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Aging, Depression, Non-Communicable Diseases and Disabilities in South Africa

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Keywords

aging, depression, multimorbidity, difficulties in activities of daily living, body mass index

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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. This study uses four waves of a panel survey 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. Depending on whether the dependent variable is binary (self-reported depression for ≥ 3 days in a week) or continuous (as in measures of overall depression and severe 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: those in their sixties, Africans and Coloureds, women, those suffering from multimorbidity, those with multiple limitations in ADLs, those in lower asset quartiles and individuals who suffered family bereavements. Factors that attenuate depression include marriage, pension, affluence, trust in a community and familiar neighbourhoods. An important feature of our study is the robustness of the key results. To reduce their depression, more public and private health care investment in the health and well-being of aged in South Africa is recommended.

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JEL Codes: I12, J13, J18

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1. Introduction

The number and proportion of persons aged 60 years or more[1] in South Africa rose during 1996-2011. The population of old South Africans (60 years or more) grew at a much faster rate than the overall population. 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, and Coloureds and Black Africans. Aged Black Africans have worse health outcomes than those from other racial groups.

Old age is often accompanied by poor health due to isolation, morbidities and disabilities in carrying out activities of daily living (DADLs) leading to depression (Tucker and Buranapin, 2001; WHO, 2017). 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 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).

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 (60 years or more), few studies have examined the complex relationships among depression, NCDs and ADL limitations (e.g., Steptoe et al., 2015). Besides, the methods used to examine these links usually lack analytical rigour. NCDs and ADL limitations are often used as explanatory variables without correcting for their endogeneity (e.g., 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 life styles. 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

[1]Aged, older, elderly, old persons are used interchangeably and are defined as persons aged 60 years or more.

Buranapin, 2001). Yet another issue is that often more than one disease and ADL limitation have more serious implications for health and well-being of the elderly (e.g., Scott et al., 2007). 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 aged person's capacity, health-care utilization and their costs of care is often significantly greater than might be expected from the summed effects of each condition". Multimorbidity affects a substantial number of people in South Africa with a significantly greater burden on the poor (Ataguba, 2013).

Despite numerous research studies on the issue of depression and its linkages with multimorbidity and disabilities, most of the 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 common NCDs and DADLs.

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 effects 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 utilizes all four waves of the panel survey. Many of the key findings are robust.

The present study is structured as follows. In Section 2, we discuss salient facts of aging and health in South Africa. This is followed by a review of recent regional and South African studies of aging, multimorbidity, disabilities, and depression in Section 3. Section 4 is devoted to a discussion of data and measures used in the analysis that includes salient features of the *National Income Dynamics* Study. Section 5 discusses the rationale for econometric specifications and definitions of variables used. The descriptive statistics and regression results are presented and interpreted in Section 6. Section 7 discusses the main contributions of our study in the light of the extant literature and limitations of the econometric analyses. Finally, Section 8 summarizes 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 urbanization contribute as much to increasing cases of noncommunicable diseases as they do to HIV, tuberculosis, and other communicable diseases (Puoane, Bradley and Hughes, 2005).

Population ageing is the major driver of projected increases in disease burden, 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 (referred to as aged, elderly) rose between 1996 - 2011 (Stats SA, 2017) from 2.4 million to 3.1 million. Moreover, the population of aged 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 in 2005[2].

In South Africa, ageing Black Africans have worse health outcomes than ageing populations 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 health-care facilities, and the political and economic marginalization that resulted from apartheid policies.

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 urban provinces. Racial differences show that elderly Whites and Indians/Asians/Others occupied a higher socio-economic status than Black Africans and Coloureds[3].

[2] 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.

[3] 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;

The proportions of rich White elderly persons were far higher than those of Black African elderly persons and Coloureds in the total population. 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.

3. Literature Review

As there are few studies of depression in South Africa, the review below draws upon some important contributions from several regions and different countries.

Kleinman (1991) that the hormonal changes characteristics 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 that 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.

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 (SAGE) data to examine factors associated with self-reported symptom-based depression among old South Africans. While both studies establish that lack of quality of life was associated with self-reported depression symptoms in the past 12 months, the former study found that functional disability, and chronic conditions were also predictors of depression. Moreover, these studies suffer from three potentially serious limitations: possible endogeneity of functional disability, lack of quality of life, and omission of chronic conditions.

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 (Kawachi and Berkman, 2001). Recent reviews show that social capital is associated with better mental health. Recent reviews show that social capital is associated with better mental health—even in the South African context with strong ethnic divisions. Using data from the first wave of the *South African National Income Dynamics Study (SA-NIDS),* Tomita and Burns (2013) found that neighbourhoods with

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.

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 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.

Myer et al. (2008) examine the associations 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 hypothesizes 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. To assess social support, Myer et al. (2008) measures bonding social capital and traumatic life events using five items in the social networks section of the World Mental Health survey schedule. The findings indicate that the association between each social construct and psychological distress persisted after adjusting for participant demographic characteristics. Comparing the models with and without adjustment for recent life events, these events appear to mediate the associations between SES and psychological distress. As in the previous study, use of stepwise regression is problematic as the coefficients from the more parsimonious specifications change significantly. Another comment is related to the asset index combining both assets and income. If there is high correlation between them, which is likely, the asset index on its own would have sufficed.

In another study, Lloyd-Sherlock & Agrawal (2014) examine the effect of pensions on self-reported health outcomes and well-being in South Africa. Using multivariate logistic regression analysis, the authors report that pension status is significantly associated with more frequent outpatient visits, awareness of hypertensive status and with treatment.

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

relevant to our study. The depression index was significantly lower among the pensioners than non-pensioners.

4. Data and Measures

4.1 Data and Study Sample

The data used in the present study are drawn from the first 4 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)). 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))[4] and is currently the sole nationally representative panel data source in South Africa. The survey was designed with a key objective to analyze various dimensions of the well-being of South Africans over time. SA-NIDS waves collect data on household wealth, individual and household demographics, health, and other socio-economic 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 as depressed if he/she was depressed for ≥3 days in a week[5].

As these comparisons are based on averages, and the effects of confounding factors are not controlled for, they have descriptive value. The regressions carried out below help isolate the contributions of individual factors.

4.2 Measures

We have used three alternative measures of depression as 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 are 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. These 10 items include if respondent was unusually bothered (item 1), had trouble keeping his/her mind on what

[4]More information on sampling design and attrition can be obtained from www.nids.uct.ac.za/ . *Last accessed: March 1, 2017.*

[5]Definitions and summary table is provided (see Table 1 and Table 2, respectively). However, detailed cross-tabulations can be obtained from authors upon request.

he/she was doing (item 2), felt depressed (item 3), felt that everything was an effort (item 4), felt hopeful about the future (item 5), felt fearful (item 6), sleep was restless (item 7), was happy (item 8), felt lonely (item 9), and could not get going (item 10). 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. Cronbach's alpha (Cronbach, 1951) is computed to assess the reliability of a summative rating (Likert, 1932) scale composed of the 10 items specified above. Cronbach's alpha scores are 0.80, 0.78, 0.76 and 0.69 for the survey years 2008, 2010, 2012 and 2014, respectively. Cronbach's alpha scores for the pooled sample is 0.70. Following Nunnally and Bernstein (1994), a modest reliability score is enough to combine these item scores to create an index. Scores from all the 10 items are added for each respondent and the total sum of scores is divided by 10. We name this variable as overall depression. In the other index, higher extreme values of each indicator (i.e. 3 and 4), including two rescaled ones, are added up and divided by 10. Lower values of each indicator (i.e. 1 and 2) are treated as 0. We name this variable as severe depression[6].

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 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 WHO classifications) in the initial years are used as health variable proxies for diseases, disability and nutritional status[7].

Following Tomita and Burns (2013), we also construct 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

[6] For an admirably clear exposition of how depression is experienced, see Tachi and Scott (2017).
[7] These are in fact a mix of ASL and IADL limitations.

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. These questions were asked only in the 2008 survey questionnaire and, therefore, we will use these items as *initial condition* in the analysis. As in depression, the reliability of the 5-point scale composed of these 4 items was assessed through Cronbach's alpha. The Alpha value of 0.72 suggests that there is sufficient internal consistency to combine these item scores to create an index. A neighbourhood social capital index for each household is 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 categorize 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 is 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.[8] Next, we constructed an individual's strong preference to remain in the neighborhood 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[9].

5. Econometric model

Given our objective, we employ an econometric model that allows us to unravel the determinants of depression in a systematic and rigorous way. So, the findings are more comprehensive and rigorous. We apply a random effects probit with Mundlak (1978) adjustment to the panel dataset for the binary depression variable defined earlier. For convenience of exposition, consider the basic model[10]:

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

[8] We also constructed household's civic participation variables based on their participation in any of 18 associations/groups but could not use due to very few observations across waves.
[9] Details available upon request.
[10] This draws upon Arulampalam (1998), Wooldridge (2010) and Greene (2012).

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

and

$y_{it} = 1\ [{y_{it}}^* > 0]$ where, y^*denotes the unobservable variable, y_{it} is the observed outcome, $\boldsymbol{x_{it}}$ is observable time-varying and time-invariant vector of exogenous characteristics, and initial values of some variables which influence y^*, $\boldsymbol{\beta}$ is the vector of coefficients associated with $\boldsymbol{x_{it}}$, α_i denotes the individual specific unobservable effect and 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,

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

The parameters of this model are easily estimated by noting that the distribution of ${y_{it}}^*$ conditional on α_i is independent normal[11]. Note that

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

where

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

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

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

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

$${y_{it}}^* = \psi + \boldsymbol{x}_{it}{}'\boldsymbol{\beta} + \bar{\boldsymbol{x}}_\iota \xi + a_i + u_{it},\ \ t = 1, \ldots \ldots T \qquad (7)$$

[11] Further details of MLE estimation are omitted, as these are available in Wooldridge (2010).

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 sub-samples of women and the Africans. Both the models (random effects probit with Mundlak adjustment and random effects regression with Mundlak adjustment) are estimated by generalized least squared (GLS). The standard errors are adjusted for clusters in individuals. A list of variables used and their definitions are given in Table 1.

Table 1. 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: African	=1 if 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-<=16, 0 otherwise
2008 Social Capital: High	=1 if social capital score>16-<=20, 0 otherwise
Social Trust	= 1 if very or somewhat likely that imagine you lost a wallet or purse that contained
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

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 aged person is classified as depressed if reported to be depressed for ≥ 3 days in a week. This analysis is then supplemented by using the two depression indices: named overall depression and severe depression. These measures are treated as continuous, following Tomita and Burns (2013) but with some variation.

For each of the three depression dependent variables, three specifications/models are used[12]. Specification I uses *initial* multimorbidity conditions, specification II uses i*nitial* nutritional status measured as BMI categories (underweight, normal, overweight, and obese), and specification III uses *initial* multiple limitations in conducting ADLs or DADLs. The main reason for using the three

[12] Specification and model are used synonymously.

specifications is that NCD, BMI and DADLs are endogenous to one another. Any differences/similarities between these results and those obtained from sub-samples of women and Africans are discussed briefly[13].

6.1 Descriptive Statistics

The percentage distributions of elderly's depression prevalence (≥3 days) by respondents' key demographic and health characteristics are given in Table 2.

Table 2: % distribution of elderly's depression prevalence (≥3 days), 2008-2014

Group/Year	2008	2010	2012	2014	All
All (60 and above)	15.4	12.6	14.0	14.5	14.1
Gender					
Male	26.3	23.5	29.0	32.7	39.9
Female	73.7	76.5	71.0	67.3	60.1
Age-groups					
60-64	36.2	39.8	34.9	34.7	36.3
65-69	31.4	24.5	22.6	24.5	22.4
70-74	13.7	22.7	18.1	17.3	17.9
75-79	13.0	7.6	13.4	9.8	11.9
80-84	3.3	3.4	4.5	6.6	7.5
85+	2.5	2.0	6.5	7.3	4.1
Race					
Black African	85.7	88.2	78.9	64.3	68.7
Coloured	4.9	3.0	7.4	12.6	8.1
Asian/Indian/Other	1.1	4.8	6.0	2.9	2.7
White	8.4	4.0	7.6	20.2	20.6
Marital Status					
Married	42.3	39.9	43.6	30.1	45.6
Living with Partner	4.2	2.3	1.8	1.0	1.8
Widow/Widower	35.2	42.4	35.9	49.8	37.9
Divorced/Separated	5.1	3.9	4.9	3.2	4.2
Never Married	13.2	11.5	13.9	16.0	10.5
Self-reported health status					
Poor	34.8	19.7	14.3	15.6	9.6
Fair	32.1	31.8	20.9	21.5	22.2
Good	21.2	22.6	39.6	36.2	38.8
Very good	7.5	14.0	12.7	17.4	20.0
Excellent	4.4	11.9	12.5	9.4	9.5
Body Mass Index Categories					
Underweight	5.4	4.4	2.7	4.2	4.6
Normal	29.2	22.0	29.7	24.8	28.4
Overweight	23.8	34.0	30.2	29.2	29.8
Obese	41.6	39.5	37.4	41.9	37.2
Occurrence of diseases					
No disease	48.7	87.0	93.0	85.5	88.4
Single disease	36.9	10.9	6.9	13.9	11.0
Multiple diseases	14.4	2.1	0.1	0.6	0.6
Disabilities in the activities of daily life DADLs)					
No DADL	33.5	43.9	n.a.	n.a.	n.a.

[13] Details are available upon request from the authors.

>1-<3 DADLs	29.5	30.1	n.a.	n.a.	n.a.
>4-<6 DADLs	22.1	15.0	n.a.	n.a.	n.a.
>7-<11 DADLs	14.9	11.1	n.a.	n.a.	n.a.
Assets wealth index group					
1st quintile	27.5	24.6	15.5	7.8	10.3
2nd quintile	34.1	23.6	19.3	12.6	15.3
3rd quintile	14.6	20.3	19.9	22.3	20.6
4th quintile	11.4	16.7	23.2	23.2	21.8
5th quintile	12.4	14.8	22.2	34.1	32.1

Note: All percentages are weighted by panel weights and are the column percentages within respective groups. Number of observations varies across years of survey and variables under considerations.

Our analysis corroborates that with an average of 14% depression prevalence between 2008- 2014, the prevalence of depression falls from 15.3% in 2008 to 14.5% in 2014, with a dip to 12.6% in 2010. In each of the years, more women are depressed than men. In 2014, for example, the share of women among the depressed is twice that of men. Consistently, depression prevalence among elderly falls with each higher age group (60-64 years to 65-69 years and so on). Widowed Africans have relatively higher depression prevalence, except in the years 2008 and 2012 where married outnumber widowed. The share of Black Africans among the depressed is highest but it declines during 2008-2014. The second largest group comprises Whites whose share jumps from 8.4% to 20.2%. Out of five wealth quintiles constructed using principal components analysis, the bottom two quintiles account for 61.6% of the depressed in 2008 but their share drops to 20.4% in 2014. In sharp contrast, the share of the fifth quintile rises from 12.4% to 34.1%.

6.2 Regression results

In Table 3, we report the results based on a binary measure of depression (i.e. depressed for ≥3 days in a week) and random effects probit with Mundlak adjustment. Both coefficient estimates and marginal effects are reported. As these are not elasticities, we can't assess whether some variables have larger effects than others. So, our comments are confined to comparisons across the three specifications. Moreover, unless coefficient and marginal effects differ in significance, we report the results based on marginal effects.

Table 3. Random effects probit regressions with Mundlak adjustment: full sample analysis

	Dependent variable: dummy for depression					
Explanatory variables	Specification I		Specification II		Specification III	
	Coeff	ME	Coeff	ME	Coeff	ME
Male	-0.143**(0.064)	-0.033**(0.015)	-0.177**(0.071)	-0.041**(0.016)	-0.135**(0.064)	-0.031**(0.015)
Age:65-69	0.014(0.089)	0.003(0.02)	0.012(0.094)	0.003(0.022)	0.035(0.090)	0.008(0.021)
Age:70-74	0.068(0.118)	0.016(0.027)	0.005(0.125)	0.001(0.029)	0.099(0.119)	0.023(0.027)
Age:75-79	0.079(0.146)	0.018(0.034)	0.019(0.155)	0.004(0.036)	0.105(0.149)	0.024(0.034)
Age:80+	-0.195(0.192)	-0.045(0.044)	-0.230(0.205)	-0.053(0.047)	-0.177(0.197)	-0.041(0.045)
Married	-0.062(0.057)	-0.014(0.013)	-0.072(0.061)	-0.016(0.014)	-0.072(0.057)	-0.017(0.013)
No Education	-0.029(0.054)	-0.007(0.012)	-0.030(0.058)	-0.007(0.013)	-0.025(0.055)	-0.006(0.013)
Diabetes/HighBP in 2008	0.159*(0.087)	0.036*(0.02)				
Cancer/HeartProblems in 2008	0.248(0.358)	0.057(0.082)				
Underweight in 2008			-0.073(0.125)	-0.017(0.029)		
Normal in 2008			0.058(0.066)	0.013(0.015)		
Overweight in 2008			-0.085(0.067)	-0.019(0.015)		
DADL in 2008: Set I					0.315**(0.161)	0.072*(0.037)
DADL in 2008: Set II					0.216*(0.111)	0.049*(0.025)
Smoke/Alcohol in 2008	0.033(0.095)	0.007(0.022)	0.073(0.100)	0.017(0.023)	0.031(0.096)	0.007(0.022)
Any Pension	-0.192**(0.089)	-0.044**(0.021)	-0.190**(0.094)	-0.044**(0.022)	-0.209**(0.089)	-0.048**(0.02)
Ever main hh decision maker	-0.150(0.132)	-0.035(0.03)	-0.130(0.148)	-0.03(0.034)	-0.131(0.132)	-0.03(0.03)
Family Size (excl.60+)	0.027(0.017)	0.006(0.004)	0.025(0.018)	0.006(0.004)	0.029*(0.017)	0.007*(0.004)
Population Group: African	0.348***(0.133)	0.08**(0.031)	0.341**(0.141)	0.078**(0.032)	0.364***(0.132)	0.083***(0.03)
Population Group: Coloured	0.289**(0.129)	0.066**(0.03)	0.228(0.139)	0.052*(0.032)	0.305**(0.128)	0.07**(0.03)
Population Group: Asian/Indian/others	0.392(0.263)	0.09(0.061)	0.159(0.292)	0.036(0.067)	0.491*(0.262)	0.113*(0.06)
Wealth: 2nd quartile	-0.008(0.094)	-0.002(0.021)	0.003(0.100)	0.001(0.023)	-0.009(0.095)	-0.002(0.022)
Wealth: 3rd quartile	-0.141(0.117)	-0.032(0.027)	-0.092(0.126)	-0.021(0.029)	-0.123(0.118)	-0.028(0.027)
Wealth: 4th quartile	-0.203(0.144)	-0.047(0.033)	-0.192(0.153)	-0.044(0.035)	-0.191(0.147)	-0.044(0.034)
Family death in last 24 months	0.204***(0.066)	0.047***(0.015)	0.158**(0.069)	0.036**(0.016)	0.216***(0.067)	0.049***(0.015)
2008 Social Capital: Moderate	-0.030(0.055)	-0.007(0.013)	-0.055(0.057)	-0.013(0.013)	-0.026(0.055)	-0.006(0.013)
2008 Social Capital: High	-0.029(0.074)	-0.007(0.017)	-0.046(0.075)	-0.011(0.017)	-0.014(0.074)	-0.003(0.017)
Social Trust	-0.140*(0.072)	-0.032*(0.016)	-0.094(0.075)	-0.022(0.017)	-0.152**(0.073)	-0.035**(0.017)
Strong preference for stay	-0.098*(0.055)	-0.023*(0.013)	-0.111*(0.058)	-0.025*(0.013)	-0.106*(0.056)	-0.024*(0.013)
Mean age:65-69	-0.530**(0.219)	-0.122**(0.051)	-0.532**(0.235)	-0.122**(0.054)	-0.569**(0.221)	-0.13***(0.051)
Mean age:70-74	-0.090(0.167)	-0.021(0.038)	-0.021(0.177)	-0.005(0.041)	-0.116(0.168)	-0.027(0.039)
Mean age:75-79	-0.490**(0.225)	-0.112**(0.052)	-0.389(0.239)	-0.089(0.055)	-0.519**(0.228)	-0.119**(0.052)
Mean age:80+	0.065(0.230)	0.015(0.053)	0.089(0.247)	0.02(0.057)	-0.011(0.236)	-0.003(0.054)
Mean family Size (excl.60+)	-0.038*(0.020)	-0.009*(0.004)	-0.033(0.020)	-0.008(0.005)	-0.039**(0.020)	-0.009**(0.005)
Mean wealth: 2nd quartile	0.022(0.133)	0.005(0.03)	0.041(0.140)	0.009(0.032)	0.030(0.134)	0.007(0.031)
Mean wealth: 3rd quartile	-0.078(0.147)	-0.018(0.034)	-0.072(0.157)	-0.016(0.036)	-0.087(0.149)	-0.02(0.034)
Mean wealth: 4th quartile	0.166(0.183)	0.038(0.042)	0.289(0.194)	0.066(0.044)	0.208(0.184)	0.048(0.042)
Intercept	-0.553(0.244)		-0.571(0.270)		-0.579(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. Coef: Coefficient. ME: Marginal effect.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.

Let us first consider demographic and life-style variables. In each of the three specifications (I, II, and III), aged males are more likely to suffer from depression than aged females, with the largest (absolute) coefficient and marginal effects 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 associations with the likelihood of depression.

Neither marital status (married=1) nor education (illiterate=1) are significant. Family support is posited to lower the prevalence of depression. However, though the magnitude is small, family size (excluding elderly members) has a significant positive effect on depression prevalence (specification III). As noted earlier, consistent with our earlier observation, neglect of the elderly, if not their abuse, in larger households can't be ruled out, resulting in more depression. However, mean household size has significant negative coefficients (in specifications I and III). It could be argued that small households are more constrained than large households in providing kin support to the old.

Among life style factors, we consider 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 the neighbours/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 and high BP as a measure of multimorbidity has a significant positive coefficient, implying that initial multimorbidity is associated with depression. Of the two multimorbidity measures, the combination of diabetes/high BP (in 2008) has a significant positive marginal effect on depression in specification I. Between the two sets of disabilities, the first set (e.g. difficulty in dressing, bathing) has the larger positive marginal effect on 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 possess a significant association with depression. If there was a death in the family in the last 2 years, it has a significant positive effect on depression in all three specifications. Family bereavement thus leads to depression.

Socio-economic status (SES) is assessed based on 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 (e.g. Myer et al. 2008). Using the Whites as the reference category, both the Africans and Coloureds have significant positive effects in all cases while Asians/Indians/Others have significant positive effects in two cases (specifications I and III).

Pensions have a significant negative effect on depression presumably because it imparts some 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 reduces the prevalence of depression (Specifications I and III). As social capital is distinguished from social trust (measured based on a thought experiment), it is somewhat intriguing that only the latter has a significant negative effect. Another aspect of social networks is the quality of the neighbourhood which induces a preference on the part of the respondent to strongly prefer living in it. In all three specifications, this significantly lowers depression but with similar marginal effects. Evidently, social networks and familiar neighbourhoods make 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.

Table 4 provides the results based on random effects regressions with Mundlak adjustment for the overall depression measure in which all values of the 10 indicators are averaged. Interpretation is based on the magnitude, sign and significance of the reported coefficients in Table 4. As in the case of depression as a dummy variable, the gender effect is robust across the specifications, with aged males less likely to be depressed. A male selection bias can't be rejected given higher mortality of males at younger ages[14].The age effect is significant for two age groups: 75-79 years and 80+ years, showing lower likelihood of

[14] Age and sex differentials further show that from age group 0 to 65–69 years, male deaths comprised higher proportions of deaths than female deaths. The proportions of female deaths exceeded those of male deaths for all the remaining older age groups (70–74 years up to age 90 years and older) (STATS SA 2017). So, greater male selectivity seems likely.

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 4. Random effects regressions with Mundlak adjustment: full sample analysis

	Dependent variable: Overall Depression		
Explanatory variables	Specification I	Specification II	Specification III
Male	-0.039**(0.017)	-0.052***(0.018)	-0.040**(0.017)
Age:65-69	-0.009(0.024)	-0.002(0.025)	-0.007(0.024)
Age:70-74	-0.034(0.033)	-0.029(0.035)	-0.031(0.033)
Age:75-79	-0.097**(0.043)	-0.103**(0.046)	-0.098**(0.044)
Age:80+	-0.141**(0.057)	-0.129**(0.062)	-0.146**(0.058)
Married	-0.059***(0.016)	-0.064***(0.017)	-0.060***(0.016)
No Education	0.003(0.016)	0.005(0.017)	0.004(0.016)
Diabetes/HighBP in 2008	0.086***(0.029)		
Cancer/HeartProblems 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(0.026)	0.012(0.028)	0.005(0.027)
Any Pension	-0.045(0.028)	-0.049*(0.029)	-0.044(0.028)
Ever main hh decision maker	-0.037(0.038)	-0.025(0.042)	-0.024(0.037)
Family Size (excl.60+)	0.007(0.005)	0.009*(0.005)	0.007(0.005)
Population Group: African	0.200***(0.034)	0.192***(0.038)	0.211***(0.034)

Population Group: Coloured	0.092***(0.034)	0.073*(0.038)	0.108***(0.034)
Population Group: Asian/Indian/others	0.017(0.066)	-0.017(0.062)	0.046(0.066)
Wealth: 2nd quartile	-0.015(0.029)	-0.012(0.031)	-0.014(0.030)
Wealth: 3rd quartile	-0.070**(0.035)	-0.063*(0.038)	-0.054(0.035)
Wealth: 4th quartile	-0.085*(0.044)	-0.089*(0.047)	-0.068(0.044)
Family death in last 24 months	0.086***(0.021)	0.076***(0.022)	0.089***(0.021)
2008 Social Capital: Moderate	0.006(0.016)	-0.002(0.017)	0.004(0.016)
2008 Social Capital: High	0.011(0.021)	0.017(0.022)	0.016(0.021)
Social Trust	-0.027(0.019)	-0.026(0.021)	-0.028(0.019)
Strong preference for stay	-0.060***(0.017)	-0.060***(0.018)	-0.062***(0.017)
Mean age:65-69	-0.103(0.063)	-0.080(0.066)	-0.112*(0.063)
Mean age:70-74	0.063(0.047)	0.066(0.049)	0.047(0.047)
Mean age:75-79	0.022(0.066)	0.044(0.069)	0.026(0.066)
Mean age:80+	0.162**(0.072)	0.154**(0.077)	0.123*(0.072)
Mean family Size (excl.60+)	-0.008(0.006)	-0.010(0.006)	-0.008(0.006)
Mean wealth: 2nd quartile	-0.053(0.042)	-0.047(0.043)	-0.055(0.042)
Mean wealth: 3rd quartile	-0.050(0.043)	-0.056(0.046)	-0.058(0.043)
Mean wealth: 4th quartile	-0.071(0.056)	-0.035(0.060)	-0.068(0.055)
Intercept	1.892***(0.070)	1.889***(0.077)	1.873***(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, married aged have significantly lower prevalence of overall depression across all three specifications. Somewhat surprisingly, pensions are associated with

lower prevalence of depression relative to those without receiving any but only in specification II. This contrasts with the robust negative effect of pensions in the dummy variable specification of depression. Both the Africans and Coloureds are more likely to be depressed relative to the Whites.

As in the case of the dummy variable specification of depression, strong preference for the same neighbourhood has a robust negative effect on overall depression. 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 overall 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 overall depression.

As in the case of dummy variable depression, the shock of a death in the family is robustly positive (in all specifications). Among the health status variables, both multimorbidity measures (diabetes/high blood pressure, and cancer/heart problems in 2008) are positively associated with overall depression, especially the latter combination. Both sets of DADLs are also significantly positively associated with depression, with the coefficient of first set of disabilities exceeding that of the second. Among the BMI categories, the aged Overweight 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.

Next, our findings, using the severity of depression measure in which extreme values of each of the 10 indicators (3 or 4) are divided by 10, are based on the results in Table 5. As noted earlier, this measure is designed to capture the more extreme cases of depression. However, the results are largely similar to overall depression case. For instance, the gender effect is negative and significant in all specifications, further confirming lower prevalence 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. Among the mean age-groups, those with means of 70-74 years and 75-79 years possess significant positive marginal effects but in one specification each, while, by contrast, those in the mean of 80 years and older have significant positive effects in all cases, thus pointing to more severe depression among these means-especially among the oldest.

Table 5. Random effects regressions with Mundlak adjustment: full sample analysis

	Dependent variable: Severe Depression		
Explanatory variables	Specification I	Specification II	Specification III
Male	-0.047**(0.020)	-0.064***(0.022)	-0.045**(0.020)
Age:65-69	-0.030(0.032)	-0.022(0.034)	-0.028(0.032)
Age:70-74	-0.060(0.043)	-0.052(0.045)	-0.055(0.043)
Age:75-79	-0.174***(0.057)	-0.180***(0.061)	-0.169***(0.058)
Age:80+	-0.229***(0.075)	-0.207***(0.080)	-0.228***(0.076)
Married	-0.057***(0.022)	-0.066***(0.023)	-0.061***(0.021)
No Education	0.006(0.022)	0.006(0.023)	0.008(0.022)
Diabetes/HighBP in 2008	0.110***(0.039)		
Cancer/HeartProblems 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(0.034)	0.045(0.037)	0.034(0.035)
Any Pension	-0.073**(0.036)	-0.082**(0.038)	-0.073**(0.036)
Ever main hh decision maker	-0.042(0.050)	-0.043(0.055)	-0.030(0.048)
Family Size (excl.60+)	0.005(0.007)	0.007(0.007)	0.005(0.007)
Population Group: African	0.154***(0.043)	0.134***(0.048)	0.161***(0.043)
Population Group: Coloured	0.071*(0.042)	0.034(0.047)	0.086**(0.042)
Population Group: Asian/Indian/others	-0.076(0.078)	-0.115(0.075)	-0.029(0.079)
Wealth: 2nd quartile	-0.014(0.038)	-0.009(0.039)	-0.011(0.038)
Wealth: 3rd quartile	-0.081*(0.047)	-0.066(0.050)	-0.057(0.047)
Wealth: 4th quartile	-0.099*(0.058)	-0.107*(0.062)	-0.072(0.057)
Family death in last 24 months	0.108***(0.030)	0.097***(0.031)	0.112***(0.029)
2008 Social Capital: Moderate	0.005(0.021)	-0.006(0.022)	0.001(0.021)
2008 Social Capital: High	0.023(0.028)	0.034(0.029)	0.027(0.028)
Social Trust	-0.057**(0.023)	-0.053**(0.025)	-0.057**(0.023)
Strong preference for stay	-0.051**(0.022)	-0.053**(0.023)	-0.057***(0.022)
Mean age:65-69	-0.111(0.081)	-0.101(0.084)	-0.128(0.081)
Mean age:70-74	0.101*(0.060)	0.088(0.063)	0.076(0.060)
Mean age:75-79	0.121(0.084)	0.145*(0.088)	0.116(0.084)
Mean age:80+	0.250***(0.090)	0.221**(0.097)	0.187**(0.091)
Mean family Size (excl.60+)	-0.008(0.008)	-0.009(0.008)	-0.009(0.008)
Mean wealth: 2nd quartile	-0.048(0.055)	-0.037(0.057)	-0.051(0.055)
Mean wealth: 3rd quartile	-0.060(0.058)	-0.076(0.060)	-0.070(0.056)
Mean wealth: 4th quartile	-0.061(0.073)	-0.007(0.077)	-0.064(0.071)
Intercept	0.903(0.093)	0.942(0.102)	0.894(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 severity of depression in all cases. This is in sharp contrast to the results obtained with depression defined as a binary variable, presumably because severe depression evokes a strong family bonding effect. Among the ethnic groups, while the Africans have a higher likelihood of depression compared to the Whites, 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. Thus, pensions have a robust effect in lowering depression. Both measures of multimorbidity significantly increase prevalence of depression, as also both sets of DADLs. Those suffering from cancer/heart problem displaying larger coefficients. 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. Besides, strong preference for the current neighbourhood significantly lowers depression. Unlike the previous case, those in the third and fourth quartiles are less likely to be depressed than in the first quartile but only in the first specification.

6.2.1 Sub-sample Analysis

In this section, we report findings of supplementary analyses using the sub-samples for women and Africans. Our comments are largely based on sub-sample specifications of overall depression.[15] However, in the case results significantly differ from depression dummy and severity of depression, we report the differences.

(a) Only women sub-sample

The findings of supplementary analyses using the sub-samples for women are interesting. Several similarities and a few significant differences are established. For instance, 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, mean age group, 70-74 years, has significant positive coefficients (specifications I and II) while mean age group, 80+ years, has significant positive coefficients in all cases. This contrasts with the depression dummy results where none of the age-groups was significant.

[15] Detailed regression results will be provided upon request.

Married women are less likely to be depressed than others in all cases. Household size (without any other old person) is positively associated with overall depression in all three specifications, as also the mean. This points to the plausibility of greater neglect or even abuse of old women in small households. This result is in line with aggregate sample results. The African women have a significant positive coefficient, implying greater likelihood of overall depression among them, as also among the Coloureds (specifications I and III), relative to the Whites. In depression dummy specification, Coloured women were not significantly different from white women.

As in the previous case, a family death in the last 24 months added to overall depression among old women in all specifications. Somewhat surprisingly, pensions don't reduce depression among them. Both measures of multimorbidity are associated with higher depression among the women, as also both sets of DADLs. This is in contrast with depression dummy specifications where multimorbidity and nutritional status measured in BMI categories cease to be significant, and between the two sets of DADLs, the first set significantly increases the probability of depression. Moreover, unlike the aggregate sample, in the women's subsample, the third wealth quartile is significantly negatively associated with depression. Neither social capital nor social trust are associated with overall depression. However, the link through a strong preference for the current neighbourhood attenuated depression among old women.

(b) Only Africans sample

As in the only women sub-sample analysis, results for only African sub-sample are largely similar to those obtained from the aggregate sample[16]. However, there are a few notable differences too. For instance, the three age-groups, 70-74 years, 75-79 years, and 80+ years, have significant negative coefficients in all specifications while, in the case of depression dummy, those in the oldest age group, 80+ years, are less prone to overall depression relative to those in the age group, 60-64 years. African old males are less likely to be depressed than African old females. Married Africans had significant negative coefficients in all three specifications. This contrasts with the depression dummy results where marital status was not significant. 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 overall depression. Both sets of DADLs are positively associated with depression (but at the

[16] Detailed regression results for both overall and severe depression will be furnished upon request.

10% level). The Overweight have a negative coefficient, implying they are less likely to be depressed than the Obese. This contrasts with depression dummy results where nutritional status isn't associated with depression. 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 overall 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 (e.g. 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.

Aging is a major factor in depression. Those in 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 or small households are generally more neglectful of them.

Old women are consistently more likely to be depressed than old men, as they are subject to violence and other stress. Besides, women are typically much more likely to be overweight and obese, leading to NCDs and subsequently higher depression[17].

The Africans are more prone to depression than the reference group of the Whites and Coloureds. There is limited evidence suggesting that Asians/Indians/Others are more likely to be depressed. Pensioners are

[17] Between 1998 and 2008, the estimated proportion of the South African adult population who were overweight or obese increases 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).

less likely to be depressed *despite* some evidence in the literature on pooling of pensions with other household resources and denying the pensioner much financial autonomy.

Of particular significance are the results on multimorbidity[18]. 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 a few cases, the Overweight are less likely to be depressed than the reference category of the Obese. Here again *reverse* causality can't be ruled out.

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

As loneliness and lack of support during a difficult situation can precipitate stress leading to depression, we experiment with construction of measures of social capital and trust as barriers to depression. A key aspect of social capital is civic participation as an example of an objectively verifiable structural dimension of social capital which refers to what people do. 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 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 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 quartiles-especially among the most affluent. However, likelihood of depression remains lower

[18] We did not use HIV/AIDS as an explanatory variable because NIDS waves do not collect sufficient information required.

among the third and fourth quartiles, implying that depression is higher in the poorest (or the least wealthy). It is somewhat surprising that *despite* marked inequalities even among the Africans, there is no wealth effect on depression.

Use of alternative measures of overall and severe depression add useful insights from a policy perspective. There are many similarities but some striking differences too. To illustrate, the similarities include positive effects of multimorbidities on each measure of depressions as also ADLs. Family bereavement is also associated with more depression measured using the three different measures. Men record lower depression than women. Wealth effects vary depending on how depression is measured, as also age effects.

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 multimorbidity[19]. 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 based on *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 measures used here), richer insights into the links between depression, morbidity and disabilities are likely.

8. Conclusion

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 complex, multi-level care that involves a longer-term engagement with the individual, and with the family. Pervasive stigma and

[19] 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.

discrimination aggravate 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 aged person's capacity, health-care utilization and their costs of care are often significantly greater than might be expected from the summed effects of each condition (WHO, 2015).

There is thus a strong case for promoting ageing in place – that is, the ability of elderly 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 later age is due to noncommunicable 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. Other benefits 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).

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 into 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.

Evidence suggests that despite aged individuals being in worse health than those younger, they use health services significantly less frequently. These patterns of utilization arise from barriers to access, lack of appropriate services and the prioritization of services towards the old (WHO 2015).

A larger ethical issue is rationing of aged health care 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: ageing populations 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 rarely trained to work with elderly population 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 ageing population remains imperfect and surmise that substantial benefits may accrue if neglected areas of health promotion and disease prevention in older age are prioritized.

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. More comprehensive reforms are on the anvil (Mayosi, 2009). However, the implementation has been unsatisfactory.

Mental health care continues to be under-funded and under-resourced compared to other health priorities in the country, even though 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. 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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References

Alaba, O., and Chola, L. (2013). 'The social determinants of multimorbidity in South Africa'. *International Journal for Equity in Health 12,* 63.

Arulampalam, W. (1998). 'A note on estimated coefficients in random effects probit models'. Working Paper No.520. Coventry: University of Warwick, Department of Economics. Warwick Economic Research Papers.

Ataguba, J. E. (2013). 'Inequalities in multimorbidity in South Africa'. *International Journal for Equity in Health,* 12, 64.

Beard, J. R. and Bloom, D. (2015). 'Towards a Comprehensive Public Health Response to Population Aging-Viewpoint'. *The Lancet* 385, 658-661.

Bloom, D., Canning, D. and Lubet, A. (2015). 'Global Population Aging: Facts, Challenges, Solutions & Perspectives'. *Daedalus,* Spring.

Brown, M., Daniels, R.C., De Villiers, L., Leibbrandt, M., & Woolard, I., (2013). 'National Income Dynamics Study Wave 2 User Manual (eds.)'. Cape Town: Southern Africa Labour and Development Research Unit.

Case, A. (2004). 'Does Money Protect Health Status? Evidence from South African Pensions'. National Bureau of Economic Research Working Paper w8495 (also in *Perspectives on the Economics of Aging* (ed. David A. Wise)), June 2004.

Case, A. and Deaton, A. (2005). 'Health and Wealth among the Poor: India and South Africa Compared'. AEA *Papers and Proceedings*. April 2005.

Chamberlain, G. (1980). 'Analysis of Covariance with Qualitative Data'. *The Review of Economic Studies 47(1),* Econometrics Issue, 225-238.

Chinhema, M., Brophy, T., Brown, M., Leibbrandt, M., Mlatsheni, C., & Woolard, I., (2016). 'National Income Dynamics Study Panel Wave 4 User Manual (eds.)', Cape Town: Southern Africa Labour and Development Research Unit.

Chisholm, D., Sweeny, K., Sheehan, P., Rasmussen, B., Smit, F., Cuijpers, P., & Saxena, S. (2016). 'Scaling-up treatment of depression and anxiety: a global return on investment analysis', *Lancet Psychiatry* 3, 415–24.

Cois. A., and Day, C. (2015). 'Obesity trends and risk factors in the South African adult population', *BMC Obesity 2,* 42.

Cronbach, L. J. 1951. Coefficient alpha and the internal structure of tests. Psychometrika 16: 297–334.

De Villiers, L., Brown, M., Woolard, I., Daniels, R.C., & Leibbrandt, M, (2013). 'National Income Dynamics Study Wave 3 User Manual (eds.)', Cape Town: Southern Africa Labour and Development Research Unit.

Greene, W. H. (2012). *Econometric Analysis*. 7th Edition, Pearson.

Kawach, I. and L. Berkman (2001) 'Social Ties and Mental Health', *Journal of Urban Health: Bulletin of the New York Academy of Medicine,* 78/3.

Kleinman, A., (1991) *Rethinking Psychiatry*, New York: The Free Press.

Likert, R. A. 1932. A technique for the measurement of attitudes. Archives of Psychology 140: 5–55.

Lloyd-Sherlock, P. and Agrawal, S. (2014). 'Pensions and the Health of Older People in South Africa: Is there an Effect?'. *Journal of Development Studies 50(11),* 1570-1586.

Mayosi, B. M., Flisher, A. J, Lalloo, U. G, Sitas, F., Tollman, S. M, Bradshaw, D. (2009). 'The burden of non-communicable diseases in South Africa'. *The Lancet 374,* 934–47.

Mundlak, Y. (1978). 'On the Pooling of Time Series and Cross-Section Data'. *Econometrica 46,* 69-85.

Myer L, Stein, D.J., Grimsrud, A., Seedat, S, Williams, D.R. (2008). 'Social determinants of psychological distress in a nationally-representative sample of South African adults'. *Social Science and Medicine 66(8),* 1828–1840.

Nunnally, J. C., and I. H. Bernstein. 1994. Psychometric Theory. 3rd ed. New York: McGraw–Hill.

Peltzer, K., and Phaswana-Mafuya, N. (2013). 'Depression and associated factors in older adults in South Africa'. *Global Health Action 6,* 1-9.

Prince, M.J., Wu, F., Guo, Y., Robledo, L. M. G., O'Donnell, M., Sullivan, R., Yusuf, S. (2015). 'The burden of disease in older people and implications for health policy and practice'. *The Lancet 385,* 549–62.

Puoane, T., Bradley, H., and Hughes, G. D. (2005). 'Obesity Among Black South African Women'. In K. Bose, Human Obesity: A Major Health Burden, Chapter 12, *Human Ecology*, Special Issue No. 13.

Riecher-Rössle, A. (2017). 'Sex and gender differences in mental disorders'. *Lancet Psychiatry 4(1),* 8-9.

SA-NIDS (2016b). Southern Africa Labour and Development Research Unit. National Income Dynamics Study 2010-2011, Wave 2 [dataset]. Version 3.1. Cape Town: Southern Africa Labour and Development Research Unit [producer], 2016. Cape Town: DataFirst [distributor], 2016

SA-NIDS (2016c). Southern Africa Labour and Development Research Unit. National Income Dynamics Study 2012, Wave 3 [dataset]. Version 2.1. Cape Town: Southern Africa Labour and Development Research Unit [producer], 2016. Cape Town: DataFirst [distributor], 2016

SA-NIDS (2016d). Southern Africa Labour and Development Research Unit. National Income Dynamics Study 2014 - 2015, Wave 4 [dataset]. Version 1.1. Cape Town: Southern Africa Labour and Development Research Unit [producer], 2016. Cape Town: DataFirst [distributor], 2016. Pretoria: Department of Planning Monitoring and Evaluation [commissioner], 2014

SA-NIDS. (2016a). Southern Africa Labour and Development Research Unit. National Income Dynamics Study 2008, Wave 1 [dataset]. Version 6.1. Cape Town: Southern Africa Labour and Development Research Unit [producer], 2016. Cape Town: DataFirst [distributor], 2016

Scott KM, Bruffaerts R, Tsang A, Ormel J, Alonso J, Angermeyer MC, Benjet C, Bromet E, de Girolamo G, de Graaf R, Gasquet I, Gureje O, Haro JM, He Y, Kessler RC, Levinson D, Mneimneh ZN, Oakley Browne MA, Posada-Villa J, Stein DJ, Takeshima T, Von Korff M. (2007). 'Depression–anxiety relationships with chronic physical conditions: Results from the World Mental Health surveys'. *Journal of Affective Disorders 103,* 113-120.

Stats SA. (2017). Mid-year population estimates, 2016, Statistical release P0302, Statistics South Africa. Pretoria: Statistics South Africa, 2016.

Steptoe, A., Deaton, A. and Stone, A. A. (2015). 'Subjective wellbeing, health, and ageing', *The Lancet 385 (9968),* 640-648.

Tacchi, M.J., and J. Scott (2017) *Depression, A Very Short Introduction*, Oxford: Oxford University Press.

Thapa, S. J., Martinez, P., and Clausen, T. (2015). 'Depression and its correlates in South Africa and Ghana among people aged 50 and above: Findings from the WHO Study on global Ageing and adult health', *J Psychiatry 17(6)*: doi:10.4172/1994-8220.1000167

Tomita A, Burns J.K. (2013). 'A multilevel analysis of association between neighbourhood social capital and depression: evidence from the first South African National Income Dynamics Study'. *Journal of Affective Disorders 144(1-2),* 101–105.

Tucker, K. L. and Buranapin, S. (2001). 'Nutrition and Aging in Developing Countries', *Journal of Nutrition 131(9),* 2417S-23S.

Vigo, D., Thornicroft, G., and Atun, R. (2016). 'Estimating the true global burden of mental illness', *Lancet Psychiatry 3,* 171–78.

WHO (2015). *World report on ageing and health 2015,* World Health Organisation, Geneva.

WHO (2017). *Depression and Other Common Mental Disorders: Global Health Estimates*, World Health Organisation, Geneva.

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge.