 days preceding the Wave 1 interview. We create indicators for reporting at least one chronic condition and for reporting at least one symptom of ill health. The survey included the ten questions that make up the Center for Epidemiologic Studies Short Depression Scale (CES-D 10) (Radloff 1997). These questions ask about feelings and behaviours over the past month and are used to construct a scale that measures a continuum of symptoms of depression and anxiety, with higher scores indicating greater risk for depression⁴. The questionnaire included questions about whether the respondent had any sort of difficulty (measured as 'they can do with difficulty', 'can do only with help' or 'can't do') in carrying out 11 activities of daily living (ADLs) such as dressing, bathing, walking up a flight of stairs and carrying heavy objects. We create a count of the number of ADLs the respondent has any sort of difficulty in executing.

Consistent with self-reported health, 37% of those who died between waves, 14% of those whose vital status is unknown and 22% of those known to be alive reported being diagnosed with at least one of these chronic conditions. Similarly, compared to those known to be alive, the deceased were significantly more likely, and those with unknown status significantly less likely, to report at least one symptom of ill health. The deceased are at significantly higher risk for depression than those who are known to be alive. In contrast, those whose vital status is unknown report fewer symptoms of depression and anxiety. On average, the deceased reported a greater number of limitations with ADLs than others.

The NIDS adult questionnaire includes a range of questions on lifestyle behaviours such as smoking and drinking. Thirty percent of the deceased and those with unknown vital status reported smoking at Wave 1. This is significantly higher than the 20% of individuals known to be alive. We create an indicator that the respondent consumes alcohol at least once a week. The deceased were not more likely to report regular drinking than those still alive, but those with unknown status were about twice as likely to report regular drinking.

In addition to self-reports of health conditions and behaviours, NIDS measured the height, weight and blood pressure of all adult respondents. Following the WHO, we classify individuals into standard categories based on their body mass index (weight in kilograms divided by the square of height in metres)⁵. Individuals with a measured systolic blood pressure in excess of 179 or a diastolic blood pressure of 109 were classified as having severe hypertension. A significantly higher proportion of the deceased were classified as underweight in Wave 1 than those known to be alive and with unknown vital status. The deceased and those with unknown status are significantly less likely to be classified as obese than those who are known to be alive. While this may appear counter-intuitive, obesity in South Africa has been shown to be positively correlated with a range of markers for socioeconomic status, particularly amongst Africans (Ardington and Case 2009). Around 9% of the deceased were classified as severely hypertensive as opposed to 5% of those known to be alive and 3% of those with unknown vital status.

Item response rates on all variables in Table 2, other than obesity and hypertension, are upwards of 99%. Valid body mass index (BMI) and blood pressure measurements are available for 86% and 88% of individuals aged 20 and older, respectively. In order to avoid selection issues in our analyses, all individuals are included and indicators that the obesity

⁴See Radloff (1997) for guidelines on constructing the score.

⁵Individuals with body mass indices (BMIs) below 18.5 are classified as underweight. Individuals with BMIs in the ranges 18.5–25, 25–30, 30–40 and 40 plus are classified as normal weight, overweight, obese and morbidly obese respectively.

and hypertension variables are missing are added to the regressions. All results are robust to estimation on the restricted sample of respondents for whom we have valid BMI and blood pressure measurements.

Overall, individuals whose vital status at Wave 2 is unknown appear to have higher socioeconomic status and better health at Wave 1 than those who were confirmed to still be alive. In contrast, the deceased come from households with fewer assets, have less education and significantly worse health measured on a range of dimensions. This would suggest that the mortality rate amongst those whose vital status is unknown is likely to be significantly lower than among those whose vital status was confirmed at Wave 2.

There are marked differences in the age profile of NIDS respondents by sex and population group and many of the socioeconomic and health variables presented in Table 2 are highly correlated with age. Given the age profile of mortality presented in Figure 1, it is more informative to compare mortality rates across sex and population groups and to examine the socioeconomic and health correlates of mortality in a multivariate context, where we can control for the confounding effect of age. Table 3 presents selected odds ratios from logistic regressions of an indicator that the respondent is deceased at Wave 2 on a range of demographic and socioeconomic variables. A quartic in age was included in each regression. Robust standard errors that allow for correlation in the unobservables for individuals drawn from the same primary sampling unit are presented below the odds ratios. Regressions are weighted using the Wave 1 post-stratification weights and exclude individuals whose vital status at Wave 2 is unknown. The first regression in Table 3 shows that females have 38% lower odds of dying between the waves of NIDS once we control for age. Age-adjusted mortality rates are significantly lower for whites compared to Africans, although the coefficient is only significant at the 10% level. It is clear from the second panel of Figure 1 that the gender gap in the odds of dying changes over the life cycle. The regression in the second column of Table 3 includes interactions between the indicator for female and indicators that the individual is in one of four age categories (0–19, 20–39, 40–59 or 60 and older). The mortality differential is initially insignificant and then increases with age. Pension-aged women have 40% lower odds of mortality than pension-aged men. The regressions in the third column include an indicator that the individual lived in an urban area, a count of household assets, the logarithm of per capita household expenditure and household size. Once we control for socioeconomic status, racial differences in the probability of dying are no longer significant. Individuals living in an urban area have significantly higher odds of mortality. Assets appear to be protective, with each additional asset associated with 5% lower odds of dying. In regressions that do not include assets (not shown but available on request), higher per capita household expenditure is also associated with lower probability of death. In the final column of Table 3, the sample is restricted to individuals aged 20 and older and we examine the association between death and educational attainment and marital status. Married individuals have significantly lower mortality risk, particularly relative to individuals who have never married or who are widowed. Education appears to be protective with each additional year of education associated with a 2.5% decrease in the odds of death between waves.

Figure 2 examines the association between education, age and mortality in more detail. The figure presents non-parametric locally weighted regressions of years of completed education on age, separately for those who are known to be alive at Wave 2, those who died between waves and those whose vital status is unknown for all individuals aged 20 to 60 at Wave 1. We see that at every age, those who are deceased by Wave 2 have a lower level of education at Wave 1 than those who are alive or those whose vital status is unknown. Until age 30, there is little difference in years of completed education between those who are known to be alive and those whose vital status is unknown. After age 30, those with unknown vital status

have higher levels of education at every age. These patterns in education by age reinforce our assumption that mortality rates are likely to be lower amongst those whose vital status is unknown. Using longitudinal data with cause of death information from rural KwaZulu-Natal, Ardington et al (2012) find that individuals who die of AIDS have significantly lower levels of education. In Figure 2, the gap in educational attainment between the deceased and those known to be alive is widest in early- to middle-adulthood, the age at which the vast majority of AIDS deaths occur.

Although the death rate between the first two waves of NIDS is slightly higher than that suggested by national estimates, our evidence suggests that individuals whose vital status is unknown are less likely to be deceased than individuals whose vital status at Wave 2 is known. This would result in NIDS estimates being in line with those from Statistics South Africa. The age and sex profile of mortality is also broadly consistent with official death notification data. For these reasons, selection issues are unlikely to seriously bias our analysis of the relationship between health status and mortality.

3. Health status and mortality

We now turn to examine the relationship between various indicators of health status measured at Wave 1 and death before Wave 2. Specifically, we investigate whether self-reported health is predictive of mortality between waves. We begin by investigating the correlates of self-reported health.

3.1. Correlates of self-rated health

Figure 3 presents non-parametric locally weighted regressions of an indicator that the individual reported poor or fair health on age separately by vital status at Wave 2. For all three groups, older people tend to report worse health. At every age, those who died between waves were more likely to report poor or fair health. The gap in self-reported health between the deceased and those known to be alive is widest for the oldest respondents. This is consistent with studies that find that the risk of death associated with poor self-rated health is highest among the elderly (Mossey and Shapiro 1982). The gap in self-reported health between the deceased and the living is narrowest in the early twenties, an age where the majority of deaths due to unnatural causes occur (Stats SA 2011). Consistent with the summary statistics in Table 2, individuals whose vital status is unknown are the least likely at every age to report poor health. Interestingly, when we control for socioeconomic status, differences in self-reported health between those whose vital status is unknown and those whose vital status is known are no longer significant (results not shown).

Before examining whether self-reported health is predictive of mortality, we investigate the correlates of self-reported health in a multivariate context. Table 4 presents selected odds ratios from ordered logistic regressions of self-reported health status on key health, demographic and socioeconomic variables. All the regressions include a quartic in age. Results in the first column show that, controlling for age, the odds of reporting a worse (higher) health status are 16% greater for women than men. Coloureds and Whites report significantly better health than Africans, while Indians tend to report worse health. Both asset ownership and household expenditure are positively associated with better (lower) self-reported health. These results follow the pattern observed in many other countries in which older people and women tend to report worse health, while assets and income appear to be protective (Case and Paxson 2005).

The second column restricts the analysis to those aged 20 and older and includes, as additional controls, educational attainment and indicators for marital status. Those with higher education tend to report better health, even after controlling for age. Each additional

year of education is associated with around 7.5% lower odds of reporting a worse health category. Married individuals report significantly better health than those cohabiting, widowed or never married.

The final regression of Table 4 includes a number of key health indicators. Individuals who have been diagnosed with at least one chronic illness have 3.2 times higher odds of reporting a worse health category than those without a diagnosed chronic condition. Reporting any minor illness or symptoms in the past month, greater limitations in activities of daily living, symptoms of depression and anxiety, and smoking are all associated with worse self-rated health. These findings are consistent with those in other developing countries which find that symptoms of illness and limitations in physical functioning are strong predictors of reporting poor rather than good health (Jylha 2009). We find no association between regular alcohol consumption and poor self-reported health. Severe hypertension also does not appear to have any relationship with self-reported health. Hypertension is typically not associated with any symptoms, so it is perhaps not surprising that it is not correlated with individuals' perception of their health status (Frankenburg and Jones 2004). Overweight individuals tend to report better self-reported health than those who are underweight. Obesity, however, is not associated with self-reported health. The strong positive association between socioeconomic status and obesity in South Africa may explain the lack of association between obesity and self-reported health.

3.2 Self-rated health and mortality

The relationship between self-reported health status and subsequent mortality in other countries is well established (DeSalvo et al. 2005, Jylha 2009). NIDS is the first dataset that allows us to investigate whether self-reported health is predictive of mortality in South Africa. Table 5 presents results from logistic regressions that examine the association between self-reported health and mortality. The first regression includes indicators for the categories of self-rated health with "excellent" as the reference category. Self-reported health status is predictive of two-year mortality with individuals reporting good, fair and poor health having 1.6, 2.5 and 3.5 higher odds of dying than those individuals reporting excellent health respectively. In the second regression, we restrict the sample to those who are aged 20 or older at Wave 1 and find that the odds ratios on the indicators for categories of self-reported health are slightly larger in magnitude for adults than for the full sample.

Several studies in developed countries have documented gender differences in the relationship between self-reported health and mortality, where there is typically a stronger association for men (Benyamini et al. 2003). In the third regression of Table 5 we examine whether the relationship between self-reported health and mortality is the same for men and women by including interaction terms between the self-reported health categories and an indicator that the individual is female. Although none of the interaction terms are statistically significant, the point estimates indicate that self-reported health status is more closely predictive of mortality for men than women. When regressions are run separately by gender (results not shown), the odds ratio for the indicator of fair health is only significant at the 10% level for women. The relationship between reporting poor health and subsequent mortality is highly statistically significant for both men and women. Our finding that gender does not significantly modify the association between self-reported health and mortality is consistent with Frankenburg and Jones (2004)'s results for Indonesia. In the fourth regression we add years of education and controls for household socioeconomic status at Wave 1, namely household size, an indicator that the household is in an urban area, a count of assets and the logarithm of per capita household expenditure. Including the controls for socioeconomic status has very little effect on the odds ratios for the various categories of self-reported health. In the final regression in Table 5, we additionally include the full range of measured and reported health conditions, characteristics and behaviours. While the odds

ratios for self-reported health decrease, they remain significant, suggesting an association between self-reported health and mortality that is unrelated to the domains of health that are captured by our other health variables. All the regressions in Table 5 exclude those whose vital status is unknown. Including these individuals results in very slight decreases in the odds ratios for self-reported health categories, but the substantive conclusions remain.

3.3 Other measures of health and mortality

We now turn to examine the association between mortality between the waves and other indicators of health and health-related behaviours. Table 6 presents selected odds ratios from logistic regressions of an indicator that the individual died between the first two waves of the NIDS panel on a range of health variables. Each regression includes a quartic in age and indicators for sex and population group. In addition, we control for socioeconomic status using the full set of socioeconomic variables included in Table 2. Reporting any chronic condition is associated with double the odds of mortality. In the second regression we include an indicator that the respondent reported one chronic condition and another indicator that they reported more than one chronic condition. Individuals with two or more chronic conditions have almost 3 times higher odds of mortality than individuals reporting no chronic conditions. It is interesting that reports of chronic conditions are predictive of mortality given both the low levels of consistency of these reports across waves and the evidence that knowledge of existing conditions is poor (Ardington and Case 2009, Ardington and Gasealahwe 2012).

Reporting any minor illnesses or symptoms in the past month, greater limitations in activities of daily living and more symptoms of depression and anxiety are all predictive of subsequent mortality even with controls for age, sex, population group and socioeconomic status. The regressions in columns 6 and 7 of Table 6 analyse the association between smoking and drinking and subsequent mortality. We find no evidence of an association between these behaviours at Wave 1 and subsequent mortality.

The final two columns of Table 6 present the association between two measured, rather than reported, health status indicators and subsequent mortality risk. Although the point estimate indicates higher odds of mortality for those with severe hypertension, the odds ratio is not statistically significant. This is in contrast to findings from Indonesia, where moderate hypertension was associated with significantly higher odds of death (Frankenberg and Jones 2004). Our analysis necessarily focuses on all-cause mortality, and it unlikely that hypertension would be predictive of deaths due to non-natural causes. We do not have data on cause of death but official death notification data show cerebrovascular diseases to be a leading cause of death amongst those aged 50 and older (Statistics South Africa 2011). Restricting the sample to individuals aged 50 and older, we find that exhibiting severe hypertension in Wave 1 is associated with 1.9 times higher odds of mortality by Wave 2 (results not shown, but available on request).

Relative to those who are normal weight, underweight individuals have more than twice the odds of death. Obesity is not significantly associated with mortality, even after controlling for socioeconomic status. Interestingly, the point estimates suggest that obesity is associated with lower mortality. These results for BMI categories are not inconsistent with international evidence. In a meta-analysis of 97 population based studies, Flegal et al. (2013) found that while morbid obesity was associated with higher mortality, grade 1 obesity (BMI between 30 and 35) was not, and overweight was associated with significantly lower mortality.

4. Conclusions

This paper exploits the rich data in the NIDS panel to explore the relationship between mortality, socioeconomic status and self-rated health for the first time in South Africa. Although the death rate between the first two waves of the panel is slightly higher than that suggested by national estimates, results from NIDS are broadly consistent with the official death notification data. As expected, we find evidence of a hump of excess mortality in early to middle adulthood associated with the AIDS pandemic, with the excess peaking earlier for women than for men.

We find evidence of a socioeconomic gradient in mortality with higher rates of mortality for individuals from asset-poor households and with lower levels of education. The gap in educational attainment is widest in the age range where AIDS is the leading cause of death. These results are consistent with Ardington et al. (2012) who document a strong socioeconomic gradient for AIDS deaths in particular.

In line with results from many industrialized countries and the few studies from developing countries, we find self-rated health to be a significant predictor of two year mortality, even after controlling for a number of key health indicators and other demographic and socioeconomic covariates. This study confirms the usefulness of self-rated health in assessing and monitoring health inequalities, examining the relationship between health, poverty and income inequality and identifying vulnerable groups. Diagnosed chronic conditions, recent illness, symptoms of depression and anxiety and limitations with activities of daily living are all associated with higher two year mortality risk.

With additional waves of the NIDS, we will be able to examine the correlates of changes in measured and reported health status and investigate whether changes in self-reported health between waves predict future deaths.

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Figure 1.
Age distribution of Wave 1 respondents by Wave 2 vital status and log-odds of dying by age at Wave 1

Figure 2.
Years of education by age and vital status at Wave 2

Figure 3.
Self reports of poor or fair health by age and vital status at Wave 2

Table 1

Status of Wave 1 permanent sample members at Wave 2

	Status at Wave 1:					
	Interviewed		Not interviewed		Total	
	N	%	N	%	N	%
Status at Wave 2:						
Alive						
Interviewed	19,281	77.00	1,873	58.42	21,154	74.89
Not interviewed	1,090	4.35	396	12.35	1,486	5.26
Dead	728	2.91	161	5.02	889	3.15
Unknown	3,942	15.74	776	24.20	4,718	16.70
Total	25,041	100	3,206	100	28,247	100

Table 2

Socio-economic status and health characteristics by vital status at Wave 2

	Alive	Dead	Unknown
<i>Demographic and socioeconomic status:</i>			
Female	0.550	0.483	** 0.504 ***
African	0.843	0.854	*** 0.674 ***
Coloured	0.076	0.079	* 0.105 *
Indian/Asian	0.021	0.008	0.032
White	0.060	0.059	0.189 ***
Urban	0.539	0.548	0.723 ***
Household size	5.607	5.168	** 4.087 ***
Assets	6.716	5.790	*** 7.414 **
Logarithm of per capita household expenditure	6.228	6.186	6.759 ***
<i>Individuals aged 20 and older:</i>			
Years of education	8.482	6.680	*** 9.592 ***
Married	0.375	0.292	*** 0.357
Living with partner	0.095	0.117	0.132 **
Widowed	0.087	0.180	*** 0.053 ***
Divorced	0.034	0.033	0.056 **
Never married	0.409	0.378	0.402
<i>Health Status:</i>			
Self-reported health status	2.169	2.978	*** 2.042 ***
Self-reports excellent health	0.365	0.180	*** 0.388
Self-reports very good health	0.282	0.211	*** 0.311
Self-reports good health	0.217	0.230	0.200
Self-reports fair health	0.089	0.208	*** 0.072 **
Self-reports poor health	0.047	0.171	*** 0.029 ***
<i>Individuals aged 20 and older:</i>			
Any chronic conditions	0.261	0.451	*** 0.184 ***
Any symptoms/illness in last 30 days	0.613	0.698	** 0.526 ***
Score on CES-D10 depression scale	8.220	9.367	*** 7.492 ***

	Alive	Dead	Unknown
Number of difficulties with Activities of Daily Living	0.339	0.956 ***	0.244 **
Smoker	0.204	0.301 ***	0.303 ***
Drinks alcohol regularly	0.091	0.118	0.171 ***
Severe hypertension (systolic > 179 or diastolic > 109)	0.049	0.093 *	0.029 ***
Underweight (BMI < 18.5)	0.056	0.153 ***	0.047
Normal weight (18.5 <= BMI < 25)	0.404	0.434	0.485 ***
Overweight (25 <= BMI < 30)	0.255	0.215	0.264
Obese (30 <= BMI < 40)	0.237	0.153 ***	0.165 ***
Morbidly obese (BMI >= 40)	0.048	0.045	0.039
Observations - all	20371	728	3942
Observations - aged 20 and older	9997	630	2289

Notes for Table 2: Means are weighted using the Wave 1 post-stratification weights. Asterisks in column 2 indicate whether differences in means between those who were still alive and those who had died by wave 2 are significant at the 1% (***), 5% (**) and 10% (*) level. Similarly, asterisks in column 3 indicate significant differences between those who were still alive and those whose vital status is unknown at Wave 2.

Table 3

Demographic characteristics, socio-economics status and mortality

	Dependent variable: Deceased at Wave 2			
	All	All	All	Aged 20 and older
Female	0.621 *** (0.073)			
Coloured	0.855 (0.130)	0.850 (0.130)	0.824 (0.103)	0.872 (0.113)
Indian	0.304 (0.225)	0.309 (0.230)	1.030 (0.415)	0.935 (0.402)
White	0.500 * (0.202)	0.496 * (0.201)	0.663 (0.187)	0.604 * (0.169)
Female × aged 0–19		1.005 (0.253)	1.067 (0.185)	
Female × aged 20–39		0.778 (0.142)	0.991 (0.136)	0.662 *** (0.095)
Female × aged 40–59		0.374 *** (0.073)	0.424 *** (0.056)	0.411 *** (0.056)
Female × aged 60 plus		0.590 ** (0.149)	0.521 *** (0.071)	0.360 *** (0.055)
Urban			1.276 *** (0.113)	
Household size			1.003 (0.016)	
Assets			0.946 *** (0.013)	
Logarithm of per capita household expenditure			0.939 (0.058)	
Living with partner				1.875 *** (0.302)
Widowed				2.264 *** (0.319)
Divorced				1.617 * (0.412)
Never married				2.050 *** (0.258)
Years of education				0.975 ** (0.012)
Observations	21,083	21,083	21,083	10,530

Notes to Table 3: Table presents selected odds ratios from logistic regression models. Each regression includes a quartic in age. Robust standard errors that allow for correlation in the unobservables for individuals drawn from the same primary sampling unit are presented below the odds ratios in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Regressions are weighted using the Wave 1 post-stratification weights. Regressions exclude individuals whose vital status at Wave 2 is unknown.

Table 4

Self-reported health status – demographic, socioeconomic and health correlates

	Dependent variable: Self-reported health		
	All	Aged 20 and older	Aged 20 and older
Female	1.163 *** (0.049)	1.355 *** (0.074)	1.068 (0.072)
Coloured	0.727 *** (0.078)	0.835 (0.109)	0.868 (0.130)
Indian	1.454 *** (0.275)	1.695 *** (0.214)	1.639 *** (0.231)
White	0.679 *** (0.132)	0.862 (0.176)	1.004 (0.174)
Urban	1.096 (0.116)	1.224 * (0.132)	1.013 (0.100)
Household size	0.995 (0.010)	1.014 (0.010)	1.013 (0.010)
Assets	0.978 * (0.012)	0.985 (0.013)	0.986 (0.013)
Logarithm of per capita household expenditure	0.910 * (0.044)	0.958 (0.050)	0.971 (0.048)
Years of education		0.924 *** (0.008)	0.942 *** (0.008)
Living with partner		1.467 *** (0.196)	1.282 ** (0.156)
Widowed		1.383 *** (0.144)	1.200 * (0.122)
Divorced		1.030 (0.182)	0.909 (0.220)
Never married		1.301 *** (0.114)	1.203 ** (0.104)
Any chronic conditions			3.198 *** (0.210)
Smoker			1.044 (0.087)
Regular alcohol drinker			0.912 (0.108)
CES-D 10 score			1.055 *** (0.008)
Number of difficulties with activities of daily living			1.281 *** (0.030)
Any minor illnesses/symptoms			2.736 *** (0.186)
Severe hypertension			1.067 (0.131)
Underweight (BMI < 18.5)			1.132 (0.132)
Overweight (25 <= BMI < 30)			0.860 * (0.071)
Obese (30 <= BMI < 40)			1.034 (0.081)
Morbidly obese (BMI >= 40)			0.944 (0.163)
Observations	20,984	10,468	10,487

Notes to Table 4: Selected odds ratios from ordered logistic regressions. Each regression includes a quartic in age. Robust standard errors that allow for correlation in the unobservables for individuals drawn from the same primary sampling unit are presented below the regression coefficients in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Regressions are weighted using the Wave 1 post-stratification weights. Regressions exclude individuals whose vital status at Wave 2 is unknown. Regression in column 3 includes indicators that BMI and blood pressure measurements are missing.

Table 5

Self-reported health status and mortality

	Dependent variable: Deceased at Wave 2				
	All	Aged 20 and older	Aged 20 and older	Aged 20 and older	Aged 20 and older
Very good self-reported health	1.348 (0.265)	1.457 (0.368)	1.630 (0.587)	1.418 (0.355)	1.389 (0.350)
Good self-reported health	1.588** (0.329)	1.614* (0.400)	1.647 (0.568)	1.525* (0.374)	1.385 (0.360)
Fair self-reported health	2.483*** (0.550)	2.627*** (0.665)	3.398*** (1.154)	2.369*** (0.608)	1.706** (0.444)
Poor self-reported health	3.538*** (0.748)	3.700*** (0.916)	4.449*** (1.483)	3.179*** (0.771)	2.085*** (0.553)
Female × Very good self-reported health			0.751 (0.364)		
Female × Good self-reported health			0.907 (0.400)		
Female × Fair self-reported health			0.563 (0.260)		
Female × Poor self-reported health			0.655 (0.315)		
Controls for socioeconomic status	No	No	No	Yes	Yes
Controls for health characteristics	No	No	No	No	Yes
Observations	20,984	10,541	10,541	10,468	10,418

Notes to Table 5: Selected odds ratios from logistic regressions. Each regression includes a quartic in age, an indicator that the individual is female and indicators for population group. Robust standard errors that allow for correlation in the unobservables for individuals drawn from the same primary sampling unit are presented below the regression coefficients in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Regressions are weighted using the Wave 1 post-stratification weights. Regressions exclude individuals whose vital status at Wave 2 is unknown. The regressions in columns 4 and 5 include controls for years of education, indicators for marital status, an indicator that the individual lives in an urban area, a count of household assets, the logarithm of per capita household expenditure and household size. The regression in column 5 includes additional indicators for any chronic conditions, severe hypertension, BMI categories, any minor illnesses, smoking, regularly drinking alcohol, score on the CESD10 depression scale, the number of problems with activities of daily living and indicators that BMI and blood pressure measurements are missing.

Table 6

Health indicators, health-related behaviours and mortality

	Dependent variable: Deceased by Wave 2					
Any chronic conditions	2.055*** (0.338)					
One chronic condition	1.817*** (0.317)					
More than one chronic condition	2.934*** (0.611)					
Any minor illnesses/symptoms	1.353* (0.231)					
CES-D10 score		1.031** (0.013)				
Number of difficulties with Activities of Daily Living		1.209*** (0.042)				
Smokes			1.299 (0.227)			
Ex smoker			1.103 (0.305)			
Drinks alcohol regularly			1.010 (0.229)			
Severe hypertension				1.368 (0.391)		
Underweight (BMI < 18.5)					2.136*** (0.404)	
Overweight (25 <= BMI < 30)					0.858 (0.175)	
Obese (30 <= BMI < 40)					0.700 (0.154)	
Morbidly obese (BMI >= 40)					0.942 (0.327)	
Observations	10,530	10,530	10,494	10,515	10,509	10,530

Notes to Table 6: Select odds ratios from logistic regression models. Each regression includes a quartic in age, an indicator for sex and indicators for population group. Robust standard errors that allow for correlation in the unobservables for individuals drawn from the same primary sampling unit are presented below the regression coefficients in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Regressions are weighted using the Wave 1 post-stratification weights. Regressions exclude individuals whose vital status at Wave 2 is unknown and are restricted to individuals aged 20 and older. All regressions include the following controls for socioeconomic status: years of education, indicators for marital status, an indicator that the individual lives in an urban area, a count of household assets, the logarithm of per capita household expenditure and household size. Regressions in columns 8 and 9 include indicators that blood pressure and BMI measurements are missing respectively.