Knowledge, risk perception and access to healthcare services for HIV and tuberculosis among university students in Johannesburg, South Africa

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Background. An increasingly diverse body of students is entering university in South Africa. HIV and tuberculosis (TB) are pressing health issues for this vulnerable population and the university campus offers an opportunity to intervene with health promotion activities.
Objectives. This study describes knowledge and risk perception of TB and HIV among high school leavers entering tertiary education.
Methods. A cross-sectional survey among first-year students, aged 18-25 years, registered at one of three universities chosen for the study in Johannesburg, South Africa. Informed consent was obtained prior to completing a self-administered, close-ended, structured questionnaire. Factors associated with poor knowledge or high risk perception were identified using modified Poisson regression.
Results. In total, 792 students were included; 53.3% (*n*=438) were categorised as having poor TB knowledge and 52.1% (*n*=412) poor HIV knowledge, while 43.4% (*n*=344) were categorised as having high TB risk perception and 39.8% (*n*=315) high HIV risk perception. Male students were more likely to have poor knowledge of HIV and perceive themselves at risk of acquiring HIV. Low socioeconomic status was associated with a high risk perception of HIV. One in 3 participants (30.6%) stated that they had never had an HIV test. In total, 24 students (9 male, 15 female) reported that they were HIV-positive, of whom 15 (62.5%) were on antiretroviral therapy. Only 14.1% had been screened for TB in the past 6 months.
Conclusion. The findings indicate a need to enhance health promotion activities among university students so as to aid preventive strategies for reducing the burden of HIV and TB infection.

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South Africa (SA), with an estimated incidence of 781 cases of TB per 100 000 population in 2016, is one of the countries with the highest burden of the disease, and it continues to be a major health problem in the country.[1,2] The relationship between TB and HIV is well documented, and HIV is a major contributor to the TB epidemic. The risk of developing TB among HIV-positive individuals is estimated to be 16-27 times higher than among those who are HIV negative.[3] HIV primarily affects people in their most productive years and, in SA, young people (ages 15 - 24) have been identified as a high-risk group.[4]

Adolescents and young adults face difficult and often confusing emotional and social pressures as they move from childhood to adulthood. Compared with adults, young people generally lack sufficient knowledge about HIV and are less likely to be tested. They also need more support to navigate healthcare and access services.[5-7] The barriers and facilitators of HIV counselling and testing (HCT) among young people have been well described.[7-9] Potential barriers include stigma, discrimination, concerns about confidentiality, lack of adequate housing, education, employment and psychosocial support. Poor HIV and sexual health knowledge, among young women in particular, has been identified as a barrier to HIV testing and prevention.[7-9] Studies have shown that young people's behaviour and how they perceive their risk of acquiring HIV can influence their intentions or decisions to test (e.g. individuals engaging in unsafe sexual practices suspect a positive result and are less likely to test).[10-12]

It is unclear if adolescents and young adults leaving high school and entering tertiary education are adequately equipped for the social complexities such as peer pressure, complex social networks or unequal power dynamics in sexual decision-making that they may encounter in their new environment. It is also unclear whether they can make informed decisions about their sexual behaviour so as to protect themselves and others from becoming infected with HIV. In 2000, SA implemented the HIV and AIDS Life Skills Programme in all primary and secondary schools. HIV education, under the Integrated School Health Programme (ISHP), aimed to make youth-friendly, sexual and reproductive health services accessible in schools with the intention of supporting HIV prevention efforts. Changes to the policy later included HCT in the range of services offered to high school learners.[7] Between 2013 and 2014, the proportion of schools implementing the ISHP dropped significantly from 60% to 20%, respectively.[4,13] While benefits of the ISHP have been described in the high school setting,[7] it is not clear if young people understand the importance of HCT or if they access HCT services once they have left high school in response to changes in their behaviour and/or risk perception.

According to the South African National Department of Higher Education and Training, over one million students enrolled in universities in South Africa for the 2016 academic year, of whom 20% were first-time students. As there is an increasingly diverse body of students entering university in South Africa, the university campus presents an important opportunity to assess students' knowledge, risk perception and health-seeking behaviour regarding TB and HIV, and identify opportunities to intervene with health promotion activities. The present study adds to the limited, but growing, body of literature that looks at the interaction between the factors and behaviour of young people entering tertiary education, while informing policy on the development of youth-friendly health services and support.[7] The study aims to describe knowledge and risk perception of TB, HIV and access to healthcare services among high school leavers entering tertiary education.

Methods

Study design

This was a cross-sectional survey among first-year students, aged 18 - 25 years, registered at one of three tertiary institutions (universities) chosen for the study in Johannesburg, South Africa.

Setting and population

Gauteng comprises the largest share of the South African population, with ~13.5 million people living in the province. Johannesburg has a population of 4.5 million, making it the largest South African city and one of the largest African cities. Johannesburg has an overall TB incidence of 326 cases per 100 000 population.[5] The three universities selected for this study are located in Johannesburg, with less than 40 km between them. The universities, with a total annual intake of 19 000 first-year students, offer a diverse range of undergraduate programmes.

The study population included all first-year students aged 18-25 years (students could thus sign written informed consent without parent/legal guardian permission) who were registered between February 2017 and November 2017 at one of three tertiary institutions (universities) chosen for the study in Johannesburg (two government subsidised and one private university). A convenience sample was obtained by approaching first-year students in common areas on the days that study staff (i.e. interviewers) visited the university campuses (e.g. library, canteen, lunch area). Because the target population of the study was high school leavers entering tertiary education, students who had completed secondary school more than three years ago and those who had been university students for more than one year (e.g. those completing a bridging year prior to registering for a formal degree) were excluded.

Study procedure

Study staff approached potential participants and those who met the initial pre-screening criteria (e.g. first-year student and registered at the university) were invited to participate. Thereafter, study staff provided a detailed explanation of the study and confirmed eligibility, and eligible students were asked to provide written informed consent. Students enrolled in the study completed a self-administered, close-ended structured questionnaire. Both the informed consent and questionnaire were available in English only. The questionnaire contained questions on participant demographics, HIV knowledge, HIV risk perception, TB knowledge and TB risk perception. Questions relating to knowledge and risk perception were derived from published questionnaires[14-21] and adapted for the local context. Assessment of knowledge (36 items for TB and 42 items for HIV) included questions about cause, mode of transmission, symptoms, risk factors, prevention, treatment and where to obtain help if sick, ways of preventing disease, and treatment for HIV and TB. Questions on risk perception (10 for TB and 20 for HIV) included questions that reflected common myths and misconceptions and also focused on perceived susceptibility to TB/HIV, perceived benefits and barriers to seeking care and disclosure of TB and/or HIV. Questions on HIV risk perception included additional questions from the validated perceived risk measure as reported by Napper and colleagues.[22] Study staff helped the participants to complete the self-administered paper-based questionnaire and then entered the responses into REDCap, an electronic data entry tool, hosted at the University of the Witwatersrand.[23]

Sample size and weighting

OpenEpi epidemiological calculator for prevalence studies was used to calculate the sample size (http://www.openepi.com/SampleSize/SSPropor.htm). Using an estimated population of 19 000 first-year university students across the three universities (regardless of gender), an anticipated percentage frequency of 50%, and a confidence limit of ±5%, the estimated sample size calculated to have sufficient power to detect true level of knowledge was 634. Taking into account a 20% non-response rate, the total sample size increased to 792. We further weighted the sampling according to the estimated number of first-year vacancies that each university had, so that participants were enrolled at a ratio of 3:6:1 for each university. During the study period, study staff (i.e. interviewers) rotated through the 3 universities and 6 campuses to enrol 792 first-year students.

Study variables

Socioeconomic status (SES) was measured using an asset index, based on ownership of assets, power source, and food security as recommended by Filmer and Pritchett (1998).[24] Assets were combined into a wealth index using weights derived through principal component analysis (PCA). The PCA involves breaking down assets (e.g. type of dwelling, radio, refrigerator) or household service access (e.g. electricity, access to water, sanitation etc.) into categorical or interval variables. The variables were then processed to obtain weights and principal components. Based on this index, SES of households was divided into three categories (low, medium and high) representing proxies for SES.

The high school where participants obtained their senior certificate after Grade 12 schooling was recoded as either a private or public high school according to name of school and city or province where the school was located. In most instances, this involved accessing the school's public website to ascertain this. Race or ethnicity was classified as reported by participants (i.e. self-identifying).

Outcomes, data and data analysis

The primary outcomes of the study were the proportion of students with poor knowledge of HIV or TB and a high risk perception of HIV or TB.

We assigned a number to participants' responses so that a score could be calculated and categorised. For TB and HIV knowledge, four-point Likert items ('True', 'Probably True', 'Probably False' and 'False') measuring either a positive or negative response to a statement were summed to create a score for the group of items. Questions with 'Yes' and 'No' response options were recoded and added to the score (e.g. a true response to the question was given 2 points and a false response 0). The total score was then split into higher and lower knowledge level based on the median score (i.e. less than the median as low/poor knowledge, and more than or equal to the median as high/adequate knowledge). For TB and HIV risk perceptions, a similar approach was taken. Using four-point Likert items, participants indicated their agreement with the statement ('Strongly agree', 'Agree', 'Disagree' and 'Strongly Disagree'). Questions for HIV risk perception that had other response options were recoded and added to the score.[14] The total score was split into low and high risk perception

based on the median score. Missing or 'Refused to answer' responses were not included in the data coding, whereas 'Don't know' was regarded as a negative response to the statement and scored accordingly. Internal consistency of each set of questions was calculated using Cronbach's method, and the alpha coefficient presented. In addition, we report the completeness of data and the average number of data fields missing for each outcome.

Participant demographics (at enrolment) are presented using proportions for categorical variables and medians with corresponding interquartile ranges (IQRs) for continuous variables, and stratified by university. Continuous data were compared using the Kruskal-Wallis for non-parametric or *t*-test for parametric data, where appropriate, while the chi-square test (or Fischer Exact test for sparse data) was used to compare proportions.

We used modified Poisson regression to estimate the association between student characteristics (e.g. gender, nationality, SES etc.) and our primary outcomes. We present the crude or univariate estimate with the 95% confidence interval for each factor. Factors with $p<0.1$ in the univariate model along with other potential confounders (10% difference between the crude and adjusted estimates) and *a priori* variables (e.g. age, gender, university, SES) were included in the final multivariate model. To minimise issues with highly correlated variables, we used principal component analysis (PCA) – a method that combines the variables in a non-correlated way – to create a new variable (e.g. SES) which was included in the model. All analyses were conducted using SAS version 9.3 (SAS Institute, USA).

The present study was approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (Certificate number M161019). All participants provided written informed consent to participate in the study.

Results

A total of 1 656 students were approached to participate in the study. A third of the students (32.1%, *n*=532) approached did not have time to participate in the study, 5% (*n*=84) were not interested in participating and 7.8% (*n*=130) were not university students or first-year students. Of those interested in participating and screened (*n*=910), 811 were eligible to participate and were enrolled. Of these, 792 were included in the analysis after fictitious data (*n*=5; where students fabricated data), duplicates (*n*=11) and those with incomplete consent (*n*=3) had been removed (Fig. 1). The age and gender of those included in the analysis were representative of all students approached, screened and enrolled (mean age 19.4 v. 19.2, 18.0 and 19.3 years; male 44.4% v. 40.9%, 43.5% and 44.6%).

The number of participants enrolled at each university reflected the relative size of the university population (i.e. *n*=228, 28.8%; *n*=480, 60.6% and *n*=84, 10.6%). The majority of students were of the Christian religion (88%), single (98.6%) and studying full-time (98.7%), with only a few students (5.5%) reporting that they were employed. Participants were predominantly between the ages of 19 and 25 years (65.8%), of black ethnicity (91.2%), South African (73.7%), female (54.8%), and mostly public high school graduates (74.4%) who completed high school in Gauteng Province (59.6%) (Table 1). Compared with participants registered at the two government-subsidised universities, the private university (*n*=84) had more female (61.9% v. 57.0% and 52.5%) and more white students (13.1% v. 4.4% and 1.3%) and a higher SES as measured by higher-than-average monthly household income, attended a private high school, tuition paid by parents, living with spouse/partner/parent, private health insurance and high SES according to the PCA ($p<0.05$).

Knowledge and risk perception

Prior to the analysis, we tested the internal consistency and completeness of the data, as presented by each outcome (Table 2). Questions related to TB risk perception had the lowest internal consistency (<0.50 indicates that the items are not appropriate; ≥0.70 is preferred). In particular, students appeared to struggle with the question '*I live*

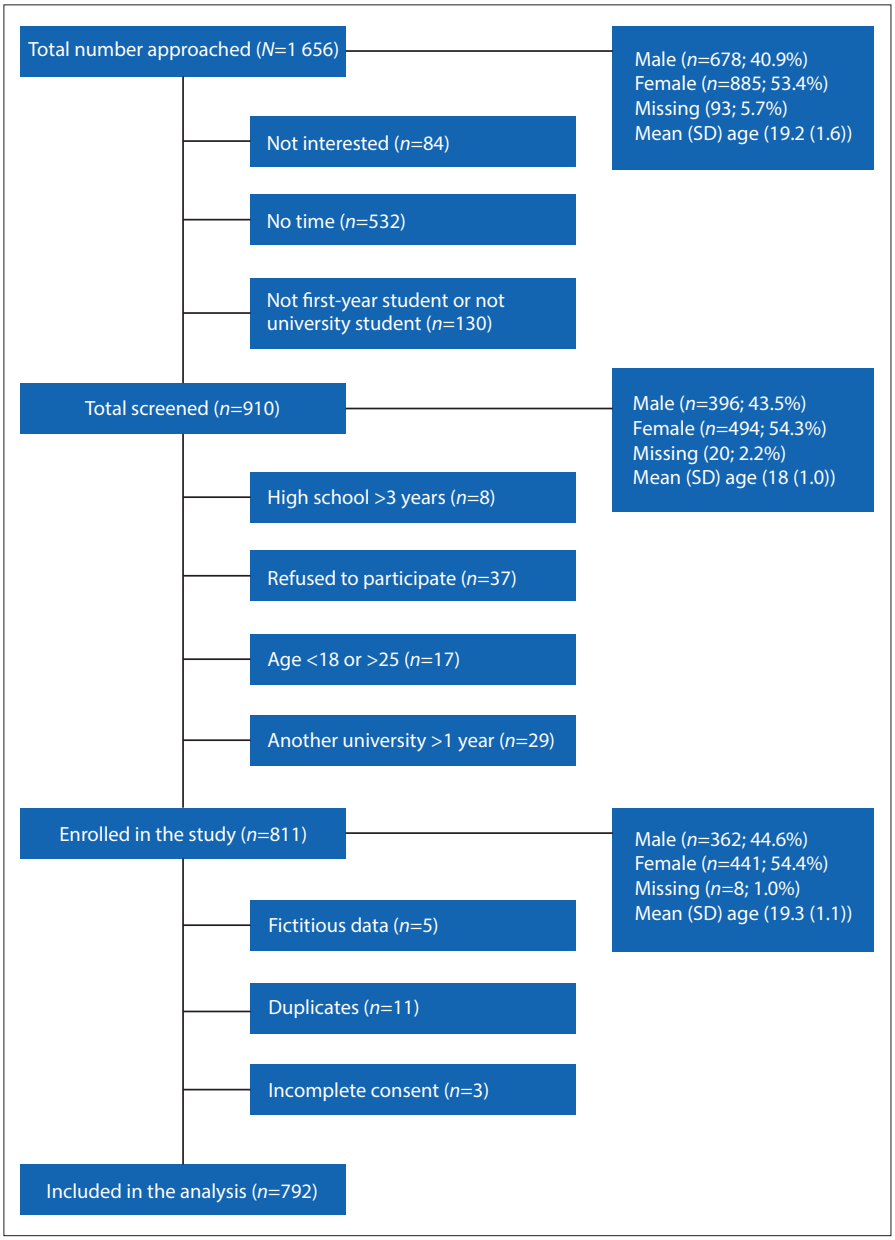

Fig. 1. Summary of study enrollment process. (SD = standard deviation.)

Table 1. Demographic characteristics of students enrolled between February and November 2017 (*N*=792)

			University site			
		All	Subsidised 1	Subsidised 2	Private	
Characteristic	Categories	*N*=792 , *n* (%)	*n*=228, *n* (%)	*n*=480, *n* (%)	*n*=84, *n* (%)	*p*-value
Age, years	18 - 19	254 (32.1)	108 (47.4)	103 (21.4)	43 (51.2)	<0.001†
	19 - 25	521 (65.8)	113 (49.6)	368 (76.7)	40 (47.6)	
	Missing	17 (2.1)	7 (3.0)	9 (1.9)	1 (1.2)	
Gender	Male	352 (44.4)	97 (42.5)	226 (47.1)	29 (34.5)	0.428
	Female	434 (54.8)	130 (57.0)	252 (52.5)	52 (61.9)	
	Other	2 (0.3)	1 (0.5)	0 (0.0)	1 (1.2)	
	Missing	4 (0.5)	0 (0.0)	2 (0.4)	2 (2.4)	
Nationality	Non-South African	120 (15.2)	36 (15.8)	66 (13.8)	18 (21.4)	0.534
	South African	584 (73.7)	171 (75.0)	350 (72.9)	63 (75.0)	
	Missing	88 (11.1)	21 (9.2)	64 (13.3)	3 (3.6)	
Ethnicity	Black	722 (91.2)	204 (89.5)	460 (95.8)	58 (69.0)	<0.001
	White	27 (3.4)	10 (4.4)	6 (1.3)	11 (13.1)	
	Coloured	20 (2.5)	4 (1.8)	9 (1.9)	7 (8.3)	
	Indian	17 (2.1)	7 (3.1)	5 (1.0)	5 (6.0)	
	Other/missing	6 (0.8)	3 (1.2)	0 (0.0)	3 (3.6)	
Faculty	Business, Economics and Finance	147 (18.6)	14 (6.1)	117 (24.4)	16 (19.0)	<0.001
	Education	104 (13.1)	78 (34.2)	26 (5.4)	0 (0.0)	
	Engineering and Built Environment	66 (8.3)	46 (20.2)	20 (4.2)	0 (0.0)	
	Health Sciences	43 (5.4)	9 (3.9)	24 (5.0)	10 (12.0)	
	Humanities and Social Sciences	100 (12.6)	23 (10.1)	52 (10.8)	25 (29.8)	
	Information Technology	21 (2.7)	7 (3.1)	8 (1.7)	6 (7.1)	
	Law and Management	163 (20.6)	3 (1.3)	152 (31.7)	8 (9.5)	
	Sciences	43 (5.4)	28 (12.3)	15 (3.1)	0 (0.0)	
	Other (e.g. bridging or gap year)	16 (2.0)	0 (0.0)	0 (0.0)	16 (19.0)	
	Missing	89 (11.3)	20 (8.8)	66 (13.7)	3 (3.6)	
Type of high school	Private	147 (18.5)	40 (17.5)	57 (11.9)	50 (59.5)	<0.001
	Public	589 (74.4)	182 (79.9)	378 (78.8)	29 (34.5)	
	Missing	56 (7.1)	6 (2.6)	45 (9.3)	5 (6.0)	
Province completed high school/Grade 12 equivalent	Gauteng	472 (59.6)	127 (55.3)	286 (59.6)	59 (70.2)	0.119
	Eastern Cape	26 (3.3)	11 (4.8)	14 (2.9)	1 (1.2)	
	Free State	11 (1.4)	4 (1.8)	6 (1.3)	1 (1.2)	
	KwaZulu-Natal	63 (8.0)	15 (6.6)	45 (9.4)	3 (3.6)	
	Limpopo	78 (9.8	24 (10.5)	53 (11.0)	1 (1.2)	
	Mpumalanga	67 (8.5)	24 (10.5)	41 (8.5)	2 (2.4)	
	North West	30 (3.8)	11 (4.8)	15 (3.1)	4 (4.8)	
	Northern Cape	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
	Western Cape	9 (1.1)	7 (3.3)	0 (0.0)	2 (2.4)	
	Outside South Africa	27 (3.4)	5 (2.4)	12 (2.5)	10 (11.8)	
	Other/missing	9 (1.1)	0 (0.0)	8 (1.7)	1 (1.2)	

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Table 1. (continued) Demographic characteristics of students enrolled between February and November 2017 (*N*=792)

			University site			
		All	Subsidised 1	Subsidised 2	Private	
Characteristic	Categories	*N*=792, *n* (%)	*n*=228, *n* (%)	*n*=480, *n* (%)	*n*=84, *n* (%)	*p*-value
Socioeconomic indicators						
Tuition paid by	Parents	302 (38.1)	52 (22.8)	183 (38.2)	67 (79.8)	<0.001
	Scholarship	97 (12.3)	57 (25.0)	35 (7.3)	5 (6.0)	
	Student loan	279 (35.3)	68 (29.8)	209 (43.5)	2 (2.4)	
	Parents and scholarship	9 (1.1)	6 (2.6)	3 (0.6)	0 (0.0)	
	Don't know	65 (8.2)	25 (11.0)	37 (7.7)	3 (3.6)	
	Refuse to answer	13 (1.6)	7 (3.1)	3 (0.6)	3 (3.6)	
	Other/missing	27 (3.4)	13 (5.7)	10 (2.2)	4 (4.8)	
Living with partner/ spouse/parent	Yes	382 (48.2)	94 (41.2)	228 (47.5)	60 (71.4)	0.004
	No	382 (48.2)	126 (55.3)	236 (49.2)	20 (23.8)	
	Refuse to answer/missing	28 (3.6)	8 (3.5)	16 (3.3)	4 (4.8)	
Share a sleeping room with other people	Yes	414 (52.3)	157 (68.9)	247 (51.4)	10 (11.9)	<0.001
	No	331 (41.8)	62 (27.2)	202 (42.1)	67 (79.8)	
	Refuse to answer/missing	47 (5.9)	9 (3.9)	31 (6.5)	7 (8.3)	
Number of people that share a room for sleeping with*	1 - 2	370 (89.3)	144 (91.7)	218 (88.3)	8 (80.0)	0.060
	3 - 4	26 (6.3)	8 (5.1)	17 (6.9)	1 (10.0)	
	5 - 7	4 (1.0)	0 (0.0)	4 (1.6)	0 (0.0)	
	8+	2 (0.5)	1 (0.6)	0 (0.0)	1 (10.0)	
	Missing	12 (2.9)	4 (2.6)	8 (3.2)	0 (0.0)	
Type of dwelling*	Student residence	418 (52.8)	135 (59.2)	249 (51.9)	34 (40.5)	0.436
	Flat	146 (18.4)	42 (18.4)	88 (18.3)	16 (19.1)	
	House	136 (17.2)	31 (13.6)	90 (18.8)	15 (17.9)	
	Other	56 (7.1)	15 (6.6)	33 (6.9)	8 (9.5)	
	Missing	36 (4.5)	5 (2.2)	20 (4.2)	11 (13.1)	
Number of people in household						0.089
	1 - 2	214 (27.0)	70 (30.7)	130 (27.1)	14 (16.7)	
	3 - 4	260 (32.8)	66 (29.0)	156 (32.5)	38 (45.2)	
	5 - 7	154 (19.4)	44 (19.3)	95 (19.8)	15 (17.8)	
	8+	78 (9.9)	21 (9.2)	52 (10.8)	5 (6.0)	
	Refuse to answer/missing	86 (10.9)	27 (11.8)	47 (9.8)	12 (14.3)	
Average monthly household income (ZAR)*						<0.001
	<3 000	162 (20.5)	50 (21.9)	102 (21.3)	10 (11.9)	
	3 000 - 5 000	66 (8.3)	17 (7.5)	42 (8.8)	7 (8.3)	
	5 001 - 10 000	45 (5.7)	9 (3.9)	33 (6.9)	3 (3.6)	
	10 001 - 30 000	43 (5.4)	18 (7.9)	24 (5.0)	1 (1.2)	
	>30 001	41 (5.2)	10 (4.4)	20 (4.2)	11 (13.1)	
	Do not know	270 (34.1)	68 (29.8)	175 (36.5)	27 (32.1)	
	Refuse to answer/missing	165 (20.8)	56 (24.6)	84 (17.5)	25 (29.8)	
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Table 1. (continued) Demographic characteristics of students enrolled between February and November 2017 (*N*=792)

			University site			
		All	Subsidised 1	Subsidised 2	Private	
Characteristic	Categories	*N*=792, *n* (%)	*n*=228 , *n* (%)	*n*=480, *n* (%)	*n*=84, *n* (%)	*p*-value
Primary income earner in household						0.523
	Participant	20 (2.5)	4 (1.8)	15 (3.1)	1 (1.2)	
	Parent/caregiver	644 (81.3)	189 (82.9)	382 (79.6)	73 (86.9)	
	Other	106 (13.4)	27 (11.8)	73 (15.2)	6 (7.1)	
	Missing	22 (2.8)	8 (3.5)	10 (2.1)	4 (4.8)	
Health insurance type	Private health insurance	256 (32.3)	68 (30.0)	138 (28.8)	50 (59.6)	0.013
	None	461 (58.2)	146 (64.0)	298 (62.1)	17 (20.2)	
	Other	3 (0.4)	0 (0.0)	3 (0.6)	0 (0.0)	
	Refuse to answer/missing	72 (9.1)	14 (6.0)	41 (8.5)	17 (20.2)	
Available assets in household*	Radio	527 (66.5)	154 (67.5)	316 (65.8)	57 (67.9)	0.929
	Television	663 (83.7)	175 (76.8)	41.4 (86.3)	74 (88.1)	0.093
	Cellphone	725 (91.5)	215 (94.3)	432 (90.0)	78 (92.9)	0.243
	Telephone	245 (30.9)	66 (29.0)	131 (27.3)	48 (57.1)	<0.001
	Bed with mattress	721 (91.0)	210 (92.1)	431 (88.8)	80 (95.2)	0.776
	Sofa set	551 (69.6)	149 (65.4)	327 (68.1)	75 (89.3)	0.001
	Table and chairs	621 (78.4)	178 (78.1)	369 (76.9)	74 (88.1)	0.092
	Refrigerator	680 (85.9)	188 (82.5)	414 (86.3)	78 (92.9)	0.131
	Laptop	512 (64.7)	138 (60.5)	300 (62.5)	74 (88.1)	<0.001
Electricity connection*	Own	407 (51.1)	102 (44.7)	248 (51.7)	57 (67.9)	0.029
	Shared	296 (37.4)	100 (43.9)	178 (37.0)	18 (21.4)	
	None	89 (11.2)	26 (11.4)	54 (11.3)	9 (10.7)	
Socioeconomic status	Low	207 (26.1)	72 (31.6)	128 (26.7)	7 (8.3)	<0.001
	Medium	223 (28.2)	57 (25.0)	150 (31.2)	16 (19.1)	
	High	190 (24.0)	49 (21.5)	103 (21.5)	38 (45.2)	
	Missing	172 (21.7)	50 (21.9)	99 (20.6)	23 (27.4)	
Household food security						
In the past four weeks, the participant/household member had to eat a limited variety of foods due to lack of resources†	Yes	252 (31.8)	77 (33.8)	165 (34.4)	10 (11.9)	0.005
	No	503 (63.5)	139 (61.0)	296 (61.7)	68 (81.0)	
	Refuse to answer	37 (4.7)	12 (5.3)	19 (4.0)	6 (7.1)	
In the past four weeks, the participant/household member had to go a whole day and night without eating anything because there was not enough food†	Yes	91 (12.0)	27 (11.8)	62 (12.9)	2 (2.4)	0.265
	No	654 (86.1)	190 (83.3)	395 (82.3)	69 (82.1)	
	Refuse to answer	47 (5.9)	11 (4.8)	23 (4.8)	13 (15.5)	

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Table 1. (continued) Demographic characteristics of students enrolled between February and November 2017 (*N*=792)

			University site			
		All	Subsidised 1	Subsidised 2	Private	
Characteristic	Categories	*N*=792, *n* (%)	*n*=228, *n* (%)	*n*=480, *n* (%)	*n*=84, *n* (%)	*p*-value
HIV and TB						
Ever had an HIV test	Yes	413 (52.1)	112 (49.1)	280 (58.3)	21 (25.0)	<0.001
	In the past 6 months	400 (96.8)	112 (100)	269 (96.1)	19 (90.5)	
	Never tested	242 (30.6)	78 (34.2)	114 (23.8)	50 (59.5)	
	Refused to answer/missing	137 (17.3)	38 (16.7)	86 (17.9)	13 (15.5)	
Times tested for HIV in the last 5 years						0.138
	Once	127 (30.8)	49 (43.8)	67 (23.9)	11 (52.4)	
	2 times	107 (25.9)	26 (23.2)	77 (27.5)	4 (19.1)	
	3 times	60 (14.5)	16 (14.3)	42 (15.0)	2 (9.5)	
	≥4 times	119 (28.8)	21 (18.8)	94 (33.6)	4 (19.1)	
Participant knows their HIV status						0.309
	Yes	555 (70.1)	156 (68.4)	352 (73.3)	47 (56.0)	
	No	177 (22.3)	59 (25.9)	88 (18.3)	30 (35.7)	
	Refuse to answer/Don't know	60 (7.6)	13 (5.7)	40 (8.4)	7 (8.3)	
HIV status	Positive	24 (3.0)	7 (3.0)	13 (2.7)	4 (4.9)	0.037
	On ART	15 (62.5)	4 (57.1)	10 (76.9)	1 (25.0)	
	Negative	559 (70.6)	153 (67.1)	355 (74.0)	51 (63.0)	
	Don't know	153 (19.3)	50 (21.9)	79 (16.4)	24 (29.6)	
	Refuse to answer/missing	56 (7.1)	18 (8.0)	33 (6.9)	2 (2.5)	
Screened for TB in the past 6 months						0.964
	No	644 (81.3)	190 (83.3)	385 (80.2)	69 (82.1)	
	Yes	112 (14.1)	29 (12.7)	72 (15.0)	11 (13.1)	
	Refuse to answer	14 (1.8	5 (2.2)	9 (1.8)	0 (0.0)	
	Don't know/missing	22 (2.8)	4 (1.8)	14 (2.9)	4 (4.8)	
Outcomes						
TB knowledge	Low (poor)	438 (55.3)	90 (39.5)	288 (60.0)	60 (71.4)	<0.001
	High	354 (44.7)	138 (60.5)	192 (40.0)	24 (28.6)	
TB risk perception	High	344 (43.4)	111 (48.7)	206 (42.9)	27 (32.1)	0.031
	Low	448 (56.6)	117 (51.3)	274 (27.1)	57 (67.9)	
HIV knowledge	Low (poor)	412 (52.1)	91 (39.9)	272 (56.7)	49 (58.3)	<0.001
	High	380 (47.9)	137 (60.1)	212 (43.3)	35 (41.7)	
HIV risk perception	High	315 (39.8)	78 (34.2)	216 (45.0)	21 (25.0)	<0.001
	Low	477 (60.2)	150 (65.8)	264 (55.0)	63 (75.0)	

*These variables were combined into a wealth index using weights derived through principal component analysis (PCA) and divided into three categories (i.e. low, medium and high) representing proxies for socioeconomic status.

Table 2. Summary of the internal consistency and completeness of questionnaire data

Questionnaire data	Items	Cronbach's alpha	Missing (per item),* median (IQR); min. - max.
TB knowledge	36	0.77	10 (7 - 15); 0 - 30
HIV knowledge	42	0.74	9.5 (8-13); 0 - 44
TB risk perception	10	0.50	18 (15-26); 11 - 96
HIV risk perception	20	0.60	26 (17-35); 11 - 69

IQR= interquartile range, TB = tuberculosis.
*Only includes where responses were missing (i.e. question was not answered). Missing or 'Refused to answer' responses were not included in the data coding whereas 'Don't know' was regarded as a negative response to the statement, scored accordingly and included in the total score calculated.

together with a lot of people in a crowded place so could get TB.' which had the highest non-response rate (12%, *n*=96).

Based on our definition, 55.3% (*n*=438) and 52.1% (*n*=412) were categorised as having poor TB or HIV knowledge while 43.4% (*n*=344) and 39.8% (*n*=315) were categorised as having high TB or HIV risk perception. Compared with participants registered at the two government-subsidised universities, those registered at the private university (*n*=84) had poorer knowledge of TB and HIV and perceived their risk of acquiring TB or HIV as low ($p<0.05$).

Compared with female participants, male students were more likely to have poor knowledge of HIV (relative risk (RR) 1.21, 95% confidence interval (CI) 1.04-1.46) and perceive themselves at risk of acquiring HIV (RR 1.63, 95% CI 1.25 - 2.12) (Table 3). Compared with those with a high SES, individuals with a low SES perceived themselves at risk of acquiring HIV (high v. low SES RR 0.67, 95% CI 0.46 - 0.98; $p<0.05$). Other factors, such as no health insurance, tuition paid by loans or scholarships, or not living with spouse/partner/parent, supported this finding ($p<0.05$ in the univariate) and contributed to a high TB and HIV risk perception (Tables 3 and 4).

HIV and TB health-seeking behaviour

One in 3 students (*n*=242; 30.6%) reported that they had never had an HIV test, and this figure was significantly higher (59.5%) among students attending the private university. Of the students who reported knowing their HIV status (*n*=555), 44% reported that they had never had an HIV test, which suggests that many students assume their status despite having never been tested, perhaps because they had not been sexually active or considered themselves at low risk.[7] Among those who had had an HIV test (*n*=413; 52.1%), the majority had been tested in the previous 6 months and, for a third (*n*=127; 30.8%) of them, this was the only test reported within the last 5 years, possibly as a result of active participation in HIV wellness days arranged by the universities. In total, 24 participants (9 male and 15 female) reported that they were HIV-positive and, of these, 15 (62.5%) were on antiretroviral therapy. Less than 15% of students enrolled (14.1%) had been screened for TB in the past 6 months. HIV testing and TB screening behaviour was similar among male and female participants ($p>0.05$).

Discussion

Compared with adults, young people generally lack sufficient knowledge about HIV and are less likely to be tested.[9] We show that, compared with females, males have a poorer knowledge of TB (62.5% v. 49.3%) and HIV (56.8% v. 47.0%), which is contradictory to other reports[25,26] but might be because adolescent women are more likely to engage in healthcare services (i.e. contraceptive services or antenatal care, which serve as potential sources of information) in our setting. The present study shows that low SES was associated with a high-risk perception of HIV. The disproportionate burden of HIV disease and HIV fear among the poor and vulnerable in South Africa has been described.[27] Those with a poor SES report lower frequency of HIV testing, poorer access to HIV information, more stigmatising attitude towards HIV, and high personal HIV risk perception.[27] Exposure to social media and interpersonal communication may be responsible for the lower HIV risk perception observed among those with a high SES. That many of the students had access to radio, television and computers/laptops, in particular those attending the private university, may explain this finding. Furthermore, gender differences seem to exist in perceptions of the risk of acquiring HIV, with males having a higher risk perception than females.

Results from the present study show that the prevalence of HIV among university students in Johannesburg, who reported their HIV status, was slightly lower than what has been reported nationally among young adults (15 - 24 years) (4.1% v. 4.6%).[28] As only 63.1% of those who responded admitted to ever having an HIV test, this number is likely to be an underestimate of HIV prevalence in this population. Less than 15% of participants had been screened for TB in the past 6 months. Because of high rates of TB/HIV co-infection, TB screening and services could serve as the entry point for HIV testing or facilitate the link to HIV counselling and testing (HCT), as a gateway to treatment and prevention services.

Adolescents and young adults are at increased risk for HIV and are the one group worldwide where reduction in new HIV cases or HIV-related mortality has not been observed.[29] Because adolescents are at high risk for both acquiring and transmitting HIV, they should be considered a priority in the development of HIV, TB and STI prevention strategies.[29] Addressing the health needs of this unique population is critical in order to achieve the UNAIDS 90:90:90 targets.[30] In particular, strategies to improve HCT as an entry point into the treatment and prevention cascade, including prevention, clinical management and psychosocial support, will be important.[5,29] Two core groups should be considered when developing or testing new technologies or interventions for this group: HIV-negatives with a focus on prevention and the reduction of new infections, and HIV-positives with a focus on testing, treatment and ultimately viral load suppression.

Study limitations

The results of this study should be considered in the light of the study limitations. Firstly, we included 3 out of more than 30 universities across SA, which may limit the generalisability of the study findings. To minimise selection bias, we included 1 private and 2 of the biggest public universities in SA – one a traditional university which offers theoretically oriented degrees and the other a comprehensive university which offers both theoretically oriented and vocationally oriented diplomas and degrees. Secondly, we only enrolled students available during study visits to the campus, which limited our ability to enrol part-time students, those attending night classes and those registered for distance education. Thirdly, Cronbach's alpha, which is considered to be a measure of scale reliability or strength of consistency was low for TB risk perception (0.50), so the results should be interpreted with caution. The use of Likert scales may introduce bias which may include central tendency bias (where participants avoid using extreme response categories), acquiescence

Table 3. Factors associated with poor TB knowledge (*n*=438) and high TB risk perception (*n*=344) among university students enrolled between February and November 2017

	Poor TB knowledge (*n*=438)			High TB risk perception (*n*=344)		
Variable	***n/N (n (%))* with outcome**	**Crude IRR (95% CI)**	**Adjusted IRR (95% CI)**	***n/N (n (%))* with outcome**	**Crude IRR (95% CI)**	**Adjusted IRR (95% CI)**
Age group						
<19	133/254 (52.3)	1		106/254 (41.7)	1	
≥19	281/521 (56.4)	1.07 (0.88 - 1.32)		232/521 (44.5)	1.07 (0.85 - 1.34)	
Gender						
Female	214/434 (49.3)	1	1	191/434 (44.0)	1	1
Male	220/352 (62.5)	**1.27 (1.05 - 1.53)**	1.22 (0.95 - 1.55)	152/352 (43.2)	0.98 (0.79 - 1.21)	0.97 (0.76 - 1.24)
Nationality						
Non - South African	76/120 (63.3)	1		46/120 (38.3)	1	
South African	317/584 (54.3)	0.86 (0.67 - 1.10)		257/584 (44.0)	1.15 (0.84 - 1.57)	
Race						
Black	397/722 (55.0)	1		323/722 (44.7)	1	
Other	40/69 (58.0)	1.10 (0.76 - 1.46)		21/69 (30.4)	0.68 (0.44 - 1.06)	
Prior TB knowledge						
No	384/670 (57.3)	1	1	289/670 (43.1)	1	
Yes	44/110 (40.0)	**0.70 (0.51 - 0.95)**	0.75 (0.55 - 1.03)	52/110 (47.3)	1.10 (0.82 - 1.47)	
Registered at						
Private university	59/83 (71.1)	1	1	27/83 (32.5)	1	
Subsidised university	216/441 (46.9)	**0.68 (0.52 - 0.92)**	0.30 (0.57 - 1.18)	203/441 (46.0)	1.42 (0.95 - 2.11)	
Completed high school						
Private high school	101/147 (68.7)	1	1	53/147 (36.1)	1	
Public high school	308/589 (50.3)	**0.76 (0.61 - 0.95)**	0.82 (0.60 - 1.01)	269/589 (45.7)	1.27 (0.94 - 1.70)	
Faculty						
Business, Economics and Finance	94/147 (64.0)	1		63/147 (42.8)	1	
Education	46/104 (44.2)	**0.69 (0.44 - 0.92)**		60/104 (57.7)	1.35 (0.95 - 1.92)	
Engineering and Built Environment	27/66 (40.9)	**0.64 (0.40 - 0.96)**		25/66 (37.8)	0.88 (0.56 - 1.40)	
Health Sciences	18/43 (39.5)	0.65 (0.37 - 1.05)		14/43 (32.6)	0.76 (0.43 - 1.36)	
Humanities and Social Sciences	57/100 (57.0)	0.89 (0.61 - 1.19)		36/100 (36.0)	0.84 (0.56 - 1.27)	
Information Technology	11/21 (52.4)	0.81 (0.44 - 1.55)		12/21 (57.1)	1.33 (0.72 - 2.47)	
Law and Management	101/163 (61.9)	0.97 (0.72 - 1.26)		68/163 (41.7)	0.97 (0.69 - 1.37)	
Other (e.g. bridging or gap year)	15/16 (93.8)	1.47 (0.86 - 2.56)		4/16 (25.0)	0.58 (0.21 - 1.60)	
Sciences	19/43 (44.2)	0.69 (0.37 - 1.05)		23/43 (53.5)	1.25 (0.77 - 2.01)	
Tuition paid by						
Parents	208/319 (65.2)	1	1	110/319 (34.5)	1	1
Other	230/473 (48.6)	**0.74 (0.62 - 0.89)**	0.82 (0.67 - 1.03)	234/473 (49.5)	**1.43 (1.14 - 1.80)**	1.32 (0.98 - 1.75)
Living with partner/spouse/parent						
Yes	228/382 (59.7)	1		163/382 (42.7)	1	
No or unknown	199/392 (50.8)	0.85 (0.70 - 1.03)		173/392 (44.1)	1.03 (0.84 - 1.28)	

...continued

Table 3. (continued) Factors associated with poor TB knowledge (n=438) and high TB risk perception (n=344) among university students enrolled between February and November 2017

Variable	Poor TB knowledge (n=438) *n/N* (*n* (%)) with outcome	Crude IRR (95% CI)	Adjusted IRR (95% CI)	High TB risk perception (n=344) *n/N* (*n* (%)) with outcome	Crude IRR (95% CI)	Adjusted IRR (95% CI)
Share a sleeping room with other people						
Yes	200/414 (48.3)	1	1	195/414 (47.1)	1	
No or unknown	204/352 (61.6)	**1.30 (1.04 - 1.62)**	1.12 (0.89 - 1.40)	139/352 (39.5)	0.84 (0.67 - 1.04)	
Health insurance						
Private health insurance	147/256 (55.6)	1		86/256 (33.6)	1	1
None	247/464 (53.2)	0.90 (0.76 - 1.13)		228/464 (49.1)	**1.46 (1.14 - 1.87)**	1.20 (0.84 - 1.69)
Socioeconomic status						
Low	104/207 (50.2)	1		96/207 (46.4)	1	1
Medium	115/223 (51.6)	1.02 (0.79 - 1.34)		108/223 (48.4)	1.04 (0.79 - 1.37)	1.07 (0.81 - 1.41)
High	105/190 (55.3)	1.1 (0.84 - 1.45)		61/190 (32.1)	**0.69 (0.50 - 0.95)**	0.94 (0.64 - 1.38)
Screened for TB in the past 6 months						
No or unknown	352/644 (54.7)	1		286/658 (43.5)	1	
Yes	60/112 (53.6)	0.98 (0.75 - 1.28)		51/112 (45.5)	1.05 (0.78 - 1.41)	
Ever had an HIV test						
Yes	223/413 (54.1)	1		185/413 (44.8)	1	
Never	136/242 (56.2)	1.04 (0.84 - 1.12)		89/242 (36.8)	0.82 (0.64 - 1.06)	
Refused to answer/missing	79/137 (57.6)	1.07 (0.83 - 1.16)		70/137 (51.1)	1.14 (0.87 - 1.50)	

IRR = incidence rate ratio; CI = confidence interval. Bold = p<0.05.

bias (where participants agree with the statement presented) or social desirability bias – presenting themselves in the best possible light. The questionnaires that were used contained an equal number of positive and negative statements ,which helped to alleviate the problem of acquiescence. However, central tendency and social desirability were more difficult to overcome. The questionnaire was also self-administered by participants, which minimised the introduction of interviewer bias but in some instances might have resulted in more missing data. Missing data also compromised the ability to calculate the PCA and derive SES for 21.7% of the participants. For almost half of the participants, the SES was that of the student whereas for others (those living with parents/guardians) the SES reflects that of their parents/guardians. Lastly, there was subjective reporting of participant data of TB/HIV testing and test results, which only relied on participants' recall ability.

Conclusion

Adolescents and young adults leaving high school and entering tertiary education not only lack sufficient knowledge, but also perceive themselves at risk of acquiring HIV and/or TB. Knowledge and risk perception differ by gender and SES, where males and those with low SES had poorer knowledge of HIV and perceived themselves at risk of acquiring HIV. Participants attending two public universities had poorer knowledge and higher risk perception than those at a private university. Despite organised wellness days for HCT and access to healthcare services on campus, many participants did not know their HIV status and had never been tested for HIV. The present study, while demonstrating gaps in knowledge about TB and HIV, highlights the need to enhance health promotion activities among university students and provide additional support to improve testing behaviour. The university campus offers an opportunity to intervene and perhaps change the way that we reach and engage adolescent men in HCT.

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Table 4. Factors associated with poor HIV knowledge (*n*=412) and high HIV risk perception (*n*=315) among university students enrolled between February and November 2017

	Poor HIV knowledge (*n*=412)			High HIV risk perception (*n*=315)		
Variable	***n/N (n ()* with outcome**	**Crude IRR (95% CI)**	**Adjusted IRR (95% CI)**	***n/N (n ()* with outcome**	**Crude IRR (95% CI)**	**Adjusted IRR (95% CI)**
Age group						
<19	133/254 (52.4)	1		85/254 (33.5)	1	1
≥19	267/521 (50.9)	0.98 (0.79 - 1.21)		224/521 (42.9)	**1.28 (1.00 - 1.65)**	1.10 (0.82 - 1.47)
Gender						
Female	204/434 (47.0)	1	1	131/434 (30.2)	1	1
Male	206/352 (56.8)	**1.25 (1.02 - 1.51)**	**1.21 (1.04 - 1.46)**	182/352 (51.7)	**1.71 (1.37 - 2.14)**	**1.63 (1.25 - 2.12)**
Nationality						
Non - South African	67/120 (55.8)	1		46/120 (38.3)	1	
South African	294/584 (49.1)	0.90 (0.69 - 1.17)		238/584 (40.8)	1.06 (0.78 - 1.46)	
Race						
Black	377/722 (52.2)	1		299/722 (41.4)	1	1
Other	34/69 (49.3)	0.94 (0.66 - 1.34)		16/69 (23.2)	**0.56 (0.34 - 0.93)**	0.78 (0.42 - 1.47)
Prior HIV knowledge						
No	276/533 (51.8)	1		212/533 (39.8)	1	
Yes	126/247 (51.0)	0.99 (0.75 - 1.16)		100/247 (40.5)	1.02 (0.80 - 1.29)	
Registered at						
Private university	48/83 (57.8)	1	1	21/83 (25.3)	1	
Subsidised university	190/441 (43.1)	0.74 (0.54 - 1.02)	0.82 (0.56 - 1.24)	164/441 (37.2)	1.47 (0.93 - 2.31)	
Completed high school						
Private high school	77/147 (54.4)	1		42/147 (28.6)	1	1
Public high school	304/589 (51.6)	0.98 (0.77 - 1.27)		254/589 (43.1)	**1.51 (1.09 - 2.09)**	1.13 (0.75 - 1.70)
Faculty						
Business, Economics and Finance	89/147 (60.5)	1	1	63/147 (41.9)	1	
Education	43/104 (41.4)	**0.68 (0.47 - 0.98)**	0.99 (0.60 - 1.64)	34/104 (32.7)	0.76 (0.50 - 1.16)	
Engineering and Built Environment	19/66 (28.8)	**0.47 (0.28 - 0.78)**	**0.56 (0.28 - 0.77)**	27/66 (40.9)	0.95 (0.61 - 1.50)	
Health Sciences	22/43 (51.2)	0.85 (0.47 - 1.25)	1.09 (0.61 - 1.92)	10/43 (23.3)	0.54 (0.28 - 1.06)	
Humanities and Social Sciences	52/100 (52.0)	0.78 (0.62 - 1.23)	1.14 (0.71 - 1.83)	35/100 (35.0)	0.82 (0.54 - 1.23)	
Information Technology	10/21 (42.9)	0.96 (0.36 - 1.41)	0.89 (0.37 - 2.16)	12/21 (57.1)	1.33 (0.72 - 2.47)	
Law and management	95/163 (58.6)	0.92 (0.70 - 1.26)	1.04 (0.59 - 1.61)	66/163 (40.1)	0.94 (0.67 - 1.33)	
Other (e.g. bridging or gap year)	9/16 (56.3)	0.92 (0.54 - 1.98)	1.09 (0.58 - 2.77)	4/16 (25.0)	0.58 (0.21 - 1.60)	
Sciences	20/43 (46.5)	0.76 (0.42 - 1.15)	0.97 (0.47 - 1.62)	19/43 (44.2)	1.03 (0.62 - 1.72)	
Tuition paid by						
Parents	181/319 (56.7)	1	1	115/319 (36.1)	1	
Other	231/473 (48.8)	**0.86 (0.67 - 0.99)**	1.11 (0.82 - 1.51)	200/473 (42.3)	1.17 (0.93 - 1.48)	
Living with partner/spouse/parent						
Yes	208/382 (54.5)	1		128/382 (33.5)	1	1
No or unknown	193/392 (49.2)	0.90 (0.74 - 1.10)		179/392 (45.7)	**1.36 (1.09 - 1.71)**	1.15 (0.88 - 1.52)

...continued

Table 4. (continued) Factors associated with poor HIV knowledge (n=412) and high HIV risk perception (n=315) among university students enrolled between February and November 2017

Variable	Poor HIV knowledge (n=412)			High HIV risk perception (n=315)		
	n/N (n ()) with outcome	Crude IRR (95% CI)	Adjusted IRR (95% CI)	n/N (n ()) with outcome	Crude IRR (95% CI)	Adjusted IRR (95% CI)
Share a sleeping room with other people						
Yes	206/414 (49.8)	1		175/414 (42.3)	1	
No or unknown	170/331 (51.4)	1.03 (0.84 - 1.29)		132/352 (37.5)	0.89 (0.71 - 1.11)	
Health insurance						
Private health insurance	118/256 (46.1)	1		79/256 (30.9)	1	1
Other	252/464 (54.2)	1.20 (0.95 - 1.46)		214/464 (46.2)	**1.50 (1.16 - 1.94)**	1.09 (0.77 - 1.54)
Socioeconomic status						
Low	104/207 (50.2)	1		104/207 (50.2)	1	1
Medium	110/223 (49.3)	0.98 (0.75 - 1.28)		89/223 (39.9)	0.79 (0.60 - 1.05)	0.89 (0.66 - 1.20)
High	86/190 (45.3)	0.90 (0.67 - 1.19)		59/190 (31.1)	**0.62 (0.45 - 0.85)**	**0.67 (0.46 - 0.98)**
Ever had an HIV test						
Yes in the past 6 months	206/413 (49.9)	1	1	169/413 (40.9)	1	
Never tested	117/242 (48.4)	0.96 (0.77 - 1.21)	1.08 (0.79 - 1.48)	96/242 (39.7)	0.97 (0.75 - 1.25)	
Refused to answer/missing	89/137 (64.9)	1.30 (0.98 - 1.63)	1.24 (0.84 - 1.83)	50/137 (36.5)	0.89 (0.65 - 1.22)	

IRR = incidence rate ratio; CI = confidence interval.
Bold = p<0.05.

project administration and study implementation while DE, NM and CN undertook data management. SA, CL and NM were involved in developing data collection tools, data collection and verification. EL and DE were the supervisor and co-supervisor of SD's Master of Medicine research project (CL and SA). DE, NM, CN and PN were involved in data analysis and interpretation of data. LL, EL, JB and PN were involved in interpretation of the results and contributed to the Discussion and Limitations sections. DE drafted the first manuscript and all authors were involved in editing, revising and critically reviewing it for important intellectual content and final approval of the manuscript. LL provided resources and funding for the project.

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