Predictors of Comprehensive Knowledge of HIV/AIDS Among People Aged 15–49 Years in Ethiopia: A Multilevel Analysis

Background: HIV/AIDS has been a big public health problem in sub-Saharan African countries including Ethiopia. Comprehensive knowledge is a basis for the prevention, control and treatment of HIV/AIDS. Several studies were focused only on the individual-level characteristics. However, comprehensive knowledge of HIV/AIDS is a multi-factorial understanding on a different level. Thus, the aim of this study was to identify the individual- and community-level factors that determine comprehensive knowledge of HIV/AIDS in Ethiopia.

Methods: This study used data from the 2016 Ethiopian Demographic and Health Survey (EDHS). A total of 25,927 (weighted) people aged 15–49 years were included in the study. A two-stage stratified cluster was used. Data were analyzed using Stata version 14. Multilevel mixed effect logistic regression was used to identify predictors of comprehensive knowledge on HIV/AIDS.

Results: Various individual- and community-level factors were associated with comprehensive knowledge of HIV/AIDS. From individual-level factors such as sex (male), educational status (educated), media exposure, and ever been tested for HIV, and from community-level factors such as place of residence (urban) and region (developed region) were predictors of comprehensive knowledge of HIV/AIDS.

Conclusion: Both individual- and community-level factors were identified as predictors of comprehensive knowledge of HIV/AIDS. The government should design strategies to address the HIV/AIDS knowledge gaps among women and other underprivileged population sub-groups.

Keywords: predictors, comprehensive knowledge, HIV/AIDS, multi-level analysis, Ethiopia

Introduction

Globally, about 37.9 million people are living with HIV/AIDS, 1.7 million people are newly infected and 770,000 deaths have occurred due to HIV/AIDS. Sub-Saharan African countries have been the potential breeding ground for the HIV epidemic. The region covers nearly two-thirds of the global HIV/AIDS cases. In Ethiopia, an estimated 737,186 and 21,265 people are living and newly infected with HIV/AIDS in 2019. Looking at AIDS-related deaths, an estimated 9,278 people died in 2019.

In response to the HIV epidemic, the Ethiopian government, in collaboration with its key development partners, has been at the forefront of developing and implementing national strategies that adhere to global directions and combine innovations with best practices within the country. Most interventions have...
been focused on information education and behavioral change communication to improve people’s knowledge towards HIV/AIDS. Having accurate HIV/AIDS knowledge about transmission and prevention is important for avoiding HIV infection and ending the stigma and discrimination against people living with HIV/AIDS. 6–8

Despite its importance, many people in Ethiopia lack comprehensive knowledge of HIV. According to the Ethiopian Demographic and Health Survey (EDHS) 2016 report, only 20% and 38% of women and men age from 15–49 years have comprehensive knowledge of HIV/AIDS. 9 The improvement was much more modest in comparing the percentage of women and men with comprehensive knowledge about HIV/AIDS between 2011 and 2016, moving from 19% to 20% among women and 32% to 38% among men.10

Previous studies have revealed that comprehensive knowledge of HIV/AIDS was determined by age, 11–17 sex, 12,13,18–23 marital status, 18,20–22 educational status, 11–20,22,24–27 religion, 14 occupation, 13,15,18 media exposure, 19,23,26,27 household wealth index, 11,12,14,16–20,23,27 history of HIV test testing and counseling, 12,20–24 age at marriage, 19 history of multiple sexual partner, 20 place of residence, 11,12,14,16–20,27 and region. 12,16,26

Many researchers have tried to identify factors associated with comprehensive knowledge HIV/AIDS. 11–27 However, they are focused on individual-level factors. In the individual-level analysis, the assumption independence was used. But, the individual observations may have some degree of correlation within a cluster they belong because of common characteristics they share. 28 Consequently, ignoring this fact generally results in false conclusions on the effect of factors on comprehensive knowledge of HIV/AIDS. Moreover, previous studies used small sample sizes which leads to bias in any conclusions. Thus, this study was aimed at identifying both the individual- and community-level factors affecting comprehensive knowledge of HIV/AIDS using multilevel modeling using EDHS 2016 data.

Methods

Study Area, Setting, and Population

Secondary data analysis was conducted using the 2016 EDHS data. The EDHS is carried out every five years. The 2016 EDHS was carried out in all parts of Ethiopia, in nine regional states and two administrative regions. Ethiopia is one of the sub-Saharan countries, found in the North-Eastern part of Africa, lying between 3° and 15° North latitude and 33° and 48° East longitudes.29 It has a total population of 114,530,078.30 A total of 25,927 people aged 15–49 years who were interviewed for HIV/AIDS-related questions from the Ethiopian DHS 2016 dataset were included for analysis.

Variable Measurement

The outcome variable (comprehensive knowledge on HIV/AIDS) was classified dichotomously as “Yes/No.” An individual was considered as having comprehensive knowledge of HIV/AIDS if he/she knew that consistent use of condoms during sexual intercourse and having just one uninfected faithful partner can reduce the chances of getting HIV, if he/she knew that a healthy-looking person can have HIV, and if he/she rejected two common misconceptions that are mosquitoes transmit HIV/AIDS and sharing food with an infected person transmits HIV/AIDS.10 The regions were categorized as developed (Tigray, Amhara, Oromia, Southern Nations, Nationalities and Peoples’ Region (SNNPR), Harari, Addis Ababa, and Dire Dawa), and developing regions (Afar, Somali, Benishangul-Gumuz, and Gambella).31 Other community-level variables were computed by aggregating the individual characteristics into clusters.32

Data Processing and Analysis

Data cleaning was conducted to check for consistency and missing values. Recoding, labeling, and exploratory analysis were performed by using Stata version 14.0. Descriptive statistics such as frequencies, median, and percentages were computed. Sample weight was done to compensate for non-proportional allocation of the sample to strata and for non-responses. Since EDHS data are hierarchical, ie, individuals were nested within communities, and Intra-class Correlation Coefficient (ICC) was greater than 10% (ICC=12%), a two-level mixed-effects logistic regression model was conducted to estimate both independent (fixed) effects of the explanatory variables and community-level random effects of comprehensive knowledge of HIV/AIDS. The log of the probability of having comprehensive knowledge of HIV/AIDS was modeled using a two-level multilevel model as follows:33

\[
\log\left[1 + \pi_{ij}\right] = \beta_0 + \beta_1 X_{ij} + \beta_2 Z_{ij} + \mu_i + \epsilon_{ij}
\]

Where, i and j are the level 1 (individual) and level 2 (community) units, respectively; X and Z refer to individual and community-level variables, respectively; \(\pi_{ij}\) is the probability of having comprehensive knowledge of HIV/AIDS for the \(i^{th}\) individual in the \(j^{th}\) community; the \(\beta\)'s

...
indicates the fixed coefficients. Whereas, β0 is the intercept, the effect on the probability of having comprehensive knowledge of HIV/AIDS in the absence of influence of predictors; and UGH shows the random effect (effect of the community on comprehensive knowledge of HIV/AIDS for the jth community and eij shows random errors at the individual level). By assuming each community had a different intercept (β0), within- and between-community variations were taken into account.

In the analysis, first bivariable multilevel logistic regression was computed and variables with a p-value less than 0.3 were entered into the multivariable multilevel logistic regression. Four models were displayed in this analysis, Model 0 (model containing no factors), Model 1 (containing only individual factors), Model 2 (containing only community factors) and Model 3 (both individual- and community-level factors). Variables with a p-value less than 0.05 had statistical significance association with the outcome variable. The result of the fixed effect will be presented as Adjusted Odds Ratio (AOR) with their 95% confidence intervals (95% CI).

The measures of variation (random-effects) were reported using ICC, proportional change in variance (PCV) and Median Odds Ratio (MOR). The ICC was used to show how much the observation within one cluster resembled each other, and MOR is a measure of unexplained cluster heterogeneity. The ICC was computed using this formula as follows: [ICC = (δ2 - δ2M) / δ2]. δ2 which shows the estimated variance of clusters. MOR is the median value of the odds ratio between the area at highest risk and the area at the lowest risk when randomly picking out two areas and calculated using the formula [MOR = exp(√2xδ2 + 0.6745) ≈ exp(0.956)]. The proportional change in variance (PCV) signifies the total variation attributed by individual-level factors and area-level factors in the multilevel model. Standard error at the cutoff point of ±2 was used to check multicollinearity and there was no multicollinearity. The goodness of fit of the model was checked by log-likelihood test.

**Ethical Approval**

An authorization letter was also obtained from CSA for downloading the EDHS data set by requesting the website www.measuredhs.com. The accessed data were used for the purpose of the registered research only. All data were treated as confidential and no effort was done to identify any household or individual respondent interviewed in the survey. The detailed information on methodology and the ethical issues was published in the EDHS report.

**Results**

**Characteristics of the Respondents**

A total of 25,927 people aged 15–49 years were included in the analysis, of these 14,599 (56.31%) were female. The mean age of respondents was 28.46 (±9.31). Regarding marital status 15,827 (61.04%) were married or living with their partner. A total of 9,704 (37.43%) respondents were not educated. About 20,219 (77.98%) of the respondents were rural residents. Out of the total respondents, 10,925 (42.14%) were from communities with a higher proportion of media exposure (Table 1).

**Individual- and Community-Level Predictors of Comprehensive Knowledge of HIV/AIDS**

After adjusting for individual- and community-level factors (model 3), sex, educational status, media exposure, residence, and region were significantly associated with comprehensive knowledge of HIV/AIDS. Male respondents were 2 times more likely to have comprehensive knowledge of HIV/AIDS than females (AOR=2.06, 95% CI= 1.77, 2.39). Primary level educated individuals were 1.8 times more likely to have comprehensive knowledge than non educated individuals (AOR=1.79, 95% CI= 1.57, 2.04). Secondary level educated individuals were 2.7 times more likely to have comprehensive knowledge of HIV/AIDS (AOR=2.66, 95% CI= 2.22, 3.18) and respondents who had higher educational status were 3.9 times more likely to have comprehensive knowledge of HIV/AIDS (AOR=3.89, 95% CI= 3.08, 4.92) compared to non-educated individuals.

Employed individuals were 1.2 times more likely to have comprehensive knowledge of HIV/AIDS compared to those who were unemployed (AOR=1.23, 95% CI= 1.10, 1.39). The odds of having comprehensive knowledge of HIV/AIDS among those who were more exposed to media were 1.3 times higher than unexposed respondents (AOR= 1.31, 95% CI= 1.16, 1.48). Those who had ever been tested for HIV were 1.2 times more likely to have comprehensive knowledge of HIV/AIDS compared to those who had never been tested for HIV (AOR= 1.25, 95% CI= 1.12, 1.38). Individuals from urban areas were 1.4 times more likely to have comprehensive knowledge of HIV/AIDS compared to rural residents (AOR=1.35,
Table 1 Individual- and Community-Level Characteristics of Respondents, EDHS 2016 (n=25,927)

| Variables                     | Frequency | Percentage |
|-------------------------------|-----------|------------|
| **Sex**                       |           |            |
| Male                          | 11,328    | 43.69      |
| Female                        | 14,599    | 56.31      |
| **Age (years)**               |           |            |
| 15–19                         | 5,563     | 21.46      |
| 20–24                         | 4,481     | 17.28      |
| 25–29                         | 4,700     | 18.13      |
| 30–34                         | 3,798     | 14.65      |
| 35–39                         | 3,142     | 12.12      |
| 40–44                         | 2,386     | 9.20       |
| 45–49                         | 1,857     | 7.16       |
| **Marital status**            |           |            |
| Not married                   | 10,100    | 38.96      |
| Married/living with partner   | 15,827    | 61.04      |
| **Religion**                  |           |            |
| Orthodox tewahido             | 11,615    | 44.80      |
| Muslim                        | 7,802     | 30.09      |
| Protestant                    | 5,987     | 23.09      |
| Othera                        | 523       | 2.02       |
| **Educational status**        |           |            |
| No education                  | 9,704     | 37.43      |
| Primary                       | 10,760    | 41.50      |
| Secondary                     | 3,584     | 13.82      |
| Higher                        | 1,879     | 7.25       |
| **Employment**                |           |            |
| Not employed                  | 8,028     | 30.96      |
| Employed                      | 17,899    | 69.04      |
| **Wealth indexb**             |           |            |
| 1st quintile                  | 8,572     | 33.06      |
| 2nd quintile                  | 4,947     | 19.08      |
| 3rd quintile                  | 12,408    | 47.86      |
| **Head of household**         |           |            |
| Male                          | 20,940    | 80.77      |
| Female                        | 4,987     | 19.23      |
| **Media exposure**            |           |            |
| Not exposed                   | 12,207    | 47.08      |
| Exposed                       | 13,720    | 52.92      |
| **Internet use**              |           |            |
| Yes                           | 2,296     | 8.86       |
| No                            | 23,631    | 91.14      |

Table 1 (Continued).

| Variables                     | Frequency | Percentage |
|-------------------------------|-----------|------------|
| **Tested for HIV**            |           |            |
| Yes                           | 12,215    | 47.11      |
| No                            | 13,712    | 52.89      |
| **Region**                    |           |            |
| Urban                         | 5,708     | 22.02      |
| Rural                         | 20,219    | 77.98      |
| **Community education status**|           |            |
| High proportion of educated   | 10,886    | 41.99      |
| Low proportion of educated    | 15,041    | 58.01      |
| **Community-level employment**|           |            |
| High proportion of employed   | 14,159    | 54.61      |
| Low proportion of employed    | 11,768    | 45.39      |
| **Community wealth status**   |           |            |
| High proportion of rich       | 14,283    | 55.09      |
| Low proportion of rich        | 11,644    | 44.91      |
| **Community media exposure**  |           |            |
| High proportion of exposed    | 10,925    | 42.14      |
| Low proportion of exposed     | 15,002    | 57.86      |

Notes: aCatholic and traditional religion follower. b1st quintile, poorest and poorer; 2nd quintile, middle; and 3rd quintile, richer and richest.

95% CI=1.10, 1.65). The odds of having comprehensive knowledge of HIV/AIDS among those who lived in developed regions were 2 times higher than those who lived in developing regions (AOR=2.04, 95% CI=1.74, 2.39) (Table 2).

Random Effects (Measures of Variation)

In the null model, the value of Intra Class Correlation was 12%. It revealed that 12% of the observations in each cluster correlate with each other. After taking into account both individual- and community-level factors (ie, in the model 3), the community-level variability has been decreased to 7%. The model also showed the highest Proportional Change in Variance (PCV); that is 45%, indicating 45% of the community-level variation on comprehensive knowledge of HIV/AIDS was explained by the combined factors at both individual- and community-
Table 2 Individual- and Community-Level Predictors of Comprehensive Knowledge of HIV/AIDS, EDHS 2016 (n=25,927)

| Individual- and Community-Level Characteristics | COR (95% CI) | Model 3 AOR (95% CI) |
|------------------------------------------------|--------------|----------------------|
| **Sex**                                        |              |                      |
| Male                                           | 2.64 (2.30, 3.02) | 2.06 (1.77, 2.39)*   |
| Female                                         | I            | I                    |
| **Age (years)**                                |              |                      |
| 15–19                                          | 1.26 (1.05, 1.50) | 1.06 (0.86, 1.31)    |
| 20–24                                          | 1.32 (1.10, 1.60) | 0.99 (0.81, 1.22)    |
| 25–29                                          | 1.15 (0.96, 1.38) | 0.92 (0.75, 1.11)    |
| 30–34                                          | 1.08 (0.88, 1.32) | 1.01 (0.81, 1.26)    |
| 35–39                                          | 1.08 (0.89, 1.31) | 1.07 (0.87, 1.31)    |
| 40–44                                          | 0.87 (0.71, 1.06) | 0.81 (0.65, 1.01)    |
| 45–49                                          | I            | I                    |
| **Educational status**                         |              |                      |
| Not educated                                    | I            | I                    |
| Primary                                        | 2.32 (2.09, 2.59) | 1.79 (1.57, 2.04)*   |
| Secondary                                      | 3.91 (3.36, 4.54) | 2.66 (2.22, 3.18)*   |
| Higher                                         | 6.69 (5.58, 8.01) | 3.89 (3.08, 4.92)*   |
| **Employment**                                 |              |                      |
| Unemployed                                     | I            | I                    |
| Employed                                       | 1.94 (1.72, 2.19) | 1.23 (1.10, 1.39)*   |
| **Wealth index**                               |              |                      |
| 1st quintile                                   | I            | I                    |
| 2nd quintile                                   | 1.17 (1.01, 1.36) | 0.99 (0.85, 1.15)    |
| 3rd quintile                                   | 1.70 (1.49, 1.93) | 1.09 (0.94, 1.27)    |
| **Media exposure**                             |              |                      |
| Not exposed                                    | I            | I                    |
| Exposed                                        | 2.18 (1.96, 2.43) | 1.31 (1.16, 1.48)*   |
| **Internet use**                               |              |                      |
| Yes                                            | 2.51 (2.17, 2.90) | 1.08 (0.91, 1.28)    |
| No                                             | I            | I                    |
| **Tested for HIV**                             |              |                      |
| Yes                                            | 1.40 (1.27, 1.53) | 1.25 (1.12, 1.38)*   |
| No                                             | I            | I                    |
| **Residence**                                  |              |                      |
| Urban                                          | 2.58 (2.29, 2.91) | 1.35 (1.10, 1.65)*   |
| Rural                                          | I            | I                    |
| **Region**                                     |              |                      |
| Developing Region                              | I            | I                    |

(Continued)

Table 2 (Continued).

| Individual- and Community-Level Characteristics | COR (95% CI) | Model 3 AOR (95% CI) |
|------------------------------------------------|--------------|----------------------|
| **Developed Region**                           | 2.36 (1.96, 2.84) | 2.04 (1.74, 2.39)*   |
| **Community education status**                |              |                      |
| High proportion educated                      | 2.26 (1.98, 2.57) | 1.03 (0.88, 1.19)    |
| Low proportion of educated                    | I            | I                    |
| **Community level of employment**             |              |                      |
| High proportion of employed                   | 1.45 (1.26, 1.66) | 1.06 (0.93, 1.20)    |
| Low proportion of employed                    | I            | I                    |
| **Community wealth status**                   |              |                      |
| High proportion of rich                       | 2.22 (1.95, 2.53) | 1.05 (0.88, 1.25)    |
| Low proportion of rich                        | I            | I                    |
| **Community media exposure**                  |              |                      |
| High proportion of exposed                    | 2.16 (1.90, 2.46) | 0.96 (0.82, 1.13)    |
| Low proportion of exposed                     | I            | I                    |

Notes: *Significant (p<0.05). †1st quintile, poorest and poorer; 2nd quintile, middle; and 3rd quintile, richer and richest. Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio.

levels. The effect of clustering is still statistically significant in the full model (model 3) (Table 3).

Discussion

In this study, several factors at both individual- and community-level were identified to have a significant association with comprehensive knowledge of HIV/AIDS. Males were more likely to have comprehensive knowledge of HIV/AIDS than women. This finding is in line with other studies conducted in Ethiopia, Sudan, Uganda, Ghana, Sierra Leone, Nigeria, and Bangladesh. This might be due to cultural malpractice in accepting male masculinity and ignoring females which restricts their ability to seek information. In addition, it may be explained due to social unacceptance of discussions with their peers and family members regarding sex and sexual issues which would further prevent their chance to obtain
Table 3 Measure of Variation for Comprehensive Knowledge of HIV/AIDS at Cluster Level by Multilevel Logistic Regression Analysis, EDHS 2016

| Random Effect | Null Model | Final Model |
|---------------|------------|-------------|
| Variance (%)  | 0.44       | 0.24        |
| ICC (%)       | 12         | 7           |
| PCV (%)       | Reference  | 45          |
| MOR           | 1.88       | 1.59        |

Model fitness

| Log-likelihood | −15,030.1 | −13,867.9 |

Abbreviations: ICC, intra-cluster correlation coefficient; MOR, median odds ratio; PCV, proportional change in variance

HIV-related information. They are also turned away from access for education, as witnessed from this study, more than two thirds of uneducated people were females.

The odds of having comprehensive knowledge of HIV/AIDS among those who were educated were higher than those who were not educated. This finding is similar to studies done in Ethiopia,2,12-15 Kenya,16 Uganda,17 Malawi,18 Nigeria,19 Ghana,20 Sierra Leone,21 Bangladesh,22 Indonesia,23 and Pakistan.24 This might be due to education causing people to be more proactive about their own health and to seek out information to protect themselves against HIV/AIDS. People can also get information on HIV/AIDS from school-based HIV/AIDS interventions. Employment had a positive association with comprehensive knowledge of HIV/AIDS. This finding is supported by studies conducted in Ethiopia,25 Malawi,15 and Ghana.18 The possible reason for this might be employed people have better education, living standard and access for information, education and communication than uneducated people.

Those who were more exposed to media were more likely to have comprehensive knowledge of HIV/AIDS than those who were not exposed to media. This finding is in line with studies done in Ethiopia,25,26 Bangladesh,19 and Pakistan.27 This might be due to the fact that the media has an enormous influence in educating and imparting proper knowledge that dilutes pre-existing misconceptions regarding HIV/AIDS.28

HIV testing had a positive association with comprehensive knowledge of HIV/AIDS. This is evidenced by other studies done in Kenya,24 Nigeria,12 and Sierra Leone.20 This might be due to providing pre-test information and post-test counseling on the key principles of HIV testing and counseling and is expected to be applied in all circumstances.35 Therefore, this creates an opportunity for individuals to get information related to HIV/AIDS prevention methods and enables them to avoid misconceptions previously held.

The odds of having comprehensive knowledge of HIV/AIDS among those who lived in urban areas were higher than those who lived in rural areas. This is similar to studies done in Ethiopia, Nigeria,12,16 Ghana,18 Sierra Leone,20 Bangladesh,14,19 Indonesia,17 and Pakistan.27 The possible reason could be urban people often enjoy a better lifestyle with easier access to health information, education, media, and healthcare facilities. Those who reside in urban areas also had more exposure to HIV/AIDS prevention and control interventions such as HIV testing and counseling campaigns, training sessions, and mass media campaigns.

Those who lived in developed regions were more likely to have comprehensive knowledge of HIV/AIDS than those who lived in developing regions. This finding is supported by a study done in Ethiopia.26 This might be due to the fact that people who live in these developing regions of Ethiopia, have poor access to education, media, and health-care facilities. Most pastoralist communities are living in those regions where delivering health and other developmental services has been very difficult, depriving them of awareness of HIV.

The main strength of this study was the use of multilevel modeling techniques which helped to hold the fixed effects of both the individual- and community-level factors. This study also used a recent nationally representative survey which can be generalized to the entire country. This study also has its own limitations; the use of secondary data limits the variables considered for analysis. Furthermore, the study is subject to recall bias.

Conclusion

In conclusion, this study indicated both individual- and community-level factors can influence comprehensive knowledge of HIV among individuals. Sex, educational status, occupation, media exposure, and history of HIV testing were significantly associated individual-level factors. Cluster characteristics like place of residence and region were the factors associated with comprehensive knowledge of HIV. Both individual- and community-level characteristics should be considered in policy making and program planning for HIV. This study recommends that the government and other concerned bodies should design strategies to address the HIV/AIDS
knowledge gaps among women and other underprivileged population sub-groups. Moreover, it is needed to increase mass media’s coverage and encourage broadcasters to take the issue of HIV on their agenda. Cultural sensitivity should also be considered as the influencing factors in the future studies.

**Abbreviations**
AIDS, acquired Immune deficiency syndrome; AOR, adjusted odds ratio; EDHS, Ethiopia Demographic and Health Survey; FMOH, Federal Ministry of Health; HIV, human immuno-deficiency virus; ICC, intra-cluster correlation coefficient; MOR, median odds ratio; PCV, proportional change in variance.

**Data Sharing Statement**
The datasets used and/or analyzed during this study is available from the corresponding author on reasonable request.

**Acknowledgments**
We would like to express our deepest gratitude to the Central Statistical Agency of Ethiopia for giving us the EDHS dataset and authorizing us to conduct the research.

**Disclosure**
The authors report no conflicts of interest in this work.

**References**

1. UNAIDS. Fact sheet-latest statistics on the status of the AIDS epidemic; 2019. Available from: https://www.unaids.org/en/resources/fact-sheet. Accessed August 15, 2020.

2. UNAIDS. UNAIDS data - statistics on the status of the AIDS epidemic; 2018. Available from: https://www.unaids.org/en/resources/documents/2018/UNAIDS-data-2018. Accessed August 15, 2020.

3. HAPCO. AIDS data and information in Ethiopia; HIV epidemic estimates; 2017 – 2021. Available from: https://www.aarc.gov.et/index.php/resources/and-on-health-related-issues/Ethiopia-data-information-on-hiv-aids. Accessed August 15, 2020.

4. HAPCO. HIV prevention in Ethiopia National Road map; 2018. Available from: https://ethiopia.unfpa.org/en/publications/hiv-prevention-ethiopia-national-road-map-2018-2021. Accessed August 15, 2020.

5. Federal HIV/AIDS Prevention and Control Office ( FHAPCO). HIV/AIDS strategic plan 2015–2020 in an investment case approach, Addis Ababa, Ethiopia, 2014. Available from: https://www.unesco.org/sites/default/files/resources/22292. Accessed August 15, 2020.

6. Fagbamigbe AF, Lawal AM, Idemadina ES. Modelling self-assessed vulnerability to HIV and its associated factors in a HIV-burdened country. Saharan J Soc Sci Asp HIV/AIDS. 2017;14(1):140–152. doi:10.10082F17290376.2017.1387598

7. Bamise OF, Bamise CT, Adegibha MA. Knowledge of HIV/AIDS among secondary school adolescents in Osun state, Nigeria. Niger J Clin Pract. 2011;14(3):338–344. doi:10.4103/1119-3077.86780

8. Obidoo CA, M’Tan CE, Schensul SL. Factors associated with HIV/AIDS sexual risk among young women aged 15–24 years in Nigeria. J Public Health Africa. 2012;3(1):15–64. doi:10.4081/jphia.2012.e15

9. Central Statistical Agency (CSA) [Ethiopia] and ICF. Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF; 2016.

10. Central Statistical Agency [Ethiopia] and ICF International. Ethiopia Demographic and Health Survey 2011. Addis Ababa, Ethiopia, and Calverton, Maryland, USA: Central Statistical Agency and ICF International; 2011.

11. Minet TH, Eysu HT, Simon AG, Afewerki WT, Henok KA, Russom T. Associates of comprehensive HIV/AIDS knowledge and acceptance attitude among male youth aged 15–24: comparison study among Ivory Coast, Cameroon and Gabon. J AIDS Clin Res. 2016;7(10):618. doi:10.4172/2155-6113.1000618

12. Oginni AB, Adebajo SB, Ahonsi BA. Trends and determinants of comprehensive knowledge of HIV among adolescents and young adults in Nigeria: 2003–2013. Afr J Reprod Health. 2017;21(2):26–34. doi:10.29063/ahrj2017/v21i2.4

13. Mitike G, Mariam DH, Tsiu A. Patterns of knowledge and condom use among population groups: results from the 2005 Ethiopian Behavioral Surveillance Surveys on HIV. Ethiop J Health Dev. 2011;25(1):35–45. doi:10.1186/1471-2458-8-429

14. Sheikh T, Uddin N, 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 Health. 2017;75:59. doi:10.1186/s13690-017-0228-2

15. Barden-O’Fallon JL, deCrafft-Johnson J, Bisika T, Sulzbach S, Benson A, Tsi AO. Factors associated with HIV/AIDS knowledge and risk perception in rural Malawi. AIDS Behav. 2004;8(2):131–140. doi:10.1023/B:ABIE.000003244.92791.63

16. Yaya S, Ghose B, Udenigwe O, Shah V, Hudani A, Ekholuenueta M. Knowledge and attitude of HIV/AIDS among women in Nigeria: a cross-sectional study. Eur J Public Health. 2018;29(1):111–117. doi:10.1093/europub/cky131

17. Pradnyani PE, Wibowo AM. The effects of socio-demographic characteristics on Indonesian women’s knowledge of HIV/AIDS: a cross-sectional study. J Prev Med Public Health. 2019;52:109–114. doi:10.3961/jpmph.18.256

18. Fenny AP, Crentsil AO, Asuman D. Determinants and distribution of comprehensive HIV/AIDS knowledge in Ghana. Glob J Health Sci. 2017;9(12):32–46. doi:10.5539/gjhs.v9n12p32

19. Dey R, Hassan MZ, Hossain MA. Prevalence of comprehensive knowledge about HIV/AIDS among ever married men and women in Bangladesh. J Sci Technol. 2013;11:91–99.

20. Gebregergish S The prevalence and determining factors of comprehensive knowledge of HIV/AIDS and condom use among adolescents in Sierra Leone Data from DHS 2013 [Unpublished thesis]; 2015

21. Elbadawi A, Mirghianni H. Assessment of HIV/AIDS comprehensive correct knowledge among Sudanese university: a cross-sectional analytic study 2014. Pan Afr Med J. 2016;24:48. doi:10.11604/pamj.2016.24.48.8684

22. CICCio L, Sera D. Assessing the knowledge and behavior towards HIV/AIDS among youth in Northern Uganda: a cross-sectional survey. Ital J Trop Med. 2010;15(1):4–29. 34

23. Oljira L, Berhane Y, Worku A. Assessment of comprehensive HIV/AIDS knowledge level among in-school adolescents in eastern Ethiopia. J Int AIDS Soc. 2013;16:17349. doi:10.7448/IAS.16.1.17349

24. Ochako R, Ulwodi D, Njagi P, Kimetu S, Onyango A. Trends and determinants of comprehensive HIV and AIDS knowledge among urban young women in Kenya. AIDS Res Ther. 2011;8(1):11. doi:10.1186/1744-6581-8-11
25. Megabiaw B, Awoke T. Comprehensive knowledge, attitude and practice of street adults towards human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) in Northwest Ethiopia. *J AIDS HIV Res*. 2013;5(6):181–187. doi:10.5897/JHAR12.046

26. Gurmu E, Etana D. HIV/AIDS knowledge and stigma among women of reproductive age in Ethiopia. *Afr J AIDS Res*. 2015;1–9. doi:10.2989/16085906.2015.1051066

27. Iqbal S, Maqsood J, Zafar A, Zakar R, Zakar MZ, Fischer F. Determinants of overall knowledge of and attitudes towards HIV/AIDS transmission among ever-married women in Pakistan: evidence from the Demographic and Health Survey 2012–13. *BMC Public Health*. 2019;19:793. doi:10.1186/s12889-019-7124-3

28. Hox J. *Multilevel Analysis: Techniques and Applications: Quantitative Methodology Series*. 2nd ed. Routledge: Taylor and France group; 2010. Available from: https://www.amazon.com/Multilevel-Analysis-Applications-Quantitative-Methodology/dp/1848728468. Accessed August 15, 2020.

29. Commission PC. The 2007 population and housing census of Ethiopia. Available from: http://www.csa.gov.et/census-report/complete-report/census-2007. Accessed August 15, 2020.

30. Ethiopian Population- World meter; 2020. Available from: https://www.worldometers.info/world-population/ethiopia-population/. Accessed August 15, 2020.

31. The Federal Democratic Republic of Ethiopia. Council of Ministers Regulation No.103/2004: The Council of Ministers Regulation for the Establishment of Federal Board to Provide Affirmative Support for Less Developed Regions. Federal Negarit Gazeta. 2004; 2634–2635

32. Birhanu BE, Kebede DL, Kahsay AB, Belachew AB. Predictors of teenage pregnancy in Ethiopia: a multilevel analysis. BMC Public Health. 2019;19:601. doi:10.1186/s12889-019-6845-7

33. Hox J, Moerbeek M, van de Schoot R. *Multilevel Analysis: Techniques and Applications, Third Edition (Quantitative Methodology Series)*. New York: Routledge; 2018. Available from: https://www.routledge.com/Multilevel-Analysis-Techniques-and-Applications-Third-Edition/Hox-Moerbeek-Schoot/p/book/9781138121362. Accessed August 15, 2020.

34. Sood S, Sheneer-Rogers CL, Sengupta M. The impact of a mass media campaign on HIV/AIDS knowledge and behavior change in North India: results from a longitudinal study. *Asian J Commun*. 2006;16(3):231–250. doi:10.1080/01292980600857740

35. FMOH. *National Guidelines for Comprehensive HIV Prevention, Care and Treatment of Ethiopia; 2017*. 

---

**HIV/AIDS - Research and Palliative Care**

**Publish your work in this journal**

HIV/AIDS - Research and Palliative Care is an international, peer-reviewed open-access journal focusing on advances in research in HIV, its clinical progression and management options including antiviral treatment, palliative care and public health policies to control viral spread. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit http://www.dovepress.com/testimonials.php to read real quotes from published authors.

Submit your manuscript here: https://www.dovepress.com/hiv-aids-research-and-palliative-care-journal