ORIGINAL RESEARCH

Determinants of HIV/AIDS prevention and transmission knowledge factors among women aged 15-49: a trend analysis based on the Bangladesh Demographic and Health Survey

Rezaul Karim Ripon, BPH [1,2], Shahriar Hossain, BPH [1,2], Shahrina Tasnim Manami, BPH [1], Mahmuduzzaman Rifat, BPH [1], Umma Motahara, BPH [1]

Abstract

Background: The number of HIV/AIDS cases is increasing daily. It had risen by more than 300% in the last seven years (from 1,207 cases in 2007 to 3,674 in 2014). Knowledge is linked to HIV/AIDS prevention and transmission. This study aimed to assess the factors of HIV/AIDS prevention and transmission knowledge among Bangladeshi reproductive-aged women from 2007 to 2014. **Methods:** We conducted a retrospective cross-sectional comparison study based on secondary data from BDHS on knowledge of HIV/AIDS transmission and prevention methods. In the study, we included a total of 46,608 unweighted individuals, ever married women (15-49 years). Multinomial logistic regression was used to examine the effect of the explanatory variables on knowledge of HIV prevention and transmission. **Results:** The prevalence of knowledge about HIV/AIDS prevention and transmission methods displayed a trend of significant increase, but HIV/AIDS prevention methods knowledge was found to be lower than knowledge about transmission. The mean difference of HIV/AIDS transmission knowledge was 62% [(95% of CI: 60%-64%), p-value <.001], whereas the mean difference of HIV/AIDS prevention methods knowledge was 50% [(95% of CI: 37%-63%), p-value .004]. For 2007, wealth index, region, highest education, and type of residence; for 2011, wealth index, highest education, and type of residence; and for 2014, age, marital status, wealth index, and highest education, respectively, were shown haves significant associations with knowledge status of HIV/AIDS prevention and transmission. Thus, the highest education and wealth index variables were found to be significant for the 2007-2014 period. **Conclusion:** HIV/AIDS prevention and transmission knowledge (medium and high status) were found to be in increment. In the Khulna region, the knowledge level was low. And in our study, another significant finding was the importance of education. In order to increase knowledge, the policy maker should organize HIV/AIDS-related health education programs with particular attention to the region and educational level of the people. **Keyword:** HIV/AIDS Prevention knowledge; HIV/AIDS Transmission knowledge; Bangladesh National Health Survey.

[1]Department of Public Health and Informatics, Jahangirnagar University, Dhaka, Bangladesh
[2]McHigher Center for Diseases Prevention

Received: April 30, 2023.
accepted: June 6, 2023.
Conflict of interest: none.

Introduction:

HIV is responsible for the transmission of AIDS from human to human, which can occur through unsafe sexual interaction, intravenous injections with contaminated needles, unscreened or contaminated blood exchange, and mother-child contact during pregnancy, delivery, or breastfeeding (1). Although the prevalence rate of HIV/AIDS in Bangladesh is relatively low for

Southeast Asia (the rate is less than 1%), (3) the number of cases is increasing daily. In Bangladesh, there were 126 HIV/AIDS positive cases in 1999, compared to 157, 188, 248, 363, 465, 668, 1,207, and 3,674 cases in each of the following years, respectively: 2000, 2001, 2002, 2003, 2004, 2005, 2007, and 2014 (4)(5). This indicates that the number of HIV/AIDS cases has risen in recent years (6). According to UNICEF, married couples account for most cases of HIV/AIDS transmission in Bangladesh (6). The rate is smaller amongst educated people. The more knowledge about transmission and prevention methods of HIV/AIDS someone has, the smaller the probability of being infected (3).

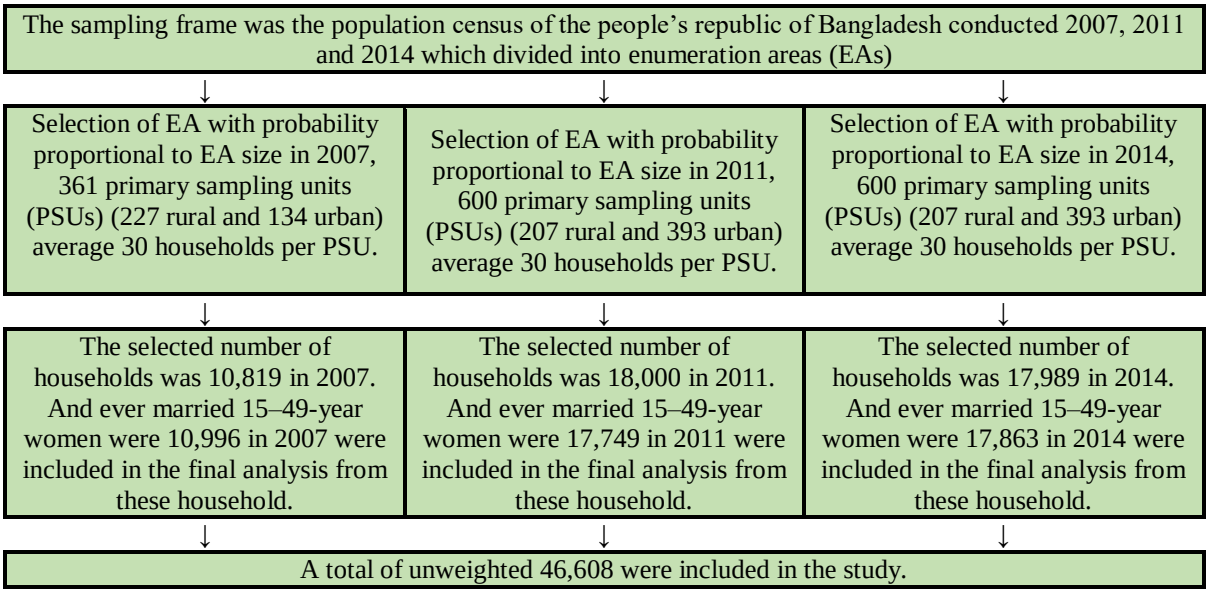
Moreover, the risk of HIV/AIDS is high in Bangladesh due to the extensive prevalence of risk factors, such as lack of awareness about HIV/AIDS, inadequate knowledge about HIV/AIDS transmission, insufficient knowledge about HIV/AIDS prevention, high amount of transport workers and migrants, unprotected sex (4), ideas about sexual reproductive health (7), symptoms of HIV/AIDS (8), female sex workers who use IUDs, low levels of education, poverty, and lack of knowledge about sexually transmitted infections (9). Furthermore, HIV/AIDS is considered a curse by people since information and essential services are insufficient. People of reproductive age (ever married women and adolescents) are more vulnerable as they are more susceptible to HIV/AIDS, which leads to rapid transmission to other age groups.

Parents feel uncomfortable discussing HIV/AIDS-associated issues with their adolescent children, and educational institutions supply marginal information on HIV/AIDS. Similarly, social and cultural restrictions keep adolescents from accessing information about HIV/AIDS transmission and prevention methods. This is a significant hindrance for developing the perceptions required for prevention. Since knowledge is associated with behavior, insufficient knowledge leads to unsafe sex, which results in HIV/AIDS transmission. Therefore, knowledge is the predominant factor in HIV/AIDS infection. In addition, it has been found that HIV/AIDS knowledge varied within enumeration locations and crosswise divisions, causing cluster effects to be significant. Urban men and women have more knowledge than rural people, which helps in the eradication of misconceptions, in addition to controlling the prevalence of HIV/AIDS. The area of coverage for preventing HIV/AIDS in Bangladesh is also limited (10). The preventative measures of HIV/AIDS are slightly inadequate and slow-paced in remote areas (10). According to UNICEF Sylhet, Dhaka, Chittagong & Khulna were the districts with the most reported HIV/AIDS cases in Bangladesh. But among those districts, the hilly area of Chittagong had a minimal scope of monitoring (10). The use of contraceptive methods such as condoms increases with educational level and wealth quintile, while the usage of injectables decreases as household income rises (11),(12). Adolescents are learning during secondary school to spread knowledge about HIV/AIDS and keep the prevalence rate low. A previous study shows that the students who attend training programs about HIV/AIDS transmission & prevention have a better understanding than the rest (13). According to UNAIDS, achieving zero new HIV infections, zero discrimination, and zero AIDS-related deaths is required to better the health of women and girls (14)(16)(17).

Considering the low degree of consciousness with respect to HIV/AIDS, particularly among vulnerable groups (adolescents, women of reproductive age, and ever-married women) and the general population, the government of Bangladesh established a National Strategic Plan, which led to an increment in HIV/AIDS treatment coverage from 37% in 2015 to 61% in 2020 (2). The World Health Organization (WHO) reported that from 2016 to 2020, the number of people acquiring HIV/AIDS declined by 29%, and the number of people dying from HIV/AIDS-related causes decreased by 48% between 2015 and 2020 (2).

Adequate knowledge and accurate information about HIV/AIDS to reduce infection and its outcomes are also essential (18). Education and behavior are also important factors in HIV/AIDS prevention (19). Studies have shown that increasing the knowledge of HIV/AIDS can significantly reduce the risk of HIV/AIDS transmission (20). Some studies have tried to determine the factors related to HIV/AIDS infections in a single survey (in 2007, 2011, and 2014, respectively). In this study, we compare these surveys, including a trend analysis. Therefore, this study aimed to assess the factors of HIV/AIDS prevention and transmission knowledge in Bangladeshi women of reproductive age from the BDHS survey from 2007 to 2014.

The sampling technique diagram is given below



Methods

Data Source, Study Area, and sampling procedure:

From 2007 to 2014, HIV/AIDS cases increased by 300% (from 1,207 cases in 2007 to 3,674 in 2014), and we included three national surveys based on data from 2007 to 2014 (4). Data for this study were obtained from the 2007, 2011, and 2014 annual reports of the Bangladesh Demographic and Health Survey (BDHS) (21)(22)(23). The BDHS survey was nationally representative, cross-sectional, and carried out in 2007 from January to March; in 2011 from July 8th to December 27th; and in 2014 from June 28th to November 9th. The BDHS was based on a two-stage stratified sample of households. The National Institute of Population Research and Training (NIPORT), a renowned organization for health-related research in Bangladesh, directed the survey. The survey was a part of the International Demographic and Health Survey program, known as DHS, which operates in 90 countries and is sponsored of the United State Agency for International Development (USAID) and mechanical support of ICF (International of Calverton) based in the USA. We included the sampling technique of this study in the following diagram.

Variable selection

Knowledge of HIV/AIDS prevention and transmission methods were the dependent variables in this study. A set of four questions related to knowledge of HIV/AIDS prevention methods and five questions related to knowledge of HIV/AIDS transmission methods were taken from the BDHS survey. The question's answer had three categories: yes/no/don't know. Categorical Principal Component Analysis (PCA) was conducted, the variables were quantified, and object scores were produced for each case. With all the component loadings being positive, the object scores identified the performance of each point in the given domain. Object scores were calculated using Categorical PCA, and then ranked into tertiles, i.e., Low, Medium, and High scores on the dimension of HIV knowledge, with 3 designating low, 2 medium, and 1 as high score (20). Multiple kinds of literature were reviewed, concentrating on demographic and household status, to ease the choice of relevant covariates in the context of HIV/AIDS prevention methods and transmission awareness (4)(20). According to the

available variables in the dataset, we picked the following objects for study: Age, Marital Status, Region, Type of Residency, Educational Level, and Household Wealth Index for the independent variables. Respondents' age in five-year groups was applied as a categorical variable. We used Currently married, Divorced/separated/ widowed categories for the marital status variable. The type of residence was classified into two sections: rural and urban. The educational status categories were: no education, primary education, secondary education, and having higher education. We also involved the household wealth index in our analysis, as it has been considered a consistent parameter of household financial state impacting overall living conditions and health status. BDHS surveys use five categories based on comprehensive income and wealth status: poorest, poorer, middle, richer, richest.

Statistical analysis

We measured descriptive statistics for the weighted prevalence of HIV/AIDS prevention and transmission knowledge-related questions and socio-demographic variables for Bangladeshi women of reproductive age in BDHS (from 2007-2014). The individual weight for women (v005) was the household weight (hv005) multiplied by the inverse of the individual response rate for women in the stratum (24). Cross tabulation and $\chi 2$ test were performed for associated probabilities and to check for a statistical association between groups, based on knowledge of HIV/AIDS prevention and transmission status score (object score) among Bangladeshi women of reproductive age. The response variable was divided into tertiles with ties to the mean, such as those with high, medium, or low scores (20). Univariate analysis was used for HIV/AIDS prevention methods, and we used transmission knowledge with positive response and t-tests to examine the mean difference (25). Given the nature of the dependent variable, we used multinomial logistic regression analysis to adjust for potential confounders and explore the independent effect of the explanatory variables on knowledge of HIV/AIDS prevention and transmission. All the variables were entered into a regression model (before performing univariable analysis, multivariable model comparisons, linearity assumption, interactions among covariates, and assessing the model's fit) (26). Odds ratios were measured to evaluate the likelihood of having high or lower status among groups than medium status, particularly socioeconomic and other characteristics. Results of regression analysis were presented as p-values and odds ratios. The association of variables was considered statistically significant if the two sides' p-value was less than 0.05. Data analysis was performed using the R programming language.

Results

Socio-demographic characteristics of the sample population

In Table 1, the socio-demographic characteristics of the weighted sample population were presented. The 30-39 years age group presented a higher rate (28.43%), while participants from the 15-19 age group had a lower rate (9.65%) from 2007 to 2014. Nearly two-thirds of the participants of the total sample population were rural residents (74.73%), and about one-third (29.33%) had no education from 2007 to 2014. Approximately 30.07% of the participants had primary education, 26.57% had secondary education, and only 12.60% had completed their higher education from 2007 to 2014. Participants were scattered throughout the various regions of the country, with the top three areas in frequency being Dhaka, Khulna, and Chittagong.

Knowledge of HIV/AIDS prevention and transmission:

People who heard about HIV/AIDS and their knowledge of HIV/AIDS prevention and transmission are presented in table 2. Overall HIV/AIDS prevention method knowledge rates were 44.30%, 53.00%, 53.10% for 2007, 2011 and 2014, respectively. And for transmission knowledge, the rates were 61.00%, 61.70%, and 62.70% for 2007, 2011, and 2014, respectively. The mean difference of HIV/AIDS transmission knowledge status was 62% [(95% of CI: 60%-64%), p-value <.001] and the mean difference of HIV/AIDS prevention methods knowledge status was 50% [(95% of CI: 37%-63%), p-value .004]. That means that average HIV/AIDS transmission knowledge was 62%, whereas the average of HIV/AIDS prevention methods knowledge was 50% from 2007 to 2014. Knowledge of HIV/AIDS prevention methods was lower than knowledge of HIV/AIDS transmission methods, although the prevalence of knowledge is increasing significantly.

Table 1 Socio-demographic characteristics of the weighted participants

Variable	Frequency (%)			
	2007	**2011**	**2014**	Overall frequency
Age				
15–19	1444 (10.15%)	1991 (9%)	2245 (9.8%)	9.65%
20–24	4665 (32.8%)	3763 (17%)	3926 (17.1%)	22.30 %
25–29	2547 (17.9%)	4015 (18.1%)	5017 (21.8%)	19.27 %
30–39	4375 (30.8%)	6185 (27.9%)	6124 (26.6%)	28.43%
40-49	3393 (23.9%)	5186 (23.4%)	5713 (24.8%)	24.03 %
Ever marital status				
Divorced/separated/ widowed	3228 (22.7%)	3391 (15.3%)	4270 (18.5%)	18.83 %
Currently married	10996(77.3%)	17749 (84.7%)	18755 (81.5%)	81.17 %
Place of Residency				
Urban	3224(22.7%)	5568(25.1%)	6453 (28%)	25.27 %
Rural	11000(77.3%)	15572(74.9%)	16572 (72%)	74.73 %
Educational status				
No Education	4710(33.1%)	5802 (26.2%)	6606 (28.7%)	29.33 %
Primary	4326 (30.4%)	6454 (29.2%)	7053 (30.6%)	30.07 %
Secondary	3348 (23.5%)	6141 (27.7%)	6564 (28.5%)	26.57 %
Higher	1884 (13.2%)	2742 (12.4%)	2802 (12.2%)	12.60 %
Region				
Barisal	848 (6%)	1176 (5.3%)	1543 (6.7%)	6.00 %
Chittagong	2454(17.3%)	3741 (16.9%)	3989 (17.3%)	17.17 %
Dhaka	4308 (30.3%)	6831 (30.9%)	7123(30.9%)	30.70 %
Khulna	1734 (12.2%)	2569 (11.7%)	2987 (13%)	12.30 %
Rajshahi	3583 (25.2%)	3202 (14.5%)	3976 (17.3%)	19.00 %
Rangpur	402 (2.8%)	2481 (11.2%)	2734 (11.9%)	8.63 %
Sylhet	895 (6.3%)	1142 (5.4%)	673 (2.9%)	4.87 %

Table 2 Weighted prevalence of correct answers by questions who reported ever hearing about HIV

Factors	Questions		Prevalence of correct answer in %			Mean difference (95%of CI) , P-value
			2007	2011	2014	
Prevention method Questions	Using Condoms		48.9%	56.6%	55.1%	53% (46%-59%), <.001
	Limiting sexual intercourse to one infected partner		47.7%	59.9%	58.9%	56% (47%-65%), <.001
	Using Condoms and Limiting sexual intercourse to one infected partner		36.2%	47.4%	48.5%	47% (34%-59%), .001
	Abstaining from sexual intercourse		44.5%	48.1%	49.9%	48% (41%-54%), .001
	Overall prevalence		44.3%	53%	53.1%	50% (37%-63%), .004
Transmission method Questions	Using unsterilized needle and syringe		69.7%	72.6%	72.5%	72% (68%-76%), <.001
	Via Blood transfusion		70.5%	73%	72.5%	72% (69%-75%), <.001
	Both		67.7%	70.3%	69.4%	69% (67%-71%), <.001
	Mother to child transmission of HIV	During Pregnancy	58.7%	55.5%	58.8%	58% (54%-62%), <.001
		During Delivery	47.7%	43.7%	45.5%	46% (41%-51%), .001
		By breastfeeding	56.1%	55.1%	57.1%	56% (54%-58%), <.001
	Overall prevalence		61%	61.7%	62.7%	62% (60%-64%), <.001

Aggregated status of knowledge of HIV/AIDS prevention and transmission was measured by three categorical variables (high status, medium status, and low status). The status is shown in table 3. The high knowledge status of HIV/AIDS prevention and transmission was 21.02%, 29.90%, and 35.60%, respectively, for 2007, 2011, and 2014. The medium knowledge status of HIV/AIDS prevention and transmission was 35.90%, 39.50%, and 47.50%, respectively, for 2007, 2011, and 2014. The low knowledge status of HIV/AIDS prevention and transmission was 43.08%, 30.60%, 16.60%, respectively, for 2007, 2011 and 2014. That means that the higher and medium knowledge status of HIV/AIDS prevention and transmission increased from 2007 to 2014. For 2007, wealth index, region, highest education, and type of residence; for 2011, wealth index, highest education, and type of residence; and for 2014, age, marital status, wealth index, and highest education; were shown to have significant associations with knowledge status of HIV/AIDS prevention and transmission. This means that the highest education and wealth index variables were significant for all years ($p<.005$) from 2007 to 2014. Region and types of residence were insignificant, but marital status and age were significant. Factors correlated with the level of HIV/AIDS prevention and transmission knowledge are shown in Table 3. A comparison between participants' knowledge scores in HIV/AIDS prevention and transmission methods related to socio-demographic variables (age, residency, education, region) and the household variable (wealth index) indicates a significant association. Place and areas of residence, as well as marital status were all significantly associated with the level of HIV/AIDS prevention and transmission method knowledge at different times.

Table 4 lists the influencing variables. Ages 21 to 30 had higher knowledge status than older ages. In 2007, it was 1.96 times higher, while in 2014, it was 1.06 times higher. Divorced/separated/ widowed marital status was associated with a higher knowledge status than currently marriage. It was 1.38 times higher in 2007 and 2.08 times higher in 2014. Dhaka, Rajshahi, and Rangpur districts had a higher knowledge status than others.

Additionally, the Khulna division had a lower knowledge of HIV/AIDS. All variables weren't significant for all years in chi-square analysis, but we used all variables to understand the best impact on higher education and wealth index variables. People with higher education status were 2.71 times more likely in 2007, 3.71 times more likely in 2011, and 3.91 times more likely in 2014 to have higher knowledge status compared to lower education status. Respondents with secondary education had medium knowledge status, and respondents with primary education had lower knowledge status compared to others. People with a rich wealth index were 1.63 more likely times in 2007, 2.41 times more likely in 2011, and 2.52 times more likely in 2014 to have higher knowledge status compared to others, while the median wealth index was associated with medium knowledge status.

Discussion:

Our study showed that the population's age, education, living condition, and wealth index affect the transmission and prevention of HIV/AIDS. Despite having a low prevalence rate in Bangladesh in comparison to other Asian countries, HIV/AIDS can be a potential threat due to the pervasive expansion of risk factors (27)(28)(29)(30).

In 2014, 55.10% of people in Bangladesh were familiar with one of the effective prevention methods of HIV/AIDS, which is using condoms during sexual intercourse. In contrast, in 2007 and 2011, the percentages were 48.90% and 56.60%, respectively. The practice of using condoms during sexual intercourse was higher in some Asian countries, such as Myanmar (60% in 2008) (31), Cambodia (74% in 2005) (31) than in African countries like Uganda (58% in 2005) (22), Tanzania (58% in 2005) (32), Sudan (39.10% in 2020) (33). Literature suggest that almost 97% of Bangladeshis have heard about HIV/AIDS, and 78.3% believe that unsafe sex is the pathway to HIV/AIDS transmission (9). Moreover, 48% of males were conscious of at least two proper ways of preventing transmission of HIV/AIDS, and the other 43% knew of at least two correct modes of transmission (13). Furthermore, 40% of people had misconceptions about the spread of HIV/AIDS from contaminated persons (34). In this study, a considerable number of people in Bangladesh knew about the two common ways of HIV/AIDS transmission, which are using unsterilized needles

Table 3 Factors correlated with level of HIV prevention and transmission knowledge

	HIV prevention and transmission knowledge **Status**								
	High Status			**Medium Status**			**Low Status**		
	2007	**2011**	**2014**	**2007**	**2011**	**2014**	**2007**	**2011**	**2014**
Age									
15–19 years	1.30%	2.20%	3.20%	4.90%	5.20%	6.50%	4.50%	4.40%	3.30%
20–24 years	5.10%	7.10%	6.20%	5.80%	6.30%	7.60%	9.10%	5.20%	2.40%
25–29 years	5.10%	5.30%	8.10%	4.30%	8.10%	8.60%	7.90%	3.30%	1.40%
30–34 years	3.70%	5.60%	7.20%	6.30%	6.40%	7.40%	5.90%	3.10%	1.20%
35–39 years	3.20%	5.20%	3.50%	3.90%	4.20%	6.10%	6.10%	5.10%	2.70%
40–44 years	2.32%	2.80%	4.20%	5.80%	5.50%	5.60%	4.30%	4.40%	3.50%
45–49 years	0.30%	1.70%	3.20%	4.90%	3.80%	5.70%	5.28%	5.10%	2.10%
Ever marital status									
Currently married	11.52%	16.40%	20.90%	18.70%	20.90%	24.80%	22.60%	16.10%	7.70%
Divorced/separated/ widowed	9.50%	13.50%	14.70%	17.20%	18.60%	22.70%	20.48%	14.50%	8.90%
Wealth Index									
Poorest	2.50%	4.10%	4.50%	3.10%	6.20%	8.30%	6.08%	4.50%	1.20%
Poor	3.14%	6.10%	5.80%	5.40%	8.60%	8.70%	8.10%	4.50%	2.50%
Middle	3.68%	7.20%	9.20%	8.90%	7.20%	9.20%	10.90%	6.20%	3.10%
Rich	4.80%	6.30%	8.30%	9.60%	7.30%	10.20%	8.90%	7.10%	4.70%
Richest	6.90%	6.20%	7.80%	8.90%	10.20%	11.10%	9.10%	8.30%	5.10%
Highest Education									
No Education	3.70%	4.60%	7.10%	7.20%	7.30%	7.30%	7.10%	5.20%	2.50%
Primary	5.82%	8.40%	8.30%	8.20%	9.10%	9.40%	12.18%	8.16%	5.30%
Secondary	6.70%	10.60%	10.90%	9.20%	13.60%	14.30%	16.90%	11.90%	6.70%
Higher	4.80%	6.30%	9.30%	11.30%	9.50%	16.50%	6.90%	4.80%	2.10%
Region									
Barisal	2.90%	5.10%	3.30%	3.30%	4.30%	5.10%	4.30%	3.70%	3.90%
Chittagong	3.10%	6.30%	3.90%	3.90%	4.90%	6.10%	4.90%	5.10%	1.20%
Dhaka	4.72%	4.70%	5.20%	5.20%	5.10%	7.50%	4.90%	6.10%	2.80%
Khulna	4.50%	4.50%	5.80%	5.80%	7.80%	10%	7.80%	4.10%	2.30%
Rajshahi	2.40%	3.80%	6.40%	6.40%	6.40%	5.50%	8.40%	3.60%	2.90%
Rangpur	1.50%	2.70%	5.10%	5.40%	5.60%	6.50%	6.40%	4.50%	2.10%
Sylhet	1.90%	2.80%	5.90%	5.90%	5.40%	6.90%	6.38%	3.50%	1.40%
Type of Residence									
Urban	7.90%	16.40%	18.70%	18.70%	20.70%	27.60%	22.70%	13.70%	7.40%
Rural	13.12%	13.50%	16.90%	17.20%	18.80%	19.90%	20.38%	16.90%	9.20%
Overall	21.02%	29.90%	35.60%	35.90%	39.50%	47.50%	43.08%	30.60%	16.60%

*Significant at $p < 0.05$

Table 4: Influencing factors of HIV prevention and transmission knowledge.

		Influencing factors of HIV prevention and transmission knowledge		
		2007	2011	2014
		OR (95% of CI)	OR (95% of CI)	OR (95% of CI)
High Score vs low score	Age			
	15–19 years	4.32(2.78-8.82) *	1.16(.14-5.12) *	0.36(.03-3.1)
	20–24 years	2.31(1.83-4.45) *	1.57(1.4-1.8) *	4.29(1.2-9.4)
	25–29 years	1.96(1.83-12.1) *	.66(.54-.82) *	1.06(0.01-5.9) *
	30–34 years	1.11(0.01-4.36) *	.21(.04-3.32) *	.63(.13-8.74)
	35–39 years	0.96(.83-1.1) *	1.1(.91-1.3) *	.05(.04-4.06)
	40–44 years	1.5(1.3-1.8)	2.5(1.9-3.41)	.95(.01-8.1) *
	45–49 years	1	1	1
	Ever marital status			
	Currently married	1	1	1
	Divorced/separated/ widowed	1.38(0.34-7.44) *	0.57(0.05-8.65)	2.08(1.92-11.24) *
	Wealth Index			
	Poorest	1	1	1
	Poor	2.5(1.23-8.58) *	1.89(1.74-11.06) *	1.17(0.14-6.21) *
	Middle	.87(.04-9.81) *	1.17(.34-4.21) *	.12(0.01-2.29) *
	Rich	1.63(0.05-2.93) *	2.41(3.03-9.84) *	2.52(0.06-4.26) *
	Richest	.17(.14-.21) *	.17(.01-6.21) *	.09(.03-4.21) *
	Highest Education			
	No Education	1	1	1
	Primary	1.4(1.26-11.24) *	0.16(0.11-2.36) *	2.71(1.64-9.78) *
	Secondary	0.44(0.02-2.71) *	1.86(.02-4.56) *	0.02(.01-4.11) *
	Higher	2.71(.64-6.78) *	3.71(.64-6.18) *	3.91(.64-4.18) *
	Region			
	Barisal	1	1	1
	Chittagong	1.21(0.04-5.32) *	0.11(.02-7.31)	2.1(1.14-15.31) *
	Dhaka	0.08(0.06-13.98) *	0.8(.6-7.98) *	0.2(0.1-9.98) *
	Khulna	.04(.03-6.05) *	0.4(.01-7.05) *	1.1(.03-16.5)
	Rajshahi	0.96(0.2-7.3) *	0.16(.07-9.3) *	1.96(1.7-2.3) *
	Rangpur	3.16(1.14-8.71)	0.81(.01-6.35) *	0.1(.01-3.34) *
	Sylhet	1.1(0.9-6.51) *	0.11(.04-8.38) *	0.21(.1-7.81)
	Type of Residence			
	Urban	1.81(1.21-16.93) *	.81(.1-.91) *	2.81(1.31-9.93)
	Rural	1	1	1
Medium Score vs low score	Age			
	15–19 years	1	1	1
	20–24 years	2.31(1.83-4.45) *	1.57(1.4-1.8)	4.29(1.2-9.4) *
	25–29 years	1.96(1.83-12.1)	.66(.54-.82)	1.96(1.81-5.9) *
	30–34 years	1.11(0.01-4.36) *	.21(.04-3.32) *	.63(.13-8.74)
	35–39 years	0.96(.83-1.1) *	1.1(.91-1.3) *	.05(.04-4.06)
	40–44 years	1.5(1.3-1.8)	2.5(1.9-3.41)	.95(.01-8.1) *
	45–49 years	4.32(2.78-8.82)	1.16(.14-5.12) *	0.36(.03-3.1) *
	Ever marital status			
	Currently married	1	1	1
	Divorced/separated/ widowed	0.25(0.08-1.45) *	1.09(0.08-7.65) *	0.85(0.75-4.96)
	Wealth Index			
	Poorest	1	1	1
	Poor	.5(1.23-8.58) *	1.89(1.74-11.06) *	3.17(3.14-6.21) *
	Middle	.87(.04-9.81) *	.17(.34-4.21) *	.12(0.01-2.29) *
	Rich	0.63(0.05-2.93) *	0.4103.03-9.84) *	0.02(0.06-2.26) *
	Richest	.17(.14-.21) *	.17(.01-6.21) *	.09(.03-4.21) *
	Highest Education			
	No Education	1	1	1
	Primary	0.4(1.26-11.24) *	0.16(0.11-2.36) *	1.71(1.64-9.78) *
	Secondary	.44(0.02-2.71) *	1.86(.02-4.56) *	0.02(.01-4.11) *

	Higher	0.71(.64-6.78) *	0.71(.64-3.18) *	0.71(.64-4.18) *
	Region			
	Barisal	1	1	1
	Chittagong	1.21(0.04-5.32) *	0.11(.02-7.31*)	2.1(1.14-15.31) *
	Dhaka	0.08(0.06-13.98)	0.8(.6-7.98) *	0.2(0.1-9.98)
	Khulna	.04(.03-6.05) *	0.4(.01-7.05)	1.1(.03-16.5) *
	Rajshahi	0.96(0.2-7.3)	0.16(.07-9.3) *	1.96(1.7-2.3) *
	Rangpur	3.16(1.14-8.71) *	0.81(.01-6.35)	0.1(.01-3.34)
	Sylhet	1.1(0.9-6.51) *	0.11(.04-8.38) *	0.21(.1-7.81) *
	Type of Residence			
	Urban	1.81(1.21-16.93) *	.81(.1-.91) *	2.81(1.31-9.93)
	Rural	1	1	1

*Significant at $p < 0.05$

and syringes (69.7%, 72.6%, and 72.5% in 2007, 2011, and 2014, respectively) and blood transfusion (70.5%, 73%, and 72.5% in 2007, 2011, and 2014, respectively). In addition to analyzing the results of 2007-2014, on average, 69.13% of the population of Bangladesh knew both ways of transmission. Mother-to-child transmission during pregnancy, delivery, and breastfeeding was another important way of HIV/AIDS transmission. Correspondingly, women of reproductive age in Bangladesh had moderate knowledge on mother to child HIV/AIDS transmission (on average, 57.66% of people know HIV/AIDS transmits from mother to child during pregnancy). However, studies show that the percentage was higher than Bangladesh in Mideast and African countries (32,33). The knowledge of mother-to-child HIV/AIDS transmission during pregnancy was 93% in Uganda (32), 89.20% in Yemen (33), 70.10% to 89% in Jordan (33), 80% in Sudan (33), and 75.40% in Egypt (33). Moreover, the knowledge of transmission during delivery in Jordan, Sudan, Egypt, Tanzania, and Uganda was 54.60%, 80%, 70.40%, 67%, and 93%, respectively (32),(33). It was noticeable that the knowledge rate on this particular transmission method has decreased in Bangladesh. In 2007, the rate was 47.70%, whereas in 2011, it was 43.50%, and in 2014 it was 45.50%. Finally, the mother-to-child HIV/AIDS transmission during breastfeeding knowledge rate was 56.10% in 2007, 55.10% in 2011, and 57.10% in 2017 in Bangladesh. In Yemen it was 59%, in Jordan 42.30%, in Sudan 71%, in Egypt 51.70%, in Tanzania 86%, and in Uganda 86% (32)(33)(35). Those with the rich wealth index had a high score on HIV/AIDS prevention and transmission knowledge, which was an increasing trend. And those with a poor wealth index had a medium score for HIV/AIDS prevention and transmission knowledge, also a rising trend. Household wealth status was significantly associated with HIV/AIDS prevention and transmission methods, as more prosperous people have higher scores than poorer people. According to WHO, economic solvency covers necessities (proper living conditions, education, healthcare services) that fulfill the need for adequate health communication and knowledge achievement (37).

Our study suggested that amongst those aged 25-29 years, currently married people with a higher wealth index and a higher education level in Dhaka city exhibited higher knowledge status from 2007-2014. Khulna division had lower knowledge, although, according to UNICEF, there was a lower monitoring gap in the Chittagong district (6). Another study in Bangladesh showed that females between 15-24 years of age had better knowledge about prevention than about HIV/AIDS transmission (9). Our study suggests that educated people are more knowledgeable about HIV/AIDS. Prior studies had demonstrated that highly educated people have relatively lower chances of getting HIV/AIDS than those who are illiterate or have a low educational level (9). Proper education introduces people HIV/AIDS transmission methods, such as unsterilized needles or syringes, unsafe blood transfusion, mother to child transmission during pregnancy, delivery, or breastfeeding (38).

Moreover, education encourages people to use condoms and limit or refrain from sexual intercourse with infected partners, misconceptions that are barriers to achieving the ultimate goal of

removing HIV/AIDS, and which can be eradicated through proper knowledge of HIV/AIDS. A study in Malawi showed that wealth index and education are the primary determinants of prevention and transmission knowledge (39). And the awareness regarding HIV/AIDS prevention and transmission knowledge increases with the increase in accordance with the household wealth index (40). Many studies showed area of residence to be a significant predictor for several low- and middle-income countries (19),(41). Knowledge hubs were a significant global public health challenge for rural people regarding HIV/AIDS prevention and transmission (41). Urban regions had a high and medium score for HIV/AIDS prevention and transmission knowledge, a trend which can be seen in our study. Many studies have showed that age might be essential in HIV/AIDS prevention and transmission knowledge (19)(42). Age proved to be a substantial factor contributing to HIV/AIDS prevention and transmission knowledge amongst Bangladeshis, with a trend of age 30 or more. Our study showed that those who are divorced/separated/widowed have a higher understanding of HIV/AIDS prevention and transmission trends. Studies in South Africa showed that divorced/separated/widowed people had lower levels of HIV/AIDS prevention and transmission knowledge (43).

With the goal of ending the infection of HIV/AIDS by 2020, Bangladesh has targeted at least 90% of people to provide early detection and treatment so that AIDS-related deaths become reduced to levels that no longer represent a significant health threat to the country (3). But HIV/AIDS-related stigma is increasing (44). Bangladesh has also gradually eradicated HIV/AIDS-related stigma and discrimination by enforcing laws and policies, preserving privacy, consciousness-building steps, and interventions locating operational barriers (3). There is still little knowledge of HIV/AIDS among people in some areas. HIV interventions can save lives, prevent infections, and limit new cases (6). For the program to succeed, the government should be more concerned about the education and wealth indexes, as our study finds.

Conclusion

From this study, we may conclude that reproductive-aged women's knowledge status of HIV/AIDS is increasing. Education and wealth index are the main factors determining knowledge of HIV/AIDS transmission and prevention methods. Government and HIV/AIDS-related Non-Governmental Organizations should be concerned with these two prominent factors, as well as other factors. Health education and promotion should be given more importance, while HIV/AIDS interventions should consider the areas of residence and the wealth index of people.

Limitations

The data used in this was secondary, which implies less control over its collection. Some years of the survey used only included married women but did not include men. In future surveys, the government should include men and women of all ages. The number of cases is increasing daily. The 2018 annual report of the Bangladesh Demographic and Health Survey (BDHS), published in October 2020, did not include the indicators of HIV/AIDS transmission and prevention methods.

Abbreviation: IUD (Intrauterine Device); BDHS (Bangladesh Demographic and Health Survey); HIV (Human Immunodeficiency Virus); AIDS (acquired immunodeficiency syndrome)

Author contribution statement

All authors have read and approved the manuscript
RKR: lead the project, wrote the paper, performed the experiments, analyzed and interpreted the data, contributed reagents, materials, analysis tools or data.

SM, STM, MR, UM: Conceived and designed the experiments, wrote the paper, Performed the experiments, contributed reagents, materials.

Acknowledgements

We are thanked to Sojib Bhuyan, Department of Accounting, Government Bangla College, Bangladesh.

ReferenceS

1. Sultana R, Das AC. Knowledge and Practice Regarding HIV among Urban-Rural Men in Bangladesh: A cross sectional study. Bangladesh J Infect Dis. 2017;2(1):3–8.

2. WHO. HIV/AIDS [Internet]. 2021 [cited 2022 Jul 24]. Available from: https://www.who.int/news-room/fact-sheets/detail/hiv-aids

3. Welfare M of H and F, Bangladesh G of the PR of. Annual Report 2018. 2018.

4. Sheikh MT, Uddin MN, Khan JR. A comprehensive analysis of trends and determinants of HIV/AIDS knowledge among the Bangladeshi women based on Bangladesh Demographic and Health Surveys, 2007-2014. Arch Public Heal. 2017;75(1):1–11.

5. Azim T, Khan SI, Haseen F, Lira Huq N, Henning L, Pervez MM, et al. HIV and AIDS in Bangladesh. J Heal Popul Nutr. 2008;26(3):311–24.

6. UNICEF. Towards ending AIDS [Internet]. 2020 [cited 2022 Jul 24]. Available from: https://www.unicef.org/bangladesh/en/towards-ending-aids

7. Gani MS, Chowdhury AMR, Nyström L. Urban-rural and socioeconomic variations in the knowledge of STIs and AIDS among Bangladeshi adolescents. Asia-Pacific J Public Heal. 2014;26(2):182–95.

8. Sarma H, Islam MA, Khan JR, Chowdhury KIA, Gazi R. Impact of teachers training on HIV/AIDS education program among secondary school students in Bangladesh: A cross-sectional survey. PLoS One. 2017;12(7):1–16.

9. Sayem A, Popsci M. An assessment of risk behaviours to HIV/AIDS vulnerability among young female garment workers in Bangladesh. Int J STD AIDS. 2010;21(2):133–7.

10. UNICEF. HIV/AIDS | UNICEF Bangladesh [Internet]. 2022 [cited 2022 Jul 24]. Available from: https://www.unicef.org/bangladesh/en/topics/hivaids

11. Kirby DB. The impact of abstinence and comprehensive sex and STD/HIV education programs on adolescent sexual behavior. Sex Res Soc Policy. 2008;5(3):18–27.

12. Kirby D. Emerging Answers. 2001.

13. Welfare M of H and F, Bangladesh G of the PR of. End Line Survey (Behaviour) on Continuation of the Prioritized HIV Prevention Services among key Population in Bangladesh funded by the Global Fund. 2017.

14. UNAIDS. Women out loud: How women living with HIV will help the world end AIDS | UNAIDS [Internet]. 2012 [cited 2022 Jul 24]. Available from: https://www.unaids.org/en/resources/presscentre/featurestories/2012/december/20121211womenoutloud

15. Singh S, Darroch JE, Bankole A. A, B and C in Uganda: The Roles of Abstinence, Monogamy and Condom Use in HIV Decline. https://doi.org/101016/S0968-8080(04)23118-4 [Internet]. 2004 [cited 2022 Jul 24];12(23):129–35. Available from: https://www.tandfonline.com/doi/abs/10.1016/S0968-8080%2804%2923118-4

16. Underhill K, Montgomery P, Operario D. Sexual abstinence only programmes to prevent HIV infection in high income countries: Systematic review. Br Med J. 2007 Aug 4;335(7613):248–52.

17. Oladepo O, Fayemi MM. Perceptions about sexual abstinence and knowledge of HIV/AIDS prevention among in-school adolescents in a western Nigerian city. BMC Public Health. 2011;11.

18. Umeh CN, Essien JE, Ezedinachi EN, Ross MW. Knowledge, beliefs and attitudes about HIV/AIDS-related issues, and the sources of knowledge among health care professionals in southern Nigeria. J R Soc Promot Health. 2008;128(5):233–9.

19. Kuete M, Huang Q, Rashid A, Ma XL, Yuan HF, Escalera Antezana JP, et al. Differences in Knowledge, Attitude, and Behavior towards HIV/AIDS and Sexually Transmitted Infections between Sexually Active Foreign and Chinese Medical Students. Biomed Res Int. 2016;2016.

20. Yaya S, Bishwajit G, Danhoundo G, Seydou I. Extent of Knowledge about HIV and Its Determinants among Men in Bangladesh. Front Public Heal. 2016 Nov 3;4:246.

21. National Institute of Population Research and Training - NIPORT/Bangladesh, Mitra and Associates/Bangladesh and MI 2009. The DHS Program - Bangladesh: DHS, 2007 - Final Report (English) [Internet]. 2009. [cited 2022 Jul 24].

Available from: https://dhsprogram.com/publications/publication-fr207-dhs-final-reports.cfm

22. Mitra and Associates NI of PR and T (NIPORT), ICF International. Bangladesh Demographic and Health 2011. Dhaka, Bangladesh Calverton, Maryland, USA NIPORT, Mitra Assoc ICF Int. 2013;1–430.

23. Ministry of Health and Family Welfare Dhaka B, Mitra. Bangladesh Demographic Health Survey 2014. 2016; Available from: https://www.unicef.org/bangladesh/sites/unicef.org.bangladesh/files/2018-10/BDHS 2014.pdf

24. Elkasabi M. Sampling and Weighting with DHS Data - The DHS Program Blog [Internet]. 2015 [cited 2022 Jul 24]. Available from: https://blog.dhsprogram.com/sampling-weighting-at-dhs/

25. Flegal, K. M., Ogden, C. L., Fryar, C., Afful, J., Klein, R., & Huang DT. Comparisons of Self-Reported and Measured Height and Weight, BMI, and Obesity Prevalence from National Surveys: 1999–2016 [Internet]. 2019 [cited 2022 Jul 24]. Available from: https://stacks.cdc.gov/view/cdc/89163

26. Rueda MDM, Cobo B, Arcos A. Regression Models in Complex Survey Sampling for Sensitive Quantitative Variables. Math 2021, Vol 9, Page 609 [Internet]. 2021 Mar 12 [cited 2022 Jul 24];9(6):609. Available from: https://www.mdpi.com/2227-7390/9/6/609/htm

27. Hossain M, Mani KKC, Sidik SM, Shahar HK, Islam R. Knowledge and awareness about STDs among women in Bangladesh. BMC Public Health [Internet]. 2014 Jul 31 [cited 2022 Jul 24];14(1):1–7. Available from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-14-775

28. Azim T, Chowdhury EI, Reza M, Faruque MO, Ahmed G, Khan R, et al. Prevalence of infections, HIV risk behaviors and factors associated with HIV infection among male injecting drug users attending a needle/syringe exchange program in Dhaka, Bangladesh. Subst Use Misuse [Internet]. 2008 Dec [cited 2022 Jul 24];43(14):2124–44. Available from: https://utsouthwestern.pure.elsevier.com/en/publications/prevalence-of-infections-hiv-risk-behaviors-and-factors-associate

29. Sarkar K, Bal B, Mukherjee R, Chakraborty S, Niyogi SK, Saha MK, et al. Epidemic of HIV Coupled With Hepatitis C Virus Among Injecting Drug Users of Himalayan West Bengal, Eastern India, Bordering Nepal, Bhutan, and Bangladesh. http://dx.doi.org/101080/10826080500410991

30. Khosla N. HIV/AIDS interventions in Bangladesh: What can application of a social exclusion framework tell us? J Heal Popul Nutr. 2009;27(4):587–97.

31. Williams B, Baker D, Bühler M, Petrie C. Increase coverage of HIV and AIDS services in Myanmar. Confl Health. 2008 Dec;2(1).

32. Hor LB, Detels R, Heng S, Mun P. The role of sex worker clients in transmission of HIV in Cambodia. Int J STD AIDS. 2005;16(2):170–4.

33. Harms G, Schulze K, Moneta I, Baryomunsi C, Mbezi P, Poggensee G. Mother-to-child transmission of HIV and its prevention: Awareness and knowledge in Uganda and Tanzania. Sahara J. 2005 Jul 1;2(2):258–66.

34. Ministry of Health & Family Welfare G of B. (PDF) Annual Program Implementation Report of Bangladesh Health, Population and Nutrition Sector Development Program (HPNSDP) 2012 [Internet]. [cited 2022 Jul 24]. Available from: https://www.researchgate.net/publication/264124322_Annual_Program_Implementation_Report_of_Bangladesh_Health_Population_and_Nutrition_Sector_Development_Program_HPNSDP_2012

35. Mumtaz GR, Hilmi N, Majed EZ, Abu-Raddad LJ. Characterising HIV/AIDS knowledge and attitudes in the Middle East and North Africa: Systematic review and data synthesis. Glob Public Health [Internet]. 2020;15(2):275–98. Available from: https://doi.org/10.1080/17441692.2019.1668452

36. Schur N, Mylne A, Mushati P, Takaruza A, Ward H, Gregson S. The effects of household wealth on HIV prevalence in Manicaland , Zimbabwe. :1–12.

37. WHO. HIV Education is Prevention – Learn More on HIVCare.org [Internet]. 1998 [cited 2022 Jul 24]. Available from: https://hivcare.org/hiv-basics/?gclid=Cj0KCQjw2_OWBhDqARIsAAUNTTH0xl1zrv1vcEATCp-puULt57965xDFSkqGKcvtlhX-m4tBokfmsb0aAi8oEALw_wcB

38. UNESCO. Literacy for Life | Global Education Monitoring Report [Internet]. 2006 [cited 2022 Jul 24].

Available from: https://en.unesco.org/gem-report/report/2006/literacy-life

39. Chirwa GC. "Who knows more, and why?" Explaining socioeconomic-related inequality in knowledge about HIV in Malawi. Sci African. 2020 Mar 1;7:e00213.

40. Srivastava S, Chauhan S, Patel R, Kumar P. A study of awareness on HIV/AIDS among adolescents: A Longitudinal Study on UDAYA data. Sci Rep. 2021 Dec 1;11(1).

41. Mostafavi E, Haghdoost A, Mirzazadeh A, Riedner G, Weis P, Kloss K, et al. Regional HIV knowledge hubs: A new approach by the health sector to transform knowledge into practice. Health Promot Int. 2014;29(1):91–7.

42. HIV.gov. U.S. Statistics [Internet]. 2019 [cited 2022 Jul 24]. Available from: https://www.hiv.gov/hiv-basics/overview/data-and-trends/statistics

43. Rohleder P, Eide AH, Swartz L, Ranchod C, Schneider M, Schür C. Gender differences in HIV knowledge and unsafe sexual behaviours among disabled people in South Africa. Disabil Rehabil. 2012;34(7):605–10.

44. Greenwood GL, Wilson A, Bansal GP, Barnhart C, Barr E, Berzon R, et al. HIV-Related Stigma Research as a Priority at the National Institutes of Health. AIDS Behav [Internet]. 2022;26(0123456789):5–26. Available from: https://doi.org/10.1007/s10461-021-03260-6