HIV/AIDS - Research and Palliative Care

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ORIGINAL RESEARCH

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

This article was published in the following Dove Press journal:
HIV/AIDS - Research and Palliative Care

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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.[1,2] 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.[3]

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.[4,5] Most interventions have

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submit your manuscript | www.dovepress.com
DovePress
http://doi.org/10.2147/HIV.S266539

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 of knowledge HIV/AIDS.[11–27] However, they are focused only 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] $\mathrm{Log}[\frac{\Pi ij}{1-\Pi ij}] = \beta_0 + \beta_1 X_{ij} + B_2 Z_{ij} + \mu_j + e_{ij}$

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; πij is the probability of having comprehensive knowledge of HIV/ADIS for the i^{th} individual in the j^{th} community; the β's

indicates the fixed coefficients. Whereas, β0 is the intercept,the effect on the probability of having comprehensive knowledge of HIV/ADIS in the absence of influence of predictors; and uj shows the random effect (effect of the community on comprehensive knowledge of HIV/ADIS for the j^{th} community and eij shows random errors at the individual levels). By assuming each community had a different intercept (β0), within- and between-communit y 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: $[\mathrm{ICC} = \frac{\delta^2}{\delta^2 + \frac{\pi^2}{3}}]$, δ^2which 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 $[\mathrm{MOR} = \exp(\sqrt{2x\delta^2 + 0.6745}) \approx \exp(0.95\delta)]$. 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
Other[a]	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 index[b]		
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
Tested for HIV		
Yes	12,215	47.11
No	13,712	52.89
Residence		
Urban	5,708	22.02
Rural	20,219	77.98
Region		
Developed Region	24,824	95.75
Developing Region	1,103	4.25
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: [a]Catholic and traditional religion follower. [b]1st 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	1	1
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	1	1
Educational status		
Not educated	1	1
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	1	1
Employed	1.94 (1.72, 2.19)	1.23 (1.10, 1.39)*
Wealth index[a]		
1st quintile	1	1
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	1	1
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	1	1
Tested for HIV		
Yes	1.40 (1.27, 1.53)	1.25 (1.12, 1.38)*
No	1	1
Residence		
Urban	2.58 (2.29, 2.91)	1.35 (1.10, 1.65)*
Rural	1	1
Region		
Developing Region	1	1
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	1	1
Community level of employment		
High proportion of employed	1.45 (1.26, 1.66)	1.06 (0.93, 1.20)
Low proportion of employed	1	1
Community wealth status		
High proportion of rich	2.22 (1.95, 2.53)	1.05 (0.88, 1.25)
Low proportion of rich	1	1
Community media exposure		
High proportion of exposed	2.16 (1.90, 2.46)	0.96 (0.82, 1.13)
Low proportion of exposed	1	1

Notes: *Significant ($p<0.05$). [a]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,[13,23] Sudan,[21] Uganda,[22] Ghana,[18] Sierra Leone,[20] Nigeria,[12] and Bangladesh.[19] 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,[12,25,26] Kenya,[24] Uganda,[22] Malawi,[15] Nigeria,[12,16] Ghana,[18] Sierra Leone,[20] Bangladesh,[14,19] Indonesia,[17] and Pakistan.[27] This could 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,[13] 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,[23,26] 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.[34]

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.

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