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Prevalence of HIV and chronic comorbidities among older adults

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Abstract

Objectives—Limited evidence is available on HIV, aging and comorbidities in sub-Saharan Africa. This article describes the prevalence of HIV and chronic comorbidities among those aged 50 years and older in South Africa using nationally representative data.

Design—The WHO's Study of global AGEing and adult health (SAGE) was conducted in South Africa in 2007–2008. SAGE includes nationally representative cohorts of persons aged 50 years and older, with comparison samples of those aged 18–49 years, which aims to study health and its determinants.

Methods—Logistic and linear regression models were applied to data from respondents aged 50 years and older to determine associations between age, sex and HIV status and various outcome variables including prevalence of seven chronic conditions.

Results—HIV prevalence among adults aged 50 and older in South Africa was 6.4% and was particularly elevated among Africans, women aged 50–59 and those living in rural areas. Rates of chronic disease were higher among all older adults compared with those aged 18–49. Of those aged 50 years and older, 29.6% had two or more of the seven chronic conditions compared with 8.8% of those aged 18–49 years ($P < 0.0001$). When controlling for age and sex among those aged 50 and older, BMI was lower among HIV-infected older adults aged 50 and older (27.5 kg/m²) than in HIV-uninfected individuals of the same age (30.6) ($P < 0.0001$). Grip strength among HIV-infected older adults was significantly ($P=0.004$) weaker than among similarly-aged HIV-uninfected individuals.

Conclusion—HIV-infected older adults in South Africa have high rates of chronic disease and weakness. Studies are required to examine HIV diagnostics and treatment instigation rates among

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Conflicts of interest

There are no conflicts of interest.

older adults to ensure equity of access to quality care, as the number and percentage of older adults living with HIV is likely to increase.

Keywords

aging; chronic disease; comorbidity; HIV; older adults; South Africa

Introduction

As of 2007, almost one in eight people living with HIV in sub-Saharan Africa was aged 50 years and older [1]. With life expectancy increasing for individuals on antiretroviral treatment (ART) [2], the number of older people with HIV will continue to increase and will have considerable impacts on the future course of the epidemic. Overall, South Africa is aging despite the impacts of HIV mortality on the total population, with the highest percentage (15.9%) of persons aged 50 years and above in sub-Saharan Africa in 2012 [3].

The aging of the HIV epidemic in South Africa has received more attention than other parts of Africa over the past few years [4–6]. Recent estimates for South Africa predict that HIV prevalence in patients aged 50 and older will nearly double in the next 30 years from 9% in 2010 to 17% in 2040, whereas the fraction of HIV-infected patients aged 50 and over will triple in the same period. The increase will be particularly pronounced among men: less than one in 12 HIV-infected people is aged over 50 in 2010 but in 2040 this will be one in four [7].

Despite this emerging evidence, there are still substantial knowledge gaps about HIV-infected individuals aged 50 and older in South Africa. Previous studies on older adults in South Africa have been conducted with subpopulations in which HIV is highly prevalent [4]. One of the key issues that has not yet received much attention in sub-Saharan Africa is noncommunicable diseases (NCDs) and comorbidities among people living with HIV.

Traditionally, HIV and AIDS-associated conditions have focused on opportunistic, primarily infectious diseases such as tuberculosis, pneumonia and Kaposi's sarcoma. However, newer evidence from developed countries demonstrates that there is also an additional burden of HIV-related and ART-related chronic comorbidities, especially among those aged 50 and older [8]. Patients aging with HIV are more likely to develop NCDs and at an earlier age than those who are HIV-uninfected, threatening the long-term survival of people living with HIV. These conditions include coronary artery disease, dyslipidemia, some cancers, metabolic syndrome, diabetes, osteoporosis and dementia [9–11]. This has led to calls for greater attention to multimorbidity in the care of people living with HIV [12,13].

However, not much evidence on comorbidities occurring in HIV-infected individuals is available from African settings. Although chronic comorbidities in the context of HIV have been acknowledged as likely [14,15], the situation has not been well quantified. A small number of African studies have measured prevalence of specific conditions among HIV-infected individuals. For instance, one study reports that cardiac abnormalities are more common in people with HIV compared with controls [16].

The topic of HIV, aging and comorbidities remains neglected by the international community [17]. Examining the realities and complexities of HIV and aging in South Africa is critical to improving quality of care and treatment options. The co-existence of communicable and NCD burdens pose complex challenges for an already taxed healthcare system: evidence is needed to better inform the South African health system and build its capacity to respond to multiple comorbidities [18–20]. In order to start to address the knowledge gaps, this article aims to describe HIV prevalence and associations between HIV and chronic comorbidities – among those aged 50 years and older in South Africa using nationally representative data.

Methods

The WHO implemented Wave 1 of the Study of global AGEing and adult health (SAGE) in six low-income and middle-income countries, including South Africa, in 2007–2008. Cross-sectional data was used from SAGE: a study with nationally representative cohorts of persons aged 50 years and older, with comparison samples of younger adults aged 18–49 years in each country, which aims to study health, health-related outcomes and their determinants. The survey instrument included multiple modules devised to measure health status, risk factors and chronic diseases, health systems coverage and responsiveness and healthcare expenditures. Biomarkers, including a blood sample, were collected. More information on SAGE survey methods and materials is available elsewhere [21–23].

Data for the South African SAGE survey were collected from March 2007 to September 2008. A population-based representative sample of the population aged 50 years or older was interviewed, with a smaller cohort of adults aged 18–49 years included for comparison purposes. The survey includes information on respondents' health, physical functioning, risk factors and perceptions of well being. Anthropometric measures were collected, including BMI and waist and hip circumferences. Dried blood spot samples were collected through finger prick and used to determine HIV status through laboratory testing. Grip strength was measured as a proxy for mobility and functioning. Interviewers were retired or unemployed nurses. Respondent consent was obtained for the interview and the blood sample. In South Africa, SAGE was carried out in partnership with the WHO, the Human Sciences Research Council (HSRC) and the National Department of Health (NDOH). Blood samples were stored and analyzed at Global Clinical and Viral Laboratories, Durban, South Africa. Ethical review and clearance was obtained through WHO and the HSRC Research Ethics Committee. Financial support was provided by the NDOH, the United States National Institute on Aging's Division of Behavioral and Social Research, HSRC and WHO.

Respondents were asked whether they had been diagnosed with a number of NCDs, using the following question format: 'have you ever been told by a health professional that you have ...?', or 'have you ever been diagnosed with ...?', for each health condition. Given the limitations of self-reported chronic conditions [24], a validated set of symptom questions and a related diagnostic algorithm were used to ascertain prevalence of angina, arthritis, asthma and depression [25]. The set of symptoms for each condition was derived from standard instruments, such as the World Mental Health Survey version of the Composite International Diagnostic Interview for the diagnosis of depression [26] or the Rose

questionnaire for angina [27]. A validated set of symptom questions is not available for diabetes or stroke prevalence, which was, therefore, based on a self-report of the condition. Hypertension prevalence was based on mean blood pressure readings of equal to or greater than 140 mmHg for SBP and 90 mmHg for DBP.

The validated WHO Disability Assessment Schedule (WHODAS) 12-item instrument was used to assess functioning and disability [28]. The total score was transformed to an index between 0 and 100, with 0 representing extreme problems or complete disability and 100 representing a total absence of disability. Grip strength was calculated as mean maximum hand grip strength of both hands in kilograms.

Data was weighted using poststratified individual probability weights based on the selection probability at each stage of selection. Individual weights were poststratified by province, sex and age groups according to the 2009 medium mid-year population estimates from Statistics South Africa [29]. Weights were not normalized. Weights sum to the total population aged 18 years and older.

Regression models were applied to data from respondents aged 50 years and older to determine associations between explanatory variables age, sex and HIV status and various outcome variables. Logistic regression was applied with prevalence of various chronic conditions and linear regression analysis was conducted for continuous variables including WHODAS, BMI, grip strength and waist-to-hip ratio. Models were weighted using the aforementioned population weights. All analyses were conducted using SAS statistical software version 9.2 (SAS Institute Inc., Cary, North Carolina, USA).

Results

In total, 4227 individuals responded to the questionnaire of whom 385 (9.1%) were aged 18–49, 1695 (40.1%) were aged 50–59, 1232 (29.1%) were aged 60–69 and 912 (21.6%) were 70 years and older. The overall response rate for those aged 50 and older was 76%. Of the total respondents, HIV status results were available for 3161 (74.8%) individuals due to some respondents not consenting as well as a small number of inconclusive results. Response rates for HIV testing ranged from 72.2% among those aged 50–59 to 76.9% for those aged 70 years and older.

Focusing on those aged 50 years and older and using sample weights so that the data is nationally representative, 6.4% of older adults in South Africa were HIV-infected at the time of the survey. This ranges from 8.6% among those aged 50–59 to 3.3% among those aged 70 and older (Table 1). The HIV prevalence estimate for those aged 18–49 years in South Africa in 2008 was 16.9% [6]. HIV prevalence was higher among women, those living in rural areas, Africans and those with less education. Prevalence was highest in the Free State (12.2%) and lowest in the Western Cape (2.1%). HIV prevalence among women aged 50–59 years was considerably higher than among men of the same age (Figure 1).

Table 2a provides data on the prevalence of chronic comorbidities by HIV status across three age groups (18–49, 50–59, >60 years). First analysis compares prevalence of comorbidities between HIV-infected older adults and HIV-uninfected older adults. Rates of

arthritis were significantly ($P < 0.0001$) lower among HIV-infected individuals over the age of 50 (6.5%) as compared with HIV-uninfected people of the same ages (18.8%).

Whereas 53.4% of all (both HIV-infected and uninfected) those aged 18–49 did not have any chronic condition, only 22.0% of those aged 50 and older did not. Only 8.8% of those aged 18–49 years had two or more conditions compared with 29.6% of those aged 50 and older ($P < 0.0001$).

BMI was lower among HIV-infected older adults aged 50 and older (27.5 kg/m²) than HIV-uninfected individuals of the same age (30.6) ($P < 0.0001$) (Table 2b). Grip strength among HIV-infected older adults (33.5 kg) was significantly ($P = 0.004$) weaker than among similarly-aged HIV-uninfected individuals (38.3 kg).

Second analysis compares comorbidities among HIV-infected individuals aged 50 and older against HIV-uninfected individuals aged 18–49. Rates of hypertension among HIV-infected individuals were significantly higher ($P = 0.0003$) among those above the age of 50. WHODAS was higher among HIV-infected older adults (23.0) than among those HIV-uninfected individuals aged 18–49 (6.2) ($P = 0.0001$).

After adjusting for age and sex using logistic regression, arthritis was the only chronic condition that was statistically significantly associated with HIV status among people aged 50 years and over (Table 3). Among individuals aged 50 years and older, living with HIV was associated with a lower prevalence of arthritis [odds ratio 0.30 (95% confidence intervals 0.14–0.65); $P=0.002$]. Among those aged 50 and older, age and sex were not associated with the presence of chronic conditions. When including those aged 18–49 as well as older individuals, as expected, there was a significant positive association between older age and presence chronic conditions.

In linear regression models in those 50 years and older (Table 4), when controlling for age and sex, HIV status was statistically significantly associated with BMI and grip strength. The grip strength of those living with HIV was on average 4.73 kg weaker than among those who were HIV-uninfected (95% confidence intervals 0.77–8.70; $P=0.019$). Those living with HIV also had on average a BMI 3.86 points lower (95% confidence intervals 2.17–5.55; $P < 0.0001$). Age and sex also had significant associations with WHODAS, BMI and grip strength.

Among those 50 years of age and older, levels of happiness and life satisfaction were lower among those who were HIV-infected. When asked how satisfied they were with life as a whole, 51.8% of HIV-infected individuals responding ‘satisfied’ or ‘very satisfied’ compared with 60.6% of those HIV-uninfected ($P=0.039$). When asked about their level of happiness, 34.6% of the HIV-infected respondents replied ‘happy’ or ‘very happy’ compared with 55.5% of those HIV-uninfected ($P < 0.0001$).

Discussion

HIV prevalence among adults aged 50 and older in South Africa remains high and is particularly elevated among Africans, women aged 50–59 years, those living in rural areas

and in some provinces such as Free State and KwaZulu-Natal. Rates of chronic disease were higher among all older adults compared with those aged 18–49 years. HIV status, however, was only statistically significantly associated with arthritis and not with any of the other conditions that we studied. When controlling for age and sex among those aged 50 and older, HIV status was significantly associated with lower BMI and weaker grip strength.

Our finding of 6.4% prevalence among all individuals aged 50 years and older is similar to that found by Peltzer *et al.* [5] in the 2005 South African HIV prevalence and behavioral survey (5.8%) and in the 2008 South African national HIV prevalence, incidence, behavior and communication survey (6.0%) [6]. The higher rate of HIV prevalence among women aged 50–59 relative to men of the same age found in this study was not seen in those two studies. The 3.3% HIV prevalence rate among those aged 70 and older could cautiously be taken as evidence of old age incidence.

A Ugandan study using the same survey methodology also found significantly lower BMI among HIV-infected older people compared with HIV-uninfected counterparts as well as lower rates of hypertension [30]. Overall, the Ugandan study found that older adults living with HIV had a similar health and functional status as other older people.

Despite significant evidence from developed country settings of associations between HIV and various chronic conditions, these were generally not found in this study among those aged 50 and older. Evidence of links between HIV and diabetes [31], cardiovascular disease [32], cerebrovascular and ischemic heart diseases [11], hypertension [33] and stroke [34] have been found in various studies in developed countries. HIV-associated arthritis has been observed in high-income countries linked to both HIV infection [35] and some antiretroviral medications [36] and emerging evidence from Uganda shows high rates of rheumatic manifestations among HIV-infected individuals [37], although the Ugandan study did not have a HIV-uninfected comparison group.

Despite this, our findings reveal lower rates of arthritis among those living with HIV aged 50 and older. There are many types of arthritis with differing causes and there is evidence that some types of ART might reduce the frequency of some types of arthritis [38,39]. Further research is needed on the interaction between HIV, antiretroviral drugs and immune function in the occurrence and severity of various forms of arthritis.

The study is enhanced by the oversampling of older adults in SAGE providing a nationally representative perspective on the health of older adults. The approximately 25% missing HIV status values, however, may introduce bias, which could be leading to the lack of relationships observed between HIV status and various comorbidities in this study. Those with missing data were more likely to be female, African and slightly younger than those who responded. This might explain the high prevalence of HIV found in women aged 50–59 years in this study.

For a number of chronic conditions, prevalence was determined based on responses to a set of self-reported symptom questions rather than clinical diagnosis. This can lead to imprecision based on each individual's interpretation of the question – especially in cases of neurological or cognitive deficit. For measures such as hypertension based on blood

pressure, the reporting of prevalence based on established cut-off points ignores the continuous association between blood pressure and hypertension [40].

A further limitation of this study is the lack of data on ART. Valcour *et al.* [31] noted that it was ART especially that was associated with increased metabolic risk factors. Given that a number of comorbidities discussed in this article are more prevalent among those on certain ART regimens, the lack of such information limits the conclusions that can be drawn. As of December 2009, 971 556 South Africans were on ART, representing 56% of those who need treatment based on WHO 2006 guidelines and 37% of those who need it based on WHO 2010 guidelines [41]. According to 2008 data, ART coverage varied between provinces, from 25.8% in the Free State to 71.7% in the Western Cape [42]. In these 2008 data, there are no figures on ART by age group or among those over 50 years of age specifically. Whether or not people aged 50 and older are over-represented or under-represented in ART programs is unknown and this would have an impact on associations with some chronic comorbidities.

The question of multimorbidity is critical to the future care and treatment models of HIV. There is a shift in care from a focus on opportunistic infections and AIDS-defining malignancies to a new set of chronic comorbidities, which may be due to chronic inflammation from long-term HIV infection as well as ART toxicities exacerbated by aging [13,17,43,44]. Evidence from developed countries shows high levels of multimorbidity among older adults [45,46]. A multimorbidity perspective has been recommended when considering optimal healthcare for older people, as it is more patient-centered and captures potentially interacting conditions [47].

This has important implications for integration of chronic care models in already strained developing country health systems. There is an opportunity to leverage the investment in HIV systems to develop an integrated response to a range of chronic diseases [48]. Chronic disease clinics that provide continuity of care, long-term adherence support and can prevent and monitor drug interactions and reactions is needed to ensure a high level of care [49].

In addition to the chronic conditions, the weaker grip strength, lower BMI and higher disability score highlights poorer overall health among older adults living with HIV compared with older adults who do not have HIV. More attention is needed to poverty, nutrition and access to disability and health services among older adults with HIV.

South Africa has added men over 50 to its list of most at-risk populations, meriting extra attention in the national HIV response [6]. Despite misperceptions to the contrary, older adults aged 50 and older in South Africa remain sexually active with 63% of men and 30% of women having had sex in the past month [5]. The most recent sexual partner of more than 11% of men aged 50–59 was aged 31–40 years, suggesting that intergenerational relationships remain of concern to HIV transmission [5]. National communication programs have failed to sufficiently target older adults leading to lower rates of HIV knowledge among those aged 50 and older [6,50].

Future research among older adults living with HIV in sub-Saharan Africa, including upcoming SAGE surveys, will need to take into account access to ART, time on ART and

the amount of time that an individual has been HIV-infected in order to better assess prevalence and incidence of comorbidities. Further diagnostic tests for chronic conditions – in addition to self-reported symptomatic algorithms – would enhance precision. Cancer and dementia are additional important health challenges among older adults and among people living with HIV that should be included in future studies. Furthermore, efforts to integrate care should be evaluated for their impact on quality of care, outcomes and avoidance of adverse drug reactions. As the HIV epidemic in Africa ages, more evidence will be needed to end the neglect of older adults and develop models of care that meet the needs of this vulnerable group.

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Fig. 1. HIV prevalence among people aged 50 years and older by age and sex, 2007–2008
Weighted to be representative of South Africa. Note: weights were poststratified by province, sex and age groups according to 2009 data from Statistics South Africa.

Table 1
HIV prevalence among people aged 50 years and older by group, 2007–2008

Variable	Group	Unweighted <i>N</i> with HIV/total <i>N</i>	Weighted HIV prevalence	Weighted 95% confidence limits
Age	50+	147/2869	6.4%	4.9–7.9%
	50–59	96/1224	8.6%	6.2–11.0%
	60–69	35/944	5.0%	2.4–7.6%
	70+	16/701	3.3%	1.4–5.1%
Sex	Male	56/1188	4.9%	3.0–6.8%
	Female	91/1681	7.5%	5.4–9.7%
Ethnicity	African/black	113/1540	8.2%	6.2–10.2%
	White	0/188	0.0%	0.0–0.0%
	Colored	19/593	2.1%	0.8–3.5%
	Indian/Asian	2/229	0.7%	0.0–2.0%
Education	Less than primary	78/1354	7.7%	5.3–10.0%
	Primary completed	30/571	6.1%	3.3–8.8%
	Secondary completed	22/465	4.2%	1.4–7.0%
	Postgraduate completed	2/104	1.4%	0.0–4.0%
Province (selected)	Free State	11/176	12.2%	2.7–21.8%
	Gauteng	14/242	6.1%	1.9–10.3%
	KwaZulu-Natal	29/399	8.8%	4.3–13.6%
	Western Cape	4/199	2.1%	0.0–4.8%
Urban/rural	Urban	85/1816	5.5%	3.8–7.2%
	Rural	62/1052	7.9%	5.2–10.6%
Marital status	Currently married/cohabitating	61/1469	4.6%	3.0–6.2%
	Never married/separated/widowed	82/1356	8.4%	5.8–11.1%

Weighted to be representative of South Africa. Note: weights were poststratified by province, sex and age groups according to 2009 data from Statistics South Africa.

Table 2
Measurement of conditions by HIV status and by age group

Condition	Unweighted N with condition	HIV status	Ages 18–49 years	Unweighted N	Ages 50–59 years	Unweighted N	Ages >60 years	Unweighted N	P value (HIV comparison) ^a	P value (age comparison) ^b
(a) Prevalence of conditions by HIV status by age group, 2007–08 (weighted to be representative of South Africa)										
Hypertension	2148	Infected	33.3%	25/53	76.0%	65/96	69.3%	36/51	0.167	0.0003
		Uninfected	53.0%	125/238	67.2%	754/1128	70.3%	1144/1595		
Depression	141	Infected	5.9%	3/49	9.3%	9/93	2.6%	2/49	0.194	0.849
		Uninfected	6.7%	11/233	5.1%	66/1089	4.5%	50/1535		
Arthritis	509	Infected	6.5%	2/49	5.1%	9/89	9.5%	5/44	<0.0001	0.999
		Uninfected	3.2%	15/221	17.4%	175/1042	20.1%	303/1457		
Angina	188	Infected	5.0%	3/51	7.2%	7/92	13.7%	6/45	0.147	0.425
		Uninfected	2.2%	8/229	7.4%	71/1048	5.8%	93/1428		
Asthma	171	Infected	2.0%	2/51	4.9%	7/93	5.5%	2/49	0.401	0.383
		Uninfected	2.8%	10/232	6.6%	62/1092	6.8%	88/1532		
Stroke	119	Infected	0.0%	0/51	3.6%	3/94	3.6%	2/49	0.476	0.012
		Uninfected	1.2%	4/233	3.8%	41/1092	5.6%	69/1536		
Diabetes	288	Infected	3.1%	1/51	10.1%	6/94	10.6%	1/49	0.780	0.118
		Uninfected	1.8%	8/233	8.4%	93/1094	10.7%	179/1537		
(b) Mean measurements by HIV status by age group, 2007–2008 (weighted to be representative of South Africa)										
BMI	3044	Infected	28.3	53	27.7	93	27.0	50	<0.0001	0.746
		Uninfected	28.5	233	31.0	1084	30.4	1513		
WHR	2952	Infected	0.86	52	0.85	90	0.89	50	0.028	0.867
		Uninfected	0.88	221	0.89	1050	0.89	1475		
WHODAS	3161	Infected	6.2	53	21.9	96	25.2	51	<0.0001	
		Uninfected	8.7	238	15.9	1128	25.6	1595		
Grip strength	2836	Infected	45.4	48	34.1	90	32.4	43	0.004	0.029
		Uninfected	46.7	226	41.1	1024	35.7	1405		

Grip strength: grip strength is measured in mean maximum hand grip strength (kilograms). WHO Disability Assessment Schedule (WHODAS): the composite score – is scaled from 0 (no disability) to 100 (high disability). Note: weights were poststratified by province, sex and age-groups according to 2009 data from Statistics South Africa. WHR, waist-to-hip ratio

^a HIV comparison compares prevalence (a) or means (b) of people aged 50 and older who are HIV-infected and those who are HIV-uninfected.

^b Age comparison compares prevalence (a) or means (b) of HIV-infected individuals aged 18–49 and 50 and older.

Table 3
Associations between chronic conditions and HIV status, age and sex by logistic regression models among those aged 50 years and older.^a

Condition	N	Variable	Odds ratio	95% confidence intervals	P value
Hypertension	2869	HIV	1.27	0.78–2.07	0.346
		Sex	1.28	0.98–1.68	0.070
		Age	1.01	0.99–1.02	0.290
Arthritis	2632	HIV	0.30	0.14–0.65	0.002
		Sex	1.17	0.82–1.68	0.388
		Age	1.00	0.99–1.02	0.583
Stroke	2771	HIV	0.80	0.24–2.64	0.714
		Sex	0.92	0.48–1.78	0.806
		Age	1.02	0.99–1.04	0.157
Angina	2613	HIV	1.29	0.57–2.92	0.537
		Sex	2.09	1.28–3.44	0.004
		Age	0.98	0.96–1.01	0.215
Diabetes	2774	HIV	1.06	0.36–3.06	0.922
		Sex	1.66	1.05–2.62	0.029
		Age	1.01	0.99–1.03	0.307
Asthma	2766	HIV	0.78	0.31–1.95	0.599
		Sex	0.73	0.43–1.23	0.238
		Age	1.00	0.98–1.03	0.833
Depression	2766	HIV	1.47	0.65–3.29	0.354
		Sex	1.02	0.55–1.87	0.963
		Age	1.00	0.96–1.04	0.873

^a A model containing HIV status, age (continuous) and sex was run for each condition.

Table 4
Associations between various measures and HIV status, age and sex by linear regression models among those aged 50 years and older.^a

Condition	N	Variable	b (95% CI)	t/F	P value
WHO disability assessment	2869	HIV (infected)	3.79 (−0.35 to 7.93)	1.79	0.073
		Sex (female)	5.00 (2.54–7.45)	3.99	<0.0001
		Age	0.64 (0.52–0.78)	9.82	<0.0001
BMI	2739	HIV (infected)	−3.86 (−5.55 to −2.17)	−4.48	<0.0001
		Sex (female)	3.26 (2.11–4.41)	5.57	<0.0001
		Age	−0.11 (−0.17 to −0.05)	−3.58	<0.001
Waist-to-hip ratio	2664	HIV (infected)	−0.02 (−0.06 to 0.02)	−1.08	0.282
		Sex (female)	−0.03 (−0.05 to −0.01)	−2.47	0.013
		Age	0.00 (0.00)	1.35	0.176
Hand grip strength	2561	HIV (infected)	−4.73 (−8.70 to −0.77)	−2.34	0.019
		Sex (female)	−7.78 (−9.38 to −6.18)	−6.50	<0.0001
		Age	−0.30 (−0.43 to −0.18)	−4.75	<0.0001

b, beta co-efficient; F, *F*-test; t, *t*-test.

^a A model containing HIV status, age (continuous) and sex was run for each condition.