Biomedical, Behavioral, and Socio-Structural Risk Factors on HIV Infection and Regional Differences in Tanzania

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ABSTRACT

This research has two aims. One is to explore the influence of STI, male circumcision, age of the first sexual intercourse, multiple sexual partners, HIV knowledge, and household wealth on HIV infection in Tanzania. The other is to explore Tanzanian regional differences in HIV prevalence. Understanding risk factors and regional differences on HIV prevalence will help create more effective HIV prevention packages. We used the 2007–2008 Tanzania HIV/AIDS and Malaria Indicator Survey and conducted logistic regressions and random-effects models for men and women, separately. We found that male circumcision decreases HIV infection; and STI, early sexual debut, and highest wealth — but not multiple partner or HIV knowledge — increases HIV infection. Regional differences account for 15% of variance for women and 12% for men. As a follow-up, we plan to add regional-level variables to conduct multilevel analyses to further explore the risk factors and regional differences in HIV infection.

Aim of this paper and future research

This paper explores the relationships among the biomedical (STI symptoms, male circumcision), behavioral (multiple sexual partner, age at first sexual intercourse), and socio-structural variables (education, marital status, AIDS knowledge, and wealth) and how regional differences account for the variance, by using a random-effect logistic regression model. For future analyses, we will add more individual-, household- and community-level variables and conduct multilevel analyses.

Background and Significance

The HIV pandemic is a critical public health concern. Sub-Saharan African countries suffer disproportionally from the heavy burden of HIV/AIDS infections. Approximately 22.5 million people in sub-Saharan Africa were living with HIV in 2009, "representing 68% of the global HIV burden". (UNAIDS 2010). However, HIV "affects different sub-group in different ways at different time." (TACAID 2008:1) The 2007–2008 Tanzania HIV/AIDS and Malaria Indicator Survey (THMHIS), for example, shows that 6.6% of women and 4.7% of men aged 15 to 49 years are HIV positive in Tanzania. Tanzania's current HIV prevalence is in fact lower compared to 7.7% of HIV positive women and 6.3% of HIV positive men reported in the 2003–04 Tanzania HIV/AIDS Indicator Survey (THIS) (TACAID 2008). Yet sharp regional differences in HIV prevalence exist in Tanzania, with the highest in the Iringa region (18.6% for women and 12.1% for men), and the lowest in the Pemba region (0.3% for men and 0.2 for men) (TACAID 2008).

Risk factors also can vary by region in Tanzania. For example, sexually transmitted infections (STIs) are highly correlated with HIV infection. Among women who participated in the THMHIS, the proportion of individuals who reported that they had STI symptoms in the last 12 months varied from 0.4% among Unguj women to 3.9% among Rukuwa women, and 1.0% among Pemba men to 8.5% among Mtwara men (TACAID 2008). Behavioral risk factors such as having multiple partners also vary by region. The proportion of individuals in the DHS who report having sexual intercourse with more than two people ranges from 0 to 6.4% for women and 6.4% to 27% for men (TACAID 2008). In addition, structural variables such as HIV knowledge differ by region. Although over 90% of men and women heard about HIV/AIDS, the knowledge about preventing HIV risk varies greatly (TACAID 2008). For example, 88.9% of women in Kigoma know that using a condom can reduce the risk of HIV, as opposed to 36.2% of women in Pemba (TACAID 2008). And 81.9% of men in Kigoma know that using condom can reduce the risk of HIV, as opposed to 48.7% of men in Pemba (TACAID 2008). It is important to examine risk factors for HIV infection and the role of biomedical (i.e. STI, male circumcision), behavioral (i.e. multiple partner, the age of first sexual intercourse) and structural (i.e. HIV knowledge, household wealth) risk factors in modifying HIV risk. It is now common knowledge in the HIV field that no standalone HIV prevention intervention will have a significant impact on the pandemic. For this reason, it is important to understand what the components of a combination HIV prevention package should be to reduce HIV incidence at a population level. (Kurth et al. 2011)

Thus, it would be meaningful to examine (a) the contribution of the various biomedical, behavioral and structural modifiers of HIV risk, if (b) the differences in HIV prevalence by

region in Tanzania are significant, and if so, (c) how much regional differences account for the variation of the prevalence rate in Tanzania, and (d) how community level variables influence the HIV prevalence rate. In this paper, we examine men and women separately because the magnitude of the influence of the risk factors could be different due to physiological or social reasons.

Data and Methods

We used the 2007–2008 Tanzania HIV/AIDS and Malaria Indicator Survey (THMIS), the second population-based survey on HIV/AIDS conducted in Tanzania (TACAID 2008). THMIS is "commissioned by the Tanzanian Commission for AIDS (TACAIDS) and the Zanzibar AIDS Commission (ZAC) and implemented by the National Bureau of Statistics (NBS) in collaboration with the Office of Chief" (TACAID 2008). This two-stage sample survey is "designed to provide up-to-date information on the prevalence of HIV infection among Tanzanian adults" (TACAID 2008: 3). HIV status was tested by blood test anonymously. This survey also provides necessary information for our analyses such as respondents' demographic background, information on sexual behaviors, HIV-related knowledge, and contraceptive use. A nationally representative sample of 9,343 women age 15–49 and 6,975 men age 15–49 were interviewed with the response rates of 96% for women and 88% for men (TACAID 2008). These surveys include HIV testing for 8,700 women age 15–49 and 6,300 men age 15–49 (TACAID 2008).

Variables

The outcome variable is HIV status: 0 for negative and 1 for positive. Our biomedical variables are STI and male circumcision. Behavioral risk variables include age at sexual debut and

number of partners. We used two structural variables. Comprehensive knowledge of AIDS/AHIV is coded for 1 if a respondent has correct answers on five AIDS-related questions asked, concerning: reducing chances of AIDS by condom use; having only one sex partner; getting AIDS by mosquito bites; sharing food with person with AIDS; and healthy looking people with AIDS. Wealth index is divided in five quintiles. It is created based on household assets such as water access and ownership of television by principal component analysis (TACAID 2008). We also control for demographic backgrounds: age in years, the highest educational level attained, and current union status.

Analysis

After the cross-tabulations between the regions and other variables and HIV, separately to examine the significant associations, we conducted logistic regression to examine whether the regions are statistically significant after control for all covariates in the model.

$$(1)\ \log\left(\frac{\pi_{ij}(x)}{1-\pi_{ij}(x)}\right) = \alpha + \beta_{ij_1} R_{ij1} + \beta_{ij_1} M_{ij1} + \beta_{ij_2} B_{ij2} + \beta_{ij3} S_{ij3} + \beta_{ij4} C_{ij4}$$

where π_{ij} is a probability of person *j* in *i*th region being HIV positive. α is a constant. The log odds of person *j* in *i*th region being HIV positive is a function of R_{jj} (regions), M_{ij} (biomedical risk factors), B_{ij} (behavioral risk factors), S_{ij} (structural risk factors) and C_{ij} (control variables). β is the log odds associated with the covariates in the model. We also used the random effects model to decompose the unexplained variance in HIV positive among the regions. This assumes that there is no correlation with the included variables and the unobserved family characteristics.

$$\log\left(\frac{\pi_{ij}(x)}{1-\pi_{ij}(x)}\right) = \alpha + \beta_{ij_1} R_{ij1} + \beta_{ij_1} M_{ij1} + \beta_{ij_2} B_{ij2} + \beta_{ij3} S_{ij3} + \beta_{ij4} C_{ij4} + \omega_j + \varepsilon_{ij}$$

Where ere π_{ij} is a probability of person *j* in *i*th region being HIV positive. α is a constant. The log odds of person *j* in *i*th region being HIV positive is a function of R_{jj} (regions), M_{ij} (biomedical risk factors), B_{ij} (behavioral risk factors), S_{ij} (structural risk factors) and C_{ij} (control variables). β is the log odds associated with the covariates in the model. ε and ω are the unobserved random effects at the regional and individual levels. We used STATA 11 for statistical analysis. The STATA output provides the panel-level variance component. ρ is the proportion of the total variance contributed by the regional-level variance component (StataCorp. 2009).

Table 1 presents the distribution of our analytical samples. Women are higher percent of HIV positive compared to men. Men are higher percent of younger population compared to women. The higher proportion of men is never married. Men have higher education. Women experienced an earlier first sexual debut compared to men. Men have higher percent of HIV comprehensive knowledge.

Table 1. Weighted Distribution of Analytical Samples : THMHS 2007-2008

	Women percentages	Men percentages
HIV Status		
Negative	93.39	95.44
Positive	6.61	4.56
Age		
15-19	21.47	26.45
20-24	18.71	16.38
25-29	17.40	14.12
30-34	14.24	13.91
35-39	12.32	11.74
40-44	8.17	8.96
45-49	7.70	8.45
Current Marital Status		
Never Married	23.82	42.76
Married	54.38	46.39
Living togethe	9.63	6.07
Widowed/divorced	12.18	4.78
Education		
No Education	21.12	11.63
Incomplete Primary	16.49	22.38
Complete Primary	52.97	51.22
Incomplete Secondary	8.097	12.17
Complete Secondary and plus	1.325	2.594
Region		
Dodoma	3.59	3.69
Arusha	4.22	3.79
Kilimanjaro	4.01	3.88
Tanga	4.55	4.31
Morogoro	4.64	4.85
Pwani	2.17	1.70
Dar es Salaam	8.43	8.41
lindi	2.63	2.35
Mtwara	3.48	3.02
Ruvuma	3.98	4.15
Iringa	4.32	4.12
Mbeya	6.14	7.10
Singida	2.09	2.16
Tabora	5.47	5.68
Rukwa	3.37	3.83
Kigoma	4.42	4.17
Shinyang	8.07	9.06
Kagera	5.51	5.78

Mwanza	8.92	8.57
Mara	3.90	3.45
Manyara	2.81	2.92
Unguja	2.29	2.13
Pemba	1.01	0.91
Male Circumcision		
No	N/A	33.51
Yes	N/A	66.16
missing	N/A	0.33
STY symptom in last 12 moths		
no	97.36	95.88
yes	1.82	3.34
missing	0.82	0.78
Multiple Partners in past 12 months		
No	83.92	61.53
More than 1	2.73	18.05
Never had sex	13.36	20.42
Age of sexual debut		
Never had sex	13.36	20.42
7-15	29.11	20.26
16-17	25.72	18.63
18-19	17.50	20.67
20 +	9.67	20.02
Missing	4.64	0.00
Comprehensive AIDS knowledge		
No	58.55	54.46
Yes	39.74	44.54
Never Heard HIV/AIDS	1.71	1.01
Wealth Index		
poorest	18.35	17.02
poorer	17.79	20.91
middle	19.34	19.16
richer	20.06	19.86
richest	24.45	23.05
Total	100	100
N	8710	6330

Results

Women

The cross-tabulations show that the regional differences are significantly associated with HIV status, STI, age at the first sex, HIV knowledge, and wealth. The largest proportion of HIV positive is 18.6% in Iringa, whereas the total is 6.6%. HIV status is significantly associated with multiple partners, age at sexual debut and wealth, but not with STI and comprehensive knowledge of HIV.

We performed the logistic regressions to examine whether the regional differences still exist after controlling for demographic variables and three types of risk factors. Table 2 presents the log odds of the probability of being HIV positive by selected regions. The coefficients of regions are unadjusted in Model 1 and are adjusted in Model 2 for all covariates in the model. Eight regions are significantly different from Dodoma in Model 1. Particularly, the odds of HIV positive in Iringa is 5.37 (exp(1.68)) times greater than Dodoma. Net of covariates, Dar es Salaam is no longer significantly different from Dodoma. Other coefficients are rather stable, but a slight increase is observed in Iringa and Mbeya from 1.68 to 1.91 and 0.88 to 1.00, respectively. The results show that the regional differences still hold after controlling for covariates.

Table 2. Log Odds of HIV Status by Selected Regions in Tanzania: THMHIS 2007-2008 Women

	Model 1				Model 2			
HIV positive	β	p-value	CI		β	p-value	CI	
Arusha	-1.61	0.022	-2.97	-0.24	-1.62	0.023	-3.00	-0.23
Pwani	0.77	0.088	-0.12	1.65	0.79	0.082	-0.10	1.68
Iringa	1.68	0.000	0.90	2.46	1.91	0.000	1.11	2.70
Mbeya	0.88	0.037	0.05	1.71	1.00	0.017	0.18	1.82
Shinyang	0.77	0.067	-0.05	1.59	1.04	0.013	0.22	1.86
Mara	0.79	0.068	-0.06	1.64	0.75	0.082	-0.09	1.60
Unguja	-1.52	0.002	-2.48	-0.56	-1.57	0.003	-2.62	-0.52
Pemba	-2.57	0.000	-3.71	-1.44	-2.19	0.000	-3.35	-1.03
(Dodoma)								
Constant	-3.16	0.000	-3.87	-2.45	-4.38	0.000	-5.46	-3.29
N	8710				8710			

Table 3 presents the log odds of the random-effects logistic regression models for women. The coefficients of STI are significant in all models, and the size and significance are rather stable, showing independent influence. Women with STI have significantly higher log odds (β=0.60, p=0.036) compared to those who did not report STI net of all covariates in Model 4. The coefficients of the sexual debut are rather stable in the magnitudes and significance. Those who had sex at an earlier age are more likely to be HIV positive. This also indicates an independent influence. However, another behavioral risk factor of multiple partners is not significant. HIV knowledge is marginally significant ($p<0.1$). Women who are from the richest households are significantly more likely to be HIV positive compared to those who are from the poorest households (β=0.80, p=0.000), whereas other women are not significantly different from the women from the poorest household. Among the risk factors, STI, sexual debut and

household wealth are significant in the final model. The total variance accounted by between-region difference is 15% after controlling for covariates.

Table 3. Random-effect logistic regression: HIV status by Risk Factors THMHIS 2007-2008 Women

	Model 1				Model 2				Model 3				Model 4			
HIV positive	β	p-value	CI		β	p-value	CI		β	p-value	CI		β	p-value	CI	
Age	0.01	0.094	0.00	0.02	0.01	0.087	0.00	0.02	0.01	0.175	0.00	0.02	0.01	0.126	0.00	0.02
Incomplete Primary	0.25	0.170	-0.11	0.61	0.25	0.177	-0.11	0.61	0.29	0.116	-0.07	0.65	0.23	0.220	-0.14	0.59
Complete Primary	0.40	0.005	0.12	0.68	0.40	0.005	0.12	0.68	0.46	0.001	0.18	0.75	0.29	0.056	-0.01	0.59
Incomplete Secondary	0.19	0.456	-0.32	0.70	0.19	0.470	-0.32	0.70	0.35	0.191	-0.17	0.86	-0.08	0.785	-0.62	0.47
Secondary or higher	0.93	0.032	0.08	1.77	0.94	0.029	0.10	1.79	0.98	0.025	0.13	1.84	0.43	0.339	-0.45	1.31
(No education)																
Married	0.71	0.001	0.31	1.10	0.70	0.001	0.30	1.10	0.08	0.702	-0.34	0.50	0.12	0.579	-0.30	0.54
Living together	1.49	0.000	1.02	1.96	1.48	0.000	1.01	1.94	0.85	0.001	0.36	1.33	0.87	0.000	0.38	1.36
Widowed/divorced	2.07	0.000	1.64	2.50	2.06	0.000	1.63	2.48	1.43	0.000	0.99	1.88	1.48	0.000	1.03	1.93
(Never married)																
Had symptom					0.69	0.017	0.12	1.25	0.61	0.035	0.04	1.17	0.60	0.036	0.04	1.17
Missing					-0.56	0.451	-2.01	0.89	-0.55	0.455	-2.00	0.90	-0.57	0.442	-2.02	0.88
(No Symptoms)																
7-15									2.08	0.000	1.18	2.99	2.04	0.000	1.14	2.95
16-17									1.85	0.000	0.94	2.75	1.80	0.000	0.89	2.70
18-19									1.75	0.000	0.83	2.67	1.69	0.000	0.77	2.61
20 +									1.68	0.001	0.73	2.63	1.60	0.001	0.65	2.55
Missing									2.06	0.000	1.07	3.06	2.02	0.000	1.03	3.01
(Never had sex)																
Had multiple partner									0.17	0.525	-0.35	0.69	0.19	0.482	-0.34	0.71
(Did not have multiple partner)																
Have Comprehensive knowledge of aids													0.20	0.081	-0.02	0.43
Never heard about HIV													0.59	0.183	-0.28	1.46
(Do not have comprehensive knowledge)																
Poorer													0.15	0.405	-0.21	0.52
Middle													-0.07	0.727	-0.45	0.31
Richer													0.17	0.373	-0.20	0.53
Richest													0.80	0.000	0.43	1.18
(Poorest)																
Constant	-4.60	0.000	-5.19	-4.00	-4.61	0.000	-5.20	-4.02	-5.87	0.000	-6.80	-4.93	-6.09906	0.000	-7.06	-5.13
sigma_u	0.78				0.77				0.73				0.76			
rho	0.15				0.15				0.14				0.15			
N	8710				8710				8710				8710			

Men

The cross-tabulations show that regional differences are significantly associated with HIV status, male circumcision, behavioral risk factors (multiple partners, age of sexual debut), and structural risk factors (knowledge of AIDS/HIV and wealth), but not with STI. The associations between HIV status and male circumcision, STI, multiple partners, age of sexual debut, and wealth are significant, but HIV knowledge is not.

Table 4 shows the log odds of the probability of being HIV positive by regions. Model 1 coefficients are unadjusted, and Model 2 presents adjusted coefficients net of other covariates in the model. Only four regions — Dar es Salaam, Iringa, Mbeya and Pemba — are significantly different from Dodoma, as opposed to nine regions for women in Model 1. Only Iringa and Pemba are significant ($p<0.05$). This suggests the regional variation could be smaller for men than for women.

Table 4. Log Odds of HIV Status by Selected Regions in Tanzania: THMHIS 2007-2008 Men

	Model 1				Model 2			
HIV positive	β	p-value	CI		β	p-value	CI	
Dar es Salaam	1.30	0.065	-0.08	2.67	0.87	0.231	-0.55	2.29
Iringa	1.77	0.011	0.40	3.14	1.42	0.041	0.06	2.77
Mbeya	1.45	0.038	0.08	2.83	1.10	0.123	-0.30	2.49
Pemba	-2.38	0.014	-4.28	-0.48	-2.16	0.024	-4.04	-0.28
(Dodoma)								
Constant	-3.75	0.000	-5.04	-2.45	-5.59	0.000	-7.02	-4.16
N	6330				6330			

Table 5 presents the results of the random-effects models for men. Two biomedical variables are significant. Circumcised men are significantly lower of HIV positive compared to uncircumcised men. The size of coefficient decreased with additional covariates slightly from -0.60 in Model 2 and -0.82 in Model 4. Men with STI are more likely to be HIV positive; the size of the coefficient decreased from Model 2 to Model 4. Early sexual debut is significantly associated with the log odds of HIV positive, but having multiple partners is not. Those who had sex at an earlier age are more likely to be HIV positive in all models, and the coefficients are rather stable. Having comprehensive knowledge is not significant for HIV status. Men from the richest households are more likely to be HIV positive compared to those from the poorest households. 12% of the total variance is explained by the regional differences net of covariates. The percent of the total variance by between-region difference of women did not decline from Model 1 to Model 4, but for men the proportion declined from 18% to 12%. This difference suggests that the regional characteristics might be an influence more for women than for men.

Table 5. Random-effect logistic regression: HIV status by Risk Factors THMHIS 2007-2008 Men

	Model 1				Model 2				Model 3				Model 4			
HIV positive	β	p-value	95% Confidence interval		β	p-value	95% Confidence interval		β	p-value	95% Confidence interval		β	p-value	95% Confidence interval	
Age	0.050	0.000	0.030	0.070	0.051	0.0000	0.031	0.071	0.049	0.000	0.029	0.070	0.051	0.000	0.031	0.071
Incomplete Primary	0.12	0.637	-0.39	0.64	0.16	0.5380	-0.35	0.68	0.20	0.446	-0.32	0.72	0.13	0.63	-0.39	0.65
Complete Primary	-0.16	0.498	-0.61	0.30	-0.07	0.7590	-0.53	0.39	-0.04	0.853	-0.50	0.42	-0.22	0.38	-0.69	0.26
Incomplete Secondary	-0.38	0.271	-1.05	0.30	-0.22	0.5270	-0.91	0.46	-0.15	0.662	-0.84	0.53	-0.52	0.15	-1.24	0.19
Secondary Plus	-0.05	0.917	-0.97	0.87	0.09	0.8510	-0.84	1.02	0.08	0.860	-0.85	1.02	-0.40	0.42	-1.36	0.56
(No education)																
Married	0.42	0.097	-0.08	0.92	0.41	0.1080	-0.09	0.91	0.14	0.590	-0.38	0.67	0.18	0.49	-0.34	0.71
Living together	0.39	0.318	-0.37	1.15	0.36	0.3510	-0.40	1.12	0.06	0.872	-0.72	0.84	0.12	0.77	-0.66	0.90
Widowed/divorced	1.24	0.000	0.61	1.87	1.23	0.0000	0.60	1.86	0.93	0.005	0.29	1.58	1.00	0.00	0.35	1.64
(Never married)																
Circumcised					-0.60	0.0030	-1.00	-0.20	-0.66	0.001	-1.06	-0.26	-0.82	0.00	-1.23	-0.41
Missing					-16.03	0.9960	-6162.38	6130.32	-14.70	0.993	-3432.22	3402.82	-16.44	1.00	-7772.52	7739.64
(Not circumcised)																
Had symptoms					0.71	0.0280	0.08	1.34	0.58	0.075	-0.06	1.22	0.63	0.06	-0.01	1.27
Missing					0.39	0.6060	-1.09	1.87	0.29	0.703	-1.19	1.77	0.37	0.62	-1.11	1.86
(No symptoms)																
7-15									0.97	0.015	0.19	1.75	1.00	0.01	0.20	1.80
16-17									0.80	0.050	0.00	1.61	0.82	0.05	0.01	1.64
18-19									0.93	0.021	0.14	1.71	0.92	0.02	0.12	1.72
20 +									0.60	0.144	-0.21	1.41	0.58	0.16	-0.24	1.41
Missing									-13.78	0.999	-29006.9	28979.3	-15.3	1.0	-68633.7	68603.1
(Never had sex)																
Had multiple partner									0.26	0.129	-0.08	0.61	0.24	0.17	-0.10	0.58
(Not had multiple partner)																
Have Comprehensive knowledge of aids													0.26	0.10	-0.05	0.57
Never heard about HIV													1.01	0.20	-0.52	2.55
(Do not have Comprehensive knowledge of aids)																
Poorer													-0.12	0.63	-0.64	0.39
Middle													0.20	0.44	-0.31	0.71
Richer													0.25	0.35	-0.28	0.77
Richest													0.76	0.01	0.19	1.34
(Poorest)																
Constant	-5.37	0.00	-6.14	-4.61	-5.07	0.00	-5.85	-4.29	-5.60	0.00	-6.52	-4.67	-5.78	0.00	-6.76	-4.80
sigma_u	0.86				0.76				0.71				0.66			
rho	0.18				0.15				0.13				0.12			
N	6330				6330				6330				6330			

Conclusion

We examined the influence of biomedical, behavioral and structural risk factors and the regional differences. We found that the regional differences still exists after controlling for age, education, marital status, STI, male circumcision for men, age of sexual debut, multiple partners, HIV knowledge, and household wealth. To examine the influence of biomedical, behavioral and structural risk factor on HIV prevalence and how much the variance is accounted by the regional differences, we conducted the random-effects logistic regression. The results confirmed that STI increases the HIV infection prevalence for both men and women and that male circumcision decreases the HIV infection prevalence. Also, early sexual debut increases the HIV infection for both. Knowledge of HIV is not significant. Men and women in the wealthiest households are more likely to be infected by HIV. Still, unobserved variance accounted by the regional differences exists.

Our findings confirm the importance of considering biomedical, behavioral and structural risk factors on the HIV prevalence in Tanzania. Moreover, these risk factors might be independently influencing HIV infection. Our findings also inform the importance of examining regional characteristics and different regional influences on men and women. Only two regions are significantly different from Dodoma, the capital: one of them is Pemba Island, which has the lowest prevalence rates; the other is Iringa, with the highest rates. In Tanzania, the high HIV prevalence rate of Iringa is a serious concern. Our findings call for further examination of regional characteristics and HIV prevalence. Moreover, the research also directs important considerations of regional differences to "design the optimal package of interventions that

matches the epidemiologic profile of a target population, delivering that package at the population level" (Kurth et al.:62).

The limitation of the current study is that it is cross-sectional. We did not consider the regional-level characteristics. We used a whole sample including sexually experienced and never sexually experienced. Tanzanians might become infected with HIV via a different route.

We will examine additional behavioral risk factors(i.e. condom use), structural factors (i.e. attitudes towards HIV, and households' characteristics), and regional characteristics to deepen our understanding of how these risk factors influence HIV prevalence by using the multilevel logistic analysis. In addition, we will perform analyses focusing on HIV prevalence between Iringa and other regions.

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