The global healthy ageing agenda: The impact of education, gender, childhood conditions and social engagement in rural South Africa

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Abstract

This paper examines factors associated with the likelihood of healthy ageing and the propensity to utilise health care resources for a rural community in South Africa and the associated policy implications. Our results suggest education exerts a positive influence, and its marginal impact is more prominent for females than males. Further, we show that better childhood health is associated with increased likelihood of ageing well. We also demonstrate an inverse relationship between health care utilisation and healthy ageing. The results presented here suggest that strategic policy investments across life courses in education and child-health fosters not only broader development goals but also enhances healthy ageing trajectories and improve the health and wellbeing of individuals across life stages. This study contributes to informing on the UN's healthy ageing global strategic agenda in the context of a poor rural region.
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1. Introduction

Population ageing represents major policy challenges for all countries. As people live longer, the concomitant rise in age related chronic health conditions threatens to place an increasing strain on health care systems and associated societal resources. Globally, the number of people aged 60 years or over is projected to more than double from 1 billion in 2019–2.1 billion in 2050 (WHO, 2020a). Population ageing is taking place fastest in developing countries, where nearly 80% of the number of people aged 60 and older (1.7 billion) are expected to be living by 2050; with Africa experiencing the fastest increase. For policymakers, of particular importance in population ageing is *how well* people age.

Recognising the global challenges population ageing represent, the WHO released a 10-year global plan of action, known as the *UN Decade of Healthy Ageing (2021–2030)* as a strategic framework to support older people to live longer and healthier lives (WHO, 2020a). The WHO framework aligns with the values and timing of the 2030 UN Sustainable Development Goals with its focus on ending poverty and improving the lives of all people (Keating, 2022; WHO, 2020a; WHO, 2015). Central to the WHO's agenda is the notion of healthy or successful ageing, which it defines as "…the process of developing and maintaining the functional ability that enables well-being into older age" (WHO, 2020a).

The WHO framework recognises the heterogeneity in the ageing process with many older persons retaining good health and maintaining high physical and social functional capabilities (Atella et al., 2021; Lowsky et al., 2014; Rowe & Kahn, 1987, 1997). Those people who experience healthy ageing may stay active longer in the labour force and can contribute to the productive output and fiscal capacity of the national economy (Marois & Aktas, 2021). The implications are that better ageing can enhance the quality of life for the elderly and may mitigate the future demands on societal resources. The degree to which policy can be designed to encourage healthy ageing depends on the understanding of its determinants and consequences.

In comparison to advanced economies, much less is known in developing countries regarding the economic and social implications of population ageing. The particular challenges healthy ageing poses in Africa has led the WHO regional committee for Africa to develop a framework for implementing priority actions for healthy ageing that more directly connects with the broader sustainable development goals (WHO, 2021). A core policy implication emanating is the need for strategic investment across the life-course to enhance the wellbeing of both older and younger people (Keating, 2022).

South Africa, the focus of this study, is expected to see the proportion of those aged 60 years or older to double from 7.7% in 2015 to 15.4% in 2050 (WHO, 2015). In poorer rural areas, the challenges of ageing populations are more pronounced given the relatively limited resources in health and related services. To date there has been very little research on healthy or successful ageing in South Africa and it is recognised that there is an urgent need for research to inform on policy development and planning to address the challenges posed by population ageing in that country (Pengpid & Peltzer, 2021; Solanki et al., 2019).

Our approach is motivated by a well-established framework conceptualising the notion of successful ageing originally provided by Rowe and Kahn who emphasise that individuals themselves can mitigate the decline in physiological and cognitive capabilities (Rowe & Kahn, 1987, 1997). Their framework consists of three intersecting key elements: low risk of disease and disease related disability; maintenance of high cognitive and physical function; and active engagement in life. A considerable body of related empirical literature has subsequently

emerged. A number of studies have shown the importance of socio-economic individual level factors (i.e. education, income and occupation), health related lifestyle factors (smoking, drinking and physical activity), socio-cultural factors (i.e. community), and environmental and macro-level factors (i.e. pollution and access to health services) on ageing well (Marois & Aktas, 2021; Hank, 2011; McLaughlin et al., 2010; Chodzko-Zajko et al., 2008; Gaudreau et al., 2007; Depp & Jeste, 2006). More recent studies identify religious beliefs and spirituality, as well as childhood conditions and other early life circumstances as important origins of successful ageing (Malone & Dadswell, 2018; Tomás et al., 2015; Brandt et al., 2012).

Our study contributes to the literature on healthy ageing in several ways. First, we analyse the data at a more disaggregated level to gain insights on the components of ageing. Second, we investigate the possibility of gender disadvantage in successful ageing. Third, we link ageing outcomes and their determinants to health care utilisation. Each of these aspects directly informs on public policy supporting the WHO's healthy ageing agenda.

The results reveal that factors positively associated with ageing well include higher education, socio-economic status, and healthy 'lifestyle' factors. We also find a positive effect of better childhood health status. For the aggregate measure of successful ageing, we do not find any differences between males and females, but the role of education is more pronounced for females. In terms of specific components of healthy ageing, we find that females have a relative disadvantage in attaining high cognitive and physical function. Further, the results suggest that health care utilisation is directly related to the degree of healthy ageing; those who age better use less health care resources. This has clear policy implications. Targeted programs aimed at improving the trajectory of ageing in a population not only yield better health outcomes for aged people, but also lower claims on health care resources.

The remainder of the paper is organised as follows. Section 2 details the data and the construction of the outcome measurement used to define successful ageing. Section 3 presents results of various model specifications and examines the relationship between successful ageing and the propensity to utilise health care services. We conclude with a discussion of these results and their policy implications in Section 4.

2. Data

2.1. Study population and data collection

The data are taken from the *The Health and Ageing Study in Africa: A Longitudinal Study of an INDEPTH Community in South Africa* (HAALSI), a collaborative project between the Harvard Center for Development and Population Studies, the INDEPTH Network, and the University of Witwatersrand, South Africa. HAALSI is a population-based survey of the drivers and consequences of chronic diseases and their effects on functional and health outcomes in an ageing population of men and women residing in rural South Africa. The baseline survey study was conducted in 2014–2015 among 5059 men and women aged ≥ 40 years residing in the rural sub-district of Agincourt in Mpumalanga Province, South Africa.[1] The study region covered a

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[1] For a detailed discussion on the survey methodology, see Harvard Center for Development and Population Studies (2016); Payne et al. (2017); Kobayashi et al. (2017) . The HAALSI is intended to mirror the Health and Retirement Study (HRS) and sister studies conducted in India, China, Brazil, and representative countries from North America and Europe.

population of around 115,000 people, of which 8974 women and 3901 men met the residence and age criteria. The final sample consists of 5059 individuals, with men oversampled to achieve greater gender balance (Payne et al., 2017). Health care facilities in the area comprise six clinics and two health centres. Three hospitals covering the district are located 40–60 kilometres outside the study site. The survey interviews covered subject matters including, socio-demographic and economic information, employment, education, physical and cognitive functioning, self-reported health status history, reported clinical diagnoses of non-communicable disease outcomes and HIV (Payne et al., 2017; Kobayashi et al., 2017). Some limited blood and physical testing including anthropometric measures were conducted together with information on visits to primary health care clinics.

2.2. Variables and measurement(s)

2.2.1. Successful ageing

To capture successful ageing, we follow the approach of a number of previous studies (Canêdo et al., 2018; García-Lara et al., 2017; Feng et al., 2014; Brandt et al., 2012; Arias-Merino et al., 2012; McLaughlin et al., 2010). To qualify as successfully aged, respondents need to meet all five of the criteria: *no major disease; no activity of daily living disabilities; high cognitive function; high physical function;* and *actively engaged*. A brief discussion of how each component is determined is outlined below.

2.2.2. No major disease (NMD)

Disease conditions were limited to a set of non-communicable diseases (NCD) associated with age. These include cardio-vascular disease (CVD), diabetes, and a recorded 'depression score'.[2] CVD was defined to exist where a respondent self-reported a medical diagnosis of angina, stroke, heart failure, heart attack, or self-reported chest pain while walking on flat ground during the previous 12 months. A person was considered to have diabetes if they either reported the condition, had been medically diagnosed, or had a fasting blood glucose measure of ≥ 7 mmol/l or ≥ 11.1/l mmol/l if non-fasting. An 8-item questionnaire was used to assess the likelihood of depression (CESD-8) which was modified for cultural appropriateness (Pengpid & Peltzer, 2019; Geldsetzer et al., 2019). An individual scoring three or more symptoms was categorised as suffering from depression.[3] A person was categorised as having no major disease if all the conditions outlined above were absent.[4]

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[2] Two major NCDs not collected in HAALSI survey data are cancer and chronic lung disease. HIV was excluded given it is a communicable disease and has a strong negative relationship to age and thus not an outcome of the ageing process per se.

[3] CESD-8 denotes Centre for Epidemiological Studies Depression Scale incorporating the 8-item version of a self-reported screening measure to identify depressive symptoms in the general adult population. The CESD-8 asks whether the person has the following symptoms in the week prior: feeling mostly depressed; everything was an effort; sleep was restless; lacking happiness; feeling lonely, not enjoying life; felt sad; could not 'get going'. *See* Schane et al. (2008) for a discussion of cut-off point.

[4] Missing values in the construction of each individual component of the categories of Successful Ageing, and the variable itself were managed in the following manner. With some missing data, it was still possible to identify that an individual would not meet the requirements of a category or having aged successfully. In these cases, the person was counted as not ageing successfully. An example would be the construction of the NMD variable where there was missing information relating to diabetes, but the individual reported having heart failure. Given that no disease could be present to qualify as having no major disease, we were able to code this person as having some disease. However, in

2.2.3. Activity of daily living disability (No ADLD)

Consistent with the approach taken by Brandt et al. (2012), Hank (2011), and McLaughlin et al. (2010), a person was designated as having no 'activity of daily living' disability provided they reported no difficulty in any of the following: walking across a room, dressing, bathing, eating, getting in or out of bed, and going to the toilet.

2.2.4. High cognitive function (HCF)

Several measures were used to assess cognitive functioning.[5] Respondents were asked to state correctly the year, month and date, and the name of current South African president (one point for each), an immediate and delayed 10-word recall test (up to ten points for each recall), forward counting from 1 to 20 (one point for correctly counting), and a number skip pattern (one point for correctly identifying the missing final digit). Following the approach adopted by McLaughlin et al. (2010), Hank (2011), Brandt et al. (2012), a composite measure was compiled to aggregate these scores. Those participants with a score at or above the median were considered to have high cognitive functioning. The use of the median score to denote high cognitive function overcomes the potential for downward bias and thus misclassification for a population cohort that is characterised by a low overall level of education.[6]

2.2.5. High physical function (HPF)

This was constructed according to three criteria. First, respondents were asked whether they either engaged in vigorous activity during a usual week or walked or used a bicycle to get to and from places. The second was a measure of gait speed, a commonly used diagnostic tool in geriatric assessment (Peel et al., 2012). Respondents needed to achieve a gait speed of walking 5 m in less than 9 s (Peel et al., 2012; Abellan van Kan et al., 2009). Finally, respondents were tested as to whether they could hold a semi-tandem stand for 10 s. To qualify as high physical functioning, an individual needed to meet all three of these criteria.

2.2.6. Actively engaged (AE)

Our measure of active engagement was achieved upon the satisfaction of two criteria. Individuals were required to have worked (with or without remuneration) in the 30 days prior to the survey or have identified themselves as being a carer for grandchildren or another adult. A second condition related to general social engagement required individuals to have regular interactions with another known individual. Those responding that they had regular interactions with a known individual several times per week, once per week or a few times per month, or those who were married, were deemed to have satisfied this component. To be actively engaged, the two criteria capturing work (or caring) and social interactions were combined such that an individual had to achieve both.

(*footnote continued*)

some cases, the missing data would not yield a clear picture, for instance if an individual had no other disease but failed to answer the question relating to diabetes. In these cases, the observation was excluded from the analysis.

[5] These measures which are derived from the US Health and Retirement Study were translated and back translated in the local Shangaan language to ensure reliability, and were pilot tested and adapted for cultural appropriateness, accuracy, and comprehension (see Kobayashi et al., 2017; Houle et al., 2019).

[6] As noted in Table 1, 79% of females and 76% of males in HAALSI study had either no education or only primary school education.

Table 1

Descriptive statistics – predictor variables and components of successful ageing.

Variables	Female			Male		
	Number of observations	Mean	Standard deviation	Number of observations	Mean	Standard deviation
Successful ageing						
Overall measure	2647	0.12	0.32	2266	0.12	0.32
- No major disease	2446	0.59	0.49	2019	0.64	0.48
- No ADL disability	2713	0.91	0.29	2344	0.90	0.30
- High cognitive functioning	2714	0.54	0.50	2345	0.57	0.50
- High physical functioning	2310	0.52	0.50	1974	0.61	0.49
- Actively engaged	2714	0.56	0.50	2345	0.41	0.49
Contemporary variables						
Age						
- 40 – 50	2714	0.22	0.41	2345	0.22	0.41
- 51 – 60	2714	0.28	0.45	2345	0.26	0.44
- 61 – 70	2714	0.23	0.42	2345	0.26	0.44
- 71 or older	2714	0.27	0.44	2345	0.26	0.44
Marital status						
- Never married	2711	0.05	0.21	2344	0.07	0.26
- Married	2711	0.36	0.48	2344	0.68	0.47
- Divorced, separated or widowed	2711	0.60	0.49	2344	0.25	0.43
Employment status						
- Working	2705	0.13	0.34	2338	0.19	0.39
- Stopped working	2705	0.41	0.49	2338	0.72	0.45
- Never worked	2705	0.45	0.50	2338	0.09	0.28
Living Alone	2714	0.08	0.26	2345	0.14	0.35
Education						
- No education	2704	0.50	0.50	2338	0.41	0.49
- Low	2704	0.29	0.46	2338	0.35	0.48
- Medium	2704	0.13	0.33	2338	0.18	0.39
- High	2704	0.08	0.27	2338	0.06	0.23
HH Expenditure (quartiles)						
- 1st	2714	0.20	0.40	2345	0.31	0.46
- 2nd	2714	0.27	0.44	2345	0.23	0.42
- 3rd	2714	0.27	0.44	2345	0.23	0.42
- 4th	2714	0.27	0.44	2345	0.23	0.42
Smoking						
- Never	2714	0.98	0.13	2345	0.56	0.50
- Stopped	2714	0.01	0.11	2345	0.25	0.43
- Current	2714	0.004	0.06	2345	0.19	0.39
Alcohol consumption						
- Never	2714	0.75	0.43	2345	0.33	0.47
- Stopped	2714	0.22	0.41	2345	0.45	0.50
- Current	2714	0.04	0.19	2345	0.22	0.42
BMI (Body Mass Index)						
- Underweight	2530	0.03	0.16	2159	0.09	0.28
- Normal	2530	0.28	0.45	2159	0.47	0.50

(*continued on next page*)

Table 1 (*continued*)

| | Female | | | Male | | |
Variables	Number of observations	Mean	Standard deviation	Number of observations	Mean	Standard deviation
- Overweight or obese	2530	0.70	0.46	2159	0.44	0.50
Childhood conditions						
- Parents together when born	2699	0.93	0.26	2341	0.93	0.26
- Father attended school	2483	0.15	0.36	2180	0.14	0.34
- Child health rating	2711	1.50	0.97	2344	1.55	0.98
Health care utilisation						
- Visit to a public clinic	2710	0.46	0.50	2342	0.36	0.48
- Number of public clinic visits	2710	0.97	1.27	2342	0.78	1.21

Note: All variables except child health rating and number of public clinic visits are indicator variables which are either zero (0) or one (1). Child health rating has a minimum value of 1 and a maximum value of 5. Number of public clinic visits has a minimum value of 0 and a maximum value of 12.

2.2.7. Health care utilisation

Survey respondents were asked whether they had visited a primary health care clinic over the previous three months. Information about the frequency of visits to these clinics was also collected, which is likely to capture two elements of health care usage. Firstly, a direct measure of local first contact with the health care system. Secondly, a more indirect measure of broader health care usage, as a proportion of patients would likely progress to being treated in the broader health system.

2.2.8. Independent variables

The survey contains information relating to a variety of social and economic data such as age, marital status, employment status, and living arrangements. Many of the underlying and associated conditions which comprise our successful ageing measure would be expected to be themselves correlated with older age (Depp & Jeste, 2006). This necessitates the inclusion of an age variable as a control and this is achieved through the inclusion of categorical age variables. To capture the effects of marital status, we categorised the population into married and never married, and distinguished these two groups from those who are divorced, separated or widowed. Working status was also included as a categorical variable.

Education has been previously associated with better health outcomes.[7] We use four categories of education: None, Low (primary school only), Medium (secondary schooling), and High (completed or enrolled in a tertiary degree). In order to capture path dependence in family education we also included a measure of the highest educational attainment for the respondent's father.[8] To control for long run antecedents, we use a measure of self-reported childhood health status, ranging from very good to very bad. To indicate health related behaviours, dummy

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[7] See for example Vogel (2012). In the context of ageing. Flisi et al. (2019) provide evidence those have higher levels of education suffer less rapid decline in cognitive function (proxied by literacy).

[8] The variable for father's education is self-reported. Thus, while it is possible there could be some bias in recall, we believe this to be relatively small since the survey question asked was quite basic and easy to remember; i.e. "*Has (Did) he ever attended school?*".

variables of whether respondents currently (or had ever) drunk alcohol or smoked tobacco were included. We included body mass index (BMI) as a covariate, to control for possible deleterious effects of under and over-nutrition. The HAALSI dataset contains details related to household expenditures on consumable items, rent, services and utilities. These were aggregated and expenditure quartiles were established as proxy categorical variables for household economic status.

Descriptive statistics for both males and females are presented in Table 1. In both the male and female sub-populations, 12% meet our criteria as having aged successfully. Across the individual components of ageing, there are some variations between males and females. For example, HPF is higher for males, whilst AE is noticeably higher for females. There are also notable differences with respect to marital status, employment status, education and consumption of alcohol and tobacco.

3. Results

3.1. Aggregate measure of ageing

We first focus on the aggregate measure of ageing. Probit results are presented in Table 2. The first specification (ALL) was run using the entire sample. To allow for the possibility of heterogeneous marginal effects by gender, we report results for two additional specifications; specification 2 (female) and specification 3 (male).[9] Relative to those who are aged between 40 and 50, respondents aged 61–70, and 71 or older are less likely to age successfully. We observe that the marginal effects have higher statistical significance and larger magnitudes for the eldest cohort. For the same age group, we also find gender differences where the lower likelihood of successfully ageing is 7.7% for women and 4.5% for men.

The female dummy in specification 1 is not significant and suggests that there is no female bias in how well people age. While current employment status does not appear to play a significant role in ageing successfully, education has a positive and significant effect. At a disaggregated level, the results suggest that education has a more pronounced positive relationship for females across all education categories. For males, medium and high levels of education do not significantly improve the quality of ageing. This distinction between males and females and its interaction with education gives rise to policy implications which are discussed in Section 4. Being married is associated with around 4.4% higher propensity to age successfully compared to those who are divorced, separated or widowed for the first specification. However, in separating gender effects, being married is statistically significant for males only. Further, for males, never having married is negatively related to ageing well, but the same result is not observed for women. Living alone appears to significantly lower the likelihood of successfully ageing for both male and female sub-populations. Whilst household expenditure has no significant effect for females, it is significantly associated with males for the higher third and fourth quartiles of the expenditure distribution.

In terms of health-related behaviours, while our results suggest that smoking does not play any significant role for either males or females, alcohol consumption is consistently associated with a lower likelihood of successful ageing for both sexes. Body Mass Index (BMI) has no

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[9] Fitted and actual values are used to measure goodness of fit. In the overall specification, the percentage of correctly specified values is 87.95; and at the disaggregated level it is 88.19 for the female sub-population, and 87.63 for males.

Table 2

Probit marginal effects of successful ageing.

Variables	ALL (1)		Female (2)		Male (3)	
	Marginal effect	Standard error	Marginal effect	Standard error	Marginal effect	Standard error
Female	-0.018	0.012	—	—	—	—
Contemporary variables						
Age (Base: 40 – 50)						
- 51 – 60	0.003	0.012	0.002	0.015	0.002	0.020
- 61 – 70	-0.023 *	0.013	-0.030 *	0.016	-0.019	0.020
- 71 or older	-0.056 ***	0.013	-0.077 ***	0.015	-0.045 **	0.020
Marital status (Base: Divorced, separated or widowed)						
- Never married	-0.031	0.019	-0.010	0.026	-0.068 ***	0.026
- Married	0.044 ***	0.011	0.021	0.013	0.066 ***	0.017
Employment status (Base: Never)						
- Working	0.018	0.016	0.012	0.018	0.035	0.037
- Stopped	0.022 *	0.011	0.002	0.013	0.047 *	0.026
Living Alone	-0.086 ***	0.010	-0.088 ***	0.011	-0.067 ***	0.018
Education (Base: No education)						
- Low	0.044 ***	0.012	0.045 ***	0.017	0.038 **	0.017
- Medium	0.063 ***	0.019	0.088 ***	0.029	0.036	0.024
- High	0.053 **	0.024	0.085 ***	0.032	0.002	0.032
HH Expenditure (quartiles) (Base: 1st quartile)						
- 2nd	-0.003	0.014	-0.022	0.017	0.011	0.021
- 3rd	0.024	0.015	-0.004	0.018	0.047 **	0.023
- 4th	0.040 ***	0.016	0.014	0.019	0.060 **	0.024
Smoking (Base: Never)						
- Stopped	-0.008	0.015	0.051	0.074	-0.015	0.017
- Current	0.007	0.020	—	—	0.014	0.022
Alcohol consumption (Base: Never)						
- Stopped	-0.022 ***	0.011	-0.038 ***	0.014	-0.046 ***	0.017
- Current	-0.042 ***	0.013	-0.070 ***	0.021	-0.040 **	0.018
BMI (Base: Normal)						
- Underweight	-0.017	0.022	-0.013	0.040	-0.020	0.025
- Overweight or obese	0.010	0.010	0.002	0.014	0.015	0.015
Childhood conditions						
- Parents together when born	0.018	0.018	0.025	0.021	0.008	0.028
- Father attended school	0.006	0.013	0.007	0.016	0.002	0.020
- Child health rating	-0.021 ***	0.006	-0.016 **	0.007	-0.023 ***	0.009
Number of observations	4182		2243		1932	

Note: Marginal effects are measured at the mean of the corresponding control variable for continuous variables, and as the difference in predicted probability of switching from 0 to 1 for dummy variables. Robust standard errors are reported. *** - significant at the 1% level; * * - significant at the 5% level; * - significant at the 10% level.

significant effect on ageing irrespective of gender. Childhood conditions of parents' marital status when born, father's education level (as proxied by attendance at school) and childhood health rating were included to capture early factors which might contribute to the ageing process. We find that among these covariates only self-reported child health has a significant effect on healthy ageing for both sexes.[10]

3.2. Individual components of ageing

While the results above yield an overall picture, addressing each of the individual components of ageing is likely to require more nuanced policy responses.[11] Using the same model as specification 1, these results are presented in Table 3. While at the aggregate level there was no evidence of female disadvantage, Table 3 reveals females perform significantly worse for *HCF* and *HPF*, and better in being *AE*. For the other two categories, *NMD* and *No ADLD*, we do not observe any gender differences. Compared to males, females are 16.5% more likely to be *AE*, while they are 9.2% and 9.5% less likely to have *HCF* and *HPF*, respectively.

The age category variables are consistently negative and significant for *NMD, HCF,* and *HPF*, with the magnitudes of the marginal effects increasing, as expected, with age. For the *No ADLD* category, however, we only observe a significant age effect for our eldest age category. Interestingly, the age categories are positive and significant for Active Engagement (*AE*) suggesting perhaps a different dynamic at play with respect to the social dimension of ageing successfully. We also observe a positive and consistent effect of being married on all five categories highlighting the positive role marital status plays for the male cohort. Currently being employed positively affects *NMD, HCF,* and *HPF*. Notwithstanding the effect of education on ageing for females (from Table 2), individual component results indicate that its effect tends to be strongest and most pronounced through *HCF*, which is expected. There is evidence for a positive relationship between household expenditure and all categories of ageing well, with the effects most pronounced in the upper two quartiles. Risky health behaviours, proxied by consumption of smoking and alcohol have different effects. Smoking is negatively associated with *HPF*, while having used to consume alcohol has negative and significant effects in all five categories. Being underweight is associated with a lower probability of satisfying *NMD, NADL, HCF* and *AE*. Being overweight or obese has a negative effect on *NMD* and *HPF*, while having a positive effect on *HCF* and *AE*. Finally, we observe that child health rating is consistently negative and significant for all five categories. Both the educational status of the respondents' father and having married parents at birth are linked with a higher probability of achieving high physical function (*HPF*). Those respondents whose parents were together when they were born more likely to be actively engaged (*AE*).

Overall, the picture is one of asymmetries in the determinants in the components of our successful ageing measure. Indeed, some of the effects are masked at the aggregate level. Our earlier results also reveal the differing dynamics governing the gender differences. We also perform a number of robustness tests for possible endogeneity, reverse causality and age sensitivity in our results and find no evidence of these concerns.[12]

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[10] Note that self-rated childhood health is measured on a descending scale. Negative coefficients imply worse health in childhood is associated with lower likelihood of ageing well.

[11] See for example Olivera and Tournier (2016) who note heterogeneity in the individual components and offer a similar analysis for Peru.

[12] Details and results of the robustness checks are available upon request.

Table 3
Probit marginal effects for each component of successful ageing.

Variables	No Major Disease (NMD)		No ADL Disability (No ADLD)		High Cognitive Functioning (HCF)		High Physical Functioning (HPF)		Actively Engaged (AE)	
	Marginal effect	Standard error	Marginal effect	Standard error	Marginal effect	Standard error	Marginal effect	Standard error	Marginal effect	Standard error
Female	0.001	0.023	0.003	0.011	-0.092 * **	0.024	-0.094 ***	0.024	0.165 ***	0.023
Contemporary variables										
Age (Base: 40 – 50)										
- 51 – 60	-0.103 ***	0.025	-0.002	0.011	-0.097 ***	0.026	-0.073 ***	0.025	0.204 ***	0.023
- 61 – 70	-0.158 ***	0.027	0.002	0.012	-0.176 ***	0.027	-0.105 ***	0.027	0.227 ***	0.025
- 71 or older	-0.178 ***	0.029	-0.033 **	0.014	-0.330 ***	0.027	-0.247 ***	0.028	0.139 ***	0.028
Marital status (Base: Divorced, separated or widowed)										
- Never married	-0.030	0.040	0.022	0.013	-0.015	0.040	-0.053	0.040	-0.118 ***	0.042
- Married	0.048 **	0.019	0.018 **	0.009	0.064 ***	0.020	0.053 ***	0.020	0.134 ***	0.019
Employment status (Base: Never)										
- Working	0.081 ***	0.026	0.007	0.013	0.081 ***	0.028	0.106 ***	0.027	0.008	0.028
- Stopped	0.019	0.020	-0.020 *	0.009	0.037 *	0.021	-0.004	0.021	0.079 ***	0.021
- Living Alone	-0.041	0.029	0.021 *	0.010	0.013	0.029	-0.028	0.030	-0.381 ***	0.023
Education (Base: No education)										
- Low	-0.059 ***	0.019	0.015 *	0.008	0.248 ***	0.017	0.030	0.020	0.044 **	0.020
- Medium	0.018	0.027	0.016	0.011	0.324 ***	0.019	0.079 ***	0.027	-0.031	0.027
- High	-0.027	0.036	0.017	0.014	0.285 ***	0.025	0.058	0.036	-0.003	0.035
HH Expenditure (quartiles) (Base: 1st quartile)										
- 2nd	-0.019	0.023	0.008	0.010	0.038	0.023	-0.061 *	0.025	0.036	0.024
- 3rd	-0.037	0.024	0.000	0.010	0.131 ***	0.022	-0.058 **	0.025	0.051 **	0.024
- 4th	-0.087 ***	0.024	0.021 **	0.010	0.219 ***	0.022	-0.027	0.025	0.123 ***	0.024
Smoking (Base: Never)										

Table 3 (*continued*)

Variables	No Major Disease (NMD)		No ADL Disability (No ADLD)		High Cognitive Functioning (HCF)		High Physical Functioning (HPF)		Actively Engaged (AE)	
	Marginal effect	Standard error	Marginal effect	Standard error	Marginal effect	Standard error	Marginal effect	Standard error	Marginal effect	Standard error
- Stopped	-0.020	0.029	0.003	0.012	-0.052 *	0.030	-0.060 **	0.029	-0.034	0.029
- Current	0.079 **	0.032	0.001	0.015	-0.020	0.036	-0.061 *	0.036	-0.031	0.036
Alcohol consumption (Base: Never)										
- Stopped	-0.036 *	0.020	-0.029 ***	0.010	-0.086 ***	0.021	-0.040 **	0.021	-0.045 **	0.021
- Current	-0.004	0.030	0.000	0.013	-0.125 ***	0.031	0.053 *	0.030	-0.035	0.031
BMI (Base: Normal)										
- Underweight	-0.066 *	0.039	-0.036 *	0.019	-0.080 **	0.040	-0.020	0.038	-0.078 **	0.038
- Overweight or obese	-0.069 ***	0.018	0.006	0.008	0.053 **	0.019	-0.039 **	0.019	0.041 **	0.018
Childhood conditions										
- Parents together when born	0.040	0.033	0.024	0.017	-0.026	0.034	0.081 **	0.035	0.066 **	0.033
- Father attended school	-0.038	0.024	-0.012	0.012	-0.023	0.025	0.059 **	0.024	-0.007	0.024
- Child health rating	-0.021 **	0.008	-0.013 ***	0.003	-0.084 ***	0.009	-0.062 ***	0.009	-0.029 ***	0.009
Number of observations	3870		4299		4300		3833		4300	

Note: Marginal effects are measured at the mean of the corresponding control variable for continuous variables, and as the difference in predicted probability of switching from 0 to 1 for dummy variables. Robust standard errors are reported.

*** - significant at the 1% level; ** - significant at the 5% level; * - significant at the 10% level.

Table 4

Probit marginal effects for propensity to visit a public clinic.

Variables	Specification 1		Specification 2	
	Marginal effect	Standard error	Marginal effect	Standard error
Successful Ageing	-0.131 ***	0.023	—	—
No Major Disease	—	—	-0.126 ***	0.018
No ADL Disability	—	—	-0.081 **	0.038
High Cognitive Functioning	—	—	-0.029	0.021
High Physical Functioning	—	—	-0.093 ***	0.019
Actively Engaged	—	—	0.021	0.019
Female	0.164 ***	0.022	0.153 ***	0.025
Contemporary variables				
Age (Base: 40 – 50)				
- 51 – 60	0.026	0.024	-0.007	0.026
- 61 – 70	0.060 **	0.026	0.024	0.029
- 71 or older	0.089 ***	0.028	0.051	0.032
Education (Base: No education)				
- Low	-0.005	0.019	-0.015	0.022
- Medium	-0.007	0.026	0.011	0.030
- High	-0.084 **	0.033	-0.089 **	0.037
Childhood conditions				
- Parents together when born	-0.024	0.032	-0.008	0.037
- Father attended school	0.005	0.023	0.004	0.025
- Child health rating	0.007	0.008	0.001	0.009
Number of observations	4182		3462	

Note: Marginal effects are measured at the mean of the corresponding control variable for continuous variables, and as the difference in predicted probability of switching from 0 to 1 for dummy variables. The regressions also control for marital status, employment status, living alone, household expenditure, smoking, alcohol consumption and BMI. Robust standard errors are reported. * ** - significant at the 1% level; ** - significant at the 5% level; * - significant at the 10% level.

3.3. Health care utilisation

One of the major policy concerns arising from ageing populations relates to expected health care expenditure. A key component of this is obviously the derived demand for health care services arising from a relatively older population. The HAALSI questionnaire assessed the frequency of visits to a public health clinic during the previous 3 months, which enables us to explore this relationship. We consider two model specifications. In specification 1, our independent variable of interest is successful ageing and in specification 2, we use the five separate components of successful ageing. These results are presented in Table 4. Overall, they demonstrate a strong and significant negative association between ageing successfully and clinical visits. In specification 1, being successfully aged lowers the likelihood of visiting a public clinic by 13.1%. In specification 2, NMD has the largest effect on clinic visits, with an absence of major disease lowering the likelihood by 12.6%. High physical function (*HPF*) and absence of disability (*No ADLD*) lower the propensity for a clinical visit by 9.3% and 8.1% points, respectively.

In terms of other explanatory variables, females are estimated to be 16.4% and 15.3% more likely to visit a health clinic compared to males, for specifications 1 and 2 respectively. The positive and significant effect of the age categories in specification 1 is likely to be captured by

Table 5

Zero-inflated poisson regression for number of public clinic visits.

Variables	Specification 1		Specification 2	
	Coefficient	Standard error	Coefficient	Standard error
Successful Ageing	-0.249 ***	0.083	—	—
No Major Disease	—	—	-0.147 ***	0.043
No ADL Disability	—	—	-0.139 **	0.061
High Cognitive Functioning	—	—	-0.051	0.047
High Physical Functioning	—	—	-0.056	0.043
Actively Engaged	—	—	0.002	0.044
Female	0.044	0.060	0.015	0.068
Contemporary variables				
Age (Base: 40 – 50)				
- 51 – 60	0.216 ***	0.068	0.159 **	0.074
- 61 – 70	0.221 ***	0.071	0.164 **	0.075
- 71 or older	0.180 **	0.071	0.119	0.076
Education (Base: No education)				
- Low	0.053	0.045	0.059	0.051
- Medium	0.028	0.062	0.034	0.068
- High	-0.144	0.097	-0.092	0.105
Childhood conditions				
- Parents together when born	0.103	0.083	0.106	0.092
- Father attended school	0.086	0.061	0.070	0.066
- Child health rating	0.005	0.017	0.023	0.018
Number of observations	4176		3458	

Note: Robust standard errors are reported. The regressions also control for marital status, employment status, living alone, household expenditure, smoking, alcohol consumption and BMI. * ** - significant at the 1% level; * * - significant at the 5% level; * - significant at the 10% level.

the variation in the individual component measures specifically controlled for in specification 2. For both specifications, being married lowers the chances of visiting a clinic.

Next, we conduct a zero-inflated poisson regression to capture the likelihood of the number of visits to a public health clinic (Table 5).[13] In specification 1, being successfully aged implies the log of expected clinical visits would decrease by 0.249 units, while holding other variables constant. In percentage terms, this equates to successful ageing being associated with a 22% decrease in the expected number of clinical visits.[14] For specification 2, the decrease in the logs of expected number of clinic visits are 0.148 and 0.140 units for those who have NMD and No ADLD, respectively. These correspond to a 13% decrease in the expected number of clinical visits. Conversely, we see no significant difference on expected visits between males and females. The signs and statistical significance of most of the other explanatory variables in our zero-inflated poisson regressions resemble those of the probit regressions. Tables 4 and 5 serve to highlight the importance of understanding the relationship between ageing successfully and the propensity to utilise health care resources and the public policy implications that stem from

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[13] We used the likelihood ratio test to confirm that the zero-inflated poisson model is preferred over the zero-inflated negative binomial model. Test result is available upon request.

[14] This is calculated through taking the exponential of the coefficient and subtracting 1.

this. Lastly, we check for possible reverse causality between successful ageing and the health care utilisation variables but find no evidence to support this effect.[15]

4. Discussion and policy implications

The management of an ageing population poses considerable policy challenges globally. For resource poor regions the scale of these challenges may be particularly acute. Nearly two thirds of the world's population aged over 60 now reside in developing countries and this proportion is expected to increase in the coming decades, most rapidly in Africa. The UN's adoption of the healthy ageing plan represents a global response to the challenges of population ageing, and its alignment to the UN's 2030 sustainable development goals places additional policy responsibilities for developing countries.

Our results presented here suggest that the determinants and the consequences of healthy ageing are complex. We demonstrate that there are overall policy investments that could foster better outcomes. The effect of these, however, appear to differ to some degree between males and females, and across the various components of ageing. We have shown in particular that females tend to underperform relative to males in terms of cognitive and physical function measures. Further gender specific analysis reveals that the marginal effects of education with respect to cognitive function is greater for females than males. Moreover, the level of deterioration in ageing with respect to cognitive function across the various age categories is far greater for females than males.[16] Importantly, whilst education for girls has become a strategic priority for the World Bank and is reflected in the UN Sustainable Development Goals, results presented here reveal the need for understanding the impact of education for women over their *entire* life course. Onur and Velamuri (2016), for example, make salient in their study the issue that where gender discrimination is pervasive, investment towards closing the gap in education extends beyond creating an educated, healthy and skilled workforce, but also increases women empowerment and overall quality of life at all ages. This is consistent with Papapetrou and Tsalaporta (2020) who identify that in ageing societies, mitigation of associated negative labour market effects require policy interventions aimed at developing human capital and increasing female participation. The important policy implication from our study is that targeted investment to close the gender gap in education, in addition to reducing poverty and empowering women during their reproductive and working years, can also improve the ageing outcomes for women.

We also find a strong influence of childhood health on the likelihood of ageing successfully, which, after controlling for contemporary conditions, was consistently dominant across all dimensions for both males and females. These results complement recent empirical work that links childhood conditions, in particular health and social economic status, with adult health and the likelihood of ageing well (Brandt et al., 2012). The obvious implication is that the capacity to influence childhood health by way of direct investment in health services and education has long run effects. It not only contributes to more proximate goals of alleviating poverty and enhancing health and well-being for the young and for adults in their productive years, but also towards better outcomes in respect of ageing successfully. The empirical results lend support to the UN's emphasis of a life course perspective where investment in intrinsic capacity during early or critical stages in life can positively influence the trajectories of healthy ageing (WHO, 2020b).

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[15] Details and results of the robustness check are available upon request.
[16] Regression results of the gender differences of education on cognitive functioning are available upon request.

Policy discussions surrounding health care utilisation and ageing usually centre on the costs of providing health care to an increasing cohort of the population. Somewhat surprising has been the lack of literature examining health care usage as a function of healthy ageing. We find a negative relationship between ageing well and the likelihood of utilising health care resources. While our data are limited to visits to health care clinics, and not overall health care services, the two are likely to be highly correlated. Health care clinics are a first point of presentation in such a community as captured in the HAALSI study, and demand for more general medical services would arise from these initial presentations. After controlling for a range of covariates, our analysis reveals that the likelihood of frequenting a health clinic is lower for those who have aged well. Policy investment aimed at improving ageing outcomes has the potential to reduce the demand for health care resources later in life and lower the fiscal pressures associated with older populations.

The results presented here suggest that strategic investments across life courses in education and child-health can foster not only broader development goals but also enhance healthy ageing trajectories and improve the health and wellbeing of individuals across life stages, benefiting both younger and older people. Further, results show that such a life course approach to supporting ageing can lower the economic burden placed on health systems in managing an older population. This study provides empirical support for policymakers to pursue a *synergistic* approach in linking the UN's sustainable development goals with its healthy ageing agenda, as has been recently advocated (Mavrodaris & Lafortune, 2022). Such a policy approach also offers the capacity to tackle other problematic issues associated with population ageing such as declining GDP growth rates and possible negative effects on savings (Papapetrou & Tsalaporta, 2020; Pascual-Saez et al., 2020).

The UN's healthy ageing action plan acknowledges the essential role of research in better understanding and acting on healthy ageing (WHO, 2020b). However, to date there has been very limited research on ageing well in developing countries. To this end, this study contributes to informing on the UN's strategic agenda in the context of a poor rural region.

Acknowledgements

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