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Depression Predictors among Older Persons in a Rural Community in South Africa

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ABSTRACT

Background: Depression is a very important part of global mental health concerns. Many of the studies on correlates of depression stopped short of finding the predictors. Predictive models will empower preventative efforts by healthcare providers and policy makers. The purpose of this study was to determine the factors predicting depressive symptoms among a population of older men and women in rural South Africa. **Methods:** Data were obtained from "Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) in the INDEPTH Health and Demographic Surveillance System (HDSS) site of Agincourt" in rural Mpumalanga province, South Africa. Previously validated short-version Center for Epidemiologic Studies Depression Scale (CES-D 8) was used to assess for depressive symptoms. Multivariable logistic regression model with stepwise selection, and receiver operating curve were used to examine the predictors of depression. **Results:** Of the 4027 participants included in this study, 743 (18.5%) met the criterion for depression (CES-D 8 score ≥3). Older age (OR 1.025, CI 1.016-1.034), diabetes (OR 1.467, CI 1.152-1.868), and alcohol consumption (OR 1.536, CI 1.261-1.872) predicted depression. Being male (OR 0.734, CI 0.588-0.915) and homemaker rather than not working (OR 0.513, CI 0.372-0.707) were protective. Compared to those who were married, depressive symptoms were significantly higher among the separated/divorced (OR 1.372, CI 1.027-1.834) and the widowed (OR 1.468, CI 1.172-1.839). **Conclusions:** It is possible to predict the development of depression in this community, and findings are generalizable to other communities and countries. Healthcare workers and policy makers should use the findings for preventative care and policies.

Keywords: Depression, South Africa, Aging, Predictors, Mental Health

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INTRODUCTION

The burden of mental illnesses is increasing worldwide [1, 2]. Rising incidence, prevalence, treatment failures and cost of care [3, 4] of mental illnesses suggest that much remains to be known. Depression is a very important part of these global mental health concerns. Simply put, depression is 'a mood disorder that causes distressing symptoms that affect how you feel, think, and handle daily activities, such as sleeping, eating, or working'. The symptoms are present in affected persons for at least 2 weeks, for most part of the day and nearly every day [5]. Over 300 million people live with depression worldwide, and according to World Health Organization (WHO) prediction, by the year 2020, depression will rank second in global disease burdens [6, 7].

Between 2005 and 2015, there was an 18.4% increase in the estimated total number of people living with depression. Approximately 3% of the world's population were affected by major depressive disorder in the year 2015 [4]. An estimated 800,000 people die every year due to suicide, which is usually a consequence of depression [8]. Presence of depressive symptoms predicted future suicide [9], and post-depression treatment phase was associated with a large downward trend in suicide rates [10]. Unfortunately, there are many undiagnosed cases [11], which makes it imperative to have a predictive model for this devastating mental health problem.

There is consensus on many of the factors associated with depression, although some variations exist among communities. The role of age, sex, education, marital status, income level, other comorbidities have been well-researched [12], albeit with some divergent conclusions. Other factors such as household population, having a living parent, impact of social network, and personal asset ownership have been less studied. Besides, many of the previous studies stopped short of interrogating whether these factors were merely associated rather than predictive of depression. Here, we examined predictive factors with which we can forecast what might happen in the future should those factors be present in an individual. Risk factors for depression that have not been well researched were included in this study.

MATERIALS AND METHODS

Study population and data

Data for this study were obtained from "Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) in the INDEPTH Health and Demographic Surveillance System (HDSS) site of Agincourt" in rural Mpumalanga province, South Africa. Of the originally selected 6281 participants, the study enrolled 5059 men and women aged ≥40 years as of July 1, 2014 who completed the interviews and permanently living in the area in the 12 months prior to 2013 census [13]. In 2015, this population-based cross-sectional study was conducted and data were collected by trained local fieldworkers via computer-assisted in-person interviews using participants' local language – Shangaan. Ethical approvals for HAALSI was granted by the "University of the Witwatersrand Human Research Ethics Committee (ref. M141159), the Harvard T. H. Chan School of Public Health, Office of Human Research Administration (ref. C13–1608–02), and the Mpumalanga Provincial Research and Ethics Committee" [14]. Other study procedures and selection of study participants were previously described [14, 15]. This study on predictors of depression focused on individuals ≥50 years old, who met or did not meet the criteria for depressions described in later section. Thus, participants less than 50 years old and those with non-valid responses (i.e. refused to answer and missing data) were excluded. Additionally, depression statuses were determined (as described below). Final study population comprised of 4027 participants who were 50 years and older, who completed the questionnaire, and whose responses to questions regarding depression were usable.

Exposure measures

Independent variables in this study were respondents' ages, sex, education, marital status, employment status, religion, having at least one parent alive, diabetes and hypertension statuses, whether they ever consumed alcohol, ever tested positive for HIV, their asset index score, and the number of individuals in the household. These variables were categorized as shown in Table 1. Other exposure measures were the social network parameters including emotional support, interactions, interaction on phone, physical support, informational and financial support. Broad definition of diabetes used was defined as 'Self-reported diabetes diagnosis; OR glucose > 7 mmol/l (126 mg/dL) in fasting group (defined as > 8 hours), glucose > 11.1 mmol/l (200 mg/dL) in nonfasting ("random or casual") samples. Individuals with missing fasting information were considered to be not fasting'. Broad definition of hypertension used was defined in HAALSI study as 'Systolic BP > 140 mmHg or diastolic BP >90 mmHg, or reports using anti-hypertensive medication at time of interview'. The definition of asset index used in this analysis was as described in HAALSI study, computed from census and asset ownership questions, Mean asset index for the entire group was 0.027592071926 (SD 2.368399371050).

Outcome measure

Outcome measure was the diagnosis of depression from shortened Center for Epidemiologic Studies Depression Scale (CES-D 8). Using CES-D 8, participants were asked if much of the time in the past week: (1) they were depressed (2) they felt that everything they did was an effort (3) that their sleep was restless (4) they were happy (5) they felt lonely (6) they did not enjoy life (7) they felt sad (8) they could not get going. By giving one point for each positive response to the questions on the scale, with reverse coding for items (2) and (4), the summation of the responses was computed for each participant. Scores were used both as continuous and as dichotomized in this analysis. A score of 3 or more (≥3) on CES-D 8 scale which indicates presence of three or more symptoms was used for the diagnosis of depression. Other studies have used the same cut-off as continuous and dichotomized data among these participants and elsewhere [16, 17]. The score of (≥3) on the CSE-D 8 compares to the score of (≥16) on the original 20-item CES-D scale which has been ascertained to represent significant depressive symptoms [18, 19].

Statistical analysis

Frequency distributions of participants' sociodemographic variables were used to characterize the study population. Participants were categorized into 'depressed' or 'not depressed'. Chi square tests were used to compared categorical dependent variable (Depression Yes/No) and categorical covariates. Unadjusted regression analysis was used to compare depression score on a continuous scale versus social network parameters on an ordinal scale. Continuous variables were presented as means and standard deviation (SD), categorical variables as percentages. Results from analyses were presented in tables and graph.

To determine a predictive model, stepwise model selection approach was adopted in multivariable logistic regression analysis, including all variables in Tables 1 and 2 as independent variables, and dichotomized depression scale as dependent variable. Entry and stay parameters were set a priori at 0.25 and 0.10 respectively. Receiver operating curve (ROC) was requested to assess the quality of the final predictive model by means of area under the curve (AUC).

Social network parameters were also dichotomized into 'received support' and 'did not receive support'. For instance, regarding emotional support, if a participant was asked 'how often you typically received emotional support from (this person), such as when you are feeling sad or anxious or upset, over the past 6 months?' and they responded – 'not at all'. Then they were considered not to have received any emotional support. However, if their response

was one of the following: every day or almost every day, a few times per week, once per week, a few times per month, once per month, a few times in the past 6 months; then they were considered to have received emotional support in the last 6 months.

For the social network questions, participants were asked to mention 6-7 persons in order of importance to them. The same sets of questions were then administered to the participants regarding each of the 6-7 persons they mentioned. For this study, we used their responses to questions about the first person (person 1, presumably the most important) on their list. Other covariates were categorized as presented in Table 1. The study hypotheses were tested at two-sided level of significance with a *P* value <0.05. SAS Enterprise Guide 7.1 supported on SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) was used for statistical analyses.

Results

Table 1 presents details of participants' characteristics and results of Chi-square analyses to determine if participants that met criterion for depression were different from those that did not. Of 5059 participants who responded to study questionnaires, those less than 50 year (918, 18.1%) were excluded. Of the remaining 4141 participants, those with no valid data/responses to CES-D 8 items were further excluded (114, 2.8%). Final enrolment into this study comprised of 4027 participants of whom 743 (18.5%) met the criterion for depression (CES-D 8 score ≥3). Mean age of entire enrolled participants was 65.7 years (SD 11.1), with over 65% of the study population in the 50 -70 years' age bracket, one-half not having any formal education (50.6%), and 50.5% married at the time of the study. Both sexes were almost equally represented.

Most of the participants were not working (76.8%), were Christians (74.4%), did not have living parents (77.7%), were diabetic (80.6%), hypertensive (66.7%) and never tested positive for HIV (88.6%). There were more participants having less than mean asset index score and almost one-half had consumed alcohol. In Table 2, unadjusted estimates of the relationship between social network parameters and depression were presented. Participants were protected from depression if there was significant interaction with person 1 on the phone, by SMS, through email or through the internet in 6 months prior to the study.

Of all potential risk factors for depression included in this study, those found to be predictive of depression were age, sex, marital status, employment status, diabetic status and whether they ever consumed alcohol. Table 3. Older age (OR 1.025, CI 1.016-1.034), diabetes (OR 1.467, CI 1.152-1.868), and alcohol consumption (OR 1.536, CI 1.261-1.872) positively predicted depression. Male participants unlike their female counterparts were significantly protected from depression (OR 0.734, CI 0.588-0.915). Compared to those who were married, the odds of depression were higher among the separated/divorced (OR 1.372, CI 1.027-1.834) and the widowed (OR 1.468, CI 1.172-1.839). Homemakers were less likely to be depressed compared to those who were not working (OR 0.513, CI 0.372-0.707). Receiver operating curve (Figure 1) presents the quality of this predictive model (AUC=0.6369).

DISCUSSION

Predictive models have been used to foretell the effects of different exposures [20]. In this study, we determined that depressive symptoms were predicted by increasing age, being separated/divorced or widowed rather than being married at the time of study, being diabetic and having ever consumed alcohol. Male sex and being a homemaker rather than unemployed, protected from depression. This model had a 64% chance of predicting depressive symptoms. Importantly, in this community, neither HIV nor the elements of social network namely emotional support, interaction, interaction on phone, physical support, informational support and financial support, predicted depression.

Table 1. Characteristics of Study Population

	Overall (N=4027)[a]	Depression		
		Yes (n=743)	No (n=3284)	P value
Age (n, %)				<.0001
50-59	1391 (34.5)	187 (25.2)	1204 (36.7)	
60-69	1282 (31.8)	229 (30.8)	1053 (32.1)	
70-79	846 (21.0)	171 (23.0)	675 (20.6)	
80+	508 (12.6)	156 (21.0)	352 (10.7)	
Age (mean, SD)	65.7 (11.1)	68.6 (11.3)	64.7 (10.6)	<.0001
Sex				0.0025
Male	1876 (46.6)	309 (41.6)	1567 (47.7)	
Female	2151 (53.4)	434 (58.4)	1717 (52.3)	
Education				0.0004
No formal education	2039 (50.6)	408 (54.9)	1631 (49.9)	
Some primary (1-7 years)	1430 (35.5)	269 (36.2)	1161 (35.5)	
Some secondary (8-11 years)	344 (8.5)	44 (5.9)	300 (9.2)	
Secondary or more (12+ years)	202 (5.0)	22 (3,0)	180 (5.5)	
Marital status				<.0001
Never married	126 (3.1)	23 (3.1)	103 (3.1)	
Separated / divorced	490 (12.2)	95 (12.8)	395 (12.0)	
Widowed	1373 (34.1)	332 (44.7)	1041 (31.7)	
Currently married	2035 (50.5)	293 (39.4)	1742 (53.1)	
Employment status				<.0001
Employed (part or full time)	488 (12.1)	53 (7.1)	435 (13.3)	
Not working	3091 (76.8)	638 (85.9)	2453 (74.9)	
Homemaker	439 (10.9)	52 (7.0)	387 (11.8)	
Religion				0.0166
None	690 (17.1)	155 (20.9)	535 (16.3)	
Christianity (including Roman Catholic, Protestant, Orthodox, Other)	3007 (74.4)	532 (71.6)	2475 (75.5)	
African Traditional	319 (7.9)	53 (7.1)	266 (8.1)	
Islam and others	7 (0.17)	3 (0.4)	4 (0.1)	
One or both parents alive				0.0181
Yes	889 (22.1)	140 (18.9)	749 (22.9)	
No	3130 (77.7)	602 (81.1)	2528 (77.1)	
Diabetes				<.0001
Yes	497 (12.3)	126 (18.3)	371 (12.1)	
No	3245 (80.6)	561 (81.7)	2684 (87.9)	
Hypertension				0.4507
Yes	2687 (66.7)	502 (69.1)	2185 (67.6)	
No	1272 (31.6)	225 (30.9)	1047 (32.4)	
Ever consumed alcohol				0.0034
Yes	1865 (46.3)	380 (51.1)	1485 (45.2)	
No	2162 (53.7)	363 (48.9)	1799 (54.8)	
Ever tested positive for HIV				0.2518
Yes	438 (10.9)	72 (9.7)	366 (11.2)	
No	3569 (88.6)	667 (90.3)	2902 (88.8)	
Asset index score				0.0048
≥ mean	1643 (40.8)	269 (36.2)	1374 (41.8)	
< mean	2384 (59.2)	474 (63.8)	1910 (58.2)	

Number of individuals in household (mean, SD)	5.4 (3.4)	5.1 (3.3)	5.5 (3.5)	0.0016

Depression score ≥3 on CES-D 8 was assigned a diagnosis of depression. Asset index scores obtained from data used for the study were computed from census and asset ownership questions. Mean asset index score was 0.027592071926. Broad definitions of diabetes and hypertension, including self-report of ever diagnosed were used for this analysis. [a] Percentages do not add up to 100 for certain variables due to some missing data on those variables.

Table 2. Unadjusted estimates of relationship between depression and social network

	β	**SE**	**P value**
Emotional support	0.02699	0.01507	0.0734
Interaction	-0.00443	0.01434	0.7576
Interaction on phone	-0.06438	0.01597	<.0001
Physical support	0.00164	0.01367	0.9048
Informational support	-0.01512	0.01522	0.3205
Financial support	-0.01105	0.01407	0.4322

Depression score (0-8) based on CESD-8 scale used as continuous variable. Each social network category based on seven (1-7) point Linkert scale.

Table 3. Predictors of depression from stepwise model selection

Effect	**OR**	**95% CI**	
Age	1.025	1.016	1.034
Sex M vs F	0.734	0.588	0.915
Marital status (ref=currently married)			
Never married	1.187	0.669	2.106
Separated / divorced	1.372	1.027	1.834
Widowed	1.468	1.172	1.839
Employment status (ref=not working)			
Employed (part or full time)	0.770	0.553	1.074
Homemaker	0.513	0.372	0.707
Diabetes Yes vs No	1.467	1.152	1.868
Ever consumed alcohol Yes vs No	1.536	1.261	1.872

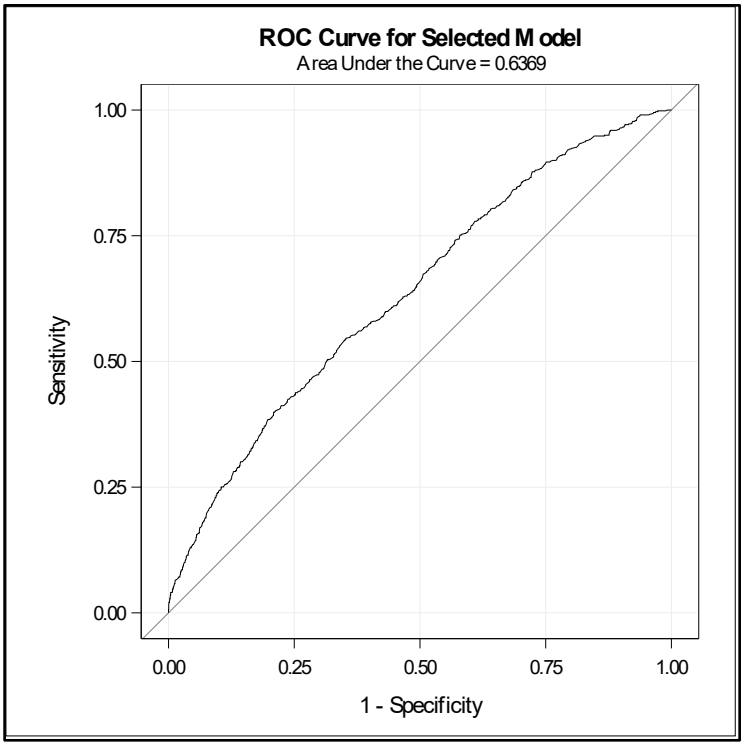

Figure 1. Receiver operating curve showing the quality of the predictive model (AUC=0.6369)

In an aging community, diseases associated with old age are common. As life expectancy from birth is increasing in South Africa, and older age is predictive of depression, the prevalence of depression is only expected to rise. Certain countries are aging rapidly, and of course, the entire world is. Nearly one-thirds on Japanese population is predicted to be senior citizens by 2030. Estimated 25% (Japan), 23% (Italy), 22% (Portugal), and 21% (Finland and Germany) are currently 65 years of age and older [21]. This longevity will likely come with health challenges such as depression. Being female was found to predict depression among the population we studied. There is a preponderance of female population in rural Mpumalanga province, and in South Africa at large. This could potentially drive the prevalence of depression, which expectedly will drive the prevalence of suicide intent, one of the dreaded consequences of depression [22].

Being separated, divorced or widowed predicted depression in this study. The current marriage statistics are appalling. In the U.S., peak marriage rate observed in 1920 (92.3%) is thrice the rate as of 2016, with women's marriage rate decreasing steadily from 1970 [23]. On the other hand, rates of divorces and annulments decreased slightly from 4 to 2.9 per 1000 total population between 2000 and 2016 respectively (excluding data for California, Hawaii, Indiana, Minnesota, and New Mexico) [24]. Between 1995 and 2016 the crude marriage rate (CMR) more than halved in Portugal, reduced by at least 2 marriages per 1000 in Korea, Mexico and the United States, while some increase were observed in Hungary, Ireland, Latvia, Lithuania, the Slovak Republic and Sweden. However, within the same period, crude divorce rates have fallen, albeit minimally, in countries like Australia, Austria, Belgium, the Czech Republic, Estonia, New Zealand, Norway, United Kingdom, United States, Belgium, and Estonia [25]. In many other countries of Europe, divorce rates are increasing. In South Africa, total number of registered civil marriages between 2003 and 2016 has declined steadily; from 2003 to 2010, total number of divorces fluctuated and then increased from 2011 to 2016 [26].

Homemakers were also found to be happier than wives who worked fulltime or part-time in a previous study [27]. On the contrary, homemakers who had wanted a career were not so happy. They were found to be personally dissatisfied than employed women, and not as satisfied as homemakers who never wanted a career [28]. However, the transition from non-employment to employment statuses has significantly reduce the number of female homemakers in late 20th century in the U.S and Germany [29]. In the population we studied, only 10.9% identified as homemaker, while the majority (76.8%) identified as 'not working'. It is possible that the latter group comprised those men and women who were at home, but did not identify as homemaker because they were career-oriented and were looking for jobs at that time. The high number of the unemployed could contribute to the high prevalence of depression in the community. South Africa has been picked by the World bank as the most economically unequal country in the world [30]. National unemployment rate has remained above 25% [31]; asset ownership, skills and wages divide of pre-apartheid era lingers on [32].

A small proportion of the study population was diabetic. Being diabetic predicted depression in this study, although the relationship between depression and diabetes could be bidirectional. Depressed people had increased risk of developing diabetes while diabetic people showed higher risks for depression in many studies [33, 34]. These findings suggest existence of complex bidirectional pathophysiological mechanisms between both conditions. Almost half of the study population had ever consumed alcohol. Other researchers also reported high rates of alcohol consumption in South Africa, especially among women of reproductive age [35]. The rate of perinatal depression is thus high [36]. In an international alcohol control study involving household survey in South Africa, 53% of the participants were heavy drinkers, defined

as "consuming ≥120 ml (96 g) of absolute alcohol (AA) for men and ≥ 90 ml (72 g) AA for women at any location at least monthly" [37].

The use of a validated short-version depression screening scale contributed to the strength of this study. High questionnaire completion rate of HAALSI study (86%) was likely enhanced by the brevity of CES-D 8 used to gather study data. Questionnaires were administered in the local language to enhance understanding. Many studies on associations between depression and other factors stopped short of forecasting. Our study tested the predictive potentials of many common and uncommon independent variables. Robustness of statistical analysis strengthened the results, and factors included in the model are applicable to most regions of the world. The AUC from ROC curve showed that there are other unmeasured or unknown factors predicting depressive symptoms in the community under study. This analysis was limited to already measured variables. Future studies should include other possible factors to increase predictive power of the model. Also, the possibility of recall bias cannot be ruled out while participants were providing answers to the questionnaires, especially considering the ages of participants.

Conclusion: From the foregoing, it is possible to predict the development of depression in this community, and findings are generalizable to other communities and countries. Healthcare workers and policy makers should use the findings for preventative care and policies. The designs of HAALSI study and this analysis are reproducible, and should be applied to other diseases.

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Conflict of interest: The authors declare that they have no conflict of interest.

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