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HIV Knowledge and associated risk factors among Commercial Motorcyclists in Dar es Salaam, Tanzania

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Abstract

Introduction

In recent years, there has been an emergence of commercial motorcyclists in 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 including; multiple sex partners, alcohol and drug abuse, low condom use, and limited knowledge of human immunodeficiency virus (HIV). This study was conducted to assess 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 were collected electronically using android tablets through the open data kit (ODK).

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 was 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 is mainly transmitted through unprotected sex and it could be prevented through use of condoms. However, 99.0% of BBRs had one or more sexual partners, but 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.

Keywords: *HIV, Risk factors, Commercial motorcyclists, Bodaboda riders, Dar es Salaam, Tanzania.*

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Introduction

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 2019 (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) in Tanzania (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 counselling (HTC) centres, link to treatment and care clinics (CTCs), 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). TheTanzanian ministry of health reported that, of all 6,109 regional and district facilities that submitted self-reported data in 2017; 26% 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 popularly known as *boda-boda* riders (BBRs) who provide quick transport services in both rural and urban areas of the country. Most of these are young active men who are more likely to share a set of high-risk behaviours for 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 which is partly culturally rooted (11, 12). A study conducted in Uganda reported low (33%) condom use and HIV prevalence of 7.5% among BBRs, with even higher prevalence (10.9%) among BBRs aged ≥25 years compared in those below 25 years of age (3%) (13).

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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. There is paucity of empirical data from studies on the magnitude of the HIV burden among BBRs, and their knowledge, attitudes and practises (KAPs) toward HIV prevention and control measures. In order to fill this gap, this study assessed the HIV knowledge and associated risk factors among BBRs in Dar es Salaam, Tanzania. Specifically, it assessed the KAPs, prevalence and associated risk factors of HIV infection among BBRs working in the Dar es Salaam region.

Methods

Study area and population

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 in Tanzania (14). According to the 2012 Census, Dares Salaam had a population of 4,364,541 (15) and based on the United Nations - World Population Prospects, it is estimated that the City of Dar es Salaam will have the population of 7.05 million by December 2021 (16). It is the most industrialized region and the largest commercial centre in the country; with HIV prevalence of 4.7% according to the 2016/17 survey (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 Ubungo. For the purpose of this study, the old administrative districts (Ilala, Kinondoni and Temeke) were retained. By 2019 Dar es Salaam region had 302,169 BBRs (17) and this study involved adult BBRs aged 18 to 59 years doing their commercial activities in Ilala, Kinondoni and Temeke districts.

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 KAPs

towards HIV among BBRs. In addition, a sero-survey was also undertaken within the HTC framework aimed at establishing the prevalence and risk factors of HIV transmission risk factors of HIV among BBRs.

Sampling technique and Sample size

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. (18), we assumed an estimated prevalence within percentage points and 95% confidence. According to the published data of 2019, the target population of BBRs in Dar es Salaam within the study area was expected to be 302,169 (17). However, during the study we managed to obtain BBRs population data of 2012 from these three municipals whereby, there were 1,334 registered BBRs in Ilala, 1,735 in Kinondoni and 1,363 in Temeke districts. 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 2011/12 (THMIS) (19) 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 the response rate of 90% among BBRs and an HIV test response rate of 80%, the overall response rate was estimated as $r = 0.9*0.8 = 0.72$ and the design effect was 1. The desired sample size for estimating prevalence (p), considering 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)

Training of study team and tool pretesting

A five-day training of research assistants was conducted prior to initiation of the study. During the training, orientation on study protocol, good clinical laboratory practice (GCLP)

and data collection tools was done. Thereafter, pre-testing and pilot survey of the data collection tools was conduct in Tanga city and the set-up used was considered to be similar to the selected study site. Pre-testing and pilot survey helped to refine data collection tools based on experience gained.

Data collection

Before data collection, Information on purpose, benefit and procedure for conducting the study were discussed with the regional administrative secretary (RAS) and the regional medical officer (RMO) of Dar es Salaam. 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.

Upon reaching the BBRs posts/stands, the research team leader introduced himself to BBRs leaders and explained to them the purpose of the study. Thereafter, the BBRs leaders introduced the study team to his fellows BBRs. The research team leader introduced the research assistants to the BBRs and clarified the aim of the study to all BBRs present at the stand. All BBRs who were ready to participate in the study were invited to the nearby ward executive office (WEO) or street chairpersons' offices for interview and HIV testing which was done after signing a written consent form. BBRs meeting the inclusion criteria and providing consent to take part in the study were assigned unique identification numbers (IDs) for this study. These BBRs were invited for interviews and testing which were done by shifts where by the BBRs who were presents at the stand were invited while others continued with their business of providing transport services to their customers.

Tools for data collection were developed based on the study's objectives, 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 central server based at the National Institute for Medical Research (NIMR) Headquarters in Dar es Salaam. Demographic information such as age, marital status, place of residence and other information including KAP of BBRs towards HIV and prevention of HIV infection were collected. In order to collect information about sexual behaviours, respondents were asked questions regarding their sexual relationships, number of partners and use of condoms for protection against HIV. A regular sexual partner was

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defined as a well-known; permanent sexual partner for unmarried BBRs and an extramarital partner for married BBRs. A casual sexual partner 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. A 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 HIV infection. Individual pre-test counselling sessions were done to each participant prior to HIV testing.

Sample collection and HIV testing

For BBR who agreed to be tested for HIV, pre- and post-test counselling were done after which test results were revealed to the respondents. All these activities were conducted by a study nurse who is a qualified counsellor. A blood sample was collected by finger prick and tested using the Tanzanian national HIV testing algorithm (20). Participants were first screened using the SD Bioline rapid test. Briefly, a finger prick blood (20µl) 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^{TM}) 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. A negative test was reported when the first test was negative while a positive test was reported when the two tests were positive.

Data Management and Analysis

The data were collected electronically using android tablets ODK software through the central server. To ensure consistency and to minimize data entry errors, the database was prepared with filters (such as age range, gender etc.). Proportions between groups were compared using χ^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, the Penalized Maximum Likelihood Estimation (PMLE) proposed by Firth (21) 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 (ranging from 18 to 59 years), and the mean age was not statistically significant among BBRs from the three districts. Majority of the participants 756/973 (77.7%) were below 35 years of age and 508/973 (52.2%) were married. Most of the BBRs 673/973 (69.2%) had primary education while 23/973 (2.3%) had no formal education. When categorized based on their area of business, 587/973 (60.3%) BBRs were from peri-urban areas of Dar es Salaam city (Table 1).

Knowledge and perceived risk of HIV transmission

Out of the 973 BBRs, 909/973 (93.4%) reported that HIV is a major health problem in Tanzania and 873/973 (89.7%) admitted that they were at high risk of acquiring HIV infections (Table 2). Majority of BBRs 695/973 (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 reported to be 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 PMTCT through safe delivery (figure 1 C).

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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
Age – mean (SD) 29.3 (7.9)	30.8 (8.5)	27.7 (7.4)	29.4 (7.7)	0.607
Age group, n (%)				
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)	<0.00.1
Marital status, n (%)				
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)	<0.001
Education level, n (%)				
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)	0.881
Business location, n (%)				
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)	0.193

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%)	χ^2 P-value
HIV in Tanzania n (%)				
Major problem,909 (93.4)	295 (93.5)	290 (90.8)	324 (95.8)	
Not a major problem,64 (6.6)	21 (6.5)	29 (9.2)	14 (4.2)	0.015
BBRs are at high risk of HIV infections				
Yes, 873 (89.7)	287 (90.8)	281 (88.2)	305 (90.1)	
No, 100 (10.3)	29 (9.2)	38 (11.8)	33 (9.9)	0.545

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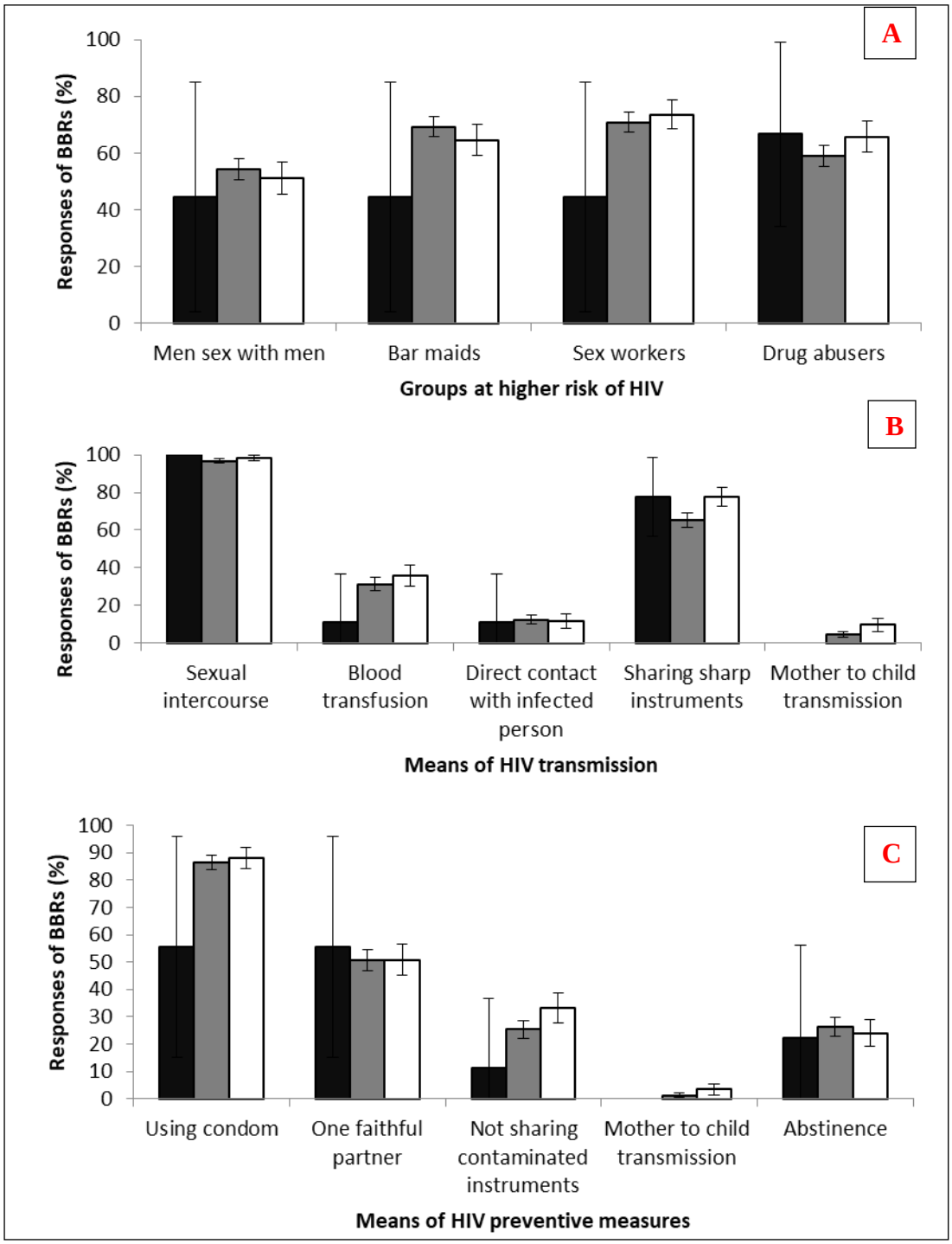

Figure 1: Knowledge of HIV among BBRs in Dar es Salaam region: Groups of people at higher risk of HIV infections by level of education (A), means of HIV transmission by level of education (B) and means of HIV prevention by level of education (C). Black bars represent no formal education; gray represent primary education while colorless represent secondary education.

Attitude and practice towards HIV infections among BBRs

Of all BBRs, 960/973 (98.6%) reported to have had sex with at least one partner in their lives. Among them, 489/960 (50.9%) reported that they had regular sexual partners whom they had permanent contacts at the time of the survey and only 183/489 (37.4%) used condom in their sexual encounters. Among BBRs who had had sex in their lives, 219/960 (22.8%) had sex with a causal sexual partner 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 years (186; 25.0%; p=0.002). Of all BBRs who ever had sex in their lives, 110/960 (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 ever received voluntary counselling and testing (VCT) for HIV, with higher VCT use (86.2%) among married BBRs.

HIV prevalence and risk factors among BBRs

A total of 523/973 (53.8%) BBRs agreed to undergo VCT for HIV and only, 13/523 (2.5%) were positive. The prevalence was higher among BBRs aged 35-59 years 6/134 (4.4%), divorced 1/26 (3.9%) and those from Temeke district 7/154 (4.6%). However, the prevalence was lower among those who had regular sexual partners, causal sexual partner and ever used drugs (1.5%, 2.3% and 2.2%, respectively). 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-o.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).

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

Variable	Age group		Total (%)	χ^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

Table 4: Prevalence of and risk of HIV infections among BBRs

Variable	HIV Prev n (%)	COR (95% CI)	P value	AOR (95% CI)	P value
Age group (n=523)					
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
Marital status (n=523)					
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
District of business (n=523)					
Ilala (n=194)	1 (1.6)	1			

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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 (1.1-317.2)	0.037
Regular sexual partner (n=521)					
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
Ever taken alcohol (n=523)					
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
Education level (n=523) ‡					
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		
Causal partner (n=521) ‡					
No (n=390)	10 (2.6)	1			
Yes (n=131)	3 (2.3)	1.0 (0.3-3.4)	0.983		
Sex with Commercial sex workers (n=521) ‡					
No (n=446)	11 (2.5)	1			
Yes (n=75)	2 (2.7)	1.3 (0.3-5.2)	0.721		
Ever used drugs (n=523) ‡					
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 no included in the multivariate analysis because they did not attain the pre-set criteria of backward stepwise analysis 0f p<0.2 as described in the method.*

Discussion

Commercial motorcycle business (Boda-boda) is widely spread in almost all corners of Tanzania and in big cities such as Dar es Salaam. It mainly involves teenagers, young adults and middle-aged men and to a lesser extent those above 50 years of age. As revealed by this study and others (22) 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 more than half the BBRs 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 (23, 24).

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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 (25). Our findings were comparable with those obtained from a study conducted in Nigeria, which showed that majority of commercial motorcyclists were aware of HIV and the risk of getting infected due to their occupation (26). Our study also reported that majority of BBRs were aware that sexual intercourse without condom is the major means of HIV transmission and this is in line with a study conducted in Kenya (27). 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 (28). 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 (29); 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 events may increase the risk of getting HIV infection as previously described (30, 31). Moreover, our study reported that about 23% and 11.5% of all BBRs had had sexual relationships with causal 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 (32). 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 (33, 34). The findings from other studies revealed that condom use is quite high in

commercial sex industry, undoubtedly higher than in non-commercial casual partnerships (35, 36) as also shown by this study. 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 (37). 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 (38). A study conducted in Malawi reported that premarital VCT was beneficial and resulted in more marriages which were HIV free (39). Thus, continuously receiving VCT services is among of the strategies for protecting individuals from HIV infections (40) 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 (41).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 (42). In recent years, most of the SSA countries including Tanzania have experienced a decrease of HIV infection (43). 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 (44). The results of this study show that the prevalence of HIV infection was higher among BBRs who were taking alcohol and 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 (45). 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 (46).

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Study limitations

The study was proposed to be conducted in only one region of Dar es Salaam, due to limited funds. The findings may not be representative of the other regions and the study might have failed to capture the wide range of behaviours among BBRs from other regions towards HIV infections, prevention, and its control measures.

Conclusion

The study showed that BBRs had high knowledge of HIV but 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. Also, majority of BBRs mostly those who were married had received VCT services for HIV compared to those who were not married. 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. To ensure availability and free distribution of condoms in BBRs' parking areas should be encouraged. There is need for a similar study to be conducted in other areas especially those with high burden of HIV burden in Tanzania.

Declaration

Ethics approval and consent to participate

The stud proposal for study 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 undertaken and confidentiality of participants' information was maintained. Information on the purpose, benefits and procedure for conducting the study was discussed with study participants, and regional and district administrative authorities including health service providers. The information was further

explained to participants in details including the right to refuse or withdraw at any time, and identifiers were kept in secure places to ensure that such information is only accessible to the authorised investigators. During analysis and interpretation, individual names were not linked to any data collected from the study.

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Availability of data and materials

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

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

DPC, MLK and DSI conceived of, designed and supervised the study including data collection, management and analysis and drafted and revised the manuscript. BPM, AMK and MGC designed and supervised the study and critically revised the manuscript. AM, GAN, MMC and PMH contributed to the conception and critically revised the manuscript. All authors read and approved the final version of the manuscript.

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List of 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 Ratio
CTC	Care and Treatment Centre
GCLP	Good Clinical & Laboratory Practices
GCP	Good Clinical Practices
DED	District Executive Director
DMO	District Medical Officer
HIV	Human Immunodeficiency Virus
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 Survey
THIS	Tanzania HIV Impact Survey
VCT	Voluntary Counselling and Testing

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