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What are the relationships between aging, depression, non-communicable diseases and disabilities in South Africa?

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Abstract

This is the first study that offers a comprehensive analysis of depression among the old (60+ years) in South Africa, using the four waves of the South Africa National Income Dynamics Study (SA-NIDS) during 2008-2014. A state-of-art econometric methodology has been used to unravel the factors underlying depression among the old over the period 2008-2014. Our study methodologically builds upon the (sparse) extant literature on aging and depression in the following ways. (i) Available studies often use stepwise regression with frequent changes in the significance of the explanatory variables. In contrast, we rely on a comprehensive specification. (ii) Endogeneity of explanatory variables (eg non-communicable diseases (NCDs), limitations in carrying out activities of daily living (ADLs) or disabilities, and body mass index (BMI) categories) is often overlooked and the estimation bias is ignored in the interpretation of the results. We circumvent this problem by working with initial values of morbidity, disabilities, and BMI categories. (iii) As there are interrelationships between morbidity, obesity, and disabilities, we use three alternative specifications with initial value(s) of each in one specification. (iv) Depending on whether the dependent variable is binary (self-reported depression for ≥3 days in a week) or continuous (as in two indices of depression), we use random effects probit with Mundlak adjustment or simply random effects with Mundlak adjustment. Among the old, those more likely to be depressed are in their sixties, Black Africans, Coloureds or women. They are more likely to be suffering from multimorbidity, multiple limitations in ADLs, to be in lower asset quartiles, or to have recently suffered a family bereavement. Factors that attenuate depression include marriage, pension, affluence, and trust in a community and familiar neighbourhoods. An important feature of our study is the robustness of the key results.

Keywords

Aging, Depression, Multimorbidity, DADLs, BMI, South Africa

JEL Codes

I12, J13, J18

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1. Introduction

Although there has been a surge in the literature on self-reported health status, non-communicable diseases (NCDs) and activities of daily living (ADL) limitations among the old (aged 60 years or more), few studies have examined the complex relationships between depression, NCDs and ADL limitations[1]. Besides, the methods used to examine these links lack analytical rigour. NCDs and ADL limitations are often used as explanatory variables without correcting for their endogeneity (eg Alaba and Chola, 2013). For example, cardiovascular disease and diabetes are associated with obesity, which itself is caused by diets rich in carbohydrates and fats and sedentary lifestyles[2,3]. Yet another issue is that often more than one disease and ADL limitation have more serious implications for health and wellbeing of the elderly[4,5,6].

The number and proportion of persons aged 60 years or more in South Africa rose during 1996-2011. The population of older South Africans grew at a much faster rate. Projections show that their proportion is likely to double by 2030. The proportion of elderly White South Africans rose at the fastest rate, followed by Indians/Asians/Others, and Coloured[7] and Black Africans. Older Black Africans have worse health outcomes than those from other racial groups.

Old age is often characterised by poor health due to isolation, morbidities and disabilities in carrying out activities of daily living (DADLs) leading to depression[8,9].

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[1] For an important contribution among others, see Steptoe et al (2015).

[2] Along with a dramatic change in age structure, there is evidence of a characteristic sequence of changes in dietary behaviour and physical activity patterns that lead to increased risk of chronic disease. This has been called the "nutrition transition" and appears to be occurring rapidly and predictably in countries throughout the world. Although overall nutrient intake adequacy improves with an increasing variety of foods, the movement toward more fats, sugars and refined foods quickly moves beyond this more optimal state to one in which diets contribute to rapidly escalating rates of obesity and chronic disease (Tucker and Buranapin, 2001).

[3] To many black women, being overweight is a desirable. This belief is now exacerbated by the idea that being thin can be equated with HIV/AIDS virus infection. Further confirmed in data from the urban township, obese and overweight women believed that their body size reflected on a husband's ability to care for his wife and family (Puoane, Bradley and Hughes, 2005).

[4] For an analysis of mental disorders, several chronic diseases are considered one at a time (eg Scott et al 2007).

[5] WHO (2015) is emphatic that "… since ageing is also associated with an increased risk of experiencing more than one chronic condition at the same time (known as multimorbidity), it is simplistic to consider the burden from each of these conditions independently. The impact of multimorbidity on an older person's capacity, healthcare utilisation and their costs of care is often significantly greater than might be expected from the summed effects of each condition".

[6] Multimorbidity affects a substantial number of people in South Africa. In addition, the poor bear a significantly greater burden of multimorbidity in illness and disability (Ataguba, 2013).

[7] Coloured is a recognised population group in South Africa, used as an official category by government agencies, including Statistics South Africa. It denotes a multiracial ethnic group originating in colonial South Africa, who have ancestry from African (Khoisan and Bantu), European, and sometimes also Asian (Austronesian and South Asian) ethnic groups.

[8] With age, declining renal function leads to malabsorption of calcium and accelerated bone loss. Requirements for vitamin D also increase with aging. The low calcium and vitamin D in the diets of many developing countries, together with the dietary and physical activity changes associated with the nutrition transition, suggest that osteoporosis will become an increasingly major problem as these populations age (Tucker and Buranapin, 2001).

Mental disorders – in different forms and intensities – affect most of the population in their lifetime. In most cases, people experiencing mild episodes of depression or anxiety deal with them without disrupting their productive activities. A substantial minority of the population, however, experiences more disabling conditions such as schizophrenia, bipolar disorder type I, severe recurrent depression, and severe personality disorders. Accordingly, a more nuanced and accurate picture of the mental health-related burden is crucial to effective allocation of resources and appropriately designed health systems in response to the nature and the scale of these challenges (Vigo et al 2016).

Motivated by these concerns, the present study focuses on the determinants of depression among the old (≥60 years) in South Africa. Much of the recent literature offers an assessment of the influence of demographic, ethnic, living arrangements, marital status, morbidity, ADL limitations (or DADLs) but in a piecemeal and *ad hoc* manner using a specification that is neither comprehensive nor rigorous. Often odds ratios are computed using logit or probit models in a step-wise manner and scant attention is given to endogeneity of some of the key explanatory variables such as morbidity and DADLs. Besides, several studies rely on a single cross-section or a single wave of the National Income Dynamics Study (SA-NIDS) which doesn't allow incorporation of individual unobservable effects. Such effects are potentially significant as it is frequently observed that there is considerable variation in depressive symptoms even when old persons suffer from a common NCD and DADL.

Our study aims to overcome these difficulties by relying on a comprehensive specification. To circumvent the endogeneity of morbidity and DADLs, their initial values are used. A random effect probit model with Mundlak's (1978) adjustment is used after due validation. The analysis is based on a rich panel data set with 4 waves of National Income Dynamics Study for 2008, 2010, 2012 and 2014 (SA-NIDS (2016a, b, c, d)). To the best of our knowledge, this is the first econometric analysis of depression that utilises all four waves of the panel survey[10]. Many of the key findings are robust.

The present study is structured as follows. In Section 2, we discuss the salient facts of aging and health in the South African economy. This is followed by a review of recent regional and South African studies of aging, multimorbidity, disabilities, and depression in Section 3[11]. Section 4 is devoted to discussion of data and descriptive statistics of depression by age, gender, race, multimorbidity, disabilities, socioeconomic status and other covariates. Section 5 discusses the variable construction and rationale of the econometric specifications used. The results are presented and interpreted in Section 6. Section 7 discusses the main contributions of our study in light of the extant literature

[9] For most recent global, regional and national estimates of depression, see WHO (2017).
[10] This is part of a larger study that aims to examine the linkage between self-reported health status, depression, NCDs, ADL limitations, ethnicity, gender, age, assets, education, cushioning role of psychosocial resources (self-esteem, family support, community networks and social cohesion), living arrangements, and pensions.
[11] We also cite a few other studies unrelated to South Africa but enrich the literature review with their powerful insights.

and limitations of the econometric analyses. Section 8 summarises the key findings from a broader policy perspective.

2. Salient Facts

South Africa faces a quadruple disease burden, including poverty-related diseases, non-communicable diseases, injuries and HIV/AIDS. Poverty, violence, rapid social and economic changes, lack of education, inadequate services and urbanisation contribute as much to increasing cases of non-communicable diseases as they do to HIV, tuberculosis, and other communicable diseases (Puoane, Bradley and Hughes, 2005).

Population ageing will be the major driver of projected increases in the disease burden in older people, most evident in low-income and middle-income countries and for strongly age dependent disorders (dementia, stroke, chronic obstructive pulmonary disease, and diabetes). These are also the disorders for which chronic disability makes a substantial contribution (Prince et al 2015).

The phenomenon of aging is clearly visible in South Africa. The percentage of the population aged 60 years and above rose between 1996-2011 (Stats SA, 2014) [12,13]. Moreover, the population of older South Africans is growing at nearly double the rate of overall population growth rate and its share is projected to almost double during 2000-2030 because of (i) a marked decline in fertility in the past few decades; (ii) the HIV and AIDS pandemic, with a higher mortality of young adults, especially women of reproductive age; and (iii) a rise in life expectancy to 62 years in 2013 – a staggering increase of 8.5 years since the low of 53.5 in 2005[14].

The composition and distribution of elderly persons reflect noticeable differences between sexes, population groups, ethnic groups and regions. Sex variations show that old age in South Africa is highly feminised. The sex ratio, a key measure of sex composition, increased from 64 to 66 elderly men per 100 elderly women over the period 1996-2011, suggesting an improvement in health among men.

Between 1996-2011, the proportion of elderly persons across population groups grew at different rates. The proportion of elderly Whites increased by 5.7 percentage points and Indians/Asians/Others by 4.8 percentage points, whereas the proportion of elderly Coloured and Black Africans grew by 1.9 percentage points and 0.4 percentage points, respectively.

[12] In this study, individuals 60 years and above are referred to as old, elderly or aged.
[13]This is one of the findings contained in the Profile of Older Persons in South Africa report, which was released by Stats SA at the Population Association of South Africa (PASA) conference in East London on 1 October, 2014. This report, which is based on the three population censuses of 1996, 2001 and 2011, provides valuable information on the demographic and socioeconomic profiles of the elderly population.
[14] As Bloom et al (2015) note, “The world’s population is aging rapidly, and older adults compose a larger proportion of the world’s population than ever before…” (p. 80). They attribute this to three factors: decreasing fertility, increasing longevity and the aging of the large population cohorts.

In South Africa, old Black Africans have worse health outcomes than old people from other racial groups and the gap in health outcomes is even wider among old Black Africans living in rural areas. These aggravated problems are attributed to isolation, poor housing, low income, poor access to healthcare facilities, and the political and economic marginalisation that resulted from apartheid policies.

The available data on living arrangements show that more than half of elderly persons live in extended households. However, there is an upward trend in the prevalence of elderly single-member households (from 16.3% in 1996 to 26.7% in 2011). Sex variations show that the proportion of elderly women living in extended households is higher compared to that of their male counterparts (Stats SA, 2014).

Evidence shows that four in ten elderly persons in South Africa are poor. More than a third make an average living, and the rich constitute about 27%. Provincial variations show that rural provinces have higher proportions of poor elderly persons compared to those residing in the urban provinces. Racial differences show that elderly Whites and Indians/Asians/Others occupied a higher socioeconomic status than Black Africans and Coloureds.

The proportions of rich White elderly persons were far higher than those of Black African elderly persons and Coloureds. There were also striking disparities of educational attainment among population groups. A high level of illiteracy is more prevalent among Coloured and Black African elderly persons. In 2011, just under a third (28.4%) of elderly Whites had attained a higher education compared to 8.2% of Indians/Asians/Others, 3.6% of Coloureds and 2.5% of Black Africans.

Our analysis also corroborates that between 2008- 2014, the prevalence of depression (persons depressed for three or more days in a week) was reduced from 15.3% to 14.5%, with a dip to 12.6% in 2010. In each of the years, more women were depressed than men. In 2014, for example, the share of women among the depressed was twice that of men (see Tables 1 and 2 and Figure 1). The share of Black Africans among the depressed was highest but it declined during 2008-2014. The second largest group comprised Whites whose share jumped from 8.4% to 20.2% (Table 2). Five wealth quintiles were constructed using principal components analysis. The bottom two quintiles accounted for 61.6% of the depressed in 2008 but their share dropped to 20.4% in 2014. In sharp contrast, the share of the fifth quintile rose from 12.4% to 34.1%[15] (Table 8).

3. Literature Review

As there are few studies of depression in South Africa, and none rigorously examining the linkages between depression, multimorbidity (including limitations of ADLs), and

[15] In a comparative analysis of India and South Africa, Case and Deaton (2005) report that the economically better-off South Africans are healthier in some respects, but not in others. They are taller and heavier, but their self-assessed health is no better; they suffer from depression and anxiety to about the same degree; they have a remarkably similar pattern of prevalence of various health conditions; and both adults and children in South Africa are more likely to go without food for lack of money.

other covariates including age, ethnicity, living arrangements, family shocks, pension and crimes in the neighbourhood, the review below draws upon some important contributions from several regions and different countries[16].

Haroz et al (2016) sought to consolidate the information gathered from decades of open-ended qualitative research, in order to characterise how depression is expressed and experienced in a wide variety of populations. Based on a systematic review of qualitative studies, they found that most research on depression conducted among non-Western populations had used measurement instruments and diagnostic criteria based on the Diagnostic and Statistical Manual of Mental Disorders (DSM) and International Classification of Diseases (ICD). The DSM-5 diagnostic criteria for Major Depressive Disorder (MDD) were reported across all regions, genders and sociocultural contexts. Most other frequently described features also appear in the DSM-5 as associated features of MDD. Across all regions, features of depressed mood/sadness, fatigue/loss of energy, problems with sleep, appetite/weight problems, suicidal thoughts, loss of interest, and worthlessness/guilt were commonly reported in qualitative studies of depression, with irritability also frequent to a lesser degree than the other features. Most of the remaining frequently described features also appear in the DSM-5 as associated features of MDD.

Haroz et al (2016) reveal that four of the most frequently mentioned ubiquitous features across studies were not part of DSM-5 diagnostic criteria: social isolation/loneliness, crying, anger and general pain. In contrast, other DSM-5 diagnostic features were not frequently reported in the global literature, specifically, problems with concentration and psychomotor agitation or slowing. Moreover, depression in men usually consists of symptoms of anger, impoverished social relationships, emotional numbness, impulse control difficulties, irritability, aggression, substance use and suicide. Women also commonly report anger as a symptom of depression.

These findings point to a review of the content of standard instruments beyond their current focus on DSM diagnostic criteria, to more accurately reflect the experience of depression worldwide and particularly for non-Western populations[17].

In the South African context, some studies have investigated associated factors of depression among the old. For instance, Thapa et al (2015), and Peltzer and Phaswana-Mafuya (2013) used 2008 Wave 1 Study of Global Ageing and Adult Health

[16] In a recent overview of different models of depression, Tacchi and Scott (2017) observe that there is no one cause and no single pathway to depression. Whether or not someone at risk of depression actually develops the disorder is partly determined by whether they are exposed to certain types of life events, the perceived level of distress associated with those events, their ability to cope with these experiences (their resilience or adaptability under stress), and the functioning of their biological stress-sensitive systems (including the thresholds for switching on their body's stress responses).

[17] Kleinman (1991) argues that the hormonal changes characteristic of clinical depression have not been found to be pathognomonic. Indeed, autonomic nervous system and limbic system changes appear to be non-specific to depression and anxiety. Besides, anxiety often accompanies depression, so the two are non-separable. It is difficult to say which is primary. It is more appropriate to think of a continuum of psychobiological responses from "pure" anxiety to "pure" depression, with most cases falling in between.

(SAGE) data to examine factors associated with self-reported symptom-based depression among old South Africans. While both of these studies established that a lack of quality of life was associated with self-reported depression symptoms in the past 12 months, the former found that functional disability and chronic conditions were also predictors of depression. However, these studies suffer from two potentially serious limitations: one, possible endogeneity of functional disability, lack of quality of life and omission of chronic conditions, and two, recall bias may be non-negligible due to 12 months' recall period.

Social capital – the features of social structure such as norms, trusts, and networks that can facilitate collective action for mutual benefit – is considered an important determinant of health, including mental health[18]. Recent reviews point to social capital being an important factor in improving mental health – even in the South African context with strong ethnic divisions. Tomita and Burns (2013) examined the association between neighbourhood-level social capital and individual depression outcomes using a multilevel regression modelling technique. They used data from the first wave of the South African National Income Dynamics Study (SA-NIDS). In this study, depression status was assessed using the self-reported 10-item version scale of the Centre for Epidemiologic Studies Depression (CES-D). The depression score was computed as the sum of the scores of the 10 items, which ranges from 0 to 30. CES-D score was treated as a continuum of psychological distress, with the level of depression increasing with increasing score[19].

Tomita and Burns (2013) used multilevel models to analyse the association between neighbourhood social capital indicators and individual depression outcome, and involved two levels: individual and neighbourhood. Four random intercept models were sequentially fitted. The main findings of the full model, that considered all explanatory variables at individual and neighbourhood levels, were that neighbourhoods with high social capital were significantly associated with lower depression scores in the residents. Social trust and neighbourhood preference were significant predictors of depression but civic participation was not.

Although these are plausible findings, some estimation issues are pertinent. One of these is the endogeneity of some of the explanatory variables, notably self-rated health status. Frequently, it is found to be endogenous to medical conditions (Case and Deaton, 2005). Nor is unemployment exogenous if premised on leisure-work choice. Finally, as noted by the authors themselves, an analysis based on a single cross-section cannot yield causal inferences.

[18] Kawachi and Berkman (2001) argue that social support can either promote a sense of self-efficacy and self-esteem or become "disabling" by reinforcing dependence. Thus social support can have "mixed" effects. Further, the effects of social ties on mental health differ also by gender. Evidence shows that women have significantly higher psychological distress than men, a finding that may be partly explained by gender differences in social network involvement.

[19] These include: 1. I was bothered by things that usually don't bother me; 2. I had trouble keeping my mind on what I was doing; 3. I felt depressed; 4. I felt that everything I did was an effort; 5. I felt hopeful about the future; 6. I felt fearful; 7. My sleep was restless; 8. I was happy; 9. I felt lonely; and 10. I could not "get going".

There is growing consensus that socioeconomic status (SES) plays a significant role in the aetiology of depression, through mechanisms of both increased individual vulnerability and reduced access to protective resources. However, there are few studies of social determinants of mental health from low- and middle-income nations. For instance, Myer et al (2008) examined the association between psychological distress and SES, social support and bonding social capital in a nationally representative sample of South African adults, canvassed between 2002 and 2004. This study also hypothesised that reduced levels of SES, social networks and social capital would each be associated with increased levels of psychological distress, independent of individual demographic characteristics.

In terms of methodological innovation, Myer et al (2008) measured non-specific psychological distress using the Kessler K-10 scale. SES was assessed from an aggregate of household income, individual educational and employment status, and household material and financial resources. Specifically, first an asset index was constructed, and income, education, and employment were added to it. These scores were then standardised and summed to get an aggregate measure of SES.

To assess social support, Myer et al (2008) measured bonding social capital and traumatic life events using five items in the social networks section of the World Mental Health survey schedule. These included items capturing aspects of social support (based on the frequency of contacts with family and friends other than those who are living together) as well as emotional support measures (based on the ability to rely on family or friends if the participant had a problem, the ability of participants to open up to their family or friends, and having someone with whom participants could share private feelings and concerns). These items were summed to form an aggregate scale in which each item received equal weighting. The bonding form of social capital at the individual level was based on four items: (1) how often participants spend time with their neighbours (reflecting community cohesiveness); (2) participants' perceptions of crime in the area (a cognitive measure of social trust); (3) whether the participant knows of local civic groups (such as social clubs or community associations); and (4) whether the participant is a member of any such community group (another measure of community cohesiveness).

Myer et al (2008) used a series of multiple logistic regression models to examine the independent effects of recent traumatic life events, socioeconomic status, social support and social capital on psychological distress. The findings from the most comprehensive model, that includes all social constructs and demographics, indicate that the association between each social construct and psychological distress persisted after adjusting for participant demographic characteristics. However, when all the social constructs were entered into a single model, the association between social support and psychological distress was attenuated after adjustment for joint confounding by SES and social capital. When both recent and traumatic life events were added to this model as putative pathways through which social determinants influenced psychological distress, the associations involving both SES and social capital persisted. Comparing the models with and without adjustment for recent life events,

these events appeared to mediate the associations between SES and psychological distress. However, the occurrence of recent life events was not an intermediate factor in the association between social capital and psychological distress. Levels of social support were less strongly associated with psychological distress; however, there was no evidence of negative life events as a mediating factor.

As in the previous study, use of stepwise regression is problematic as the coefficients from parsimonious specifications change significantly. Hence the coefficients obtained from them are of no importance. Another comment is related to the asset index combining both assets and income. If there is high correlation between them, which we suspect is the case, the asset index on its own would have sufficed.

Lloyd-Sherlock and Agrawal (2014) examined the effect of pensions on self-reported health outcomes and wellbeing in South Africa. Using SAGE data for South Africa, this study noted that pension coverage for people aged 65 and over was 79%, higher than 51% coverage for the population aged 50 and over. This means that the pensioner and non-pensioner household categories are both sufficiently large. Although South Africa does contain a number of contributory schemes, the social assistance old-age grant accounts for a large majority of pension benefits being paid out. The study exclusively focusses on Black South Africans, rather than the full set of racial groups. Although basic healthcare services are generally speaking available, even in relatively poor rural locations, a significant proportion of older South Africans make little or no use of health services.

The authors used pensions of the oldest member of the pension household as the outcome indicators. In most cases, it is likely that this will be the individual within the household who is in receipt of the old-age pension. The selected covariates for the multivariate analysis were: rural/urban status; level of education; household wealth quintile; sex; and five-year age groups (for oldest household member). The inclusion of sex and rural/urban location reflects the widespread evidence that these factors significantly affect health outcomes for older people in South Africa. Level of education was selected as general marker of lifetime socioeconomic status, which can also affect health outcomes. The inclusion of age was particularly important, since this tends to be higher for the oldest members of pensioner households. Wealth quintiles were derived from an index of household ownership of durable goods, dwelling characteristics (type of floors, walls and cooking stove), and access to services (improved water, sanitation and cooking fuel) for a total of 21 assets. Number of outpatient visits in past year was selected to indicate the older people's general level of engagement with healthcare providers. Other indicators include awareness, treatment and control of hypertension status, and a number of self-reported health outcomes (including depression), to enhance comparability with previous studies.

Using multivariate logistic regression analysis, the authors reported that pension status was significantly associated with more frequent outpatient visits, awareness and treatment of hypertensive status, but not control. Rural location was not significantly associated with outpatient visits, but was significantly associated with lower awareness of hypertension. Female sex was associated with healthcare facility utilisation. There

were no significant associations with education or five-year age group, with the exception of the 55-59 age group, which was positively associated with all outcomes other than control. Pension status was not significantly associated with self-reported general health, depression or anxiety. There were no significant associations with any of the other covariates, other than third to fifth wealth quintiles and completed secondary education or more (both associated with higher self-rated health scores).

They also found that although there is a strong intuitive logic that old-age pensions should enhance older people's health status, this effect is contingent on a number of other considerations. These include the extent to which the pension income is retained by the older person or is pooled or appropriated by other household members. Evidence suggests that pension pooling is a widespread practice across developing countries. In many cases, older people appear to pool their pensions voluntarily, and this can enhance their household status. However, there are also indications of pensioner abuse and forced appropriation of benefits. The capacity to convert pension income into better health also depends on the availability of suitable health services – this is often very limited, particularly in rural districts. The study also found some evidence of a short 'honeymoon' effect for self-reported quality of life.

In the South African context, using 1999 Langeberg Survey, Case (2004) examined impact of income, in the form of an old age pension, on households' health outcomes and established that the health status improved for all household members in households that pool income. Along with children's height, and nutritional status (meals missed and hunger), Case (2004) used self-reported health status, ADL limitations, and depression index as measures of health outcomes. The latter health outcome variables are relevant to our study.

Self-reported health status was measured on an ordinal scale ranging from 1=Excellent, to 5=Very Poor. Another variable of interest was number of limitations in the ADLs – measured by counting difficulties of older respondents' in activities such as dressing, bathing, eating, toileting, taking a bus, taxi, or train, doing light work in or around the house, managing money (if they had to), climbing a flight of stairs, lifting or carrying a heavy object, and walking 200-300 meters, If an older respondent reported difficulty with an activity (answering "difficult, but can do with no help," "can do but only with help," or "can't do"), then the respondent was given a value of "1" for having a limitation in that activity. The number of limitations was then summed over all activities. Case (2004) found that limitations in ADLs are significantly correlated with health status.

Case (2004) also quantified depression index as the simple sum of responses from eight questions that were asked of each adult respondents, "how often in the past week they felt that i. they could not stop feeling miserable, ii. felt depressed, iii. felt sad, iv. cried a lot, v. did not feel like eating, vi. felt that everything was an effort, vii. experienced restless sleep, and viii. felt they could not get going". Specifically, for each, if the respondent reported that he or she felt as in i-viii "most of the time", that response was coded as a 1 and 0 otherwise and then the sum was computed that ranged from 0 to 8. The depression index was significantly lower among the pensioners.

4. Data and descriptive statistics

The data used in the present study are drawn from the first four waves of the nationally representative South African National Income Dynamics Study (SA-NIDS) for 2008, 2010, 2012 and 2014 (SA-NIDS (2016a, b, c, d)).[20] These waves constitute a rich panel data conducted every two years since its first wave in 2008. NIDS employs stratified sampling procedures (Chinhema et al (2016), De Villiers et al (2013), Brown et al (2013))[21] and is currently the sole nationally representative panel data source in South Africa. The survey was designed with a key objective to analyse various dimensions of the wellbeing of South Africans over time. SA-NIDS waves collect data on household wealth, individual and household demographics, health, and other socioeconomic characteristics. SA-NIDS captures depression in terms of its duration in a week by asking "please state how often you have felt depressed during the past week" with categorical responses not depressed, depressed for 1-2 days, depressed for 3-5 days, and depressed for 5-7 days in a week. We constructed a depression variable and classified a person ≥60 years as depressed if he/she was depressed for ≥3 days in a week.

Table 1 and Figure 1 depict distributions of depressed among the old (≥60 years) in 2008, 2010, 2012 and 2014. In 2008, about a third of the old were depressed for 1-2 days in a week. This share reduced to a quarter in 2010, marginally increased to 28% in 2012 and then to 31% in 2014. The proportion of old persons with depression for ≥3 days in a week ranged from 13% to 15% in the period 2008-2014 – well over 15% in 2008, 13% in 2010, 14% in 2012, and 14.5% in 2014.

[20]These data were obtained online from www.nids.uct.ac.za/. NIDS data are managed by SALDRU (Southern Africa Labour and Development Research Unit), Cape Town.
[21]More information on sampling design and attrition can be obtained from www.nids.uct.ac.za/ . Last accessed: March 1, 2017.

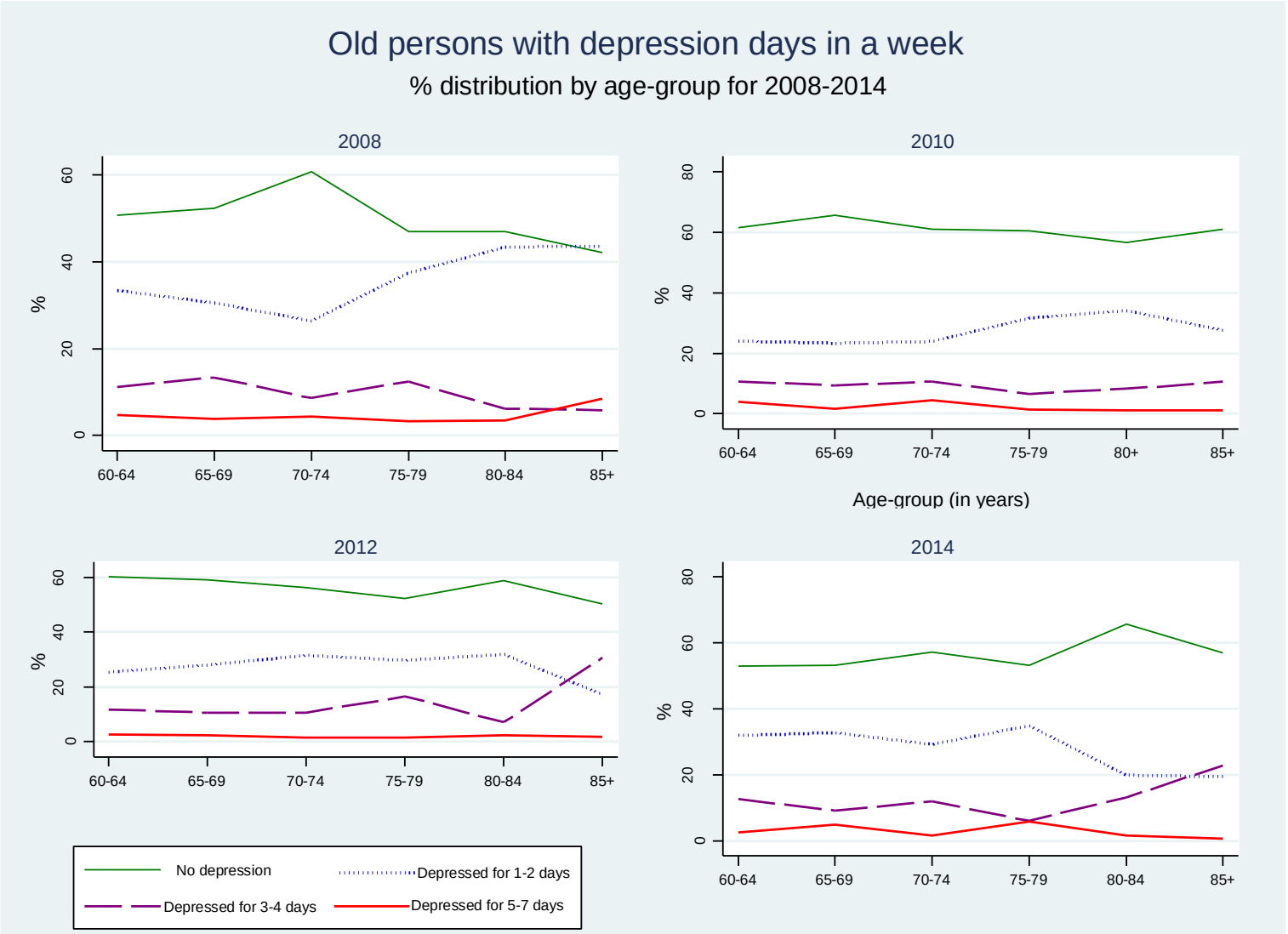
Table 1: % distribution of depression prevalence among old age population by age groups 2008-2014

Age groups	How often you feel depressed in a week?						
Survey Years	Not depressed	1-2 days	3-4 days	5-7 days	<3 days	≥3days	Total
	(C1)	(C2)	(C3)	(C4)	(C5) =(C1) +(C2)	(C6) =(C3) +(C4)	(C7) =(C5) +(C6)
2008							
60-64	50.7	33.4	11.2	4.7	84.1	15.9	100.0
	(34.2)	(35.7)	(35.2)	(38.6)	(34.7)	(36.2)	(35.0)
65-69	52.3	30.5	13.4	3.8	82.8	17.2	100.0
	(28.3)	(26.2)	(33.7)	(25.2)	(27.5)	(31.4)	(28.1)
70-74	60.7	26.4	8.6	4.3	87.1	12.9	100.0
	(19.1)	(13.2)	(12.6)	(16.6)	(16.8)	(13.7)	(16.3)
75-79	46.9	37.4	12.4	3.3	84.2	15.8	100.0
	(11.4)	(14.4)	(14.1)	(9.9)	(12.6)	(13.0)	(12.6)
80-84	47.0	43.4	6.2	3.5	90.4	9.6	100.0
	(4.7)	(7.0)	(2.9)	(4.3)	(5.6)	(3.3)	(5.2)
85+	42.2	43.6	5.8	8.4	85.8	14.2	100.0
	(2.2)	(3.7)	(1.4)	(5.5)	(2.8)	(2.5)	(2.8)
60+	51.9	32.8	11.1	4.2	84.6	15.4	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
2010							
60-64	61.5	24.0	10.6	3.9	85.5	14.5	100.0
	(34.1)	(32.8)	(37.8)	(46.3)	(33.7)	(39.8)	(34.5)
65-69	65.6	23.3	9.4	1.7	88.9	11.1	100.0
	(29.4)	(25.8)	(27.0)	(16.3)	(28.4)	(24.5)	(27.9)
70-74	60.9	23.9	10.7	4.5	84.8	15.2	100.0
	(18.4)	(17.8)	(20.8)	(29.0)	(18.2)	(22.7)	(18.8)
75-79	60.4	31.6	6.6	1.4	92.0	8.0	100.0
	(11.7)	(15.0)	(8.1)	(5.9)	(12.6)	(7.6)	(12.0)
80-84	56.6	34.1	8.2	1.1	90.6	9.4	100.0
	(4.2)	(6.3)	(3.9)	(1.8)	(4.8)	(3.4)	(4.6)
85+	61.0	27.6	10.5	1.0	88.5	11.5	100.0
	(2.2)	(2.4)	(2.4)	(0.8)	(2.2)	(2.0)	(2.2)
60+	62.1	25.3	9.7	2.9	87.4	12.6	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
2012							
60-64	60.2	25.4	11.7	2.7	85.6	14.4	100.0
	(35.3)	(30.9)	(33.6)	(42.3)	(33.9)	(34.9)	(34.0)
65-69	59.2	28.0	10.5	2.3	87.2	12.8	100.0
	(25.4)	(24.8)	(21.9)	(26.5)	(25.2)	(22.6)	(24.8)
70-74	56.4	31.5	10.6	1.5	87.9	12.1	100.0
	(20.5)	(23.7)	(18.8)	(14.3)	(21.5)	(18.1)	(21.1)
75-79	52.4	29.7	16.5	1.5	82.0	18.0	100.0
	(9.4)	(11.1)	(14.4)	(7.3)	(10.0)	(13.4)	(10.4)
80-84	58.8	31.9	7.0	2.3	90.7	9.3	100.0
	(7.0)	(7.8)	(4.0)	(7.4)	(7.2)	(4.5)	(6.9)
85+	50.4	17.2	30.7	1.7	67.6	32.4	100.0
	(2.5)	(1.7)	(7.3)	(2.2)	(2.2)	(6.5)	(2.8)
60+	58.0	28.0	11.9	2.1	86.0	14.0	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Age groups	How often you feel depressed in a week?						
Survey Years	Not depressed	1-2 days	3-4 days	5-7 days	<3 days	≥3days	Total
	(C1)	(C2)	(C3)	(C4)	(C5) =(C1) +(C2)	(C6) =(C3) +(C4)	(C7) =(C5) +(C6)
2014							
60-64	53.0	31.9	12.6	2.6	84.9	15.1	100.0
	(32.0)	(34.4)	(37.0)	(26.6)	(32.9)	(34.7)	(33.1)
65-69	53.3	32.8	9.1	4.8	86.1	13.9	100.0
	(24.8)	(27.3)	(20.5)	(38.3)	(25.7)	(24.5)	(25.5)
70-74	57.3	29.2	11.9	1.6	86.5	13.5	100.0
	(19.3)	(17.6)	(19.5)	(9.2)	(18.7)	(17.3)	(18.5)
75-79	53.2	34.9	6.0	5.9	88.1	11.9	100.0
	(11.6)	(13.6)	(6.4)	(21.9)	(12.3)	(9.8)	(12.0)
80-84	65.6	19.9	13.1	1.5	85.5	14.5	100.0
	(7.8)	(4.2)	(7.6)	(3.0)	(6.5)	(6.6)	(6.5)
85+	56.9	19.4	22.9	0.7	76.3	23.7	100.0
	(4.6)	(2.8)	(9.0)	(1.0)	(4.0)	(7.3)	(4.4)
60+	54.9	30.7	11.3	3.2	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations. Not depressed group includes respondents that are either not at all or rarely depressed for less than a day per week.

Figure 1: % distribution of old age individuals with depression by their age group 2008-2014



Of the total depressed for ≥3 days, a little over two thirds of the old were concentrated in the 60-69 year old age group in 2008. This share fell to 64% in 2010, to 58% in 2012 and to under 60% in 2014. The proportion of depressed for ≥3 days fell marginally by 0.5% (from 15% to 14.5%) in the period 2008-2014. Altogether the prevalence of depression (≥1 day) fell from about 48% in 2008 to 45% in 2014.

Table 2 presents gender distributions of the old with depression for ≥3 days in a week during 2008-2014.While the proportion of depressed old males (≥3 days in a week) varied around 11%, the proportion of depressed old females varied around 16% during 2008-2014. So the prevalence of depression among old females was much higher than among old males. The share of females among the depressed was 2-3 times higher than that of males during 2008-2014. In both 2008 and 2014, based on the t-tests, the mean values of prevalence of depression were *significantly* higher for females than males[22]. The majority of depressed were females. But their share declined from about 74% in 2008 to over 67% in 2014. However, the χ^2 test doesn't show a significant difference between the two distributions.

Table 2: % distribution of depression prevalence among old age population by gender and race 2008-2014

	How often they feel depressed in a week											
	2008			2010			2012			2014		
Group	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
Gender												
Male	87.7	12.3	100.0	91.8	8.2	100.0	89.4	10.6	100.0	88.1	11.9	100.0
	(34.1)	(26.3)	(32.9)	(38.0)	(23.5)	(36.2)	(39.9)	(29.0)	(38.4)	(41.1)	(32.7)	(39.9)
Female	83.1	16.9	100.0	84.9	15.1	100.0	83.8	16.2	100.0	83.8	16.2	100.0
	(65.9)	(73.7)	(67.1)	(62.0)	(76.5)	(63.8)	(60.1)	(71.0)	(61.6)	(58.9)	(67.3)	(60.1)
All	84.6	15.4	100.0	87.4	12.6	100.0	86.0	14.0	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0	(100.0)	(100.0)	(100.0	(100.0)	(100.0)	(100.0	(100.0)	(100.0)	(100.0
Race												
Black African	81.4	18.6	100.0	82.5	17.5	100.0	83.5	16.5	100.0	86.5	13.6	100.0
	(68.2)	(85.7)	(70.9)	(60.0)	(88.2)	(63.6)	(65.0)	(78.9)	(67.0)	(69.4)	(64.3)	(68.7)
Coloured	89.2	10.8	100.0	95.9	4.1	100.0	88.5	11.5	100.0	77.4	22.6	100.0
	(7.4)	(4.9)	(7.0)	(10.1)	(3.0)	(9.2)	(9.3)	(7.4)	(9.0)	(7.3)	(12.6)	(8.1)
Asian/Indian	88.3	11.7	100.0	71.1	28.9	100.0	72.5	27.5	100.0	84.2	15.8	100.0
/Other	(1.4)	(1.1)	(1.4)	(1.7)	(4.8)	(2.1)	(2.6)	(6.0)	(3.1)	(2.6)	(2.9)	(2.7)
White	93.8	6.2	100.0	98.0	2.0	100.0	94.9	5.1	100.0	85.8	14.2	100.0
	(23.0)	(8.4)	(20.8)	(28.2)	(4.0)	(25.2)	(23.1)	(7.6)	(20.9)	(20.7)	(20.2)	(20.6)
All	84.6	15.4	100.0	87.4	12.6	100.0	86.0	14.0	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0	(100.0)	(100.0)	(100.0	(100.0)	(100.0)	(100.0	(100.0)	(100.0)	(100.0

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations.

[22] Potential risk factors include the influence of sex hormones, women's blunted hypothalamic (pituitary) adrenal axis response to stress, girls' and women's lower self-esteem and higher tendency for body shame and rumination, higher rates of interpersonal stressors, experienced violence, childhood sexual abuse, and – on a social level – lack of gender equality and discrimination. Briefly, many factors that are well known to increase the risk of depression are more prevalent in women and thus contribute to their higher depression rate (Riecher-Rossle, 2017).

Four groups of race are distinguished in Table 2: Black Africans, Coloureds, Asian/Indian/Others, and Whites. The prevalence of depression among Black Africans for ≥3 days in a week ranged between about 14%-19% during 2008-2014; among Coloureds over a much larger range, 4% to 23%; among Asians/Indians/Others (for short, AIO) the range was large too, from 12% to 29%; and among Whites, however, the range was low, from 2% to 14%. Among Black Africans, the mean of depressed was significantly higher in 2014 relative to 2008; among Coloureds, it was also significantly higher in 2014; among AIO, there was no significant difference; and among Whites, it was significantly higher in 2014.

The t-tests of mean differences in the prevalence of depression (with Whites as the reference group) show that the prevalence was significantly higher among Black Africans and Coloureds than among Whites in 2008 (at the 1% level); however, there was no difference between Whites and AIO. In 2014, there was no significant difference between the Whites and the remaining three race groups. A vast majority of the depressed were the Black Africans, whose share fell sharply from about 86% in 2008 to over 64% in 2014. In sharp contrast, the share of the depressed Coloureds more than doubled (from under 5% to under 13%) during the same period. Going by the χ^2 test, these distributions were significantly different.

The distribution of prevalence of depression by marital status is given in Table 3. Among the Married, prevalence of depression ranged between about 10%-13%; among those Living with a Partner, the range was much larger, from about 8% to 30.5%. Among Widows/Widowers, it was narrow, between 16% and 19%; and the range among Divorced/Separated was narrow too (9.5% to about 16%). The mean of depressed was significantly higher in 2014 relative to 2008; that of Living with a Partner wasn't; that of Widows/Widowers wasn't either; nor of the remaining two categories.

Table 3: % distribution of depression prevalence among old age population by marital status 2008-2014

	How often they feel depressed in a week											
	2008			2010			2012			2014		
	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
Marital Status												
Married	87.1	12.9	100.0	90.2	9.8	100.0	87.2	12.8	100.0	90.5	9.6	100.0
	(52.0)	(42.3)	(50.5)	(53.1)	(39.9)	(51.5)	(48.5)	(43.6)	(47.8)	(48.2)	(30.1)	(45.6)
Living with Partner	69.5	30.5	100.0	90.0	10.0	100.0	91.2	8.8	100.0	92.2	7.8	100.0
	(1.8)	(4.2)	(2.1)	(3.0)	(2.3)	(2.9)	(3.0)	(1.8)	(2.8)	(1.9)	(1.0)	(1.8)
Widow/Widower	83.5	16.5	100.0	82.6	17.4	100.0	84.0	16.0	100.0	81.0	19.0	100.0
	(32.5)	(35.2)	(32.9)	(29.0)	(42.4)	(30.7)	(30.7)	(35.9)	(31.4)	(35.8)	(49.8)	(37.9)
Divorced/Separated	84.8	15.3	100.0	90.6	9.5	100.0	83.9	16.1	100.0	89.1	10.9	100.0
	(5.2)	(5.1)	(5.2)	(5.4)	(3.9)	(5.2)	(4.1)	(4.9)	(4.3)	(4.4)	(3.2)	(4.2)
Never Married	78.2	21.8	100.0	85.1	15.0	100.0	85.7	14.3	100.0	78.0	22.0	100.0
	(8.6)	(13.2)	(9.3)	(9.4)	(11.5)	(9.7)	(13.6)	(13.9)	(13.7)	(9.6)	(16.0)	(10.5)
All	84.6	15.4	100.0	87.4	12.6	100.0	86.0	14.0	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations.

Relative to the Married, that of Living with a Partner wasn't significantly different in either 2008 or 2014; that of Widows/Widowers was significantly higher in both 2008 and 2014; that of Divorced/Separated wasn't; and that of Never Married was also significantly higher in 2014. Both Married and Widows/Widowers accounted for a large majority of the depressed, ranging from 77.5% in 2008 to 80% in 2014. However, the share of Married among total depressed declined from 42% in 2008 to 30% in 2014 while that of Widows/Widowers rose from 35 % to close to 50 % during the same period. As a result, it became the single largest group of depressed in 2014. However, going by the χ^2 test, these distributional changes were not significant.

There are five categories of self-reported health status: Poor, Fair, Good, Very Good, and Excellent. Distributions of prevalence of depression by self-reported health status are given in Table 4. Among those in Poor Health, the prevalence fell from 35% in 2008 to 23.5% in 2014; among those in Fair Health, it declined from a little under 18% to 14%; among those in Good Health, it rose from 11% to 13.5%; among those in Very Good Health, it rose from under 6% to 12.6%, and among those in Excellent Health, from over 8% to over 14%.

Table 4: % distribution of depression prevalence among old age population by self-reported health status: 2008-2014

	How often they feel depressed in a week											
	2008			2010			2012			2014		
	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
Self-reported health status												
Poor	65.1	35.0	100.0	70.2	29.8	100.0	70.8	29.2	100.0	76.5	23.5	100.0
	(11.7)	(34.8)	(15.2)	(6.7)	(19.7)	(8.4)	(5.7)	(14.3)	(6.9)	(8.6)	(15.6)	(9.6)
Fair	82.3	17.7	100.0	78.0	22.0	100.0	87.9	12.1	100.0	86.0	14.0	100.0
	(26.9)	(32.1)	(27.7)	(16.3)	(31.8)	(18.3)	(24.8)	(20.9)	(24.2)	(22.3)	(21.5)	(22.2)
Good	88.9	11.1	100.0	90.5	9.5	100.0	85.3	14.7	100.0	86.5	13.5	100.0
	(30.7)	(21.2)	(29.2)	(31.1)	(22.6)	(30.0)	(37.4)	(39.6)	(37.7)	(39.2)	(36.2)	(38.8)
Very good	94.2	5.8	100.0	93.2	6.8	100.0	90.2	9.8	100.0	87.5	12.6	100.0
	(22.0)	(7.5)	(19.8)	(27.9)	(14.0)	(26.1)	(19.1)	(12.7)	(18.2)	(20.5)	(17.4)	(20.0)
Excellent	91.6	8.4	100.0	91.3	8.7	100.0	86.5	13.5	100.0	85.6	14.4	100.0
	(8.8)	(4.4)	(8.1)	(18.0)	(11.9)	(17.3)	(13.1)	(12.5)	(13.0)	(9.5)	(9.4)	(9.5)
All	84.7	15.3	100.0	87.4	12.7	100.0	86.0	14.0	100.0	85.5	14.5	100.0

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations.

The mean of depressed among those in Poor Health was significantly higher in 2008 relative to 2014. There were no significant differences in the means of those in Fair Health and in Good Health, respectively. However, the mean of depressed among those in Very Good Health was significantly higher in 2014 than in 2008. There was no significant difference between the means of depressed in Excellent Health in 2008 and 2014.

The second set of comparisons are of means of depressed in different health categories *relative* to the mean depressed among those in Poor Health, in 2008 and 2014. On average, those in Poor Health were significantly more depressed than those in Fair Health in 2008 but not in 2014. Those in Poor Health were also significantly

more depressed than those in Good Health in both 2008 and 2014. Those in Poor Health were also significantly more depressed than those in Very Good Health in both 2008 and 2014. Those in Poor Health were also significantly more depressed than those in Excellent Health.

In brief, those in Poor Health were most depressed. Those in Poor Health had the largest share of the depressed, followed closely by those in Fair Health in 2008. However, in 2014, the largest share was of those in Good Health-more than double of those in Poor Health. The share of those in Fair Health among total depressed also fell sharply. The $\chi 2$ test confirms significant distributional changes (at the 1% level).

Table 5 presents distributions of prevalence of depression by Body Mass Index (BMI) categories: Underweight, normal, overweight and obese. Among the Underweight, the prevalence of depression fell from 18% in 2008 to 12% in 2014; among the normal, it declined from 16% to 12%; among the Overweight, from 15% to 13%; and among the Obese, it declined from 17.5% to 15%.

Table 5: % distribution of depression prevalence among old age population by body mass index category 2008-2014

	How often they feel depressed in a week											
	2008			2010			2012			2014		
	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
Body Mass												
Underweight	82.4	17.6	100.0	85.8	14.2	100.0	87.2	12.8	100.0	87.9	12.1	100.0
	(4.9)	(5.4)	(5.0)	(3.9)	(4.4)	(4.0)	(3.1)	(2.7)	(3.0)	(4.7)	(4.2)	(4.6)
Normal	84.5	15.5	100.0	91.1	8.9	100.0	85.1	14.9	100.0	88.2	11.8	100.0
	(31.1)	(29.2)	(30.8)	(33.0)	(22.0)	(31.6)	(28.2)	(29.7)	(28.4)	(29.0)	(24.8)	(28.4)
Overweight	84.8	15.2	100.0	85.3	14.7	100.0	86.5	13.5	100.0	86.7	13.3	100.0
	(25.9)	(23.8)	(25.6)	(29.0)	(34.0)	(29.7)	(32.1)	(30.2)	(31.9)	(29.8)	(29.2)	(29.8)
Obese	82.5	17.5	100.0	85.4	14.6	100.0	85.5	14.5	100.0	84.8	15.2	100.0
	(38.2)	(41.6)	(38.7)	(34.1)	(39.5)	(34.8)	(36.6)	(37.4)	(36.7)	(36.4)	(41.9)	(37.2)
All	83.7	16.3	100.0	87.2	12.8	100.0	85.7	14.3	100.0	86.5	13.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations.

The t-tests show that there was no significant difference in the mean prevalence of depression among the underweight between 2008 and 2014; it fell significantly among the normal; however, there was no significant difference among the overweight or the obese. Relative to the underweight mean, the normal mean wasn't significantly different in 2008 but was significantly lower in 2014; the overweight mean wasn't significantly different in either 2008 or 2014; nor was the obese mean. The obese were the largest group among the depressed in both 2008 and 2014, followed by the normal and then the overweight in 2008. The share of the overweight rose in 2014 while that of the normal fell, with the former becoming the second largest group. However, the $\chi 2$ test didn't indicate significant distributional changes.

Distributions of the depressed by single and multiple NCDs are given in Table 6. Among those without any disease, the prevalence of depression remained almost

unchanged at about 14% between 2008 and 2014. Those suffering from a single NCD had the highest prevalence of 18% in 2008, which remained almost unchanged in 2014[23]. Although the prevalence of depression among those with multiple diseases fluctuated most, it fell slightly from 16% in 2008 to 15% in 2014.

Table 6: % distribution of depression prevalence among old age population by disease: 2008-2014

How often they feel depressed in a week												
	2008			2010			2012			2014		
	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
Occurrence												
No disease	86.4	13.6	100.0	87.8	12.2	100.0	85.1	14.9	100.0	86.0	14.0	100.0
	(56.1)	(48.7)	(55.0)	(90.2)	(87.0)	(89.8)	(86.6)	(93.0)	(87.5)	(88.9)	(85.5)	(88.4)
Single disease	81.9	18.1	100.0	85.3	14.7	100.0	91.7	8.4	100.0	81.7	18.3	100.0
	(30.4)	(36.9)	(31.4)	(9.1)	(10.9)	(9.4)	(12.3)	(6.9)	(11.6)	(10.5)	(13.9)	(11.0)
Multiple	83.8	16.2	100.0	70.3	29.7	100.0	98.2	1.8	100.0	85.1	14.9	100.0
	(13.5)	(14.4)	(13.7)	(0.7)	(2.1)	(0.9)	(1.0)	(0.1)	(0.9)	(0.6)	(0.6)	(0.6)
All	84.6	15.4	100.0	87.4	12.6	100.0	86.0	14.0	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations.

The t-test shows that there was no significant difference in the prevalence of depression among those without any NCD, with a single and multiple NCDs between 2008-2014. Between those without any NCD and those with a single NCD, the prevalence of depression was significantly higher among the latter (at the 5% level) but only in 2014. Between those without any NCD and those with multiple NCDs, the prevalence was significantly lower among the former (at the 5% level) but only in 2008.

Among the depressed, the largest share was of those without any NCD, followed by those with a single disease, and then those with multiple diseases. The share of those without any disease shot up in 2014, with marked reductions in the shares of those with single and multiple diseases. That these distributional changes were significant is confirmed by the $\chi 2$ test (at the 1% level).

Distributions of prevalence of depression by disability in carrying out activities of daily living (DADLs) are given in Table 7. Among those without any DADL, the prevalence of depression declined slightly from over 11% in 2008 to under 10% in 2010[24]. Among those with 1-3 DADLs, the prevalence was higher but remained unchanged in 2010. Among those with 4-6 DADLs, the prevalence was much higher than among those without any DADL in both years but declined in 2010. The highest prevalence was among those with 7-11 DADLs, which fell from over 35% to 27% during 2008-2010.

[23] In 2010, however, the prevalence of depression was highest.
[24] The data on DADLs are available only for 2008 and 2010.

Table 7: % distribution of depression prevalence among old age population by ADL limitation: 2008-2014

	How often they feel depressed in a week											
	2008			2010			2012			2014		
	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
Disabilities in the activities of daily life (DADLs)												
No DADL	88.7	11.3	100.0	90.4	9.6	100.0						
	(47.7)	(33.5)	(45.6)	(59.8)	(43.9)	(57.8)						
≥1-≤3 DADLs	85.6	14.4	100.0	85.6	14.4	100.0	*Information not collected*			*Information not collected*		
	(31.9)	(29.5)	(31.5)	(25.8)	(30.1)	(26.3)						
≥4-≤6 DADLs	79.3	20.7	100.0	82.4	17.6	100.0						
	(15.4)	(22.1)	(16.4)	(10.1)	(15.0)	(10.7)						
≥7-≤11	64.9	35.1	100.0	73.0	27.0	100.0						
	(5.0)	(14.9)	(6.5)	(4.3)	(11.1)	(5.2)						
All	84.6	15.4	100.0	87.4	12.6	100.0	86.0	14.0	100.0	85.5	14.5	100.0
	(100.0	(100.0	(100.0	(100.0	(100.0	(100.0	(100.0	(100.0	(100.0	(100.0	(100.0	(100.

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations.

The t-tests confirm that, relative to the prevalence of depression among those without any DADL, the prevalence was significantly higher among those with 1-3 DADLs, as also among those with 4-6 DADLs, and those with 7-11 DADLs. Those without any DADLs composed the largest share of the depressed in both 2008 and 2010, with the share considerably larger in 2010. Those suffering from 4-6 DADLs were the third largest but their share fell in 2010. The lowest share was of those afflicted with 7-11 DADLs, and it declined in 2010. The $\chi 2$ test confirms that these distributional changes were significant (at the 5% level).

A wealth index was constructed using principal components analysis (PCA). It was divided into quintiles. Cross-tabulation of prevalence of depression by quintile is given in Table 8. Prevalence of depression in the first quintile fell from about 19% in 2008 to 11% in 2014; in the second quintile, it dropped from a high of 25% to 12%; in the third quintile, it rose from 14% to under 16%; in the fourth, from 11% to well over 15%; and in the fifth, from under 9% to well over 15%.

Table 8: % distribution of depression prevalence among old age population by asset (wealth) index group: 2008-2014

How often they feel depressed in a week												
	2008			2010			2012			2014		
	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
Assets												
1st quintile	81.1	18.9	100.0	79.6	20.4	100.0	81.3	18.7	100.0	89.0	11.0	100.0
	(22.2)	(27.5)	(23.1)	(14.0)	(24.6)	(15.4)	(10.9)	(15.5)	(11.5)	(10.7)	(7.8)	(10.3)
2nd quintile	75.1	24.9	100.0	82.2	17.8	100.0	81.1	18.9	100.0	88.1	11.9	100.0
	(19.3)	(34.1)	(21.6)	(15.9)	(23.6)	(16.8)	(13.4)	(19.3)	(14.2)	(15.7)	(12.6)	(15.3)
3rd quintile	85.9	14.1	100.0	84.5	15.5	100.0	86.5	13.5	100.0	84.3	15.7	100.0
	(16.7)	(14.6)	(16.4)	(16.1)	(20.3)	(16.6)	(20.7)	(19.9)	(20.6)	(20.3)	(22.3)	(20.6)
4th quintile	89.1	10.9	100.0	89.7	10.3	100.0	84.9	15.1	100.0	84.6	15.4	100.0
	(17.5)	(11.4)	(16.5)	(21.3)	(16.7)	(20.7)	(21.1)	(23.2)	(21.4)	(21.5)	(23.2)	(21.8)
5th quintile	91.3	8.7	100.0	93.8	6.2	100.0	90.4	9.6	100.0	84.7	15.3	100.0
	(24.4)	(12.4)	(22.5)	(32.8)	(14.8)	(30.5)	(33.8)	(22.2)	(32.2)	(31.8)	(34.1)	(32.1)
All	84.2	15.8	100.0	87.3	12.7	100.0	86.0	14.0	100.0	85.6	14.4	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations. Asset index (scores) are constructed using Principle Component Analysis (PCA) based on Tetra-choric correlations.

The t-test shows that the prevalence of depression in the first quintile dropped significantly (at the 1% level) during 2008-2014; as also in the second quintile. However, there was no significant difference in the third and fourth quintiles. By contrast, in the fifth quintile, the mean in 2008 was significantly lower than in 2014. Examining the quintile shares in the total depressed, the largest share was of those in the second quintile, followed by that of the first in 2008. However, there were reversals in 2014, as the shares of the fifth, fourth and third quintiles rose sharply. In fact, more than a third of the depressed were in the fifth quintile. The $\chi 2$ test confirms that the burden of depression shifted to the affluent – especially the most affluent.

We examined the association between depression and a range of negative shocks. The latter are: (i) theft, fire or destruction of household property; (ii) widespread death and/or disease of livestock; (iii) any major crop failure; (iv) any other negative event; and (v) at least one of above major events. Referring to Table 9, the prevalence of depression among those who experienced shock (i) – theft, fire or destruction of household property – spiked from 1% to well over 23% in 2014, as also their share in total depressed, from barely 0.2% to 11%.

Table 9: % distribution of depression prevalence among old age population by negative household event (shock) 2008-2014

How often they feel depressed in a week

	2008			2010			2012			2014		
	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
(i) Any theft, fire, or destruction of household property?												
No	84.9	15.2	100.0	87.0	13.0	100.0	85.9	14.1	100.0	86.2	13.8	100.0
	(97.7)	(99.8)	(98.0)	(96.6)	(99.6)	(97.0)	(97.0)	(96.7)	(97.0)	(94.0)	(89.2)	(93.3)
Yes	98.8	1.2	100.0	98.3	1.7	100.0	84.4	15.6	100.0	76.7	23.4	100.0
	(2.3)	(0.2)	(2.0)	(3.4)	(0.4)	(3.0)	(3.0)	(3.4)	(3.0)	(6.0)	(10.8)	(6.7)
All	85.1	14.9	100.0	87.4	12.6	100.0	85.9	14.1	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
(ii) Any widespread death and/or disease of livestock?												
No	84.9	15.1	100.0	87.4	12.6	100.0	86.0	14.0	100.0	85.7	14.3	100.0
	(99.4)	(98.9)	(99.3)	(99.8)	(99.7)	(99.8)	(99.5)	(99.1)	(99.4)	(96.7)	(95.5)	(96.5)
Yes	76.7	23.3	100.0	79.2	20.8	100.0	77.2	22.8	100.0	81.6	18.5	100.0
	(0.6)	(1.1)	(0.7)	(0.2)	(0.3)	(0.2)	(0.5)	(0.9)	(0.6)	(3.3)	(4.5)	(3.5)
All	84.9	15.2	100.0	87.4	12.7	100.0	86.0	14.0	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
(iii) Any major crop failure?												
No	84.6	15.4	100.0	87.6	12.4	100.0	86.0	14.0	100.0	85.5	14.6	100.0
	(98.0)	(99.7)	(98.3)	(99.4)	(97.0)	(99.1)	(99.6)	(99.6)	(99.6)	(98.2)	(98.8)	(98.2)
Yes	96.9	3.1	100.0	59.7	40.3	100.0	87.3	12.8	100.0	90.0	10.1	100.0
	(2.0)	(0.4)	(1.7)	(0.6)	(3.0)	(0.9)	(0.4)	(0.4)	(0.4)	(1.9)	(1.2)	(1.8)
All	84.9	15.2	100.0	87.4	12.6	100.0	86.0	14.0	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

	How often they feel depressed in a week											
	2008			2010			2012			2014		
	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total	<3 days	≥3 days	Total
(iv) Any other negative event?												
No	85.1	14.9	100.0	87.4	12.6	100.0	85.9	14.1	100.0	85.6	14.4	100.0
	(99.8)	(99.9)	(99.8)	(99.2)	(99.8)	(99.3)	(100.0)	(100.0)	(100.0)	(96.7)	(96.4)	(96.6)
Yes	94.9	5.1	100.0	96.6	3.5	100.0	0.0	0.0	0.0	84.5	15.6	100.0
	(0.3)	(0.1)	(0.2)	(0.8)	(0.2)	(0.7)	(0.0)	(0.0)	(0.0)	(3.3)	(3.6)	(3.4)
All	85.2	14.9	100.0	87.4	12.6	100.0	85.9	14.1	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
(v) At least one of above major events?												
No	84.2	15.8	100.0	87.3	12.7	100.0	86.1	13.9	100.0	86.4	13.6	100.0
	(95.0)	(98.5)	(95.6)	(95.2)	(96.2)	(95.3)	(96.1)	(95.3)	(96.0)	(86.5)	(80.7)	(85.7)
Yes	94.8	5.3	100.0	89.8	10.2	100.0	83.6	16.4	100.0	80.5	19.5	100.0
	(5.0)	(1.5)	(4.4)	(4.8)	(3.8)	(4.7)	(3.9)	(4.7)	(4.0)	(13.5)	(19.3)	(14.4)
All	84.6	15.4	100.0	87.4	12.6	100.0	86.0	14.0	100.0	85.5	14.5	100.0
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Note: All percentages are weighted by panel weights. Numbers in parentheses are the column percentages. Number of observations varies across years of survey and variables under considerations. A depression for <3 days refers to rare or moderate depression, and ≥3 refers to severe depression.

The t-tests confirm that the prevalence was significantly higher (at the 1% level), among those who experienced shock (i), in 2014 relative to 2008. The prevalence among those who didn't experience this shock was significantly higher in 2008. However, there was no significant difference among those who didn't experience this shock. The mean of depressed among those who didn't experience theft, fire or destruction of household property was significantly higher than that of those who experienced it in 2008. The difference, however, ceased to be significant in 2014.

Turning to the shock (ii) of widespread deaths and/or disease of livestock, the prevalence of depression among those who experienced this shock fell from a high of about 23% in 2008 to 19% in 2014, and was higher than the prevalence among those who didn't experience this shock in both years. However, the t-test does not confirm significant difference in prevalence among those who experienced this shock between 2008-2014. Similarly, there is no significant difference between this group and others who didn't experience shock in these years. The share of those who experienced this shock among the depressed rose from about 1% to 4.5%, with a corresponding reduction in the share of those who didn't. The $\chi 2$ test confirms significant distributional changes between 2008-2014.

The third negative shock is a major crop failure. The prevalence of depression among those who experienced this shock rose from a low of about 3% in 2008 to over 10% in 2014. In both years, the prevalence was lower in this group relative to the group which didn't experience it. The t-test confirms that in both years the prevalence was significantly higher (at the 1% level) in the latter. The share of those who experienced this shock among total depressed rose from barely 0.4% to 1.2%. The distributional changes between 2008-2014 were, however, not significant in terms of the $\chi 2$ test.

5. Methodology

5.1. Variable constructions

We have used three alternative measures of depression as the dependent variables. First, a binary depression variable that takes the value 1 if a person is classified as depressed for 3 days or more in a week and, 0 otherwise. Next, following Tomita and Burns (2013) but with some variation, two new indices of depression were constructed, based on the self-reported 10-item version scale of the Centre for Epidemiologic Studies Depression (CES-D) available in the adult questionnaire of SA-NIDS. The rating scales for two items, "I feel hopeful about the future" (item 5), and "I was happy" (item 8), were reversed in line with others so that higher values reflected greater hopelessness and greater unhappiness. Scores from all the 10 items were added across each individual and the sum was divided by 10. We named this variable depression index I. In the other, higher extreme values of each indicator (ie 3 and 4), including two rescaled ones, were added up and divided by 10. Lower values of each indicator (ie 1 and 2) were treated as 0. We named this variable depression index II.

As indicated earlier, the explanatory variables include ethnicity, gender, and religion as time invariant individual characteristics, and time varying characteristics such as age, education, asset quartile, living arrangements, whether married and living together, whether a pensioner, smoked and/or consumed alcohol, ever been a main household decision maker, whether a death occurred in the family in the last 24 months, household size without another elderly person, and whether the person belongs to a social network. Multi-morbidity of NCDs (diabetes/high blood pressure (BP) and cancer/heart problems), two sets of ADL limitations or DADLs (set I includes daily activities like dressing, bathing, eating, toileting, and transportation, and set II includes daily activities such as walking, working, money management, climbing stairs, lifting weight, and cooking) and BMI categories (underweight, normal, overweight and obese, based on World Health Organisation (WHO) classifications) in the initial years are used as health variable proxies for diseases, disability and nutritional status.

Following Tomita and Burns (2013), we also constructed a categorical neighbourhood-specific social capital variable based on four key indicators provided in the SA-NIDS Household questionnaire: (i) household's support network and reciprocity assessed by the question, "How common is it that neighbours help each other out?", (ii) household's association activity assessed by the question, ''How common is it that neighbours do things together?'' (iii) household's collective norms and values assessed by the question, ''How common is it that people in your neighbourhood are aggressive?'', and (iv) household's sense of safety assessed by the question ''How common is burglary and theft in your neighbourhood''. For the first two questions, responses were rated on a 5-point scale, with 1 being never happens, and 5 being very common while for the last two questions, responses were rated on a 5-point scale, with 1 being very common, and 5 being never happens. A neighbourhood social capital index for each household was then computed by adding responses from all the above four questions. This neighbourhood social capital index ranges from 2 to 20 for each of the households and a higher index reflects higher social capital. We categorised neighbourhood social capital index into three groups: low (2–12), moderate (13–16) and high (17–20).

Further, to understand how much households trust someone who lives close by, a social trust dummy variable was constructed from the response to the question, ''Imagine you lost a wallet or purse that contained R200 and it was found by someone who lives close by'' – with 1 being very or somewhat likely, 0 being not likely at all to be returned with the money in it.[25] Next, we constructed an individual's strong preference to remain in the neighbourhood that takes the value 1 if the preference is strong, and 0 if moderate or low preference to stay, unsure, or moderate to strong preference to leave the neighbourhood. Finally, based on the ownership of households' various assets, four wealth quartiles were constructed using principal component analysis for econometric analyses.

[25] We also constructed household's civic participation variables based on their participation in any of 18 associations or groups but could not use due to very few observations across waves.

5.2. Model specifications

We apply a random effects probit with Mundlak (1978) adjustment to the panel dataset for binary depression variable defined earlier. For convenience of exposition, consider the basic model[26]:

$y_{it}^{*} = \boldsymbol{x}_{it}'\boldsymbol{\beta} + v_{it,}$ *i=1,2,...,n* and *t=1,...,T* (1)

$$v_{it} = \alpha_i + u_{it} \quad (2)$$

and

$\mathrm{y_{it}} = 1\,[\mathrm{y_{it}}^{*} > 0]$ where, y^{*}denotes the unobservable variable, $\mathrm{y_{it}}$ is the observed outcome, $\mathrm{x_{it}}$ is observable time-varying and time-invariant vector of exogenous characteristics, and initial values of some variables which influence y^{*}, β is the vector of coefficients associated with $\mathrm{x_{it}}$, α_{i} denotes the individual specific unobservable effect and $\mathrm{u_{it}}$ is a random error.

$1\,[y_{it}^{*} > 0]$ is an indicator function taking the value 1 if $y_{it}^{*} > 0$ and 0 otherwise. In the case of random effects (RE) probit it is also assumed that $u_{it} \sim IN(0, \sigma_u^{2})$. For estimation using MLE, it is further assumed that, conditional on the $\boldsymbol{x_{it}}$, $\alpha_i \sim IN(0, \sigma_\alpha^{2})$ are independent of the u_{it} and the x_{it}. This implies that the correlation between two successive error terms for the same individual is a constant given by,

$$\rho = corr(v_{it}, v_{it-1}) = \frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_u^2} \quad (3)$$

The parameters of this model are easily estimated by noting that the distribution of y_{it}^{*} conditional on α_i is independent normal[27]. Note that:

$$P(y_{it} = 1 | \alpha_i, \boldsymbol{x}_{it}) = P\left(\frac{u_{it}}{\sigma_u} > -\boldsymbol{x}_{it}'\boldsymbol{\beta} - \alpha_i\right) = \Phi(z_{it}) \quad (4)$$

where

$$z_{it} = -(\boldsymbol{x}_{it}'\boldsymbol{\beta} + \alpha_i)/\sigma_u \quad (5)$$

The assumption $\alpha_i \sim IN(0, \sigma_\alpha^{2})$ is a very strong assumption. Moreover, it is not enough to assume that α_i and x_i are uncorrelated or even $E(\alpha_i | x_i) = 0$. If x_{it} contains an intercept, the assumption, $E(\alpha_i) = 0$, doesn't involve loss of generality.

To allow for correlation between α_i and x_i, Chamberlain (1980) assumed a conditional normal distribution with linear expectation and constant variance. A Mundlak (1978) version of Chamberlain's assumption, is given as:

$$\alpha_i | x_i \sim N(\psi + \bar{x_i}\xi, \sigma_a^{2}) \quad (6)$$

[26] This draws upon Arulampalam (1998), Wooldridge (2010) and Greene (2012).
[27] Further details of MLE estimation are omitted, as these are available in Wooldridge (2010).

where $\bar{x_i}$ is the average of $\boldsymbol{x}_{it}$, t=1,…,T and ${\sigma_a}^2$ is the variance of a_i in the equation $\alpha_i = \psi + \bar{\boldsymbol{x}}_i\xi + a_i$. That is, ${\sigma_a}^2$ is the conditional variance of α_i, which is assumed not to depend on x_i.

$$y_{it}{}^* = \psi + \boldsymbol{x}_{it}{}'\boldsymbol{\beta} + \bar{\boldsymbol{x}}_i\xi + a_i + u_{it}, \quad t = 1, \ldots\ldots T \tag{7}$$

Equation (7) is also referred to as Chamberlain's random effects probit. While assumption (6) is restrictive in that it specifies a distribution for α_i and x_i, it allows for some dependence between α_i and x_i. We use standard random effects regressions with Mundlak adjustment, as in equation (7), for the other two continuous dependent variables. All the models are estimated for the aggregate sample of persons 60 years or more, and subsamples of women and Black Africans. Both the models (random effects probit with Mundlak correction and random effects regression with Mundlak correction) are estimated by generalised least squared (GLS). The standard errors are adjusted for clusters in individuals.

6. Results

A selection of results based on aggregate samples with three different measures of depression are discussed below. We will begin with random effects probit results in which an old person is classified as depressed if reported to be depressed for ≥3 days in a week. This analysis is then supplemented by the two depression indices: one in which the average value of the 10 indicators of depression is the dependent variable (depression index I) and in another where only extreme values of these indicators (3 or 4) are summed and divided by 10 (depression index II). These indices are treated as continuous, following Tomita and Burns (2013) but with some variation[28].

For each of the three depression dependent variables, three specifications/models are used[29]. Specification I uses initial multimorbidity conditions, specification II uses nutritional status measured as BMI categories (underweight, normal, overweight, and obese), and specification III uses multiple limitations in conducting ADLs or DADLs. Any differences/similarities between these results and those obtained from subsamples of women and Black Africans are discussed briefly[30]. A list of variables used and their definitions are given in Table 10.

[28] Depression=1 if depressed for ≥3 days, 0 if rarely or occasionally. Depression index 1 is the sum of scores of 10 indicators, each ranging from 1 to 4, divided by 10. This score varies from 1 to 4, 1 being low, and 4 being most severe. Depression index 2 is the sum of scores of 10 indicators, each ranging from 3 to 4, divided by 10. The score varies from 0 to 4. As all values other than 3 or 4 are treated as 0, those suffering depression rarely or occasionally are lumped together, 4 denotes most severe cases of depression.
[29] Specification and model are used synonymously.
[30] Details are available upon request from the authors.

Table 10: Definitions of variables used

Variables	Definition
Depression dummy	=1 if feels depressed for 3 or more days in a week, 0 if only for <3 days
Depression Index I	Average score of 10 depression related indicators each range from 1-4
Depression Index II (severe only)	Average score of 10 depression related indicators each range from 3-4, 1-2=0
Gender	
Male	=1 if individual is male, 0 otherwise
Female (Reference)	=1 if individual is female, 0 otherwise
Age group dummies	
Age:60-65	=1 if age group is 60-64, 0 otherwise
Age:65-69	=1 if age group is 65-69, 0 otherwise
Age:70-74	=1 if age group is 70-74, 0 otherwise
Age:75-79	=1 if age group is 75-79, 0 otherwise
Age:80+	=1 if age group is 80 and above, 0 otherwise
Marital Status	
Married	=1 if married, 0 otherwise
Education	
No Education	=1 if Illiterate, 0 if primary and above
Household Size	
Family Size (excl.60+)	Household size excluding old age members
Population group	
Population group: White	=1 if White, 0 otherwise (reference)
Population group: Coloured	=1 if Coloured, 0 otherwise
Population group: Black African	=1 if Black African, 0 otherwise
Population group: Asian/Indian/Others	=1 if Asian, Indian and other, 0 otherwise
Health and disease variables	
Disease	
Diabetes/high BP in 2008	=1 if diabetes or high BP in 2008, 0 otherwise
Cancer/heart problems in 2008	=1 if cancer or heart problems in 2008, 0 otherwise
BMI indicators	
Underweight in 2008	=1 if underweight in 2008, 0 otherwise
Normal in 2008	=1 if normal in 2008, 0 otherwise
Overweight in 2008	=1 if overweight in 2008, 0 otherwise
Obese in 2008	=1 if obese in 2008, 0 otherwise (reference)
Difficulties in activities of daily life (DADL)	
DADL in 2008: Set I	=1 if individual had set I of initial difficulties in daily activities like dressing, bathing, eating, toileting, and transportation, 0 otherwise
DADL in 2008: Set II	=1 if individual had set II of initial difficulties in daily activities such as walking, working, money management, stairs, lift weight, cooking, 0 otherwise
Wealth quartiles	
Wealth: 1st quartile (Reference)	Wealth index: 1st quartile
Wealth: 2nd quartile	Wealth index: 2nd quartile
Wealth: 3rd quartile	Wealth index: 3rd quartile
Wealth: 4th quartile	Wealth index: 4th quartile
Other household and community variables	
Family death in last 24 months	=1 if there is a family death in past 24 months, 0 otherwise
Smoke/Alcohol in 2008	=1 if smoke cigarette and drink alcohol, 0 otherwise
Any Pension	=1 if receiving any pension, 0 otherwise
2008 Social Capital: Low (Reference)	=1 if social capital score<=12, 0 otherwise
2008 Social Capital: Moderate	=1 if social capital score>12 to ≤16, 0 otherwise
2008 Social Capital: High	=1 if social capital score>16 to ≤20, 0 otherwise
Social Trust	=1 if very or somewhat likely that imagine you lost a wallet or purse that contained R200 and it was found by someone who lives close by, 0 if unlikely
Strong preference for stay	=1 if strong preference to stay in the same area, 0 otherwise
Ever main hh decision maker	=1 if individual has ever been a main household decision maker, 0 otherwise

Mean of time-variant variables	
Mean age:65-69	Mean of age: 65-69
Mean age:70-74	Mean of age: 70-74
Mean age:75-79	Mean of age: 75-79
Mean age:80+	Mean of age: 80+
Mean family size (excl. 60+)	Mean of family size (excl. 60+)
Mean wealth: 2nd quartile	Mean of wealth: 2nd quartile
Mean wealth: 3rd quartile	Mean of wealth: 3rd quartile
Mean wealth: 4th quartile	Mean of wealth: 4th quartile

In Table 11, we report the results based on a binary measure of depression (ie depressed for ≥3 days in a week) and random effects probit with Mundlak adjustment. Let us first consider demographic and life-style variables. In each of the three specifications (I, II, and III), old males were less prone to depression than old females, with the largest (absolute) coefficient in specification II (which omits multimorbidity variables and includes BMI categories). Somewhat surprisingly, age is not significantly associated with depression. However, means of age groups (over the four panel waves), 65-69 years and 75-79 years, have significant negative coefficients. Neither marital status (married=1) nor education (illiterate=1) have significant coefficients. Family support is posited to lower the prevalence of depression but the significant positive coefficient of household size with no other member older than 60 years (specification III) is not consistent with it. However, mean household size has significant negative coefficients (in specifications I and III).

Table 11: Random effects probit regressions with Mundlak adjustment: full sample analysis

Dependent variable: dummy for depression			
Explanatory variables	Specification I	Specification II	Specification III
Male	-0.143**	-0.177**	-0.135**
	(0.064)	(0.071)	(0.064)
Age: 65-69	0.014	0.012	0.035
	(0.089)	(0.094)	(0.090)
Age: 70-74	0.068	0.005	0.099
	(0.118)	(0.125)	(0.119)
Age: 75-79	0.079	0.019	0.105
	(0.146)	(0.155)	(0.149)
Age: 80+	-0.195	-0.230	-0.177
	(0.192)	(0.205)	(0.197)
Married	-0.062	-0.072	-0.072
	(0.057)	(0.061)	(0.057)
No education	-0.029	-0.030	-0.025
	(0.054)	(0.058)	(0.055)
Diabetes/high BP in 2008	0.159*		
	(0.087)		
Cancer/heart problems in 2008	0.248		
	(0.358)		
Underweight in 2008		-0.073	
		(0.125)	
Normal in 2008		0.058	
		(0.066)	
Overweight in 2008		-0.085	
		(0.067)	
DADL in 2008: Set I			0.315**
			(0.161)
DADL in 2008: Set II			0.216*
			(0.111)
Smoke/alcohol in 2008	0.033	0.073	0.031
	(0.095)	(0.100)	(0.096)
Any pension	-0.192**	-0.190**	-0.209**
	(0.089)	(0.094)	(0.089)
Ever main hh decision maker	-0.150	-0.130	-0.131
	(0.132)	(0.148)	(0.132)
Family size (excl.60+)	0.027	0.025	0.029*
	(0.017)	(0.018)	(0.017)
Population group: Black African	0.348***	0.341**	0.364***
	(0.133)	(0.141)	(0.132)
Population group: Coloured	0.289**	0.228	0.305**
	(0.129)	(0.139)	(0.128)
Population group: Asian/Indian/Others	0.392	0.159	0.491*
	(0.263)	(0.292)	(0.262)
Wealth: 2nd quartile	-0.008	0.003	-0.009
	(0.094)	(0.100)	(0.095)
Wealth: 3rd quartile	-0.141	-0.092	-0.123
	(0.117)	(0.126)	(0.118)
Wealth: 4th quartile	-0.203	-0.192	-0.191
	(0.144)	(0.153)	(0.147)
Family death in last 24 months	0.204***	0.158**	0.216***
	(0.066)	(0.069)	(0.067)

Dependent variable: dummy for depression			
Explanatory variables	Specification I	Specification II	Specification III
2008 social capital: moderate	-0.030	-0.055	-0.026
	(0.055)	(0.057)	(0.055)
2008 social capital: high	-0.029	-0.046	-0.014
	(0.074)	(0.075)	(0.074)
Social trust	-0.140*	-0.094	-0.152**
	(0.072)	(0.075)	(0.073)
Strong preference for stay	-0.098*	-0.111*	-0.106*
	(0.055)	(0.058)	(0.056)
Mean age: 65-69	-0.530**	-0.532**	-0.569**
	(0.219)	(0.235)	(0.221)
Mean age: 70-74	-0.090	-0.021	-0.116
	(0.167)	(0.177)	(0.168)
Mean age: 75-79	-0.490**	-0.389	-0.519**
	(0.225)	(0.239)	(0.228)
Mean age: 80+	0.065	0.089	-0.011
	(0.230)	(0.247)	(0.236)
Mean family size (excl. 60+)	-0.038*	-0.033	-0.039**
	(0.020)	(0.020)	(0.020)
Mean wealth: 2nd quartile	0.022	0.041	0.030
	(0.133)	(0.140)	(0.134)
Mean wealth: 3rd quartile	-0.078	-0.072	-0.087
	(0.147)	(0.157)	(0.149)
Mean wealth: 4th quartile	0.166	0.289	0.208
	(0.183)	(0.194)	(0.184)
Intercept	-0.553	-0.571	-0.579
	(0.244)	(0.270)	(0.245)
# of observations	4,477	3,970	4,378
# of individuals	1,460	1,267	1,424
Wald χ^2	86.82***	66.78***	94.30***
Degrees of Freedom	32	33	32

*Notes: If a person is depressed, the individual is assigned value 1 and 0 otherwise. Random effects probit standard errors are adjusted for clusters in individuals. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Two sets of difficulties in daily activities in 2008 (initial year): set I includes dressing, bathing, eating, toileting, and transportation, set II includes walking, working, money management, stepping stairs, lifting weight, and cooking.*

Among life style factors, we considered smoking and/or alcohol consumption. This doesn't have a significant coefficient in any specification. Another variable is strong preference for the neighbourhood. For the old, it is likely to be important as familiarity with their neighbours and friends in close proximity is often reassuring during any personal crisis or emergency. As it turns out, strong preference for the neighbourhood is associated with lower prevalence of depression in all specifications. This is often viewed as a link to social capital (Myer et al 2008, Tomita and Burns, 2013).

Diabetes/high BP as a measure of multimorbidity has a significant positive coefficient, implying that initial multimorbidity aggravates depression. Besides, both sets of (initial) limitations in carrying out ADLs have significant positive coefficients (specification III). As far as BMI categories are concerned (specification II), none possessed a significant coefficient. If there was a death in the family in the last two years, it had a significant positive effect on depression in all three specifications. Family bereavement thus leads to depression[31].

Socioeconomic status (SES) is assessed on the basis of asset quartiles. Using the first as the reference quartile, none of the three quartiles have significant coefficients. Neither do the means possess significant coefficients. These are surprising results as SES appears to be correlated with depression in several studies (eg Myer et al 2008). Using the Whites as the reference category, both the Black Africans and Coloureds have significant positive coefficients in all cases while Asians/Indians/Others have significant positive coefficients in two cases (specifications I and III). This suggests that the Whites were least prone to depression.

Pension has a significant negative effect on depression presumably because it imparts financial autonomy in meeting medical expenses *despite* likely pooling of financial resources. This result is in line with the findings of Case (2004) that pensions protect the health of all household members working in part to protect the nutritional status of household members, in part to improve living conditions, and in part to reduce the stress under which adult household members negotiate day-to-day life.

Neither moderate nor high social capital (relative to low social capital) were associated with depression. However, social trust reduced the prevalence of depression (Specifications I and III). Evidently, social networks and familiar neighbourhoods make a considerable difference to the old in lessening their social isolation and consequently depression. The Wald chi-square statistic corroborates the joint significance of all coefficients at the 1% level in all specifications.

Considering the subsample of women only, there are a few significant differences and several similarities[32]. None of the age groups have a significant coefficient. Neither marital status nor education were associated with depression among old women. Family size (without any other member exceeding 60 years) has a more robust positive

[31] Although these estimates are time-varying, we decided to use initial estimates as subsequent estimates are patchy.
[32] Details will be given upon request to the authors.

effect (the coefficient is significant in specifications I and III), as does its mean (significant in all three specifications). This points to the plausibility of greater neglect or even abuse of old women in larger households.

Somewhat surprisingly, multimorbidity (diabetes/high BP and cancer/heart disease) ceases to be significant. Nutritional status measured in BMI categories is not significantly associated with depression. Between the two sets of DADLs, the first set significantly increases the probability of depression. Race matters, as in the aggregate sample. Both the Black African and AIO women were more likely to be depressed than White women (the coefficient for Coloured women was not significant). Shock of a family death has a larger effect among women than in the aggregate sample, as do pensions (in absolute value in specifications I and III). While the first adds to depression, the latter attenuates it. Preference for the present neighbourhood diminishes the risk of depression among old women and the coefficients are larger than in the aggregate sample.

Unlike in the aggregate sample, high social capital reduced depression among women (but only in specification II). It is somewhat intriguing why social trust has significant negative effects on women's depression (only in specification III) but the (absolute) values of the coefficients are lower. Together with the strong preference for current neighbourhood, social networks and trust are of considerable importance in attenuating depression among old women. Moreover, unlike in the aggregate sample, those in the third wealth quartile were less likely to be depressed (relative to the first quartile) in all three specifications in the women's subsample.

In the subsample of old Black Africans, there are a few notable differences and many similarities[33]. Males were less likely than females to be depressed. Of the age groups considered, those in the oldest group (80+ years) were less prone to depression relative to those in the age group of 60-64 years in all three specifications. The mean age group, 65-69 years, had significant negative coefficients (specifications I and III). As in the aggregate sample, neither marital status nor education had a significant effect on depression. Although family size didn't have a significant coefficient, its mean had a significant negative effect in all cases.

Multimorbidity (diabetes/high BP) and the first set of DADLs also added to depression[34] among Black Africans. Nutritional status wasn't associated with depression. As in the aggregate sample, family death aggravated depression in all specifications. Neither social capital nor social trust possessed a significant coefficient. However, the link through a strong preference for the current neighbourhood attenuated depression.

Table 12 provides the results based on the first depression index in which all values of the 10 indicators are averaged. As in the case of depression as a dummy variable, the gender effect is robust across the specifications, with males less likely to be depressed.

[33] Details are available upon request from the authors.
[34] The other multimorbidity combination of cancer/heart disease had few observations. Hence it was dropped.

The age effect is significant for two age groups: 75-79 years and 80+ years, showing lower likelihood of depression among them relative to the reference group, 60-64 years. However, the mean age group of the oldest, 80+ years, has a significant positive effect.

Table 12: Random effects regressions with Mundlak adjustment full sample analysis

Dependent variable: depression index I			
Explanatory variables	Specification I	Specification II	Specification III
Male	-0.039**	-0.052***	-0.040**
	(0.017)	(0.018)	(0.017)
Age: 65-69	-0.009	-0.002	-0.007
	(0.024)	(0.025)	(0.024)
Age: 70-74	-0.034	-0.029	-0.031
	(0.033)	(0.035)	(0.033)
Age: 75-79	-0.097**	-0.103**	-0.098**
	(0.043)	(0.046)	(0.044)
Age: 80+	-0.141**	-0.129**	-0.146**
	(0.057)	(0.062)	(0.058)
Married	-0.059***	-0.064***	-0.060***
	(0.016)	(0.017)	(0.016)
No education	0.003	0.005	0.004
	(0.016)	(0.017)	(0.016)
Diabetes/high BP in 2008	0.086***		
	(0.029)		
Cancer/heart problems in 2008	0.173**		
	(0.085)		
Underweight in 2008		0.007	
		(0.037)	
Normal in 2008		-0.008	
		(0.019)	
Overweight in 2008		-0.038**	
		(0.019)	
DADL in 2008: Set I			0.129**
			(0.061)
DADL in 2008: Set II			0.103**
			(0.041)
Smoke/alcohol in 2008	0.006	0.012	0.005
	(0.026)	(0.028)	(0.027)
Any pension	-0.045	-0.049*	-0.044
	(0.028)	(0.029)	(0.028)
Ever main hh decision maker	-0.037	-0.025	-0.024
	(0.038)	(0.042)	(0.037)
Family size (excl. 60+)	0.007	0.009*	0.007
	(0.005)	(0.005)	(0.005)
Population Group: Black African	0.200***	0.192***	0.211***
	(0.034)	(0.038)	(0.034)
Population Group: Coloured	0.092***	0.073*	0.108***
	(0.034)	(0.038)	(0.034)
Population Group: Asian/Indian/Others	0.017	-0.017	0.046
	(0.066)	(0.062)	(0.066)

Dependent variable: depression index I			
Explanatory variables	Specification I	Specification II	Specification III
Wealth: 2nd quartile	-0.015	-0.012	-0.014
	(0.029)	(0.031)	(0.030)
Wealth: 3rd quartile	-0.070**	-0.063*	-0.054
	(0.035)	(0.038)	(0.035)
Wealth: 4th quartile	-0.085*	-0.089*	-0.068
	(0.044)	(0.047)	(0.044)
Family death in last 24 months	0.086***	0.076***	0.089***
	(0.021)	(0.022)	(0.021)
2008 social capital: moderate	0.006	-0.002	0.004
	(0.016)	(0.017)	(0.016)
2008 social capital: high	0.011	0.017	0.016
	(0.021)	(0.022)	(0.021)
Social trust	-0.027	-0.026	-0.028
	(0.019)	(0.021)	(0.019)
Strong preference for stay	-0.060***	-0.060***	-0.062***
	(0.017)	(0.018)	(0.017)
Mean age: 65-69	-0.103	-0.080	-0.112*
	(0.063)	(0.066)	(0.063)
Mean age: 70-74	0.063	0.066	0.047
	(0.047)	(0.049)	(0.047)
Mean age: 75-79	0.022	0.044	0.026
	(0.066)	(0.069)	(0.066)
Mean age: 80+	0.162**	0.154**	0.123*
	(0.072)	(0.077)	(0.072)
Mean family size (excl. 60+)	-0.008	-0.010	-0.008
	(0.006)	(0.006)	(0.006)
Mean wealth: 2nd quartile	-0.053	-0.047	-0.055
	(0.042)	(0.043)	(0.042)
Mean wealth: 3rd quartile	-0.050	-0.056	-0.058
	(0.043)	(0.046)	(0.043)
Mean wealth: 4th quartile	-0.071	-0.035	-0.068
	(0.056)	(0.060)	(0.055)
Intercept	1.892***	1.889***	1.873***
	(0.070)	(0.077)	(0.070)
# of observations	4,492	3,984	4,393
# of individuals	1,461	1,267	1,425
Wald χ^2	431.1	358.8	418.6
Degrees of Freedom	32	33	32

*Notes: Random effects GLS standard errors are adjusted for clusters in individuals. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Two sets of difficulties in daily activities in 2008 (initial year): set I includes dressing, bathing, eating, toileting, and transportation, and set II includes walking, working, money management, stepping stairs, lifting weight, and cooking.*

Family size (excluding any other old member) has a (weakly) significant positive effect (specification II). Unlike the dummy variable case of depression, marital status (married 1 and 0 otherwise) significantly lowers the prevalence of depression across all three specifications. Somewhat surprisingly, receiving a pension lowered the prevalence of depression relative to those without a pension, but only in specification II. This contrasts with the robust negative effect of pensions in the dummy variable specification of depression.

As in the case of the dummy variable specification of depression, strong preference for the same neighbourhood has a robust negative effect on the depression index. Social capital doesn't have a significant effect on depression while social trust does (specifications I and II). Both third and fourth quartiles have significant negative effects on depression. These effects seem robust (specifications I and II). The mean of fourth quartile also has a negative effect. These suggest that affluence (relative to the first wealth quartile) attenuates depression.

As in the case of dummy variable depression, the shock of death in the family was robustly positive (in all specifications). Among the health status variables, both multimorbidity measures (diabetes/high blood pressure, and cancer/heart problems in 2008) were positively associated with depression. Both sets of DADLs were also significantly positively associated with depression. Among the BMI categories, the overweight aged were less likely to be depressed than the obese. The Wald test confirms joint significance of all coefficients in all cases at the 1% level.

Our findings, using the second depression index in which extreme values of each of the 10 indicators (3 or 4) are divided by 10, are based on the results in Table 13. The results are largely similar. For instance, the gender effect is negative and significant in all specifications, further confirming lower chance of depression among the males. Older individuals in age groups, 75-79 years and 80+ years, are less likely to be depressed than the reference age group (60-64 years). However, the two oldest age group means, 75-79 years and 80+ years, have significant positive coefficients.

Table 13: Random effects regressions with Mundlak adjustment full sample analysis

Dependent variable: depression index II			
Explanatory variables	Specification I	Specification II	Specification III
Male	-0.047**	-0.064***	-0.045**
	(0.020)	(0.022)	(0.020)
Age: 65-69	-0.030	-0.022	-0.028
	(0.032)	(0.034)	(0.032)
Age: 70-74	-0.060	-0.052	-0.055
	(0.043)	(0.045)	(0.043)
Age: 75-79	-0.174***	-0.180***	-0.169***
	(0.057)	(0.061)	(0.058)
Age: 80+	-0.229***	-0.207***	-0.228***
	(0.075)	(0.080)	(0.076)
Married	-0.057***	-0.066***	-0.061***
	(0.022)	(0.023)	(0.021)
No education	0.006	0.006	0.008
	(0.022)	(0.023)	(0.022)
Diabetes/high BP in 2008	0.110***		
	(0.039)		
Cancer/heart problems in 2008	0.186***		
	(0.034)		
Underweight in 2008		0.010	
		(0.049)	
Normal in 2008		-0.014	
		(0.026)	
Overweight in 2008		-0.067***	
		(0.023)	
DADL in 2008: Set I			0.255***
			(0.093)
DADL in 2008: Set II			0.118*
			(0.061)
Smoke/alcohol in 2008	0.034	0.045	0.034
	(0.034)	(0.037)	(0.035)
Any pension	-0.073**	-0.082**	-0.073**
	(0.036)	(0.038)	(0.036)
Ever main hh decision maker	-0.042	-0.043	-0.030
	(0.050)	(0.055)	(0.048)
Family size (excl.60+)	0.005	0.007	0.005
	(0.007)	(0.007)	(0.007)
Population Group: Black African	0.154***	0.134***	0.161***
	(0.043)	(0.048)	(0.043)
Population Group: Coloured	0.071*	0.034	0.086**
	(0.042)	(0.047)	(0.042)
Population Group: Asian/Indian/Others	-0.076	-0.115	-0.029
	(0.078)	(0.075)	(0.079)
Wealth: 2nd quartile	-0.014	-0.009	-0.011
	(0.038)	(0.039)	(0.038)
Wealth: 3rd quartile	-0.081*	-0.066	-0.057
	(0.047)	(0.050)	(0.047)
Wealth: 4th quartile	-0.099*	-0.107*	-0.072
	(0.058)	(0.062)	(0.057)
Family death in last 24 months	0.108***	0.097***	0.112***
	(0.030)	(0.031)	(0.029)

Dependent variable: depression index II			
Explanatory variables	Specification I	Specification II	Specification III
2008 social capital: moderate	0.005	-0.006	0.001
	(0.021)	(0.022)	(0.021)
2008 social capital: high	0.023	0.034	0.027
	(0.028)	(0.029)	(0.028)
Social trust	-0.057**	-0.053**	-0.057**
	(0.023)	(0.025)	(0.023)
Strong preference for stay	-0.051**	-0.053**	-0.057***
	(0.022)	(0.023)	(0.022)
Mean age: 65-69	-0.111	-0.101	-0.128
	(0.081)	(0.084)	(0.081)
Mean age: 70-74	0.101*	0.088	0.076
	(0.060)	(0.063)	(0.060)
Mean age: 75-79	0.121	0.145*	0.116
	(0.084)	(0.088)	(0.084)
Mean age: 80+	0.250***	0.221**	0.187**
	(0.090)	(0.097)	(0.091)
Mean family size (excl. 60+)	-0.008	-0.009	-0.009
	(0.008)	(0.008)	(0.008)
Mean wealth: 2nd quartile	-0.048	-0.037	-0.051
	(0.055)	(0.057)	(0.055)
Mean wealth: 3rd quartile	-0.060	-0.076	-0.070
	(0.058)	(0.060)	(0.056)
Mean wealth: 4th quartile	-0.061	-0.007	-0.064
	(0.073)	(0.077)	(0.071)
Intercept	0.903	0.942	0.894
	(0.093)	(0.102)	(0.093)
# of observations	4,492	3,984	4,393
# of individuals	1,461	1,267	1,425
Wald χ^2	293.3***	236.1***	251.1***
Degrees of Freedom	32	33	32

*Notes: Random effects GLS standard errors are adjusted for clusters in individuals. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Two sets of difficulties in daily activities in 2008 (initial year): set I includes dressing, bathing, eating, toileting, and transportation, and set II includes walking, working, money management, stepping stairs, lifting weight, and cooking.*

Marriage attenuates depression in all cases. This is in sharp contrast to the results obtained with depression defined as a binary variable. While the Black Africans have a higher chance of depression compared to the White group, Asians/Indians/Others cease to have a significant coefficient. The Coloureds are also more likely to be depressed (specification I and III), relative to the Whites.

Pensioners are likely to be less depressed than non-pensioners in all cases. Pensions thus have a robust effect in lowering depression. Both measures of multimorbidity significantly increase occurrence of depression, as do both sets of DADLs. The overweight are less likely to be depressed relative to the obese. A family death in the previous 24 months adds to depression. This is robust across different measures of depression and different specifications (I, II and III).

As in the previous case, social trust reduces depression and a strong preference for the current neighbourhood significantly lowers depression. This further reinforces the case for strengthening social trust and personal networks. Unlike in the previous case, those in the third and fourth quartiles are less likely to be depressed than in the first quartile but only in specification I.

The findings of supplementary analyses using the subsamples for women and Black Africans are interesting[35]. Let us first consider the results for old women, based on the first depression index. Each of the three age groups, 70-74, 75-79 and 80+ years, has a significant negative coefficient (the last two in all specifications) relative to the reference age group. However, the mean age group 70-74 years has significant positive coefficients (specifications I and II) while the mean age group 80+ years has significant positive coefficients in all cases.

Married women were less likely to be depressed than others in all cases. Household size (without any other old person) was positively associated with depression in all three specifications, as was the mean. The Black African women have a significant positive coefficient (in all cases), implying greater likelihood of depression among them, as also among Coloured women (specifications I and III), relative to White women.

As in the previous case, a family death in the last 24 months added to depression among old women in all specifications. Somewhat surprisingly, pensions didn't reduce depression among the women. Both measures of multimorbidity were associated with higher depression among women, as were both sets of DADLs. The third wealth quartile was significantly negatively associated with depression among women in all specifications. Neither social capital nor social trust were associated with depression. However, the link through a strong preference for the current neighbourhood attenuated depression among old women in all three specifications.

The second supplementary analysis is based on the Black African subsample and the first depression index. These results are largely similar to those obtained from the

[35] Detailed results obtained with both indices of depression are available upon request from the authors.

aggregate sample[36]. Gender/male has a significant negative coefficient in all specifications, implying males were less likely to be depressed than females. The three age groups, 70-74 years, 75-79 years and 80+ years, all have significant negative coefficients in all specifications. Their means, however, have significant positive coefficients. Married Black Africans had significant negative coefficients in all three specifications, as did the married in the aggregate sample. Household size (without any other old person) aggravates depression. However, mean family size attenuates it. There is no significant effect of pensions.

Both measures of multimorbidity have significant positive coefficients in all cases, implying higher likelihood of depression. Both sets of DADLs are positively associated with depression (but at the 10% level). The overweight have a negative coefficient, implying they were less likely to be depressed than the Obese. Shock of a death in the family adds to the depression. Strong preference for current neighbourhood lowers depression in all specifications. Neither social capital nor social trust have significant effects except through a strong preference for the current neighbourhood as an attenuating factor. None of the wealth quartiles or their means have significant effects on depression.

7. Discussion

This is the first study that offers a comprehensive analysis of determinants of depression among the old (60+ years) in South Africa, using the four waves of the National Income Dynamics Study (NIDS) (2008, 2010, 2012 and 2014). A state-of-art econometric methodology (eg random effects probit with Mundlak adjustment or random effects with Mundlak adjustment) has been used to unravel the factors underlying depression among the old over the period 2008-2014.

Depression is defined in different ways. First, a self-reported measure was used. NIDS gives data on not depressed in a week, depressed for 1-2 days, 3-4 days and 5-7 days. We focused on those depressed for ≥3 days in a week. In another specification/model, following Tomita and Burns (2013) but with some variation, two new indices of depression were constructed, based on the self-reported 10-item version of the Centre for Epidemiologic Studies Depression (CES-D) scale available in the adult questionnaire of SA-NIDS. While Tomita and Burns (2013) used the sum of the scores of the 10 items as a measure of depression, which ranges from 0 to 30, we employed two variants: in one, the scales for indicator 5: “I feel hopeful about the future”, and indicator 8: “I was happy” were reversed in line with others (higher values reflected greater hopelessness and greater unhappiness) and divided by 10. In the other, extreme values of each indicator (including two rescaled ones), 3 or 4, were added up and divided by 10.

[36] Detailed results obtained with both indices of depression are available upon request from the authors.

The explanatory variables included demographic variables (age, family size, gender, marital status), life style characteristics (whether smokes/consumes alcohol, prefers to live in the same neighbourhood), ethnicity/race (whether Black African, White, Coloured, Asian/Indian/Other), education, shock (death in the family in the last 24 months), whether a pensioner, socioeconomic status measured through asset quartiles/quintiles, measures of social capital and social trust, health status measured using multimorbidity and sets of DADLs, and BMI categories (underweight, normal, overweight and obese). To carry out the Mundlak adjustment, averages of time varying variables (age, household size and wealth quartile) were used.

Our study builds methodologically upon the (sparse) extant literature on aging and depression in the following ways. (i) Available studies often use stepwise regression with frequent changes in the significance of the explanatory variables. In contrast, we rely on comprehensive *a priori* specifications. (ii) Endogeneity of explanatory variables (eg morbidity, DADL, BMI categories) is often overlooked and the estimation bias is ignored in the interpretation of the results. We circumvent this problem by working with *initial* values of morbidity, disabilities, and BMI categories. (iii) As there are interrelationships between morbidity, obesity, and disabilities, we use three alternative specifications with initial value(s) of each in one specification. (iv) As fixed effect specification/model doesn't allow use of time invariant characteristics (eg gender, ethnicity/race), a random effects model is used. Depending on whether the dependent variable is binary (self-reported depression for ≥3 days in a week) or continuous (as in two indices of depression), we use a random effects probit with Mundlak adjustment or simply random effects with Mundlak adjustment.

As the slopes are likely to differ between the aggregate sample and subsamples for women and the Black Africans, we supplement aggregate analyses with a selection of the results from the subsamples. An important feature of our empirical analyses is the *robustness* of several key results.

Aging is a major factor in depression. Those in their early 60s are generally more likely to be depressed than older persons in their 70s and 80s. Women are more likely to be depressed than men. Married men and women are less likely to be depressed than others. Marriage thus serves as a barrier to loneliness and a source of support during periods of stress for old persons. However, somewhat counterintuitively, old persons in larger households without any other old person are more prone to depression. It is not clear whether larger households result in neglect of old persons or their abuse.

Old women were consistently more likely to be depressed than old men, as they are subject to violence and other stressors, often associated with conflicts over the man's drinking, the woman having more than one partner, and her not having post-school education. Two underlying factors are the unequal position of women and the acceptance of certain forms of interpersonal violence. Another factor is that women are typically much more likely to be overweight and obese, leading to NCDs and

subsequently higher depression[37]. The results with BMI categories were, however, inconclusive. A challenging aspect of obesity prevention in Black South Africans is the positive perception that both women and men attach to a large body size.

Black Africans are more prone to depression than the reference groups of Whites and Coloureds. There is limited evidence suggesting that Asians/Indians/Others are more likely to be depressed. Pensioners are less likely to be depressed *despite* some evidence in the literature on pooling of pensions with other household resources and denying the pensioner any financial autonomy. Although this can't be ruled out, it is evident that the favourable effect of pensions in preventing depression is robust.

Contrary to extant literature, smoking and/or consumption of alcohol are not associated with depression. Interactions with some other explanatory variables (eg age, race) didn't yield a significant effect, nor did lack of elementary education. We surmise that the result may change if we had more detailed data on higher educational attainments.

Of particular significance are the results on multimorbidity[38]. Two combinations of NCDs (diabetes and higher BP, and cancer and heart disease) on which we had sufficient observations are significantly positively associated with depression. There may be a two-way causality that we have not investigated here. Equally important are the associations between DADLs and depression. In many cases, both sets of DADLs are positively associated with depression. The relationship between depression and BMI categories (underweight, normal, overweight and obese) is generally not confirmed except that in some cases overweight were less likely to be depressed than the reference category of obese. Here again *reverse* causality can't be ruled out.

Shock of a family member's death (in the last 24 months) was robustly linked to higher depression. There is some evidence suggesting that this shock had stronger effects on women relative to the aggregate sample. Although other shocks were considered (eg major crop failure), none yielded significant effects.

As loneliness and lack of support during a difficult situation can precipitate stress leading to depression, we experimented with the construction of measures of social capital and trust as barriers to depression. A key aspect of social capital is civic participation. Civic participation is also an example of an objectively verifiable structural dimension of social capital, which refers a person's activities. Social trust is a subjective example of cognitive social capital which refers to what people feel. The question in NIDS regarding preference for current neighbourhood as a mediator of the relationship between neighbourhood social capital and health outcomes incorporates

[37] Between 1998 and 2008, the estimated proportion of the South African adult population who were overweight or obese increased from 29.1% to 31.1% among males (+6.9% in relative terms), and from 56.2 to 59.5% among women. Recent studies have produced evidence of an association between BMI and gender (higher BMI among women than among men), alcohol use (positive relationship), tobacco (negative relationship), physical exercise (higher level of physical exercise associated with lower BMI), urban vs. rural living (with the former associated with higher values of BMI) (Cois and Day, 2015).

[38] We were constrained from using HIV/AIDS as an explanatory variable because of extremely patchy data.

an important aspect of neighbourhood integration and a connection to networks that possess resources. Ours is an improvement on the Tomita and Burns (2013) study, which used only 2008 SA-NIDS data, as we use all four waves of the panel.

Although social capital doesn't have a significant effect (except in a limited way), social trust does. Besides, the mediating role of strong preference for the current neighbourhood is confirmed across most specifications. An exceptional case is that of the Black Africans for whom neither social capital nor social trust is of any consequence except the mediating role of preference for the current neighbourhood.

The burden of depression in terms of shares of depressed in total depressed has risen in the more affluent quintiles – especially that of the most affluent. However, likelihood of depression remained lower among the third and fourth quartiles, implying that depression was higher in the poorest (or the least wealthy)[39]. It is somewhat surprising that *despite* marked inequalities even among the Black Africans, there is no wealth effect on depression. The use of Mundlak adjustment is justified by significant coefficients of mean age groups (65-69 and 80+ years), mean wealth quartiles (fourth quartile) and mean household size (without another old person).

Two limitations of this study may be noted. One is that it doesn't address the question of *reverse* causality. Recent evidence points to reverse causality between depression and NCDs or comorbidity between them[40]. The second is that it doesn't explore the links between predicted depression and self-rated health status. This is a serious concern as some influential studies legitimise self-rated health status on the basis of *ad hoc* regressions in which this variable is regressed on morbidity without adjustment for its endogeneity. A deeper scrutiny that overcomes the endogeneity of morbidity is thus necessary before drawing any inferences about the validity of this measure. Finally, as a dynamic panel model is feasible with depression defined as a continuous variable (as in the depression indices used here), richer insights into the links between depression, morbidity and disabilities are likely.

8. Concluding Observations

Mental disorders – in different forms and intensities – affect most of the population in their lifetime. In most cases, people experiencing mild episodes of depression or anxiety deal with them without disrupting their productive activities. A substantial minority of the population, however, experiences more disabling conditions such as schizophrenia, bipolar disorder type I, severe recurrent depression, and severe personality disorders. While common mild disorders are amenable to self-management and relatively simple educational or support measures, severe mental illness demands

[39] For the cross-tabulations, we used wealth quintiles and for the econometric analysis wealth quartiles.

[40] A few examples suffice: both cancer and pain are common in older patients, and depression is a frequent co-morbid condition. Depression can precede a diagnosis of cancer, notably lung and pancreatic cancer, and high rates of depression are seen in breast cancer and head and neck tumours.

complex, multi-level care that involves a longer-term engagement with the individual, and with the family. Yet, despite the considerable burden and its associated adverse human, economic, and social effects, governments and donors have failed to prioritise treatment and care of people with mental illness. Indeed, pervasive stigma and discrimination contributes to the imbalance between the burden of disease due to mental disorders, and the attentions these conditions receive (Vigo et al 2016, Chisholm et al 2016).

Unfortunately, alongside a dramatic change in age structure, there is a characteristic sequence of changes in dietary behaviour and physical activity patterns that heighten the risk of chronic disease. Although overall nutrient intake adequacy improves with an increasing variety of foods, the movement toward more fats, sugars and refined foods overtakes this more optimal state to one in which diets contribute to rapidly escalating rates of obesity and chronic disease. In South Africa, the transition to a Western diet is becoming evident in both rural and urban areas.

Ageing is also associated with an increased risk of experiencing more than one chronic condition at the same time (multimorbidity). The impact of multimorbidity on an older person's capacity, healthcare utilisation and their costs of care are often significantly greater than might be expected from the summed effects of each condition (WHO, 2015). Untreated hearing loss affects communication and contributes to social isolation and loss of autonomy, with associated anxiety, depression and cognitive decline. Visual impairments limit mobility, affect interpersonal interactions, trigger depression, become a barrier to accessing information and social media, increase the risk of falls and accidents, and make driving hazardous.

There is thus a strong case for promoting ageing in place – that is, the ability of older people to live in their own home and community safely, independently, and comfortably, regardless of age, income or level of intrinsic capacity. The greatest burden of disability is estimated to come from sensory impairments, back and neck pain, chronic obstructive pulmonary disease, depressive disorders, falls, diabetes, dementia and osteoarthritis (WHO 2015).

Because most of the disease burden in older age is due to non-communicable diseases, risk factors for these conditions are important targets for health promotion. Strategies to reduce the burden of disability and mortality in older age by enabling healthy behaviours and controlling metabolic risk factors should therefore start early in life and continue across the life course.

Engaging in physical activity across the life course has many benefits, including increasing longevity. It has several other benefits in older age. These include improving physical and mental capacities (for example, by maintaining muscle strength and cognitive function, reducing anxiety and depression, and improving self-esteem); preventing disease and reducing risk (for example, of coronary heart disease, diabetes and stroke); and improving social outcomes (for example, by increasing community

involvement, and maintaining social networks and intergenerational links) (WHO, 2015).

The management of malnutrition in older age needs to be multidimensional. Various types of interventions are effective in reversing these patterns of malnutrition. The nutrient density of food must improve, particularly that of vitamins and minerals, but energy and protein are important targets. A specific concern is much higher prevalence of overweight and obesity among South African women. Unhealthy diet translates into cardiovascular disease, diabetes, and cancer, and subsequently depression.

An additional factor associated with higher depression among women is higher rates of interpersonal stressors, experienced violence, childhood sexual abuse, and – on a social level – lack of gender equality and discrimination. Forms of violence lie on a continuum between slapping, persuading a woman to have sex, threatening to beat, hitting with sticks or other objects, pushing, assaulting with fists, violent rape, and stabbing with a knife or shooting. Having some form of post-school education protects against abuse. The mechanism of protection is not just through economic independence, as many other women with less education are economically independent, but also a greater social empowerment (ie social networks, self-confidence, or an ability to utilise sources of information and resources available in society).

Evidence suggests that despite older people being in worse health than those younger, older people use health services significantly less frequently. These patterns of utilisation arise from barriers to access, a lack of appropriate services and the prioritisation of services towards the acute needs of younger people.

A larger ethical issue is rationing of healthcare to older people on the notion that health services are scarce and must be allocated to achieve the greatest good for the greatest number of people. WHO 2015 rejects this view on two counterarguments: older people have made the greatest contribution to socioeconomic development that created these services, and they are entitled to live a dignified and healthy life.

A major policy concern is that health workers are often trained to respond to pressing health concerns, rather than to proactively anticipate and counter changes in function, and are rarely trained to work with older people to ensure they can increase control over their own health. Although most patients within health systems are older, curricula frequently overlook gerontological and geriatric knowledge and training, and may lack guidance on managing common problems, such as multimorbidity and frailty. Beard and Bloom (2015) are emphatic that surveillance of health behaviours in older people remains imperfect and surmise that substantial benefits may accrue if neglected areas of health promotion and disease prevention in older age are prioritised.

An important landmark has been the promulgation of the Mental Health Care Act 2002 in South Africa. The Act has served as a key instrument of reform of mental health care within general health services, and for facilitating community-based care. Mental health service norms have been developed for serious psychiatric disorders, for community

mental health services, and for children and adolescents. More comprehensive reforms are on the anvil (Mayosi, 2009). However, the implementation has fallen far short of its objectives. A review by Department of Health, Republic of South Africa, draws pointed attention to the failures.

Mental health care continues to be under-funded and under-resourced compared to other health priorities in the country; despite the fact that neuropsychiatric disorders are ranked third in their contribution to the burden of disease in South Africa, after HIV/AIDS and other infectious diseases. In fact, mental health care is usually confined to management of medication for those with severe mental disorders, and does not include detection and treatment of other mental disorders, such as depression and anxiety disorders.

In the South African context, the relationship between HIV/AIDS and mental illness is particularly pertinent. Research in South Africa shows that, with high prevalence in both, mental illness and HIV coexist in a complex relationship. Mental health impacts on and is exacerbated by the HIV/AIDS epidemic, both being mutually reinforcing risk factors. Mental health problems are common in HIV disease, cause considerable morbidity, and are often not detected by physicians. The proposed National Mental Health Policy Framework and Strategic Plan 2013-2020 is a bold and comprehensive initiative. However, the challenge of curbing depression in South Africa is daunting.

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