Socio-economic and demographic associations with multi-morbidity of chronic diseases among older adults in South Africa

Introduction

The coexistence of several diseases, referred to multi-morbidity, is associated with adverse health and healthcare outcomes (Gijsen et al. 2001), such as increased mortality risk (Marengoni et al. 2009), declines in quality of life and functional status (Loza et al. 2009), complications to treatment and strategies, and increased health costs (Schneider et al. 2009a). Whilst research into the prevalence and causes of the multi-morbidity of chronic diseases has been conducted in developed contexts, such as Australia (Britt et al. 2008), United States (Schneider et al. 2009a; Wolff et al. 2002) and European countries (Loza et al. 2009; Marengoni et al. 2008), developing countries remain an under-researched context. Yet, research has shown developing countries are in the process of a health transition characterised by a rise in chronic disease (Amuna and Zotor 2008). The development of two or more chronic diseases has been associated with older age (Britt et al. 2008; Uijen and van de Lisdonk 2008), consequently multi-morbidity is likely to be on the rise in countries experiencing rapid population ageing. The number of older persons in developing countries is expected to triple between 2013 and 2050 from 554 million to 1.6billon (United Nations 2013). Further research is needed to explore the health status of older persons in these contexts to inform healthcare policy and planning. The aims of this paper are to firstly explore which chronic diseases are likely to co-exist together, and secondly examine the socio-economic, demographic and behavioural associations with the occurrence of multimorbidity.

Context of South Africa

South Africa is undergoing transition in terms of its health profile with demographic ageing being a major factor behind this change. Despite the impact of HIV on adult mortality, with 8.9% of its population aged 60 years and older, South Africa has one of the oldest populations in Africa with the exception of Mauritius (14.7%) and Reunion (13.4%) (United Nations 2015). The percentage aged 60 years and older is expected to rise to 15.6% by 2050, amounting in the doubling of the absolute number of older persons from 4,183,000 to 9,881,000 between 2010 and 2050. The health status of older persons is not well understood due to a paucity of studies (Gomez-Olive et al. 2010). Nonetheless, it is recognised that population ageing is contributing to a new health profile, with emerging chronic diseases joining injuries, HIV/AIDS and other infectious diseases as major causes of death, disease and disability (Norman et al. 2007). In

addition to population ageing, the increase in non-communicable diseases in South Africa has also been attributed to a rise in the adoption of risk behaviours such as high tobacco and alcohol consumption, low levels of physical activity and unhealthy diets (Mayosi et al. 2009). Yet it should be noted these behaviour are not just restricted to the younger population but are prevalent among older agegroups (Phaswana-Mafuya et al. 2013a). The impact of the above noted demographic and behavioural shifts are evidenced in the statistics. In 2004 chronic diseases accounted for 28% of the total disease burden as measured by disability-adjusted years in South Africa (Mayosi et al. 2009), with cardiovascular disease, diabetes mellitus and cancers being major diseases. Among persons aged 50 years and older hypertension (30%), arthritis (25%) and diabetes (9%) have been found to the most common chronic conditions, with the prevalence of Angina (5%), chronic lung disease (3%) and stroke (4%) being lower (Phaswana-Mafuya et al. 2013b). As well as estimating the burden of individual chronic diseases, Phaswana-Mafuya et al. (2013b) report that 22.5% of older persons in South Africa are suffering from two or more chronic conditions. The addition of NCDs to the South Africa's disease profile and the known presence of a quadruple burden of disease poses questions of how to best allocate healthcare resources (Gomez-Olive et al. 2010). The reported level of multi-morbidity raises further questions of whether population ageing in South Africa is creating a further challenge for the healthcare system in the treatment and management of the coexistence of multiple chronic diseases?

Methods

Between 2007 and 2008, the World Health Organisation sponsored Wave 1 of the Study on Global Ageing and Adult Health (SAGE). Conducted in six low and medium income countries, this survey had the aim to collect rich and detailed data on the health status of older adults. This research draws upon the South African SAGE. This representative data of older adults is based on a two stage probability sample (Phaswana-Mafuya et al. 2012). All primary sampling units (PSU) were stratified by residence and province. Within each stratum an enumeration area (EA) was selected making a total of 600 EAs. 30 households that had at least one person aged 50 plus resident were selected in each EA, as where an additional 2 households representing the age group 18-49 (Phaswana-Mafuya et al. 2012). The survey oversamples individuals that are aged 50 and over (n=3840) to produce reliable data on older adults. A smaller sample of individuals aged 18-49 (n=385) yeas was collected as a control group (Phaswana-Mafuya et al. 2012). For the purpose of our analysis only the sample of persons aged 50 years and older was used.

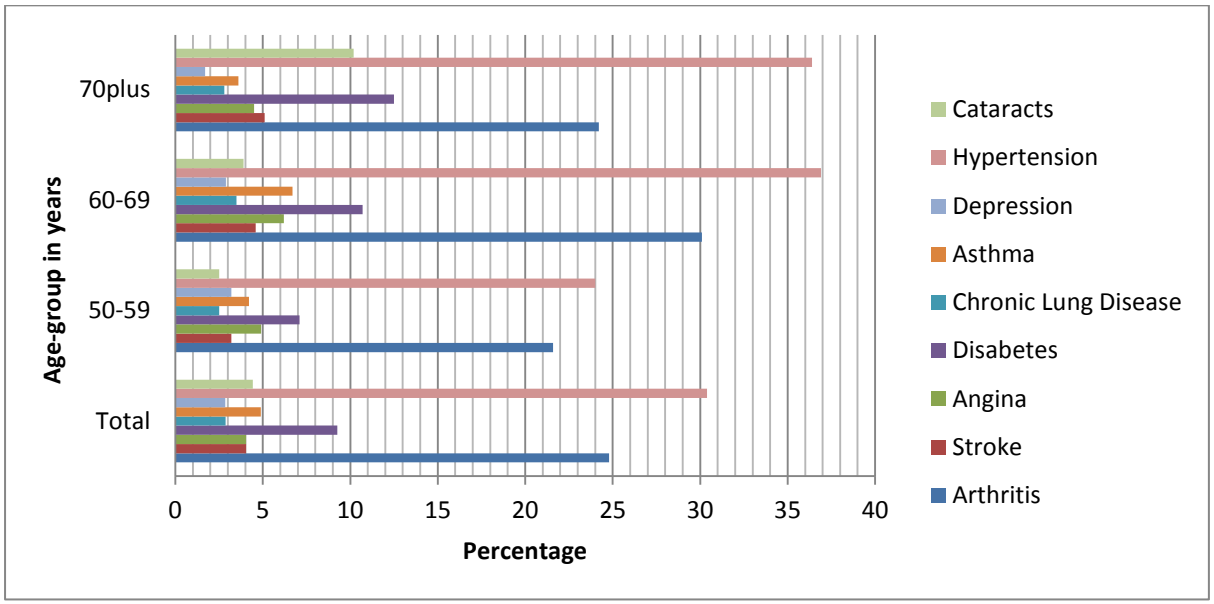
In terms of the outcome variables, this study is interested in the occurrence of comorbidity and multimorbidity. Often these concepts are used inter-changeably, yet the 'Report on the National Institute on Ageing Task Force on Comorbidity' sees multimorbidity and comorbidity as clearly distinguishable. Comorbidity is the presence of additional diseases beyond an index disease, whilst multi-morbidity is the co-existence of any 2 or more diseases (Yancik et al. 2009). Firstly this paper uses descriptive analysis to investigate which chronic diseases are likely to co-exist (comorbidity) among older people in South Africa. Secondly, step-wise logistic regression was carried out to examine the relationship between socio-demographic characteristics and the presence of two or more chronic conditions. The occurrence of chronic conditions was self-reported by participants in the SAGE in response to the question '*as a health care professional ever told you, you have….?*' Conditions explored were cataracts, hypertension, depression, asthma, chronic lung disease, diabetes, angina, stroke and arthritis. Information on self-reports of these different chronic conditions was used to create a dichotomous variable representing the presence of two or more chronic diseases (1) or not (0).

In the logistic regression, data on on sex, age, marital status, wealth, education, religion, race and place of residence was included as independent covariates. The wealth index was created from the access and ownership of 21 assets. Education encompasses no formal education to high education. Low education referred to achieving less than primary school education or the completion of primary school. Completion of secondary or high school was classified as medium level of education. The completion of college or accomplishment of a post-graduate degree was categorised as a high education level. To avoid small sample size issues the groups medium and high level of education were merged together. Goodness of fit of the model was assessed using the Hosmer and Lemeshow test, whilst multicollinearity was evaluated using the variance inflation. The analyses were weighted using post stratified individual probability weights. All analyses were performed using the statistical analysis program STATA version 13.

Results

The prevalence of chronic conditions among older adults in the SAGE survey has been previously reported by Phaswana-Mafuya et al. (2013b). The results of this study are summarised in Figure 1; the most common chronic condition among older persons is hypertension (self-reported by 30% of respondents), followed by arthritis (25%). Depression and chronic lung infection had the lowest reported prevalence (2.9% each). The reported prevalence of diabetes, angina and stroke was 9%, 5% and 4% respectively.

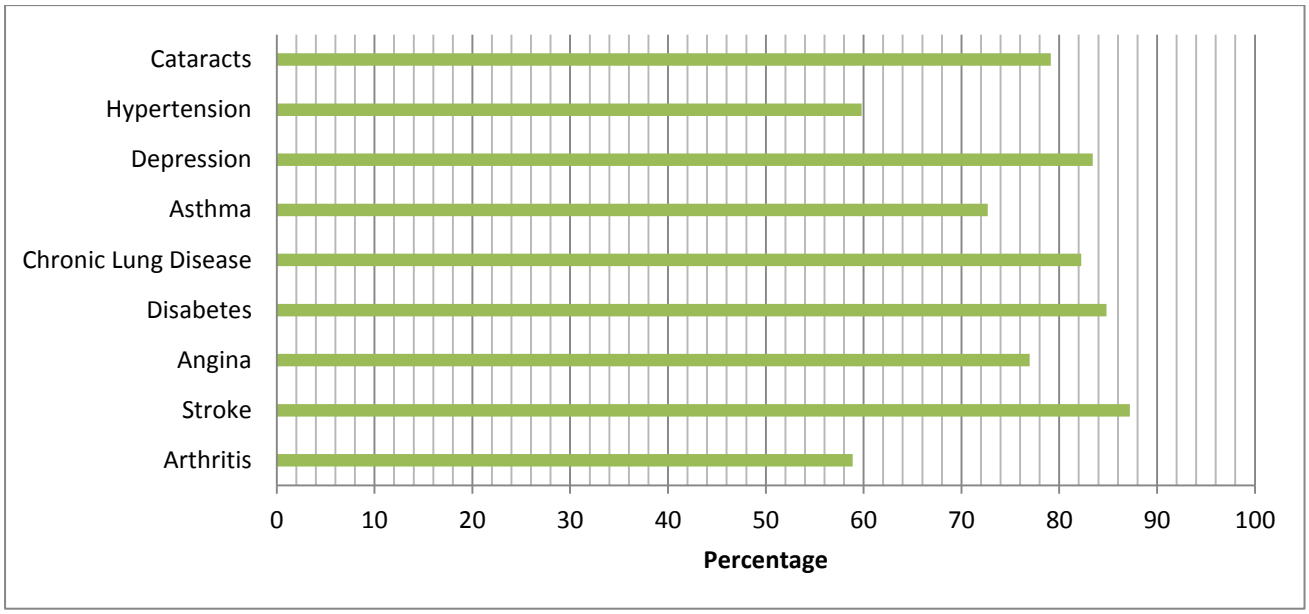
Figure 1: Self-reported chronic conditions among those aged 50 years and older



Weighted estimates

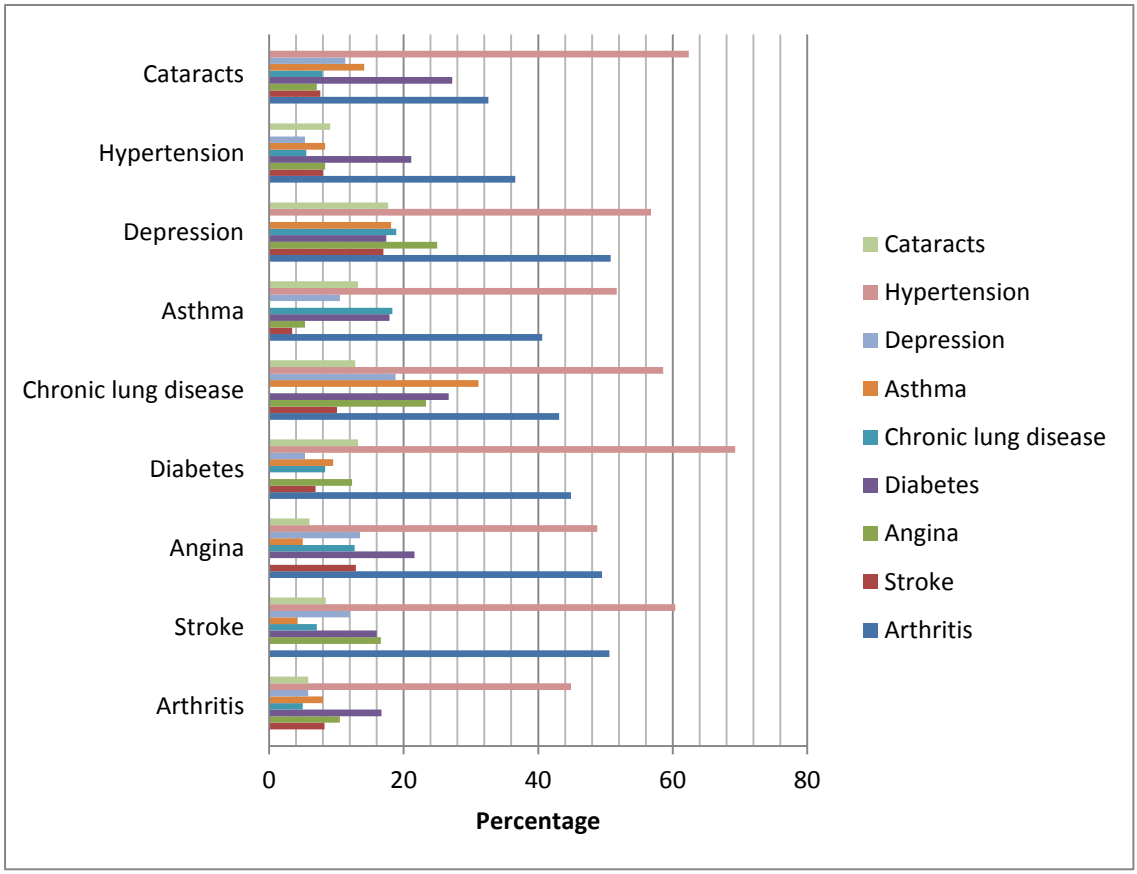
Figure 2 reveals those who self-reporting having one of the chronic conditions listed by SAGE are also likely to also report further chronic conditions. Figure 3 provides insights into which chronic diseases are likely to coexist in this population. Figure 2 identifies stokes as the condition in which individuals are most likely to experience other chronic conditions. Over 80% who self-reported having been diagnosed ever with stoke, reported also having been diagnosed with other chronic conditions. 60% of this group self-reported they had also been diagnosed with hypertension, whilst 51% self-reported arthritis and 16% angina and diabetes each. The most common single condition reported by this population is hypertension. Among those reporting they have been diagnosed with this disease, 60% reported having been diagnosed with further chronic conditions with 37% and 21% reporting to have been diagnosed with arthritis (37%) and diabetes (21%). Figure 2 and 3 also suggests the coexistence of mental and physical conditions. 83% of those who self-reported having been diagnosed with depression also self-reported other chronic conditions. The prevalence of depression is also higher amongst those reporting another chronic condition compared to the general population. Whilst 3% of the whole sample reported having ever been diagnosed with depression, this figure was 5% for those with hypertension or diabetes. The prevalence reported for those with other conditions was higher, 13.5% among those reporting having ever been diagnosed with angina.

Figure 2: Percentage of those 50 years and older reporting further chronic conditions by an index disease



Weighted estimates

Figure 3: Prevalence of multimorbidity



Weighted estimates

The second aim of this paper was to investigate the relationship between multimorbidity by socio-demographic characteristics. Table 1 illustrates the prevalence of multimorbidity by different groups, and reveals a significant association with age, sex, marital status, place of residence, education, wealth and race (p<0.01). Approximately 23% of older adults reported that they suffer from two or more chronic conditions. The prevalence of multimorbidity increased with age, from 17.4% in the age group 50 to 59 to 28.7% among respondents aged 70 plus. Just over 26% of women reported multimorbidity, whilst 18.1% of males indicated that they have more than one chronic condition. The prevalence of multimorbidity was found to be higher among separated or widowed and separated participants (27.9%) compared to those who have never been married (18.2%) and are currently married or cohabiting (21.4%). Respondents living in an urban environment reported a higher prevalence of multimorbidity (25.1%) comparted to participants living in rural areas (18.4). The level of multimorbidity was lower among white respondents (26.3%) compared to coloured (31.8%). The occurrence of multimorbidity increased with wealth, from 15.5% among the lowest wealth quintile to 15.5% in the highest wealth quintile.

Table 1: Percentage of those aged 50 years and older reporting ever having been diagnosed with two or more chronic conditions

Variable	Characteristic	Percent	CI	n
Total		22.8	20.6-25.1	829
Age	50-59	17.4	14.7-20.4	297
	60-69	27.7	23.5-32.2	308
	70 plus	28.7	23.7-34.3	223
	p-value	*p*<0.01		
Sex	Male	18.1	14.9-21.6	273
	Female	26.4	23.5-29.5	555
	p-value	*p*<0.01		
Marital Status	Never	18.2	13.2-24.5	94
	Married/Cohabiting	21.4	18.5-24.5	392
	Separated/Widowed	27.9	24.0-32.1	332
	p-value	*p*<0.01		
Residence	Urban	25.1	22.3-28.1	636
	Rural	18.4	15.1-22.1	191
	p-value	*p*<0.01		
Education	None	18.9	14.9-23.6	159
	Low	24.9	21.7-28.4	416
	Medium/High	22.3	18.4-26.8	243
	p-value	*p*<0.01		
Wealth	Poor	15.5	11.2-20.2	79
	Poorer	19.3	14.9-24.8	129
	Middle	24.1	19.7-29.1	189
	Rich	26.9	21.9-32.7	223
	Richer	28.1	23.1-33.7	204
	p-value	*p*<0.01		
Race	African/Black	19.7	17.2-22.3	364
	White	26.3	17.8-36.9	61
	Coloured	31.8	24.6-39.9	171
	Indian/Asian	34.6	24.9-45.7	113
	p-value	*p*<0.01		

Weighted estimates

The results of the fitted logistic regression models are presented in Table 2 in term of the odd ratios of respondents reporting to ever having been diagnosed with two or more chronic conditions. Overall age, gender, place of residence, being Coloured or Asian and having greater wealth were found to be associated with the presence of multimorbidity and were statistically significant. Marital status, being White, being poor and having higher education showed no significant association with the prevalence of multimorbidity. Women were more likely to self-report multimorbidity compared to males. Table 2 illustrates that the odds of self-reporting multimorbidity by women were 1.87 times the odds than for men. Living in a rural environment decreased the likelihood of individuals reporting multimorbidity. The odds of rural residents reporting multimorbidity were 0.70 times the odds of urban residents. The likelihood of reporting multimorbidity is the greatest for participants belonging to the richest wealth quintile compared to those belonging to the poorest wealth quintile (OR 1.86). It has been found that the odds of self-reporting multimorbidity by older adults aged 70 plus were 1.72 times times the odds of those in the age group 50 to 59 years.

Table 2: Odds ratio for the occurrence of multimorbidity among older adults

Variable	Characteristics	Odds Ratio		95% Conf. Interval	
Age	50-59	1			
	60-69	1.69	**	1.2	2.37
	70plus	1.72	**	1.17	2.51
Sex	Male	1			
	Female	1.87	***	1.35	2.6
Marital status	Married/Cohabiting	1			
	Never married	0.67		0.42	1.06
	Separated/Widowed	1.32		0.95	1.84
Race	African/Black	1			
	White	0.99		0.55	1.77
	Coloured	1.53	*	1.02	2.31
	Indian/Asian	1.66	*	1.03	2.7
Residence	Urban	1			
	Rural	0.70	*	0.5	0.98
Education	Low education	1			
	No education	0.62	*	0.42	0.91
	Medium education	0.72		0.49	1.07
Wealth	Poorest	1			
	Poor	1.19		0.71	2.00
	Middle	1.43		0.88	2.33
	Rich	1.63		1.00	2.67
	Richest	1.86	*	1.11	3.14

Weighted estimates; * $p<0.05$; ** $p<0.01$; *** $p<0.01$

Discussion

This study builds upon previous investigations of the prevalence of multiple chronic diseases among older adults in the South African context, through firstly considering which chronic conditions are likely to co-exist (co-morbidity), and secondly using multivariate regression techniques to explore relationships between the reporting of two or more chronic conditions (multimorbidity) with socio-demographic characteristics. As found by Phaswana-Mafuya et al. (2013b) of respondents aged 50 years and older in the SAGE dataset 23% reported having been diagnosed with two or more chronic conditions. This level of multimorbidity calls for reorganization of health systems in South Africa, with the need for more integrated care and treatment of conditions. Yet, knowledge of which conditions are likely to coexist will ease healthcare planning and increase efficiency of resource allocation. We found that those reporting to have been every diagnosed with any of the chronic conditions investigated by SAGE, over two-thirds reporting having further chronic conditions. Whilst hypertension is the most common single chronic disease in the population, stoke was a disease which was most likely to coexist with other chronic diseases. Diabetes, hypertension and arthistis were disease found to commonly coexist with other chronic diseases. Yet previous research based on the World Health Survey shows that comorbidity does not exist just between physical conditions, but also between physical and mental conditions (Moussavi et al. 2007). Our study confirms that such a pattern exists among older persons in South Africa. Of those reporting ever having been diagnosed with depression, over four-fifths of these had also been diagnosed with other chronic conditions. Whilst there has been improvements in the policy and legislative arena in South Africa with the introduction of the Mental Health Care Act in 2002, Lund et al's, (2010) analysis of input and process indicators indicate an sustained unmet need for mental health services. The known impact of comorbid depression on causing greater declines in health status (Moussavi et al. 2007) suggests benefit to be gained from integrated mental health care provision in South Africa.

Turning to the socio-demographic associations with multimorbidity, our logistic regression found small differences compared to Phaswana-Mafuya et al.'s (2013b) chi-square analysis of the same data. Whereas the latter study found a non-significant relationship between education and the outcome of multimorbidity, we found that those with no education were less likely to have two or chronic conditions compared to those with low levels of education. This result is in contrast to findings by Alaba and Chola (2013) who found no association between education and multimorbidity among the general adult population in South Africa, and by Hein et al. (2014) and Khanam et al.

(2011) who considered the association of literacy with the presence of two or more diseases among older persons in urban Burkina Faso and rural Bangladesh respectively. Furthermore, when controlling for other socio-demographic factors the significant association of marital status found by Phaswana-Mafuya and his colleague becomes insignificant. This has found by other studies of multimorbidity among the elderly in other low income countries (Hein et al. 2014; Khanam et al. 2011)

In addition to education, we found that age, gender, race, residence and wealth were significantly associated with the presence of two or more chronic conditions amongst the SAGE sample. Age followed J shaped impact, whereby the odds of reporting the presence of two or more chronic conditions was the significantly higher for both the groups aged 60-69 and 70 years plus in comparison to those aged 50-59 years; however the odds of the former groups were of a similar magnitude. Life expectancy in South Africa is currently 61 years (United Nations 2015), consequently the similar effect of these two age groups on multimorbidity, rather than the expected increasing impact, could be attributed to an survival effect whereby it might be the most healthy that live to the oldest ages (Khanam et al. 2011). Females in this study were also more likely to report multimorbidity than men, a finding that has been theorised by previously studies to be attributed to genetic variances, lifecourse events and differences in lifestyles (Hein et al., 2014). In contrast to negative relationships between household income and multimorbidity (Agborsanaya et al. 2012; Schafer et al. 2012), or the positive relationship between deprivation and multimorbidity (Orueta et al. 2013), found in literature focused on developed countries, our study found relatively wealthier older adults were more likely to report having two or more chronic conditions. There could be several explanations for this finding; the first being non-communicable diseases being labelled as diseases of affluence and risk factors being associated with increasing wealth, and secondly inequality in access to primary health care resulting in low treatment, but also importantly for this study possibly low diagnosis, of chronic conditions among the poor (Schneider et al. 2009b). Such explanations of risk factors and access to health care could be responsible for higher prevalence of multi-morbidity in urban areas found by this study. Such results suggests the need for public health promotion among all sections of society to reduce risk factors, whilst there need to be interventions to increase access to primary health care for the poorest and those living in rural areas.

Conclusion

This study aims to increase understanding of those most at risk of experiencing multiple chronic conditions in South Africa, as well as the specific combination of conditions they may experience. This study found that females, those over 60 years as opposed to 50-59 years, Colors or

Indians/Asians, living in urban areas, having low education as opposed to none and being from the richest wealth quintile were more likely to report having been diagnosed with two or more chronic conditions. Such knowledge is vital to inform healthcare planning and to enable the targeting of inventions; an important strategy in the context of limited resources.

Our study has several limitations that merit recognition. As acknowledged by Phaswana-Mafuya et al. (2013b) reliance on self-reports of disease could result in the underestimation of the prevalence of multimorbidity. Individuals may have conditions which they have not been officially diagnosed with, nor them aware of any symptoms. As noted some of the associations found by this study could be the outcome of greater diagnosis of chronic conditions among certain groups, rather than the greater presence of these conditions. This form of data is also subject to reporting bias where individuals may wish to not reveal ill health. Furthermore, the SAGE only inquired about the diagnosis of a limited set of chronic conditions, and the exclusion of conditions such as cancer from the questionnaire is likely to have impacted on the level of multimorbidity of chronic diseases found in this population. This limitation also makes comparability of the results to other studies using different criteria difficult. In addition to accuracy of reporting, our measurement of multimorbidity also has shortcomings. Whilst a binary variable representing the reporting of the presence of two or more conditions or not is simple to calculate, it is limited in that it fails to take account of the total number or severity of conditions. Further research could investigate whether our results are replicable using different measures, such as the simple count (Guralnik et al., 1989) or Charlson Index (Charlson et al., 1987).

References

Agborsangaya, C.B., Lau, D., Lahtinen, M., Cooke, T. and Johnson, J.A. (2012) Multimorbidity Prevalence and Patterns Across Socio-economic Determinants: A Cross-Sectional Survey, *BMC Public Health,* 12:201.

Alaba, O. and Chola, L. (2013) The Social Determinants of Multimorbidity in South Africa, *International Journal for Equity in Health,* 12: 63.

Amuna, P. and Zotor, F.B. (2008) Epidemiological and Nutrition Transition in Developing Countries: Impact on Human Health and Development, *Proceedings of the Nutrition Society,* 67(1): 82-90.

Britt, H.C., Harrison, C.M., Miller, G.C. and Knox, S.A. (2008) Prevalence and Pattern of Multimorbidity in Australia, *Medical Journal of Australia,* 189(2): 72-77.

Charlson, M.E., Pompei, P., Ales, K.L., MacKenzie, C.R. (1987) A New Method of Classifying Prognostic Comorbidity in Longitudinal Studies: Development and Validation, *Journal of Chronic Diseases,* 40: 373-383.

Gijsen, R., Hoeymans, N., Schellevis, F.G., Ruwaard, D., Satariano, W.A., Van Den Bos, G.AM. (2001) Causes and Consequences of Comorbidity: A Review, *Journal of Clinical Epidemiology,* 54(7): 661-674.

Gomex-Olive, F.X., Thorogood, M., Clark, B.D., Kahn, K. and Tollman, S. M. (2010) Assessing Health and Wellbeing Among Older People in Rural South Africa, *Global Health Action,* Supplement 2, 23-35.

Guralnik, J.M, LaCroix, A.Z., Everett, D.F., Kovar, M.G (1989) *Aging in the Eighties: The Prevalence of Comorbidity and its Association with Disability,* Advance Data. From Vital Statistics of the National Centre for Health Statistics, No 170, National Centre for Health Statistics, Hyattsville, Maryland.

Hein, H., Berthe, A., Drabo, M., Meda, N., Konate, B., Tou, F., Badini-Kinda, F. and Macq, (2014) Prevalence and Patterns of Multimorbidity Among the Elderly in Burkina Faso: Cross-Sectional Study, *Tropical Medicine and International Health,* 19(11):1328-1333.

Khanam, M.A., Streatfield, P.K., Kabir, Z.N., Qui, C., Cornelius, C. and Wahlin, A. (2011) Prevalence and Patterns of Multimorbidty Among Elderly People in Rural Bangladesh, *Journal of Health, Population and Nutrition,* 29(4)L 406-414.

Loza, E., Jover, J.A., Rodriguez, L. and Carmona, L. (2009) Multimorbidity: Prevalence, Effect on Quality of Life and Daily Functioning, and Variation of This Effect When One Condition Is a Rheumatic Disease, *Seminars in Arthritis and Rheumatism,* 38(4): 312-319.

Lund, C., Klenintjes, S., Kakuma, R. and Flisher, A.J. (2010) Public Sector Mental Health Systems in South Africa: Inter-Provincial Comparisons and Policy Implications, *Social Psychiatry and Psychiatric Epidemiology, 45:* 393-404.

Marengoni, A., Rizzuto, D., Wang, H., Winblad, B. and Fratiglioni, L. (2009) Patterns of Chronic Multimorbidity in the Elderly Population, *Journal of American Geriatrics Society,* 57(2): 225-230.

Mayosi, B., Flisher, A., Lalloo, U.G., Sitas, F., Tollman, S.M. and Bradshaw, D. (2009) The Burden of Non-Communicable Diseases in South Africa, *The Lancet,* 374(9693): 934-947.

Moussavi, S., Chatterji, S., Verdes, E., Tandon, A., Patel, V. and Ustun, B. (2007) Depression, Chronic Diseases and Decrements in Health: Results from the World Health Surveys, *The Lancet,* 370(9590): 851-858.

Norman, R., Matzopoulos, R., Groenewald, P. And Bradshaw, D. (2007) The High Burden of Injuries in South Africa, *Bulletin of the World Health Organisation,* 85(9): 695-702.

Orueta, J., Nuno-Solinis, R., Garcia-Alvarez, A. and Alonso-Moran, E. (2013) Prevalence of Multimorbidity According to the Deprivation Level Among the Elderly in the Basque Country, *BMC Public Health,* 13: 918.

Phaswana-Mafuya, N., Peltzer, Schneider, M., Makiwane, M., Zuma, K., Ramlagan, S., Tabane, C., Davids, A., Mbelle, N., Matseke, G. and Phaweni, K. (2012) Study on global AGEing and adult health (SAGE) , South Africa 2007–2008. Geneva: World Health Organization.

Phaswana-Mafuya, N., Peltzer, K., Chirinda, W., Musekiwa, A. and Kose, Z. (2013a) Sociodemographic predictors of multiple non-communicable disease risk factors among older adults in South Africa, *Global Health Action,* 6:20680.

Phaswana-Mafuya, N., Peltzer, K., Chirinda, W., Musekiwa, A., Kose, Z., Hoosain, E. and Davids, A. (2013b) Self-Reported Prevalence of Chronic Non-Communicable Diseases and Associated Factors Among Older Adults in South Africa, *Global Health Action,* 6: 20936.

Schafer, I., Hansen, H., Schon, G., Hofels, S., Altiner, A., Dahlhaus, A., Gensichen, J., Riedel-Heller, S., Weyer, S., Blank, W.A., Konig, H., Von dem Knesebeck, O., Wegscheider, K., Scherer, M., van den Bussche, H. and Wiese, B. (2012) The Influence of Age, Gender, and Socio-economic Status on Multimorbidity Patterns in Primary Care: First Results from the Multicare Cohort Study, *BMC Health Services Research,* 12: 89.

Schneider, M., Bradshaw, D., Steyn, K., Norman, R. and Laubscher, R. (2009) Poverty and Non-Communicable Diseases in South Africa, *Scandinavian Journal of Public Health,* 37: 176-186.

Schneider, K.M., O'Donnell, B.E. and Dean, D. (2009) Prevalence of Multiple Chronic Conditions in the United States' Medicare Population, *Health and Quality of Life Outcomes,* 7:82.

Uijen, A.A. and Van De Lisdonk, E.H. (2008) Multimorbidity in Primary Care: Prevalence and Trend Over the Last 20 Years, *European Journal of General Practice,* 14(Supplement 1): 28-32.

United Nations. (2013) *World Population Ageing 2013,* United Nations Department of Economic and Social Affairs, New York.

United Nations. (2015) *World Population Prospects: The 2012 Revision,* United Nations Department of Economic and Social Affairs, New York.

Wolff, J.L., Starfield, B. and Anderson, G. (2002) Prevalence, Expenditure and Complications of Multiple Chronic Conditions, *Archives of Internal Medicine,* 162(20): 2269-2276.

Yancik, R., Ershler, W., Satariano, W., Hazzaed, W., Cohen, H.J. and Ferrucci, C.L. (2007) Report on the National Institute on Aging Task Force on Comorbidty, *Journals of Gerontology: Series A,* 62(3): 275-280.