

# Awareness, utilization of HIV testing and counselling services and sero-status among commercial motorcyclists in Dar es Salaam, Tanzania

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## Research article

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## Abstract

**Background:** In recent years, there has been an emergence of commercial motorcyclists in all parts of Tanzania known as boda-boda riders (BBRs); and these are mainly young active males. BBRs are potentially likely to share a set of high-risk behaviours for transmission of HIV. These include multiple sex partners, alcohol and drug abuse, low condom use, and limited knowledge of HIV. This study assessed the awareness, utilization of HIV testing and counselling (HTC) services and sero-status of HIV among BBRs in Dar es Salaam, Tanzania.

**Methods:** A cross-sectional study was conducted in August 2016 in three districts (Ilala, Kinondoni and Temeke) of Dar es Salaam, Tanzania; 1) to collect quantitative data on knowledge, attitude and practise of BBRs toward HIV infections (behavioural survey); and 2) to determine HIV prevalence among BBRs through HTC (sero-survey). Data was collected electronically using android tablets through the open data kit platform hosted at the central server.

**Results:** In the behavioural survey, 973 BBRs (aged 18 - 59 years) were interviewed; majority (77.7%) were <35 years old and 52.2% were married. Over 93% of BBRs reported that HIV is a major public health problem in Tanzania and 89.7% thought that they were at high risk of acquiring HIV. More than 95% knew that HIV mainly is transmitted through unprotected sex and it can be prevented through use of condoms. However, 99.0% of BBRs had one or more sexual partners, only 37.4% used condoms with their regular extra-marital partners. For the sero-survey, 523 (53.8%) BBRs were tested and only 13 (2.5%) were positive, with a significantly higher prevalence among those aged 35-59 years. The risk of HIV infections was significantly lower among married BBRs (OR=0.2; 95%CI: 0.1-0.9, p=0.041) and those who had regular sexual partners (OR=0.2; 95%CI: 0.1-0.9, p=0.028). However, the risk was significantly higher among BBRs who were taking alcohol (OR=4.5; 95%CI: 1.1-18.6, p=0.037).

**Conclusion:** Despite high knowledge of HIV among BBRs, they were still at high risk of acquiring HIV due to risky behaviours such as relationships with multiple sexual partners, low use of condoms and taking alcohol.

## Background

Globally, human immunodeficiency virus (HIV) remains the leading cause of deaths, with 37.9 million people already infected with the virus by 2018 [1, 2]. Approximately 40% of the new HIV infections occur in groups of active young people aged 15–24 years [3]. On average, the prevalence of HIV among adults between 15–49 years of age in Sub-Saharan Africa (SSA) was 3.9% in 2020 [4]. Earlier studies showed that adolescents and youths are at higher risk of HIV and other sexually transmitted infections (STIs) due to immature biology, highly sexual active nature, barrier to quality preventive services and contextual factors (such as poverty and economic activities) [5]. According to the Tanzania HIV Impact survey (THIS) of 2016/17, HIV prevalence among adults (aged 15–49) was 4.7% with approximately 1.4 million people living with HIV (PLHIV) [6]. However, in 2018 the estimated prevalence of HIV in Tanzania was 4.6% in adults aged 15–49 while PLHIV were 1.6 million [7].

Tanzania has implemented different HIV preventive and control measures which pragmatically aimed at reducing the spread of infection among the community. These include establishing community-based outreach, HIV testing and counseling (HTC) centres, link to treatment and care clinic (CTC), promoting condoms use, safe blood transfusion, medical male circumcision, introduction of prevention of mother to child transmission (PMTCT) of HIV and drug addiction treatment houses [8]. The Tanzanian ministry of health reported that, of all 6,109 regional and district facilities that submitted self-reported data in 2017, 26% reported that they were offering Antiretroviral therapy (ART) and other services to PLHIV and the general public through CTCs [9].

The recently emerged commercial motorcycle business in Tanzania and other countries uses cyclists known as boda-boda riders (BBRs) who are very popular throughout the country, and provide quick transport services in both rural and urban areas. Most of these are young active men who are more likely to share a set of high-risk behaviours to HIV infections, including multiple sex partners, low condom use and illicit drug use [10]. BBRs are also believed to have low levels of knowledge about HIV and other STIs, personal negligence or carelessness and negative attitudes towards condom use for sex which is partly culturally rooted [11, 12]. A study conducted in Uganda reported low condom use (33%) and HIV prevalence of 7.5% among BBRs, with even higher prevalence (10.9%) among BBRs aged  $\geq$  25 years compared to below 25 years of age (3%) [13].

There is anecdotal evidence showing that HIV pandemic is still a major health problem and may have a significant impact on the newly emerged risk population of BBRs in Tanzania. This is supported by the fact that majority of the BBRs are male adolescents and youths (aged between 18 and 35 years) with potential risk behaviours that might make them vulnerable to contracting HIV [13]. These risky behaviours could be attributed to low knowledge of HIV and other STIs, personal attitudes towards use of condoms (such as social stigma about condom use) and low utilization of HIV treatment and care services. However, there is paucity of empirical data from systematic studies on the magnitude of the HIV burden among BBRs, and their knowledge, attitudes and practises toward HIV prevention and control measures. In order to fill this gap, this study assessed the awareness, utilization of HIV testing and counselling (HTC) services and sero-status of HIV among BBRs in Dar es Salaam, Tanzania.

## Methods

### Study area.

This study was conducted in August 2016 in three districts (covering both peri-urban and urban areas) of Dar es Salaam region, namely Ilala, Kinondoni and Temeke districts. Dar es Salaam region was purposively selected due to large number of BBRs compared to other regions [14]. According to the 2012 Census, Dares Salaam had a population of 4,364,541 [15]. It is the most industrialized region and the largest commercial centre in the country; with HIV prevalence of 4.7% in 2016/17 [6]. Administratively, the Region was divided into three districts of Ilala, Kinondoni and Temeke but it has recently been further divided making a total of five districts, namely Ilala, Kigamboni, Kinondoni, Temeke and Ubungu. For the purpose of this study, the old administrative districts (Ilala, Kinondoni and Temeke) were retained.

## Study Design

This was a cross-sectional survey that utilized a mixture of formative and intervention approaches. The formative phase involved an exploratory survey to establish level of the knowledge, attitudes and practices (KAP) towards HIV infections among BBRs. In addition, there was a BBRs' sero-survey aimed to establish the prevalence within the HTC framework and risk factors of HIV in this group.

### Training of study team

A five days training of research assistants was conducted prior to initiation of the study. During the training, orientation on study protocol, good clinical practice (GCP), and good clinical laboratory practice (GCLP) and data collection tools was done. Thereafter, pre-testing and pilot survey of the data collection tools in a set-up similar to the selected study site was conducted. Pre-testing and pilot survey helped to refine the data collection tools based on experience gained.

### Screening of targeted study population

This study involved adult BBRs aged 18 to 59 years who were doing their commercial activities in Ilala, Kinondoni and Temeke districts. The study was introduced to them and they were voluntarily asked for oral and written consent to take part in the study. BBRs meeting the inclusion criteria were assigned unique identification numbers (IDs) for this study.

### Data collection

The tools for data collection were developed based on the study's theoretical framework, literature review and pre-tested in a comparable BBRs population in Tanga City. A structured questionnaire was originally developed in English and translated in Kiswahili and then translated back in English by a language expert to ensure consistency before use. The questionnaire was developed on an Open Data Kit (ODK) software running on android tablets which were connected via internet to the server based at the National Institute for Medical Research Headquarters in Dar es Salaam. Demographic information such as age, marital status, and place of residence were collected and other information including KAP of BBRs towards prevention of HIV infections. In order to collect information about sexual partners, respondents were asked to provide a report of their sexual relationships. A regular sexual partner was defined as a well-known and permanent sexual partner for unmarried BBRs and an extramarital partner for married BBRs. A casual sexual partners was defined as a partner whom the BBRs had one or more sexual encounters without serious commitment and not well-known to one's peers. Relationship with commercial sex workers was defined as an encounter between a BBRs and a woman whereby payments were made for the sexual event.

Respondents were also asked to participate in the sero-survey which involved HTC to determine the prevalence and risk factors of getting HIV infection. Individual pre-test counselling sessions were done to each participant prior to HIV testing. Personal data such as age, marital status, education levels, district of business, using alcohol and/or drugs and relationships with regular, casual or commercial sexual partners, were used to determine the association between these factors and HIV prevalence, and to assess the risk factors for HIV infection among BBRs.

### Sampling technique and Sample size

The study included BBRs from the three districts of Ilala, Kinondoni and Temeke. Probability proportional to size (PPS) technique based on the number of registered BBRs was used to determine randomly the proportional sample of study participants to be included in each component of the study.

The sample size was based on the objective of determining the prevalence of HIV among BBRs which was an unknown population parameter. To estimate the sample size required, using the formula explained by Lemeshow et al. [16], we assumed an estimated  $p$  within  $d$  percentage points and 95% confidence. This study was conducted in three districts and targeted population of BBRs in Dar es Salaam but their number is not clearly known. By 2012 there were registered 1334 motorcycles in Ilala, 1735 in Kinondoni and 1363 in Temeke. Assuming that there is no significant difference on the prevalence of HIV in these districts, the prevalence rates of adult male aged 15-49 years in Dar es Salaam of 5.3% according the Tanzania HIV and Malaria Indicator Survey of 2013 (THMIS) [17] was used. The required sample size was calculated such that the prevalence of HIV can be estimated within 2% of the true general population prevalence of men with 95% confidence. Assuming response rate of 90% among BBRs and an HIV test response rate of 80%, the overall response rate was estimated as  $r = 0.9 \times 0.8 = 0.72$  and the design effect was 1. The desired sample size for estimating prevalence ( $p$ ), taking into account the design effect and the response rate, then the minimum sample size was estimated to be 670, with an addition of 28% of non-response, the required sample size was adjusted to 857 BBRs. However, the sample size of 973 BBRs was used, based on the proportions of registered commercial motorcycles (as mentioned above): 316 from Ilala, 319 in Kinondoni and 338 from Temeke. Furthermore, at least 50% of all BBRs were randomly selected from the three districts to participate in the sero-survey (Ilala = 194, Kinondon = 175 and Temeke = 154)

Before recruitment of BBRs, Information on purpose, benefit and procedure for conducting the study was discussed with regional administrative secretary (RAS) and regional medical officer (RMO). Then, the research team was directed to report to the district executive directors (DEDs) of the three districts to meet with officials responsible for health. After consultation with the district medical officers (DMOs), the team then proceeded to meet with the HIV coordinators in order to start the study activities.

### Sample collection and HIV testing

A blood sample was collected by finger prick for HIV testing using the Tanzanian national HIV testing algorithm [18]. Participants were first screened using the SD Bioline rapid test, briefly, a finger prick blood (20 $\mu$ l) was taken using a capillary pipette and the blood was put into a sample pad. Four drops of assay diluent were then added, the test results were read after 20 minutes. For positive test results, a second rapid test (Uni - Gold™) was used to confirm the results.

Briefly, finger prick blood was taken using a disposable pipette; two drops of blood were dispensed into a sample pad. Then two drops of wash solution were added and left for 10 minutes to read the results.

## Data Management and Analysis

The data were collected electronically using the android tablets ODK software through the central server hosted at NIMR headquarters. To ensure consistency and minimize data entry errors, the database was prepared with filters (such as age range, gender etc.) to restrict entry of incorrect or out of range data. Proportions between groups were compared using  $\chi^2$ -test. Univariate, bivariate and multilevel analysis were done to estimate adjusted odds ratios (OR) and 95% confidence intervals (CI) for associations between HIV and other variables of interest. Univariate analysis was used in exploratory and descriptive analysis of the data, while multivariate analysis was done to assess the relationship between two or more covariates, such as age groups and risk of HIV infections. Multilevel analysis was used to determine the magnitude of the risk between the dependent variable (such as HIV status) against multiple independent variables (such as socio-demographic variables) while controlling for confounding variables which were identified during exploratory analysis. For multivariate analysis, variables were retained using backward stepwise regression if they were statistically significant at the level of  $P < 0.2$  or if the coefficients of regression of the other variables in the same computation was substantially changed by their inclusion in the model. Because the prevalence of HIV in this study was very low (rare), the Penalized Maximum Likelihood Estimation (PMLE) proposed by firth [19] was adopted. PMLEs seemed to be unbiased even in cases with small sample size and very few events when using logistic regression. Therefore firth logistic regression model was substantially proposed to be used to get odds ratios. P-value was considered significant when it was  $< 0.05$ .

## Results

### Baseline characteristics

The study included 973 BBRs with mean age of 29.3 (SD=7.9) years (ranged from 18 to 59 years) and the mean age was not statistically significance among BBRs from the three districts. Majority of participants (77.7%) were below 35 years of age and 52.2% were married. Most of the BBRs (69.2%) had primary education while 2.3% had no formal education. When categorized based on their area of business, 60.3% of the BBRs were from peri-urban areas of the Dar es Salaam city (Table 1).

**Table 1: Demographic characteristics of BBRs recruited in the three districts of Ilala, Kinondoni and Temeke)**

Variable	Ilala n=316 (32.5%)	Kinondoni n=319 (32.8%)	Temeke n=338 (34.7%)	P-value
<b>Age – mean (SD)</b> 29.3 (7.9)	30.8 (8.5)	27.7 (7.4)	29.4 (7.7)	0.607
<b>Age group, n (%)</b>				<0.00.1
18 – 34 years, n=756 (77.7)	218 (69.0)	274 (85.9)	266 (78.7)	
35 – 59years, n=217, (22.3)	98 (31.0)	45 (14.1)	72 (21.3)	
<b>Marital status, n (%)</b>				<0.001
Single, n=432 (44.4)	122 (38.6)	174 (54.5)	136 (40.2)	
Married, n=508 (52.2)	181 (57.3)	136 (42.6)	191 (56.5)	
Divorced, n=33 (3.4)	13 (4.1)	9 (2.9)	11 (3.3)	
<b>Education level, n (%)</b>				0.881
No formal education, n=23 (2.3)	7 (2.2)	9 (2.8)	7 (2.1)	
Primary education, n=673 (69.2)	221 (69.9)	214 (67.1)	238 (70.4)	
Secondary education, n=277 (28.5)	88 (27.9)	96 (30.1)	93 (27.5)	
<b>Business location, n (%)</b>				0.193
Peri-urban, n=587 (60.3)	203 (64.2)	183 (57.4)	201 (59.5)	
Urban, n=386 (39.7)	113 (35.8)	136 (42.6)	137 (40.5)	

### Knowledge and perceived risk of HIV transmission

Table 2 shows knowledge of HIV infections among BBRs in Dar es Salaam region. Out of the 973 BBRs, 909 (93.4%) reported that HIV is a major health problem in Tanzania and 873 (89.7%) admitted that they were at high risk of acquiring HIV infections. Figures; 1 A, B and C show responses of BBRs regarding their perceived risk, transmission and preventive measures of HIV. Majority of BBRs (71.4%) reported that commercial sex workers were at higher risk of getting HIV infections; while other groups including barmaids, homosexual men and drug abusers were also at high risk (figure 1 A). Majority (>95%) of the BBRs reported that sexual intercourse is the major means of HIV transmission (figure 1 B). The main means of HIV prevention known to BBRs was condom use while the least known means of HIV prevention was PMCT through safe delivery (figure 1 C).

**Table 2: Knowledge of BBRs on HIV infections by districts (n 973)**

Variable	Ilala, n= 316 (25.5%)	Kinondoni, n= 319 (32.8%)	Temeke, n= 338 (34.7%)	$\chi^2$ P-value
<b>HIV in Tanzania n (%)</b>				
Major problem, <b>909 (93.4)</b>	295 (93.5)	290 (90.8)	324 (95.8)	0.015
Not a major problem, <b>64 (6.6)</b>	21 (6.5)	29 (9.2)	14 (4.2)	
<b>BBRs are at high risk of HIV infections</b>				
Yes, <b>873 (89.7)</b>	287 (90.8)	281 (88.2)	305 (90.1)	0.545
No, <b>100 (10.3)</b>	29 (9.2)	38 (11.8)	33 (9.9)	

**Attitude and practice towards HIV infections among BBRs**

Of all BBRs (n=973), 960 (98.6%) reported to have had sex with at least one partner in their lives. Among them, 489 (50.9%) reported that they had regular sexual partners whom they had permanent contacts at the time of the survey and only 183 (37.4%) used condom in their sexual encounters. Among BBRs who had had sex in their lives, 219 (22.8%) had sex with a casual sexual partners in a period of three months before the study. The proportion of BBRs with casual sexual relationships was significantly higher among those aged 18 – 34 year (186; 25.0%; p=0.002). Of all BBRs (960) who ever had sex in their lives, 110 (11.5%) reported to have had sexual relationship with commercial sexual partners and majority of these (95/110; 86.4%) used condoms during their last sexual encounters with commercial workers. The proportion of condom use when engaging with commercial sexual partners was not significantly different among BBRs of different age groups (Table 3). Of the BBRs, 82.0% had received voluntary counselling and testing (VCT) for HIV, with higher VCT use among married BBRs, (86.2%).

**Table 3: Attitude and practices of BBRs, their sexual relationships with different partners and condom use**

Variable	Age group		Total (%)	$\chi^2$ P-value
	18-34 years n (%)	35-59 years n (%)		
Relationship with regular sexual partners (n=960)				
Yes	412 (55.5)	77 (35.5)	489 (50.9)	
No	331 (44.5)	140 (64.5)	471 (49.1)	<0.001
Use of condom with regular sexual partners (n=489)				
Yes	158 (38.4)	25 (32.5)	183 (37.4)	
No	254 (61.6)	52 (67.5)	306 (62.6)	0.328
Relationship with casual sexual partners (n=960)				
Yes	186 (25.0)	33 (15.2)	219 (22.8)	
No	557 (75.0)	184 (84.8)	741 (77.2)	0.002
Use of condom with casual sexual partners (n=219)				
Yes	115 (61.8)	21 (63.6)	136 (62.1)	
No	71 (38.2)	12 (36.4)	83 (37.9)	0.844
Relationship with commercial sexual partners (n=960)				
Yes	88 (11.8)	22 (10.1)	110 (11.5)	
No	655 (88.2)	195 (89.9)	850 (88.5)	0.539
Use of condom with commercial sexual partners (n=110)				
Yes	78 (88.6)	17 (77.3)	95 (86.4)	
No	10 (11.4)	5 (22.7)	15 (13.6)	0.165

#### HIV prevalence and risk factors among BBRs

A total of 523 (53.8%) BBRs agreed to undergo VCT for HIV and only, 13 (2.5%) were positive. The prevalence was higher among BBRs aged 35-59 years (4.4%), divorced (3.9%) and those from Temeke district (4.6%). However, the prevalence was lower among those who had regular sexual partners (1.5%), casual sexual partner (2.3%) and ever used drugs (2.2%). High HIV prevalence was also reported in BBRs who had had sex with commercial sex workers (2.7%) and those who were taking alcohol (3.9%). The risk of HIV infections was significantly lower among married BBRs (AOR=0.2; 95%CI: 0.1-0.9, p=0.041) and those with regular sexual partners (AOR=0.2; 95%CI: 0.1-0.9, p=0.028). However, the risk was significantly higher among BBRs who were conducting business in Temeke district (AOR=4.3; 95%CI: 1.1-17.2, p=0.037) and those who were taking alcohol (AOR=4.5; 95%CI: 1.1-18.6, p=0.037 (table 4).

**Table 4: Prevalence of and risk of HIV infection among BBRs**

Variable	HIV Prev n (%)	COR (95% CI)	P value	AOR (95% CI)	P value
<b>Age group (n=523)</b>					
18 to 34 years (n=389)	7 (1.8)	1		1	
35 to 59 years (n=134)	6 (4.4)	2.5 (0.9-7.3)	0.093	3.5 (1.0-13.2)	0.058
<b>Marital status (n=523)</b>					
Single (n=225)	6 (2.7)	1		1	
Married (n=272)	6 (2.2)	0.8 (0.3-2.5)	0.730	0.2 (0.1-0.9)	0.041
Divorce (n=26)	1 (3.9)	2.0 (0.3-12.3)	0.460	0.7 (0.1-5.1)	0.719
<b>District of business (n=523)</b>					
Ilala (n=194)	1 (1.6)	1			
Kinondoni (n=175)	3 (1.7)	1.1 (0.2-5.0)	0.891	1.5 (0.3-7.4)	0.587
Temeke (n=154)	7 (4.6)	2.0 (0.8-10.1)	0.119	4.3 (1.1-17.2)	0.037
<b>Regular sexual partner (n=521)</b>					
No (n=245)	9 (3.7)	1		1	
Yes (n=276)	4 (1.5)	0.4 (0.1-1.3)	0.125	0.2 (0.1-0.9)	0.028
<b>Ever taken alcohol (n=523)</b>					
No (241)	2 (0.8)	1			
Yes (282)	11 (3.9)	4.1 (1.0-16.1)	0.049	4.5 (1.1-18.6)	0.037
<b>Education level (n=523) ‡</b>					
No formal education (n=11)	0 (0.0)	1			
Primary education (n=374)	11 (2.9)	0.7 (0.1-13.1)	0.829		
Secondary education (n=138)	2 (1.5)	0.4 (0.1-9.3)	0.584		
<b>Causal partner (n=521) ‡</b>					
No (n=390)	10 (2.6)	1			
Yes (n=131)	3 (2.3)	1.0 (0.3-3.4)	0.983		
<b>Sex with Commercial sex workers (n=521) ‡</b>					
No (n=446)	11 (2.5)	1			
Yes (n=75)	2 (2.7)	1.3 (0.3-5.2)	0.721		
<b>Ever used drugs (n=523) ‡</b>					
No (n=385)	10 (2.5)	1			
Yes (n=138)	3 (2.2)	0.9 (0.3-3.1)	0.899		

COR=Crude Odds Ratios; AOR=Adjusted Odds Ratios; CI=Confidence Interval; Prev=Prevalence

‡ These variables were not included in the multivariate analysis because they did not attain the pre-set criteria of backward stepwise analysis of  $p < 0.2$  as described in the method.

## Discussion

Commercial motorcycle business (Boda-boda) is widely spread in almost all corners of Tanzania and most of the areas in Dar es Salaam region. It mainly involves teenagers, young adults and middle-age men and sometimes those above 50 years of age. As revealed by this study and other [20] majority of BBRs were aged <35 year, with low level of education and were engaging in potentially high risk practices making them vulnerable to HIV infections. Although most of the BBRs (over half) were married, they had been engaging in sexual relationship with regular, casual or commercial sexual partners. This kind of multiple sexual relationships was likely to make not only BBRs but also their permanent partners (wives or girlfriends) vulnerable to HIV infections [21, 22].

Knowledge of BBRs on the magnitude of HIV in this study was quite high and most of them were aware that they are at high risk of HIV infection. The BBRs were also aware of how HIV is transmitted and how to prevent its transmission mainly through use of condoms. This high level of knowledge could be due to different national campaigns which have been undertaken in Tanzania in the past two decades, to increase public awareness of HIV [23]. Our findings were

comparable with that obtained in another study which was conducted in Nigeria, which showed that majority of commercial motorcyclists were aware of HIV and the risk of getting infected due to their occupation [24]. Our study also reported that majority of BBRs were aware that sexual intercourse is the major means of HIV transmission like in the study conducted in Kenya [25]. Similarly, awareness that condom use is the main HIV preventive measure could be possibly due to behaviour change communication interventions for HIV which have been implemented in Tanzania [26]. The level of awareness of HIV transmission and prevention was slightly related to education level, and this was similar to the study that was conducted in Ghana [27]; which demonstrated that there was no advantage of higher education levels in the knowledge of HIV preventive measures. However, there was low knowledge with regards to blood transfusion as one of the means of HIV transmission and PMTCT as one of the preventive measures possibly related to age and gender. Most of BBRs were young males and a large proportion were single, suggesting that they rarely got involved in blood transfusion as well as maternal child health services through antenatal clinics where PMTCT services are provided.

It was shown that majority of BBRs had multiple sexual relationships including those with regular sexual partners (apart from their spouses or permanent girlfriends) and only few of them (~37%) used condoms during sex. The act of having multiple sexual partners and the reckless behaviour of not using condom during sexual relationships may increase the risk of getting HIV infection as previously described [28, 29]. Moreover, our study reported that about 23% and 11.5% of all BBRs had had sexual relationships with casual and commercial partners, respectively; but majority of these (>62%) used condoms during their encounters. High proportion of condom use among the BBRs especially with commercial sex workers, suggest that BBRs had high knowledge and were aware of the high risk of acquiring HIV from commercial sexual workers [30]. Although this was not explored in this study, high condom use among BBRs who had sex with commercial sexual workers could also be due to the demand by sex workers (to protect themselves against HIV) as shown in other studies [31, 32]. The findings from other studies revealed that condom use is quite high in commercial sex industry, undoubtedly higher than in non-commercial casual partnerships [33, 34]. This could also be due to the perception that commercial sexual workers are playing a major role in spreading HIV infection than other sexual partners [35]. However, the findings from this study showed that majority of the BBRs including those who were married were not using condoms in their sexual encounters with regular partners, suggesting that the risk of acquiring HIV among BBRs might still be even higher although most of them were HIV negative.

The findings also showed that majority of BBRs particularly those who were married had received VCT services for HIV compared to those who were not married. This could possibly be due to the fact that most of the married BBRs could have been forced to test before their marriage as emphasized by some religious groups. Although not formally mandatory but widely practised/accepted in Tanzania and elsewhere, VCT before marriage has been considered as one of the key strategies for the control of HIV by reducing the potential transmission among new couples [36]. A study conducted in Malawi reported that premarital VCT was beneficial and resulted in more marriages which were HIV free [37]. Thus, continuously receiving VCT services is among strategies for protecting individuals from HIV infections [38] and it should be emphasized across all age groups.

The study findings revealed very low HIV prevalence among BBRs contrary to what was previously reported in Uganda [39]. In addition, the prevalence and risk of HIV infection was found to be lower among married BBRs than divorced ones. This could imply that being married might act as a shield against HIV infection as reported in a study conducted in Taiwan [40]. In recent years, most of the SSA countries including Tanzania have experienced a decrease of HIV infection [41]. This has been attributed to different intervention measures, such as use of antiretroviral drugs (ARVs) among PLHIV and the scale-up of community awareness (education) towards HIV transmission and prevention leading to high knowledge and uptake of these and other HIV interventions [42]. However, the prevalence of HIV infection was higher among BBRs who were taking alcohol and even their risk was six times higher compared to those who were not taking alcohol. This may imply that taking alcohol has an effect on decision to have sex, consistent use of condoms and adherence to other HIV preventive strategies [43]. Higher prevalence of HIV in Temeke district could be attributed to socio-demographic and economic factors. The district has very high population density, high proportion of young and un-employed adults (15 – 49 years) and low socio-economic status which could potentially increase the risk to HIV infection [44].

## Conclusion

The study showed that BBRs had high knowledge of HIV but were still at high risk of acquiring HIV due to risk behaviours such as relationships with multiple sexual partners, low use of condoms and taking alcohol. Although the prevalence of HIV was low among BBRs, the high level of risk behaviours reported by BBRs suggests that further monitoring of this and similar groups are urgently required. There is also a need to design and implement appropriate strategies to prevent HIV infections among BBRs. The Ministry of Health and other stakeholders should design tailor made programmes including health education to promote and enhance consistent use of HIV preventive measures such as sticking to a single sexual partners, abstinence and condom use. Similar studies should also be conducted in other areas especially those with high HIV burden and with other groups which might also be at high risk of acquiring HIV due to the nature of their occupation.

## Abbreviations

AIDS Acquired Immune Deficiency Syndrome

ART Antiretroviral Therapy

ARV Antiretroviral

AOR Adjusted Odds Ratios

BBRs Boda-boda Riders

CI Confidence Interval  
COR Crude Odds Ratios  
CTC Care and Treatment Centre  
GCLP Good Clinical Laboratory Practice  
GCP Good Clinical Practice  
DED District Executive Director  
DMO District Medical Officer  
HIV Human Immunodeficiency Viruses  
HTC HIV Testing and Counselling  
KAP Knowledge Attitudes and Practices  
MRCC Medical Research Coordinating Committee  
NIMR National Institute for Medical Research  
ODK Open Data Kit  
PLHIV Persons Living with HIV  
PMLE Penalized Maximum Likelihood Estimation  
PMTCT Prevention of mother to child transmission  
PPS Probability Proportional to Size  
RMO Regional Medical Officer  
STI Sexually Transmitted Infections  
SSA Sub-Saharan Africa  
THMIS Tanzania HIV and Malaria Indicator  
THIS Tanzania HIV Impact Survey  
VCT Voluntary Counselling and Testing

## **Declarations**

### **Ethics approval and consent to participate**

This study's proposal was submitted to the Medical Research Coordinating Committee (MRCC) of the National Institute for Medical Research (NIMR) for ethical and scientific review and received an approval number NMR/HQ/R.8a/Vol.IX/2235. The survey was planned and implemented such that confidentiality of participants (BBRs) was respected and protected. Participants were informed of the study objectives and methodology and upon consenting they proceeded with questionnaires and/or interviews and/or HIV testing. Research assistants who took part in data collection were trained in ethical procedures to ensure informed consent process was properly administered and confidentiality of participants' information was maintained. Information on purpose, benefit and procedure for conducting the study was discussed with regional and district administrative authorities including health service providers. Similar information was explained to participants including the right to refuse or withdraw at any time, and identifiers were kept secret. During analysis and interpretation, individual names were not linked to any data collected from the study.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets of this study will be available from the corresponding author on a reasonable request and upon institutional approval and signing of the data transfer agreement (DTA) from NIMR.

### **Competing interests**

The authors declare that they have no competing interests.

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## Authors' contributions

DPC, MLK and DSI designed and supervised the study, data collection, management and analysis and prepared the manuscript. BPM, AMK and MGC designed and supervised the study and prepared the manuscript. AM, GAN, MMC and PMH collected data and prepared the manuscript. All authors reviewed and approved the final version of the manuscript.

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## Authors' information

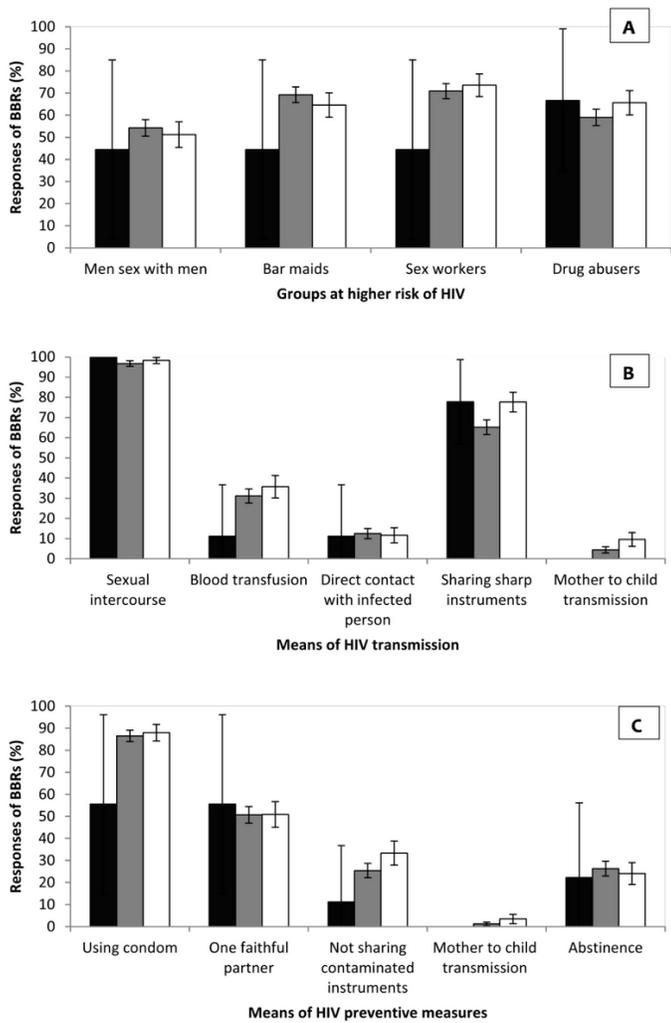
Not applicable

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## Figures



**Figure 1**  
 Knowledge of HIV among BBRs in Dar es Salaam region: Group of people at higher risk of HIV infections by level of education (A), means of HIV transmission by level of education (B) and means of HIV prevention by level of education (C). Black bars represent no formal education, gray represent primary education while colourless represent secondary education. (Should be placed just below Table 2)