Prevalence and factors associated with hypertension among older people living with HIV in South Africa

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Abstract

Background: People living with HIV (PLHIV) are experiencing increased life expectancy mostly due to the success of anti-retroviral therapy. Consequently, they face the threat of chronic diseases attributed to ageing including hypertension. The risk of hypertension among PLHIV requires research attention particularly in South Africa where the prevalence of HIV is highest in Africa. We therefore examined the prevalence and factors associated with hypertension among older people living with HIV in South Africa.

Methods: We analysed cross-sectional data on 514 older PLHIV. Data were extracted from the WHO SAGE Well-Being of Older People Study (WOPS) (2011–2013). The outcome variable was hypertension status. Data was analysed using STATA Version 14. Chi-square and binary logistic regression were performed. The results were presented in odds ratio with its corresponding confidence interval.

Results: The prevalence of hypertension among PLHIV was 50.1%. Compared to PLHIV aged 50–59, those aged 60–69 [OR = 2.2; CI = 1.30,3.84], 70–79 years [OR = 2.8; CI = 1.37,5.82], and 80+ [OR = 4.9; CI = 1.68,14.05] had higher risk of hypertension. Females were more likely [OR = 5.5; CI = 2.67,11.12] than males to have hypertension. Persons ever diagnosed with stroke were more likely [OR = 3.3; CI = 1.04,10.65] to have hypertension when compared to their counterparts who have never been diagnosed with stroke. Compared to PLHIV who had no clinic visits, those who visited the clinic three to six times [OR = 5.3; CI = 1.35,21.01], or more than six times [OR = 5.5; CI = 1.41,21.41] were more likely to have hypertension.

Conclusion: More than half of South African older PLHIV are hypertensive. The factors associated with hypertension among older PLHIV are age, sex, ever diagnosed with stroke and number of times visited the clinic. Integration of hypertension management and advocacy in HIV care is urgently needed in South Africa in order to accelerate reductions in the prevalence of hypertension among older PLHIV, as well as enhance South Africa's capacity to attain the Sustainable Development Goal target 3.3.

Keywords: Hypertension, Risk factors, Older people, HIV, South Africa, Social Demography, Public Health

Background

Human immunodeficiency virus (HIV) continues to be a pandemic affecting millions of people worldwide. According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), there are 38 million individuals living with HIV worldwide, with 1.5 million new infections in 2020 and nearly 6 million persons being unaware
of their HIV status [1]. HIV is endemic in sub-Saharan Africa (SSA) where most people suffer the greatest burden of the disease [2, 3]. South Africa has the largest number of people living with HIV globally with an estimated 8 million people are living with HIV (PLHIV) in 2017 [4, 5]. To facilitate reduction in the incidence and prevalence of HIV, there have been global commitments such as the ended Millennium Development Goals (MDG), and the adopted Sustainable Development Goals (SDGs) target 3.3 which aims at ending HIV by 2030 [6]. These interventions have contributed to a significant decline in global HIV-related mortalities from a peak of 1.90 million in 2004 to 1.5 million in 2010 and 0.77 million in 2018 [7]. In South Africa, successful implementation of anti-retroviral therapy (ART) programme has also reduced HIV-related mortalities in the country [8]. Consequently, the effect of ART on viral load suppression has greatly improved due to ART has the life expectancy of PLHIV alongside a decline in opportunistic infections [8]. However, there has been an observed increase in hypertension among PLHIV. Improved understanding of factors associated hypertension among PLHIV is vital for designing tailored and targeted interventions [8–10].

Literature shows that the biology of HIV infection is such that there is pro-inflammatory effect on vascular endothelium which tends to significantly exacerbate PLHIV’s risk of hypertension [9, 11]. A related study [12] also postulates that ART, which is responsible for improving the health outcome and life expectancy of PLHIV increases the likelihood of having lower levels of high-density lipoprotein (HDL) cholesterol (i.e., good cholesterol), which tends to significantly increase the risk of hypertension among PLHIV. Thus, the occurrence of hypertension among PLHIV is undeniably intrinsic and varies across countries. In the United States for instance, the prevalence of hypertension among PLHIV is 67% [13]; in Uganda, the prevalence stands at 29% [14].

Beyond these biological risk factors, the question however remains whether socio-demographic, lifestyle and health-seeking factors have any association with respect to hypertension among PLHIV. Studies conducted in Nigeria [15], Malawi [16] and Ethiopia [17] indicate that place of residence, diabetes status, high body mass index, use of ART, alcohol consumption and ageing were significantly associated with higher risk of hypertension among PLHIV. People with hypertension are at high risk of other ill-health conditions including cardiovascular events, including artherosclerosis, coronary disease, myocardial infarctions, and heart failure [18, 19]. Therefore, hypertension may adversely affect the quality of life of PLHIV. As such, evidence-based studies are needed to advance policy and planning intervention for the management of hypertension in HIV care. Yet, there is dearth of nationally representative studies that have examined the prevalence and factors associated with hypertension among older PLHIV in South Africa.

To the best of our knowledge, only one study [8] has examined the factors associated with hypertension among PLHIV in South Africa. However, Chiwandire et al’s study [8] did not focus on the elderly or older people 50 years and older living with HIV in South Africa. Moreover, their study did not include residual confounders such as health-seeking behaviour. Hence, there are still gaps in what is known about the factors associated with hypertension among older PLHIV in South Africa. We, therefore, sought to examine the prevalence and factors associated with hypertension among older people living with HIV in South Africa.

Methods

Data source

In this study, older people are categorised as younger old (50–64), young old (65–74 years), old old (75–84 years), and the oldest old (85 years and above) [20]. Data utilised in this study were acquired from the WHO SAGE Well-Being of Older People Study (WOPS). These were population-based HIV surveys conducted in South Africa between 2010 (Wave 1) and 2013 (Wave 2) in collaboration with the Africa Centre Demographic Information System (ACDIS) [21]. The SAGE WOPS study gathers comparable longitudinal data on a variety of health, demographic, and social markers that are relevant to the health and functional status of older persons who are HIV-positive or have HIV/AIDS in their family [20]. In addition, the survey looked at the respondents’ nutritional status, and HIV treatment. Concerning the sampling method, the survey’s sample was divided into five groups [20]. At the onset of Wave 1 of the project in 2010, the sample for Group 1 consisted of adults who had been receiving HIV therapy for at least a year. Aged individuals in Group 2 of Wave 1’s 2010 cohort who were not receiving HIV therapy or had only had it for three months or less. The third group of HIV-positive people in Wave 1 of 2010 were those who lived with adult (14–49-year-old) children. Group 4 was made up of elderly people who had experienced an HIV-related death of an adult household member in 2010. The aged who were not receiving HIV therapy or had only received it for three months or fewer in 2013 during Wave 2 were included in Group 5 [20]. The sampling methodology is described in detail elsewhere [22, 23].

Measures

Outcome variable

The outcome variable is based on the question “Have you ever been diagnosed with hypertension”. The response
option was "Yes" or "No", which has coded into a binary outcome with Yes = 1 and No = 0.

**Independent variables**
The following factors were identified and selected as explanatory variables based on literature review [15–17], and their availability in the dataset: age, sex, education, employment, body mass index (BMI), marital status, and household wealth index. Age was recoded as (0 = 50–59, 1 = 60–69, 2 = 70–79, 3 = 80+), sex (coded 1 = male, 2 = female), level of education (recoded 0 = no formal education, 1 = basic, 2 = secondary+), employment (0 = not working, 1 = working), marital status (recoded 0 = married, 1 = divorced/separated, 2 = never married, 3 = widowed). Body mass index of respondents was calculated based on weight and height using standardised computation (0 = underweight, 1 = normal, 2 = overweight, 3 = obese), wealth index (0 = poorest, 1 = poorer, 2 = middle, 3 = richer, 4 = richest). Wealth index variable was computed from respondents' source of water, toilet facility, cooking fuel, electricity, household assets, and having domestic animals using principal component analysis (PCA). PCA post estimation test was done with Kaiser–Meyer–Olkin of 0.7 indicating a good measure of sampling adequacy. Wealth index was then divided into five quintiles (1 = poorest, 2 = poorer, 3 = middle, 4 = richer, 5 = richest). The comorbidity variables were derived from the questions on whether a respondent has ever been diagnosed of the following health conditions: diabetes (0 = No, 1 = Yes), stroke (0 = No, 1 = Yes), arthritis (0 = No, 1 = Yes), asthma (0 = No, 1 = Yes), heart disease (0 = No, 1 = Yes), and depression (0 = No, 1 = Yes). We also derived some lifestyle behaviour variables from the following questions: 'how many servings of fruits, and vegetables do you eat on a typical day? And 'Have you ever smoked tobacco or used smokeless tobacco?' (recoded 0 = No, 1 = Yes), and Have you ever consumed a drink that contains alcohol? (recoded 0 = No, 1 = Yes). Health-seeking behaviour characterised by the number of clinical visits (recoded 0 = not at all, 1 = once/twice, 2 = three to six times, 3 = more than six times) was also included as an independent variable.

**Data analysis**
We used STATA Version 14 as the tool for data analyses. Descriptive statistics were used to summarise hypertension status and its correlates. Chi-square test were used to test for differences between categorical variables. Binary logistic regression analysis was used to examine variables associated with hypertension. In all, four Models were fitted in the study. Model I introduced only socio-demographic factors (age, sex, education, employment, wealth status and body mass index). Model 2 adjusted for comorbidities (depression, heart disease, arthritis, asthma, diabetes, cancer and stroke). Model 3 varies from Model 1 & 2 based on the inclusion of lifestyle behaviour (tobacco and alcohol consumption, and fruit and vegetable consumption), and the complete model includes health-seeking (times visited the clinic in the last 12 months) in addition to all variables in preceding models (I-IV).

**Ethical approval**
This study followed the Declaration of Helsinki. The Ethics Review Committee of the World Health Organization, Geneva, Switzerland, approved the South Africa-SAGE Well-Being of Older People Study (WOPS) Wave 2. All participants signed a written informed consent form. The authors of this paper were not directly involved in the data collection operations. All methods were performed in accordance with the relevant guidelines and regulations. We requested access to the data at: http://www.who.int/healthinfo/sage/cohorts/en/.

**Results**
**Background characteristics by hypertension status**
Table 1 presents proportions of respondents’ hypertension status by, socio-demographic, comorbidities, lifestyle behaviour and health-seeking variables. Most of the respondents were aged 50–59 years and predominantly females. Predominantly, the participants were widowed, had basic education, unemployed, and with a normal BMI. Overall, out of the 518 respondents, 50.1% of them were hypertensive. The prevalence of hypertension was higher among females (58.0%), those aged 80 years and above (65.0%), ever been diagnosed with stroke (71.4%), and ever diagnosed with diabetes (74.4%). The prevalence of hypertension was higher among those who visited the clinic 3–6 times within the last 12 months prior to the survey (56.8%).

**Binary logistic regression results of associated factors of hypertension**
Table 2 shows the results from the binary logistic regression showing the factors associated with hypertension among PLHIV. In Model IV, which is the final model, age, sex, ever diagnosed with stroke and number of times visited clinic were the factors that were associated with hypertension among PLHIV. Compared to PLHIV aged 50–59, those aged 60–69 [AOR = 2.2; CI = 1.30, 3.84], 70–79 years [AOR = 2.8; CI = 1.37, 5.82], and 80+ [AOR = 4.9; CI = 1.68, 14.05] had higher risk of hypertension. Concerning sex, females living with HIV were more likely [AOR = 5.5; CI = 2.67, 11.12] than males to have hypertension. Persons ever diagnosed with
Table 1  Background characteristics by hypertension status

| Covariates               | Frequency | Hypertensive Status | X²   | p-value |
|--------------------------|-----------|---------------------|------|---------|
|                          |           | Non-hypertensive    |      |         |
|                          |           | %   (n)              |      |         |
|                          |           | Hypertensive        |      |         |
|                          |           | %   (n)              |      |         |
| Overall                  | 517       | 49.9    258  | 50.1  | 259     |
| Socio-demographics       |           |                     |      |         |
| Age                      |           |                     | 10.44| 0.02    |
| 50–59                    | 249       | 56.6    141  | 43.4  | 108     |
| 60–69                    | 149       | 47.7    71   | 52.4  | 78      |
| 70–79                    | 79        | 41.8    33   | 58.2  | 46      |
| 80+                      | 40        | 35.0    14   | 65.0  | 26      |
| Sex                      |           |                     | 44.95| 0.00    |
| Male                     | 118       | 77.1    91    | 22.9  | 27      |
| Female                   | 400       | 42.0    168   | 58.0  | 232     |
| Marital status           |           |                     | 2.38 | 0.50    |
| Married                  | 136       | 54.4    74    | 45.6  | 62      |
| Separated/divorced       | 37        | 54.0    20    | 46.0  | 17      |
| Never married            | 135       | 50.4    68    | 49.6  | 67      |
| Widowed                  | 209       | 46.4    97    | 53.6  | 112     |
| Education                |           |                     | 5.72 | 0.06    |
| No education             | 250       | 46.8    117   | 53.2  | 133     |
| Basic                    | 256       | 51.6    132   | 48.4  | 124     |
| Secondary and above      | 11        | 81.8    9     | 18.2  | 2       |
| Employment               |           |                     | 7.44 | 0.01    |
| Not working              | 468       | 48.1    225   | 51.9  | 243     |
| Working                  | 48        | 68.8    33    | 31.2  | 15      |
| Body mass index          |           |                     | 8.46 | 0.04    |
| Underweight              | 30        | 63.3    19    | 36.7  | 11      |
| Normal                   | 159       | 58.5    93    | 41.5  | 66      |
| Overweight               | 119       | 51.3    61    | 48.7  | 58      |
| Obese                    | 172       | 44.2    76    | 55.8  | 96      |
| Wealth status            |           |                     | 0.69 | 0.95    |
| Poorest                  | 102       | 49.0    50    | 51.0  | 52      |
| Poorer                   | 102       | 51.0    52    | 49.0  | 50      |
| Middle                   | 101       | 49.5    50    | 50.5  | 51      |
| Richer                   | 109       | 52.3    57    | 47.7  | 52      |
| Richest                  | 94        | 46.8    44    | 53.2  | 50      |
| Comorbidity              |           |                     |      |         |
| Ever diagnosed with depression |     |                     | 1.17 | 0.28    |
| No                       | 483       | 50.5    244   | 49.5  | 239     |
| Yes                      | 32        | 40.6    13    | 59.4  | 19      |
| Ever diagnosed with heart disease |      |                     | 0.42 | 0.52    |
| No                       | 507       | 50.3    255   | 49.7  | 252     |
| Yes                      | 10        | 40.0    4     | 60.0  | 6       |
| Ever diagnosed with arthritis |      |                     | 2.83 | 0.09    |
| No                       | 395       | 52.1    206   | 47.9  | 189     |
| Yes                      | 122       | 43.4    53    | 56.6  | 69      |
| Ever diagnosed with asthma |       |                     | 2.06 | 0.15    |
| No                       | 491       | 49.3    242   | 50.7  | 249     |
| Yes                      | 25        | 64.0    16    | 36.0  | 9       |
| Ever diagnosed with diabetes |      |                     | 11.28| 0.00    |
stroke were more likely [AOR = 3.3; CI = 1.04,10.65] to have hypertension as compared to their counterparts who have never been diagnosed with stroke. Compared to PLHIV who had no clinic visits, those who visited the clinic 3–6 times [AOR = 5.3; CI = 1.35,21.01] or more than six times [AOR = 5.5; CI = 1.41,21.41] were more likely to have hypertension.

Discussion
The study reveals that there is a high prevalence of hypertension (50.1%) among PLHIV in South Africa. The estimated prevalence is higher than the 14.3% prevalence that was reported by Chiwandire et al. [8]. This prevalence is further higher than the estimated prevalence in other African countries such as Ghana (30.8%) [24], and Ethiopia (12.7%) [17]. It is worth noting that unlike previous studies, this study population is limited to elderly PLHIV. The sharp difference between the prevalence found in this study when compared to other studies, clearly indicates that the prevalence of hypertension in PLHIV increases with increasing age. Our study underscores the urgency and need for the South African government to prioritise and strengthen the healthcare system to integrate hypertension management into HIV care. Hypertension advocacy would have to be part of the basic service package provided to PLHIV in South Africa. This may be beneficial in the long run to reduce the prevalence of hypertension among this cohort.

Concerning the factors associated with hypertension among PLHIV, we found sex differences in the risk of hypertension. Older females living with HIV were five times more likely than their male counterparts to have hypertension. Similar findings have been reported in

| Table 1 | (continued) |
| --- | --- |
| **Covariates** | **Frequency** | **Hypertensive Status** | **Non-hypertensive** | **Hypertensive** | **X^2** | **p-value** |
|  |  |  | % | (n) | % | (n) |
| --- | --- | --- | --- | --- | --- | --- |
| No | 474 | 52.3 | 248 | 47.7 | 226 |  |  |
| Yes | 43 | 25.6 | 11 | 74.4 | 32 |  |  |
| Ever diagnosed with cancer |  |  |  |  |  |  |  |
| No | 510 | 50.6 | 258 | 49.4 | 252 | 2.73 | 0.10 |
| Yes | 6 | 16.7 | 1 | 83.3 | 5 |  |  |
| Ever diagnosed with stroke |  |  |  |  |  |  |  |
| No | 495 | 51.1 | 253 | 48.9 | 242 | 4.09 | 0.04 |
| Yes | 21 | 28.6 | 6 | 71.4 | 15 |  |  |
| **Lifestyle behaviour** |  |  |  |  |  |  |  |
| Fruit consumption |  |  |  |  |  |  |  |
| <2 | 145 | 48.3 | 70 | 51.7 | 75 | 0.38 | 0.83 |
| 2 | 194 | 49.0 | 95 | 51.0 | 99 |  |  |
| 3+ | 155 | 51.6 | 80 | 48.4 | 75 |  |  |
| Vegetable consumption |  |  |  |  |  |  |  |
| <2 | 283 | 48.1 | 136 | 51.9 | 147 | 2.20 | 0.33 |
| 2 | 138 | 49.3 | 68 | 50.7 | 70 |  |  |
| 3+ | 97 | 56.7 | 55 | 43.3 | 42 |  |  |
| Tobacco consumption |  |  |  |  |  |  |  |
| No | 450 | 48.0 | 216 | 52.0 | 234 | 6.77 | 0.01 |
| Yes | 66 | 65.2 | 43 | 34.9 | 23 |  |  |
| Alcohol consumption |  |  |  |  |  |  |  |
| No | 405 | 46.7 | 189 | 53.3 | 216 | 8.80 | 0.00 |
| Yes | 112 | 62.5 | 70 | 37.5 | 42 |  |  |
| **Health seeking** |  |  |  |  |  |  |  |
| Times visited the clinic in last 12 months |  |  |  |  |  |  |  |
| No visit | 22 | 72.7 | 16 | 27.3 | 6 | 8.69 | 0.03 |
| Once/twice | 72 | 56.9 | 41 | 43.1 | 31 |  |  |
| 3 – 6 times | 148 | 43.2 | 64 | 56.8 | 84 |  |  |
| More than six times | 239 | 49.0 | 117 | 51.0 | 122 |  |  |
### Table 2  Binary logistic regression results of associated factors of hypertension

| Explanatory variables | Model I | Model II | Model III | Model IV |
|-----------------------|---------|----------|-----------|----------|
|                       | OR (95% CI) | AOR (95% CI) | AOR (95% CI) | AOR (95% CI) |
| **Socio-demographics** |         |          |           |           |
| **Age**               |         |          |           |           |
| 50–59                 | Ref     | Ref      | Ref       | Ref      |
| 60–69                 | 1.6 [0.99, 2.48] | 1.7* [1.03, 2.69] | 1.8* [1.08, 2.89] | 2.2** [1.30, 3.84] |
| 70–79                 | 2.1* [1.11, 4.04] | 2.3* [1.18, 4.49] | 2.3* [1.17, 4.68] | 2.8** [1.37, 5.82] |
| 80+                   | 2.6* [1.11, 5.88] | 2.8* [1.19, 6.58] | 3.0* [1.20, 7.55] | 4.9** [1.68, 14.05] |
| **Sex**               |         |          |           |           |
| Male                  | Ref     | Ref      | Ref       | Ref      |
| Female                | 5.9*** [3.20, 10.74] | 5.9*** [3.07, 11.22] | 5.5*** [2.75, 10.85] | 5.5*** [2.67, 11.12] |
| **Marital status**    |         |          |           |           |
| Married               | Ref     | Ref      | Ref       | Ref      |
| Separated/divorced    | 0.6 [0.24, 1.50] | 0.6 [0.22, 1.41] | 0.6 [0.23, 1.66] | 0.7 [0.27, 2.00] |
| Never married         | 0.8 [0.47, 1.52] | 0.9 [0.47, 1.62] | 0.9 [0.47, 1.73] | 0.8 [0.40, 1.58] |
| Widowed               | 0.8 [0.48, 1.36] | 0.8 [0.48, 1.43] | 0.9 [0.51, 1.60] | 0.8 [0.45, 1.55] |
| **Educational level** |         |          |           |           |
| No education          | Ref     | Ref      | Ref       | Ref      |
| Basic                 | 0.8 [0.56, 1.27] | 0.8 [0.54, 1.26] | 0.8 [0.54, 1.28] | 0.8 [0.51, 1.27] |
| Secondary and above   | 0.3 [0.04, 1.70] | 0.2 [0.02, 2.06] | 0.2 [0.02, 2.41] | 0.2 [0.02, 1.82] |
| **Employment**        |         |          |           |           |
| Not working           | Ref     | Ref      | Ref       | Ref      |
| Working               | 0.7 [0.34, 1.36] | 0.6 [0.31, 1.34] | 0.6 [0.28, 1.28] | 0.9 [0.39, 1.99] |
| **Body mass index**   |         |          |           |           |
| Underweight           | Ref     | Ref      | Ref       | Ref      |
| Normal                | 0.9 [0.37, 2.42] | 0.9 [0.35, 2.75] | 1.0 [0.35, 3.09] | 0.9 [0.28, 2.92] |
| Overweight            | 1.0 [0.40, 2.75] | 1.0 [0.36, 1.80] | 1.1 [0.36, 3.47] | 1.1 [0.32, 3.59] |
| Obese                 | 1.2 [0.47, 3.09] | 1.2 [0.44, 3.51] | 1.2 [0.42, 3.66] | 1.2 [0.37, 3.89] |
| **Wealth status**     |         |          |           |           |
| Poorest               | Ref     | Ref      | Ref       | Ref      |
| Poorer                | 0.9 [0.50, 1.74] | 0.8 [0.46, 1.61] | 0.7 [0.37, 1.43] | 0.6 [0.29, 1.25] |
| Middle                | 1.0 [0.55, 1.99] | 0.9 [0.48, 1.81] | 0.9 [0.42, 1.71] | 0.6 [0.30, 1.38] |
| Richer                | 0.7 [0.37, 1.29] | 0.7 [0.37, 1.29] | 0.6 [0.31, 1.20] | 0.5 [0.26, 1.10] |
| Richest               | 1.1 [0.53, 2.09] | 1.0 [0.49, 2.05] | 1.0 [0.47, 2.12] | 0.7 [0.32, 1.74] |
| **Comorbidity**       |         |          |           |           |
| Ever diagnosed with depression | Ref | Ref | Ref | ref |
| Yes                   | 1.5 [0.68, 3.43] | 1.5 [0.65, 3.60] | 1.4 [0.57, 3.29] |         |
| Ever diagnosed with heart disease | Ref | Ref | Ref | Ref |
| Yes                   | 1.0 [0.21, 5.05] | 1.3 [0.23, 7.17] | 1.7 [0.22, 13.44] |         |
| Ever diagnosed with arthritis | Ref | Ref | Ref | Ref |
| Yes                   | 1.3 [0.79, 2.08] | 1.4 [0.84, 2.26] | 1.5 [0.87, 2.62] |         |
| Ever diagnosed with asthma | Ref | Ref | Ref | Ref |
| Yes                   | 0.7 [0.21, 2.07] | 0.5 [0.16, 1.60] | 0.5 [0.16, 1.56] |         |
| Ever diagnosed with diabetes | Ref | Ref | Ref | Ref |
| Yes                   | 2.1 [0.93, 4.60] | 2.0 [0.88, 4.69] | 2.2 [0.94, 5.28] |         |
studies conducted among the general South African HIV population [8]. The findings are further substantiated by earlier studies that found similar sex variations in the risk of hypertension among PLHIV [25, 26]. A plausible explanation for the sex differences is that, unlike men, women go through a series of body changes such as menopause. After menopause, as is the case of older women, there is endogenous oestrogen withdrawal which exacerbates the likelihood of post-menopausal hypertension [27]. During pregnancy, women sometimes face gestational hypertension and eclampsia [28].

Ageing was another factor that increased the risk of hypertension among South African older PLHIV. Persons aged 80 years and older had the greatest odds of having hypertension compared to those aged 50–59 years. This finding mirrors that of previous studies conducted in Ghana [24], South Africa [8], Nigeria [15], Malawi [16] and Ethiopia [17]. As opined by Fahme, Bloomfield and Peck [29], ageing is characterised by gradual vascular stiffening which significantly increases blood pressure, hence, exacerbating the risk of hypertension. Such biological effects of increased arterial resistance and vascular stiffening, may thus, explain why ageing significantly increases the risk of hypertension in PLHIV. The findings imply that age can be a marker for beginning hypertension management during HIV care. Standard modules for mandatory

### Table 2 (continued)

| Explanatory variables               | Model I       | Model II      | Model III     | Model IV      |
|-------------------------------------|---------------|---------------|---------------|---------------|
| Ever diagnosed with cancer          |               |               |               |               |
| No                                  | Ref           | Ref           | Ref           | Ref           |
| Yes                                 | 5.5 [0.90,33.20] | 6.2 [0.98,39.35] | 5.7 [0.75,42.79] |               |
| Ever diagnosed with stroke          |               |               |               |               |
| No                                  | Ref           | Ref           | Ref           |               |
| Yes                                 | 1.9 [0.65,5.65] | 2.6 [0.84,8.22] | 3.3* [1.04,10.65] |               |
| **Lifestyle behaviour**             |               |               |               |               |
| Fruit consumption                   |               |               |               |               |
| <2                                  | Ref           | Ref           | Ref           |               |
| 2                                   | 1.12 [0.65,1.94] | 1.0 [0.54,1.74] |               |               |
| 3+                                  | 0.9 [0.49,1.50] | 0.9 [0.51,1.72] |               |               |
| Vegetable consumption               |               |               |               |               |
| <2                                  | Ref           | Ref           | Ref           |               |
| 2                                   | 0.9 [0.53,1.46] | 0.7 [0.43,1.25] |               |               |
| 3+                                  | 0.6 [0.33,1.12] | 0.6 [0.33,1.20] |               |               |
| Tobacco consumption                 |               |               |               |               |
| No                                  | Ref           | Ref           | Ref           |               |
| Yes                                 | 1.1 [0.49,2.31] | 1.0 [0.44,2.29] |               |               |
| Alcohol consumption                 |               |               |               |               |
| No                                  | Ref           | Ref           | Ref           |               |
| Yes                                 | 0.9 [0.51,1.76] | 1.8 [0.59,2.37] |               |               |
| **Health seeking**                  |               |               |               |               |
| Times visited the clinic in last 12 months |               |               |               |               |
| No visit                            |               |               |               |               |
| Once/twice                          |               |               |               |               |
| 3 – 6 times                         |               |               |               |               |
| More than six times                 |               |               |               |               |
| **Constant**                        | 0.23          | 0.19          | 0.22          | 0.06          |
| **Model fitness**                   |               |               |               |               |
| Prob > chi2                         | <0.001        | <0.00         | <0.00         | <0.00         |
| AIC                                 | 612.29        | 606.23        | 594.15        | 546.44        |
| Pseudo R²                           | 0.11          | 0.12          | 0.13          | 0.15          |
| N                                   | 518           | 518           | 518           | 518           |

*p < 0.05, **p < 0.01, ***p < 0.001; ref reference category, OR odds ratio, CI confidence interval*
hypertension management sessions for older PLHIV would be necessary for reducing the risk of hypertension among older PLHIV.

Our study reveals that older PLHIV who had ever been diagnosed with stroke were three times more likely to have hypertension as compared to their counterparts who have never been diagnosed with stroke. The present study is consistent with findings from a hospital-based survey that showed that hypertension increased among persons who have ever been diagnosed with stroke for the first time [30]. It is unclear how and why the risk of hypertension is high among persons who have ever been diagnosed with stroke. A related study [31] has shown that substantial proportion of hypertensive go unaware until a stroke occurs for the first time. Although not significant in the final regression model, 74.4% of persons ever diagnosed of diabetes were hypertensive. Ferrannini and Cushman [32] have postulated that the high prevalence of hypertension among person diagnosed with diabetes may be due to biological pathways such as, “insulin resistance in the nitric-oxide pathway; the stimulatory effect of hyperinsulinaemia on sympathetic drive, smooth muscle growth, and sodium–fluid retention; and the excitatory effect of hyperglycaemia on the renin–angiotensin–aldosterone system”. Therefore, older PLHIV who get diagnosed with diabetes would have initiate preventive and control interventions for hypertension. Relatedly, we observed that older PLHIV who often visited the clinic were more likely to have hypertension. Thus, through frequent clinic visits, PLHIV have the opportunity to undergo hypertension screenings and gain information about hypertension. Consequently, they become more likely to get to know about their hypertensive status.

Our findings call for the integration of hypertension management into ongoing HIV care services across all levels of the healthcare architecture. These could be enhanced by having hospital guidelines that integrate HIV and hypertension care along healthcare continuum. National advocacy and campaign could be championed to accelerate efforts to have hypertension management integrated in all aspect of healthcare to older PLHIV. There is also the need to sustain health education and promotion programmes that are tailored to the needs of women if efforts are to be made to reduce the prevalence of hypertension and HIV amongst them.

Strengths and limitations

Our study draws its conclusions from a representative sample size of older PLHIV. Hence, we are able to generalise our findings to all older PLHIV in South Africa. Also, the questionnaires and methods of data collection used by the WHO WOPS has been validated, thereby ensuring the reliability of our findings. Nevertheless, there are some limitations that must be taken into account when interpreting the findings. We relied on a secondary data that used cross-sectional design. As such, we are unable to establish causal inferences in the risk factors of hypertension among older PLHIV. Also, the source data does not capture evidence on which health outcome occurred prior to the other. For instance, hypertension is a major risk factor for stroke. Our findings that the risk of hypertension is high among persons who have ever been diagnosed with stroke could therefore be due to the fact that hypertension occurred prior to stroke events.

Conclusion

In this study, we examined the prevalence and factors associated with hypertension among older people living with HIV in South Africa. We conclude that more than half of South African older PLHIV are hypertensive. Also, the factors associated with hypertension among older PLHIV are age, sex, ever diagnosed with stroke and number of times visited the clinic. Integration of HIV care and hypertension management, and advocacy in HIV care is urgently needed in South Africa in order to accelerate reductions in the prevalence of hypertension among older PLHIV, as well as enhance South Africa’s capacity to attain the SDG targets, particularly SDG 3.3.

Abbreviations
ACDIS: Africa Centre Demographic Information System; ART: Anti-retroviral therapy; HIV: Human immunodeficiency virus; PLHIV: People living with HIV; SDGs: Sustainable Development Goals; SSA: Sub-Saharan Africa; WOPS: Well-Being of Older People Study.

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Authors’ contributions
JO, CA, BAO and KSD conceived the study. JO and CA analysed the data. All authors drafted the manuscript and reviewed the article. All authors read and approved the final manuscript. KSD supervised the study.

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Availability of data and materials
The data used to support the findings of this study is available from the corresponding author upon request. Data is available at the WHO SAGE Wave 2 office and through the WHO website http://www.who.int/healthinfo/sage/cohorts/en/.

Declarations
Ethics approval and consent to participate
This study followed the Declaration of Helsinki. The Ethics Review Committee of the World Health Organization, Geneva, Switzerland, approved the South Africa-SAGE Well-Being of Older People Study (WOPS) Wave 2. All participants signed a written informed consent form. The authors of this paper were not
directly involved in the data collection operations. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
We declare no competing interests.

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