COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES
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Determinants of knowledge, attitude and practice towards HIV/AIDS among youth students from selected public universities in Ethiopia:

A Multilevel Ordinal Logistic Regression Analysis

By:

Werku Shanko

Advisor: Dejen Tesfaw (PhD)

A thesis submitted to the Department of Statistics, Addis Ababa University, in partial fulfillment of the requirements for the Degree of Master of Science in Statistics (Biostatistics)

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DECLARATION

I, the undersigned, declare that the thesis is my original work, has not been presented for degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

Name: Werku Shanko

Signature: _____

Date: _____

Place of submission: Department of Statistics, College of Natural and Computational Sciences, Addis Ababa University.

This thesis has been submitted for examination with my approval as a University advisor.

Advisor's Name: Dejen Tesfaw (PhD)

Signature: _____

Date: _____

Addis Ababa University
College of Natural and Computational Sciences

This is to certify that the thesis prepared by **Werku Shanko**, entitled: Determinants of Knowledge, Attitude and Practice towards HIV/AIDS among Youth from Selected Public University Students in Ethiopia: A Multilevel Ordinal Logistic Regression Analysis and submitted in partial fulfillment of the requirements for the Degree of Master of Science in Statistics (Biostatistics) complies with requirements of the university and meets the accepted standards with respect to originality and quality.

Signed by the examining committee:

Name	**Signature**	**Date**
Advisor: Dejen Tesfaw (PhD)	_____	_____
Examiner: Eshetu Wencheko (Professor)	_____	_____
Examiner: Mokonnen Taddese (Associative Professor)	_____	_____

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Abstract

Determinants of Knowledge, Attitude and Practice towards HIV/AIDS among Youth from Selected Public University Students in Ethiopia: A Multilevel Ordinal Logistic Regression Analysis

Werku Shanko

HIV/AIDS has become one of the world's most serious public health and development challenges, particularly in low and middle income countries (WHO, 2015). Estimates show that globally at the end of 2016, 36.7 million people were living with the HIV infection, 1.8 million people were newly affected and 1 million people died from HIV related illness(UNAIDS, 2017). And also, half of new infections are among young people aged 15–24 years of which majority of the newly infected young people were from eastern and southern Africa including Ethiopia (UNAIDS, 2015-2016). The main objective of the study was to identify factors that affect the knowledge, attitude and practice towards HIV/AIDS among selected public university regular students in Ethiopia. A total of 2,176 students were considered in the study. Descriptive analysis, single-level and multilevel ordinal logistic regression model were used for data analysis using socio-economic, demographic, and health related variables as independent variables and knowledge, attitude and practice towards HIV/AIDS as the dependent variable. The results of the study showed that, out of a total of the 2,176 sampled students, 172 (representing 7.9%) were not knowledgeable, 1056 (representing 48.5%) were fairly knowledgeable and 948 (representing 43.6%) were knowledgeable towards HIV/AIDS. Furthermore, out of 2,176 the sampled students, 608 (representing 27.9%) had unfavourable attitude, 1,268(representing 58.3%) had fairly favourable attitude and 300 (representing 13.8%) had favourable attitude towards HIV/AIDS, respectively. Regarding to practice of HIV/ADIS, out of the 2,176 sampled students, 1,073(49.3%) had poor practice, 656(30.1%) had medium level of practice and 447(20.5%) had good practice towards HIV/AIDS, respectively. The level-single ordinal logistic regression analysis revealed that the variables that affect the students' knowledge, attitude and practice towards HIV/AIDS in public universities of Ethiopia were "sex", "age", "family place of residence", "family life status", "family average monthly income", "student's pocket money"," current sexual partner", "mass-media contribution", "role of university", "peer pressure", "using drug ", respectively. The multilevel ordinal logistic regression analysis revealed that there was significant variation with regard to students' knowledge, attitude and practice towards HIV/AIDS across the departments under investigation.

List of Acronyms

AIDS	Acquired Immunodeficiency Syndrome
BSS	Behavioral surveillance survey
FMoH	Federal Ministry of Health
HAPCO	HIV/AIDS Prevention Control Office
HIV	Human Immunodeficiency Virus
HSEP	Health Service Extension Program
KAPs	Knowledge, Attitude and Practices
KT	Knowledge Translation
LRT	Likelihood-Ratio Test
ML	Maximum Likelihood
MOH	Ministry Of Health
NEPAD	New Partnership for African Development
PLWHA	People Living with HIV/AIDS
STDs	Sexually Transmitted Diseases
TB	Tuberculosis
UNAIDS	Joint United Nations Program on HIV/AIDS
UNFPA	United Nations Population Fund
UNICEF	United Nations International Children's Emergency Fund
VPRTT	Office of Vice President for Research and Technology Transfer
WHO	World Health Organization

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1. Introduction

1.1 Background of the Study

HIV/AIDS has become one of the world's most serious public health and development challenges, particularly in low and middle income countries (WHO, 2015). Since the start of the epidemic, globally 76.1 million people have become infected with HIV/AIDS and 35 million people died from HIV related illness and also still spread rapidly in many countries over the years and became a global health problem (UNAIDS, 2016). Estimates show that globally at the end of 2016, about 36.7 million people were living with the HIV infection and 1.8 million people were newly affected by the diseases and also 1 million people died from HIV related illness(UNAIDS, 2017). Everyday some 5,000young people in the world become infected with HIV, which translates into almost 2 million new infections per year (UNAIDS, 2015).

Worldwide, half of new infections are among young people from 15–24 years of age of which the majority of the newly infected young people were from eastern and southern Africa. In Ethiopia the trend exists in the same manner (UNAIDS, 2015-2016). As of 2016, there were 19.4 million people living with HIV/AIDS in eastern and southern Africa. Estimates show that 790,000 of newly infected people are in eastern and southern Africa of which 710,000 were young people and also 420,000 people died from HIV/AIDS related illness (UNAIDS 2016). Estimates show that in Ethiopia 30,000 of people were newly infected by HIV/AIDS of which 26,000 are young people (UNAIDS, 2016).

The global HIV/AIDS situation for adolescents is extremely serious, and the need for stronger focused response is urgent. Young people are particularly vulnerable to HIV infection because of risky sexual behaviors and substance abuse. They are convoluted by lack of access to accurate and personalized HIV information and prevention services and a host of other socio-economic reasons. Young people of age 15–24 represent 45% of all new HIV infections. In order for young people to take provisions to protect themselves against HIV infection, they first have to regard themselves as potentially at risk of becoming infected. Individuals who deny the presence of HIV/AIDS in their community have a perceived invulnerability to the disease. Individuals who have had sex should have a higher perceived HIV/AIDS risk than virgins; and individuals who

have high-risk sex (no or infrequent condom use, or multiple partners) should have higher perceived risks than individuals who engage in low-risk sex (UNAIDS, 2016).

Ethiopia is one of the sub-Saharan countries highly affected by the HIV/AIDs pandemic. The prevalence of HIV infection among adults in Ethiopia was estimated to be 2.4% of which most of the burden occurring among younger age groups (Tewabe et al., 2012; Regassa and Kedir 2011). Adolescence is a transitional phase between childhood and adulthood characterized by physiological, cognitive and emotional changes. The most common changes include developed sexual characteristics, abstract thought, fantasized role in different situations, increased sexual interests and peer influences (Shiferaw et al., 2011). HIV/AIDS affects young members of the societies especially adolescents between the age of 15 to 24 who are vulnerable and at risk of the disease. It is also estimated that most regular undergraduate university students lie within the age group of 18 to 24 years (Regassa and Kedir, 2011).

According to the WHO (2009) 60 to 80% of Ethiopia's morbidity and mortality are due to communicable and infectious diseases such as malaria, tuberculosis (TB) and HIV/AIDS. According to the Federal Ministry of Health (FMoH), the estimated adult prevalence of HIV/AIDS in Ethiopia is approximately 2.2% (2006). Notably, HIV prevalence among Ethiopian women is higher at 2.6% in comparison to Ethiopian men at 1.8% (WHO, 2009). The highest HIV/AIDS rates are reported in urban dwelling centers. For example, in the capital of Addis Ababa the prevalence is estimated at 7.7% of the population, which largely represents younger adults (FMoH, 2006).

According to the FMoH (2006), Ethiopia's HIV infections are mainly transmitted by heterosexual contact, whereby the most vulnerable groups are young Ethiopians from the ages of 15-24 years. The government of Ethiopia declared HIV/AIDS detrimental to the future working force of the nation commenting that the loss of young adults in their productive years of life has affected the country's overall economic output. Thus, the already strained health systems within Ethiopia will continue to be washed-out as HIV/AIDS infections continue to target Ethiopia's young working force.

The youth are much more prone to HIV infection as well as other sexually transmitted infections as a result of a lack of correct health information; engagement in risky behaviors, economic

exploitation, regional and national conflicts and a lack of access to adequate reproductive health services. The current trend in knowledge, attitudes and practice towards HIV/AIDS clearly demonstrates the need for further awareness strategies among Ethiopian students. Moreover, the national HSEP based on the MDGs, states the urgency in integrating a multi-level approach, which addresses the knowledge gaps and misconceptions towards HIV/AIDS (FMoH, 2006). Furthermore, the FMoH stresses the importance of addressing these strategies among the target population of young Ethiopians (FMoH, 2006).

It is reasonably possible to think that university students are educated, inspired, able to practice upon the information they receive and as a result, they are among a low risk population (Regassa et al., 2011). Nevertheless, results of previous studies showed that most sexual risk behaviors among college and university students might have been acquired through a period of campus life (Regassa et al., 2011) and hence they are likely to be a risk of HIV/AIDS. Therefore, preventing the transmission and the acquiring of HIV must focus upon behavior and behavioral changes.

Knowledge is very important for acquiring optimum health. Attitude formation is not essentially a function of the amount of information one receives but a function of how that information was acquired (Agbedia, 2013). Moreover, increasing knowledge of HIV/AIDS can be a powerful means of fostering positive attitudes and building safe practices among population. Hence, a clear understanding about knowledge, attitude and practices (KAPs) among any population is very important for planning to control or prevent the spread of HIV/AIDS. So it is prudent to conduct this study among youth public university students in order to understand their knowledge, attitude and practices (KAPs) regarding HIV/AIDS.

1.2 Statement of the Problem

The HIV/AIDS pandemic is the worst health crisis in history. It is clearly moved beyond being HIV primarily a health and psychosocial issue to economic and developmental crisis. Globally, progress in preventing new HIV infections among youth and adolescents has been unacceptably slow in which more than 54% youth and adolescents aged 15–24 years living with HIV in 2016 increased by 30% relative to 2005 (UNICEF, 2017). Africa is home to 15.2% of the world population. However, sub-Saharan Africa accounts for almost 70% of the global total of new HIV infections and 70% of all AIDS death in 2013, and 1.1 million People died of AIDs related causes in 2013 (UNAIDS, 2014).

Estimate from Ethiopian Public Health Institute (EPHI) shows that the number of newly infected people with HIV in the year of 2015, 2016 and 2017 were 27,104, 27,288 and 22,827, respectively, in which more than 50% were young people (EPHI, 2017).

Young women aged 15–24 years are at particularly high risk of HIV infection, accounting for 20% of new HIV infections among adults globally in 2015, despite accounting for just 11% of the adult population. In sub-Saharan Africa, young men accounted for 25% of new HIV infections among adults and women accounted for 56% of new HIV infections among adults (UNAIDS, 2016). Gender inequalities, including gender-based violence, exacerbate women's and girls' physiological vulnerability to HIV and block their access to HIV services (UNAIDS, 2016). Young people are denied the information and the freedom to make free and informed decisions about their sexual health, with most lacking the knowledge required to protect them from HIV.

High prevalence countries are experiencing dramatic drops in life expectancy, the ill and the dying are overwhelming. The already strained public health services and millions of children being orphaned often without adequate social safety nets, HIV/AIDS deepens household poverty, threatens development, social cohesion, political stability, food security and life expectancy and imposes devastating economic burden. Without effective reduction of its spread and impact, the epidemic will slash human and economic development on the continent and as expressed in the millennium development goals and by the New Partnership for African Development (NEPAD) to more Africa forward into a renaissance of development and reduced poverty.

This study attempts to identify some factors that affect knowledge, attitudes and practice towards HIV/AIDS among university students in Ethiopia. Several studies in Ethiopia were conducted using descriptive and binary logistic regression models. This study uses single level and multilevel ordinal logistic regression models to identify significant factors related to knowledge, attitudes and practice towards HIV/AIDS.

1.3 Objectives of the Study

1.3.1 General Objective

The main objective of the study was to identify the factors that affect the knowledge, attitude and practice towards HIV/AIDS among selected public university regular students in Ethiopia using single level and multilevel ordinary logistic regression analyses.

1.3.2 Specific Objectives

- ☑ To describe the socio-economic, demographic and health related factors related to KAPs towards HIV/AIDS among youth students of selected public universities.
- ☑ To examine within and between students and department level differences in determining the students' KAPs towards HIV/AIDS.

1.4 Significance of the Study

The continued spread of HIV/AIDS despite aggressive prevention programs and wide spread public awareness presents a public health issue. This study would contribute to identifying knowledge, attitude and practice of HIV/AIDS prevention among youth public university students, which clearly show the gap and help concerned bodies to give consideration to reduce the mortality and prevalence of highly active age groups due to HIV/AIDS disease.

Therefore, the study will be helpful in providing information about knowledge, attitude and practice towards HIV/AIDS prevention among youth in public university students. This in turn will help as baseline information for policy makers and concerned bodies working on health to design strategy.

Generally, a better understanding of the factors affects Knowledge, Attitude and Practice towards HIV/AIDS are an important way of keeping youth healthy. Therefore, the finding of this study is expected:

- to give awareness of factors or risk factors on the Knowledge, Attitude and Practice towards HIV/AIDS to youth of public university students.
- provide information for decision makers to fill gaps of the actual practice on youth students' Knowledge, Attitude and Practice towards HIV/AIDS in Ethiopian public universities.
- to serve as a reference for further researches and to make strategic recommendations.

2. Literature Review

In East Africa countries, HIV prevalence began declining about a decade ago and has stayed stable in many countries. Although eastern and southern Africa has only about 6.2% of the world's population, it is home to half of the world's people living with HIV. The region continued to be the hardest hit by the HIV epidemic, with 46% of the world's new HIV infections in 2015. Nearly 40% of new HIV infections in the region in 2015 were in South Africa, and another 50% occurred in eight countries: Ethiopia, Kenya, Malawi, Mozambique, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe (Global AIDS Response Progress Reporting, 2016)

The scale-up of services to prevent transmission of HIV has not been matched in other key prevention areas, leaving sizable gaps in services. Progress in the provision and use of condoms has largely delayed; the gap in sub-Saharan Africa alone is more than 3 billion male condoms a year, over 50% of the estimated need. Voluntary medical male circumcision has been rapidly expanded—reaching almost 11.7 million men in 14 priority countries in just a few years—but the annual numbers of circumcisions performed within eight of these countries declined in 2015 compared to 2014. Key harm reduction services are unavailable in most of the countries where injecting drug use has been documented. However, problems remain with HIV prevention. Declines in new HIV infections among adults have slowed, threatening further progress towards the end of the AIDS epidemic. Since 2010, the annual number of new infections among adults (15+) has remained static at an estimated 1.9 million [2015 range of 1.7 million–2.2million] (UNAIDS, 2016).

In 2015, among 1, 900, 000 new HIV infections adults, only 38% of people living with HIV are virally suppressed and condoms available in sub-Saharan Africa cover less than half of the need. Two-thirds of young people do not have correct and comprehensive knowledge of HIV (UNAIDS, 2016).

Declines in new HIV infections among adults have slow, threatening further progress towards the end of the AIDS epidemic. Since 2010, the annual number of new infections among adults (15+) has remained static at an estimated 1.9 million [2015 range of 1.7 million–2.2 million] (UNAIDS, 2016). Efforts to reach fewer than 500 000 new HIV infections by 2020 are off track.

This simple conclusion sits atop a complex and diverse global tapestry. Data from 146 countries show that some have achieved declines in new HIV infections among adults of 50% or more over the last 10 years, while many others have not made measurable progress, and yet others have experienced worrying increases in new HIV infections (UNAIDS. 2016).

Nubed and Akoachere (2016) used binary logistic regression analysis to identify factors related to knowledge, attitude and practice towards HIV/AIDS among senior secondary school in Fako Division in Cameroon. This study revealed that sex and age were found to be statistically significant effect with knowledge, attitude and practice towards HIV/AIDS. This study also showed that about 66.4 % of students obtained their information on HIV/AIDS from sex education at school, 16.4 % from the radio, and 8.6 % from friends while 6.0 % heard about HIV from family members. The majority (98.8 %) acknowledged that a healthy looking person can have the infection. However, misconceptions about routes of transmission were observed, more than half of participants demonstrated an adequate understanding of HIV transmission and prevention. Risky behaviors were found among participants as about 60 % practice safe sex and 40 % reported not to. Up to 42.2 % respondents had a history of sexual intercourse of which 56.25 % had used a condom during their last three sexual encounters and 18.8 % were intoxicated during their last sexual encounter. About 40.5 % reported that they had done an HIV test before, while only 22.3 % of these did the HIV test within 12 months prior to the study. Only 38.1 % knew their HIV status. Only 52.5 % of students had positive attitudes towards PLHIV and those who had negative attitudes comprised 47.5 %, that is about half of the respondents had negative views about HIV infected people.

Ethiopia has the 16th highest HIV/AIDS prevalence rate and the third largest population living with HIV/AIDS (PLWHA). According to UNAIDS the infection rate rose quickly from an estimate of 2.2 million Ethiopian adults and about 1,200,000 children are orphan due to AIDS and according to MOH, the prevalence rate is estimated to be 6.6% with urban HIV prevalence estimated reaching as high as 13.7% and that of rural as low as 3.7%. The highest prevalence of HIV is seen in group of 15-24 years, Ethiopians effort to decrease poverty is systematically hindered by AIDS. This pandemic is significantly affecting the Ethiopian education sector with doubled face. It affects the demand of education by reducing the number of students attending education and it also affects supply of education due to increased death and sickness of teacher

or instructors. A lack of information continues to be a primary stumbling which together with several other factors limits the effectiveness of effort to counter the spread and impact of the disease. These factors include stigma, discrimination, and silence and develop about the disease, poverty, inequality, gender inequality, war, conflict and STDs (Madawalabu University, on policy and strategy on HIV/AIDS. November 2010).

The social cost of HIV/AIDS to individual people, to families and to the whole country of Ethiopia cannot be underestimated in Ethiopia AIDS is the leading cause of death in 15-49 age group. This has enormous implications for the encouraging of the region because so many of the working populations are affected by the virus almost 72,000 people in Ethiopia died of AIDS in 2007 (MOH, 2010).

Study conducted in Mezan Tepi (on Mezan Tepi university students) by using of descriptive method of data analysis. From a total of 372 participants, 254(68%) were males and 118(32%) were females. All of the students knew what causes HIV/AIDS. The majority about knew major transmission routes. Sexual transmission mentioned as a major routes transmission in their study by 281(75.5%) of students but knowledge was translated into practice as 133(35.6%) approved premarital sex and practiced it. They have concluded that the study participants have good knowledge of HIV/AIDS related to its cause, routes of transmission and also about preventive mechanism by this knowledge was not practiced (Zemenu et al.; 2015)

A study undertaken in Bale Zone, Ethiopia (in Batu Terara Preparatory School Students in Goba Town) by using descriptive method revealed that almost all of the students in the study had heard at least one of HIV/AIDS preventive methods. Abstinence, faithfulness to one's partner and usage of condom as a means of HIV/AIDS prevention methods were responded by 93.4%, 84.1% and 47.1% of students respectively. Unsafe sex 96.7%, sharing sharp material 90%, unsafe blood transfusion 96.5% and mother to child transmission 87.5% were reported by students. Only 12.6% reported mosquito bite, 10.7% eating raw meat, prepared by HIV infected person, 8.76% sharing toilet, 9% sharing public swimming and 10.4% shaking hands with infected person as a mode of transmission. About 64% of students were responding as a pregnant woman can transmit HIV to her unborn child and 73.9% reported that mother can transmit HIV/AIDS to her child during breast feeding. About 53% of respondents had positive attitude toward using condom. About 54.1% of respondents were used condom and 38.5% of them used

nothing. About 71.1% of students reported that they were tested for HIV and the rest 122 28.9% are not tested for HIV/AIDS, from this where the majority 27.6% who were not tested are because of fear of .the result (Mohammed et al., 2015).

Nambatya Diana (2010) used binary logistic regression analysis to identify factors related to knowledge, attitude and practice towards HIV/AIDS among youth of Northern Uganda region. The study revealed that age, sex, residence and parent occupation were found to be statistically significant affect knowledge, attitude and practice towards HIV/AIDS. The study also showed that about 88% youth were knowledgeable towards HIV/AIDS, 67% of youth had favourable attitude towards and 34% had good practice towards practices that leads to HIV/AIDS.

Beryl et.al (2015) used multinomial logistic regression to identify significant factor related with multiple sexual partner of practice towards HIV/AIDS. The study indicates that, the chance of having multiple sexual partners was higher for male than for female. Place of residence (Urban/Rural) was also found to be associated with multiple sexual partners.

Wondemagegn et al., (2014) used multiple logistic regression analysis to identify factors related to knowledge, attitude and practice towards HIV/AIDS among Bahir Dar University students in Ethiopia. The study revealed that level of education; sex and religion were found to be statistically significant affect knowledge, attitude and practice towards HIV/AIDS. This study also showed that only 45.7% students were knowledgeable towards HIV/AIDS and about 82.8% had favorable attitude. Knowledgeable students had more favorable attitudes compared to not-knowledgeable students (87.6% vs. 78.6%). Good practices towards HIV/AIDS were observed among 41.7% of respondents. The majority (80.5%) of participants were not confident to discuss condom use by demonstration. Students who were knowledgeable and had favorable attitude have better preventive practices towards HIV/AIDS compared to students who are not-knowledgeable and those who had unfavorable attitudes, respectively.

3. Data and Methodology

3.1 Source of Data

The source of data used for the study is secondary data. The data were obtained from the 3th round thematic research project of Addis Ababa University, Office of Vice President for Research and Technology Transfer (VPRTT), under the supervision of Dr. Dejen Tesfaw on knowledge, attitudes and practice towards HIV/AIDS among youth public university students in Ethiopia. The data for this study have been collected in 2018 academic year.

3.2 Sampling Design and Selection Scheme

Ethiopian public universities are classified into three generations based on their establishment time (Dugassa and Alemfrie, 2015). Ethiopian public universities were stratified into three non-overlapping subgroups based on year of establishment. Considering costs and logistical feasibilities six target universities (i.e. Addis Ababa University, Gondar University, Dire Dawa University, Wollo University, Adigrat University and Wolkite University) were selected using stratified systematic sampling with probability proportional to size sampling technique; size being number of students in a university. Departments and students were selected from each of the above public universities, by using power allocation sampling technique. Colleges and departments were selected from each of the above public universities using power allocation and proportional allocation sampling technique, respectively. Based on cost and logistic feasibility, the research team decided to take five colleges/faculties and three departments in each college/faculty. At most two sections were taken from each department depending on the size of the class.

3.3 Study Variables

3.3.1 Response Variables

The response variables were “knowledge”, “attitudes” and “practices” towards HIV/AIDS, which have more than two ordinal categories. A detailed description of the response variables is given as follows:

- Knowledge = level of educational difference about the mode of transmission, sign and symptoms and ways of prevention as well as control. A student has been classified as (Mwambete et.al, 2006 as cited in Demis et.al, 2017):
  - ✓ **Knowledgeable:** if the student correctly answers at least 75% of the total knowledge-based on questions.
  - ✓ **Fairly knowledgeable:** if the student correctly answers $50 - 74\%$ of the total knowledge-based questions.
  - ✓ **Not knowledgeable:** if the student correctly answers $< 50\%$ of the total knowledge-based questions.
- Attitude = the value of youth or young student toward HIV/AIDS. A student has been classified as (Demis et.al, 2017):
  - ✓ **Favorable attitude:** if the student correctly answers at least 75% of the total attitude-based questions,
  - ✓ **Fairly favorable attitude:** if the student correctly answers $50 - 74\%$ of the total attitude-based questions,
  - ✓ **Unfavorable attitude**: if the student correctly answers $< 50\%$ of the total attitude-based questions.
- Practice = activities towards HIV/AIDS, either for prevention or control. A student has been classified as (Mohammed et al., 2014 and Demis et.al, 2017):
  - ✓ **Good practice:** if the student correctly answers at least 75% of the total practice-based questions
  - ✓ **Medium practice:** if the student correctly answers $50 - 74\%$ of the total practice-based questions,
  - ✓ **Poor practice:** if the student correctly answers $< 50\%$ of the total practice-based questions

3.3.2 Independent Variables

The independent variables include in this study were grouped into socio-economic, demographic, health related factors that affect knowledge, attitudes and practice towards HIV/AIDS among youth undergraduate graduating class students in selected Ethiopian public universities. These independent variables are described as shown in Table 3.1.

Table 3.1: Description of socio-economic, demographic and health related variables

Variables	Description	Values
Sex	Sex	0 = Male 1 = Female
Age	Age	0 = 18-20 1 = 21-23 2 = >= 24
Marital_status	Marital status	0 = Single 1 = Married 2 = Divorced 3 = Widowed
Religion	Religion	0 = Orthodox 1 = Muslim 2 = Protestant 3 = Catholic 4 = Others
Family_residence	Family residence	0 = Urban 1 = Rural
Student_lifestyle	Where students live	0 = On the campus 1 = Out of the campus
Family_lifestatus	Family life status	0 = Both alive 1 = Only mother alive 2 = Only father alive 3 = Both Died
Parent_occupation	Parent occupation	0 = Formal employee 1 = Farmer 2 = Casual laborer 3 = Self-employed 4 = Other
Family_Average_monthly_income	Family average monthly income	0 = <1000ETB 1 = 251-500 ETB 2 = 501-1000 ETB 3 = 1001-1500 ETB 4 = >1500 ETB
Stu_average_pochet_money	Student average monthly income	0= <250 ETB 1 = 251-500 ETB

		2 = 501-1000 ETB 3 = 1001-1500 ETB 4 = >1500 ETB
Cu_sexual_partner	Having current sexual partner	0 = Yes 1 = No
Massmedia_contribution	Mass media contribution	0 = Yes 1 = No
Counseling_service	Availability of counseling service	0 = Yes 1 = No
University_role	Role of university	0 = Yes 1 = No
Preffered_source	Preferred source of information	0 = Mass-Media 1 = Health workers 2 = internet
Peer_pressure	Peer pressure	0 = Yes 1 = No
Using_drug	Using drug	0 = Yes 1 = No

3.4. Methods of Data Analysis

Regression methods have an integral component of any data analysis concerned with describing the relationship between a response variable and one or more explanatory variables. Logistic regression model is used when the dependent variable is categorical, taking two or more possible values. This model allows one to predict the log odds of outcomes of a response variable from a set of explanatory variables that it can be continuous, discrete, categorical, or a mix of any of these. When a dependent variable has more than two categories and the values of each category have a meaningful sequential order where a value is indeed 'higher' than the previous one, then we can use ordinal logit link function. Logistic regression model can be used mainly for two reasons. The first is from a mathematical point of view, it is an extremely flexible and easily used function, and second it leads meaningful interpretation (Hosmer and Lemeshow, 2011).

The advantage of using multilevel ordinal analysis is the possibility to estimate the relationship between log odds of more than two ordinal categorical response variables on different levels with a set of independent variables. Therefore, in this study, we used single level and multilevel ordinal logistic regression model to analyze the data. The single ordinal logistic regression model is used to analyze data by considering a single dependent variable having more than two ordinal categories with respect to independent variables whereas the multilevel ordinal logistic

regression analysis of the data was used to check variations for KAP towards HIV/AIDS for selected university students across departments.

3.4.1. Single Level Ordinal Logistic Regression Model

3.4.1.1. Model Description

Let Y_{ij} be an ordinal response variable with j categories for the i^{th} subject, alongside with a vector of covariates X_i. A regression model establishes a relationship between the covariates and the set of probabilities of the categories $\gamma_{ij} = P(Y_i = y_j|X_i), j = 1, 2, \dots, J$. Usually, regression models for ordinal responses are not expressed in terms of probabilities of the categories, but they refer to convenient one-to-one transformations, such as the cumulative probabilities $\gamma_{ij} = P(Y_i \leq y_j|X_i), j = 1, 2, \dots, J$. We note that, the last cumulative probability is necessarily equal to 1, so the model specifies only $J - 1$ cumulative probabilities.

An ordinal logistic regression model for an ordinal response Y_i with J categories is defined by a set of $J - 1$ equations where the cumulative probabilities $\gamma_{ij} = P(Y_i \leq y_j|X_i)$ are related to a linear predictor $\beta^T X_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_j X_{ij}$ through logit transformation, i.e.

The parameters α_j, called thresholds or cutpoints, are in increasing order $(\alpha_1 < \alpha_2 < \cdots < \alpha_{J-1})$. It is not possible to simultaneously estimate the overall intercept β_0 and all the $J - 1$ thresholds: in fact, adding an arbitrary constant to the overall intercept, β_0, can be counteracted by adding the same constant to each threshold α_j. This identification problem is usually solved by either omitting the overall constant from the linear predictor $(\beta_0 = 0)$ or fixing the first threshold to zero $(\alpha_1 = 0)$. The vector of the slopes β is not indexed by the category index j, thus the effects of the covariates are constant across response categories.

3.4.1.2. Cumulative logits

One way to use category ordering forms logits of cumulative probabilities are:

$$\gamma_{ij} = P(Y_i \leq j) = \pi_{i1} + \pi_{i2} + \cdots + \pi_{ij}. \quad \text{Or}$$

$$\gamma_{ij} = P(Y_i \leq j|X_i) = \pi_1(X) + \pi_2(X) + \cdots + \pi_j(X);\ j = 1, 2, \dots, J$$

The cumulative logits are defined by:

$$\text{logit}[P(\text{Y} \leq \text{j}|\text{X})] = \log\left(\frac{\text{P}(\text{Y} \leq \text{j}|\text{X})}{1 - \text{P}(\text{Y} \leq \text{j}|\text{X})}\right) = \ln\left[\frac{\pi_1(\text{X}) + \pi_2(\text{X}) + \cdots + \pi_\text{j}(\text{X})}{\pi_{\text{j}+1}(\text{X}) + \pi_{\text{j}+2}(\text{X}) + \cdots + \pi_\text{J}(\text{X})}\right] \ldots\ldots\ldots\ldots \quad (3.1)$$

Each cumulative logit uses all J response categories. Better, models can use all $J-1$ cumulative logits in single parsimonious model.

3.4.1.3. Proportional Odds Model

A model that simultaneously uses all cumulative logits is:

$$\text{logit}[P(Y \leq j|X)] = \ln\left[\frac{\pi_1(\text{X}) + \pi_2(\text{X}) + \cdots + \pi_\text{j}(\text{X})}{\pi_{\text{j}+1}(\text{X}) + \pi_{\text{j}+2}(\text{X}) + \cdots + \pi_\text{J}(\text{X})}\right] = \alpha_\text{j} + \beta_1\text{x}_\text{i} + \cdots + \beta_\text{p}\text{x}_\text{p} = \alpha_\text{j} + \beta^\text{T}\text{X}, \ldots\ldots (3.2)$$

Each cumulative logit has its own intercept. The α_j are increasing in j, since $P(Y \leq j|X)$ increases in j for fixed X, and the logit is an increasing function of this probability. It is based on the assumption that the effects of the independent variables $x_1, \ldots., x_p$ are the same for all categories, on the logarithmic scale.

3.4.1.4. Methods of Parameter Estimation

The most commonly used method of parameter estimation in ordinal logistic regression model is the method of maximum likelihood estimation (MLE). The method of maximum likelihood estimation yields to estimate values for the unknown parameters which maximize the probability of obtaining the observed set of data. Let $y_{i1}, \ldots, y_{iJ}$ be binary indicators of the response for subject i. The likelihood function is given as follows:

$$\prod_{i=1}^{n}\left[\prod_{j=1}^{J}\pi_j(X_i)^{y_{ij}}\right] = \prod_{i=1}^{n}\left[\prod_{j=1}^{J}\left(P(Y \leq j|X_i) - P(Y \leq j-1|X_i)\right)^{y_{ij}}\right]$$

$$= \prod_{i=1}^{n}\left[\prod_{j=1}^{J}\left(\frac{exp(\alpha_j + \beta' X_i)}{1 + exp(\alpha_j + \beta' X_i)} - \frac{exp(\alpha_{j-1} + \beta' X_i)}{1 + exp(\alpha_{j-1} + \beta' X_j)}\right)^{y_{ij}}\right]$$

Taking the natural logarithm of both sides yields the following expression for log-likelihood function and it can be verified that the first two partial derivatives of the log-likelihood function exists. Hence, through maximization of the obtained equation, we can theoretically estimate the parameter vector β. But the equation is nonlinear in β and the estimates do not have a closed

form expression. Therefore, β will be obtained by maximizing using a numerical iterative method (Agresti, 1996). Since the likelihood equations are non- linear in their parameters, we use iteration method. The most commonly used iteration techniques are Newton Raphson or Fisher iteration. For this study, the Newton Raphson method is used to obtain the MLE of the parameters. The Newton-Raphson iterative method expresses $\hat{\beta}_v$ as the initial estimate of β. Then the first step of Newton-Raphson iterative method can be expressed as:

$$\hat{\beta}_{v+1} = \hat{\beta}_v + (x^t \hat{u}_v x)^{-1} x^t (y - \hat{\pi}_v)$$

where $\hat{u} = \text{diag}[\hat{\pi}(1-\hat{\pi})]$ is a diagonal matrix with its diagonal elements $\hat{\pi}_v(1-\hat{\pi}_v)$, $\hat{\pi}_v$, is initial estimate of π, $E(y) = \pi$ and $v = 0, 1, 2, \ldots$

The iteration will continue until there is no change between the elements from one iteration to the next, that is, until $\hat{\beta}_{v+1}$ is sufficiently close to $\hat{\beta}_v$. At that point, the maximum likelihood estimates are said to have converged.

3.4.1.5. Goodness of fit for Ordinal Regression Model

The goodness of fit of a model measures how effective or well the model describes the response variables. Assessing goodness of fit involves investigating how the predicted values a closer to the observed values. Clearly, the fit is good if there is a good agreement between the fitted and observed data. Some common approaches to test the goodness of fit of the model are Chi-square statistic, Deviance, Likelihood ratio chi-square statistic (Agrest, 1996 and Dobson, 2002).

3.4.1.6. Statistical Test of Individual Parameters

Wald Test

The Wald test statistic is also an alternative test which is commonly used to test the significance of the individual logistic regression coefficients for each independent variable (that is, to test the null hypothesis in logistic regression analysis that a particular logit (effect) coefficient is zero i.e. $H_O: \beta_i = 0 \ vs \ H_a: \beta_i \neq 0$. The Wald test statistic is:

$$W = \left[\frac{\hat{\beta}_i}{se(\hat{\beta}_i)}\right]^2 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (3.3)$$

Under the null hypothesis for large sample size, this statistic has an approximate chi-square distribution with one degree of freedom. (Menard, 2002).

3.4.2. Multilevel Logistic Regression Model

Multilevel logistic regression model is appropriate for research designs where data for respondents are organized more than one level (i.e., nested data). The units of analysis are usually individuals at a lower level (students) who are nested within contextual/aggregate units at a higher level (departments). A multilevel logistic regression model is also referred to as a hierarchical logistic regression model, or as a random effects (mixed effects) logistic regression model. The multilevel logistic regression extends from single level logistic regression model by including random effects from the model (Snijders and Bosker, 1999).

Multilevel logistic regression analysis can be employed in the simplest case without explanatory variables, (usually called the empty model) and also with explanatory variables by allowing only the intercept term or both the intercept and slopes (regression coefficients) to vary randomly. In this study, multilevel logistic regression model taking into account the data to be analyzed on the case of two-levels. We note that extensions to the case of three or higher levels is straight forward. In this study, students were considered as level 1 and departments were considered as level 2 (Snijders and Bosker, 1999).

3.4.2.1. A Two Level Ordinal Logistic Regression Model

Multilevel analysis is a methodology for the analysis of data with complex patterns of variability, with a focus on nested sources of variability. The best way to analysis multilevel data is an approach that represents within-group as well as between group relations within a single analysis, where 'group' refers to the units at the higher levels of the nesting hierarchy. Very often it makes sense to use probability models to represent the variability within and between groups, in other words, to conceive of the unexplained variation within groups and the unexplained variation between groups as random variability. For instance, a study of students' within departments means that not only unexplained variation between students', but also unexplained variation between departments' is considered as random variable. This can be expressed by statistical models called random coefficient model. Multilevel analysis is an approach to the analysis of such data including the statistical techniques as well as the methodology of how to use these (Snijders and Bosker, 1999).

Multilevel (random effects) ordered logit models are suitable for the analysis of correlated ordinal responses. Multilevel ordinal outcomes assume that, the covariate effects are the same across the levels of the ordinal outcome. The ordinal logistic regression model, described as the proportional odds model, provides a useful approach for analyzing ordinal outcomes. For multilevel data, where observations are nested within clusters (e.g. students, departments,), mixed-effects regression models (aka multilevel or hierarchical linear models) are often used to account for the dependency inherent in the data (Goldstein, 2011).

Models for ordinal outcomes often include the proportional odds assumption for model covariates. For an ordinal response with J categories, this assumption states that the effect of the covariate is the same across the J-1 cumulative logits of the model (or proportional across the cumulative odds).

3.4.2.2. Testing heterogeneous proportions

The most commonly used test statistic to check for heterogeneity of proportion between groups (departments) which is proper application of multilevel analysis is chi-square test statistic. To

test whether there are indeed systematic differences between the groups (department), the chi-square test can be used.

$$\chi^2 = \sum_{j=1}^{g} n_j \frac{\left(\bar{Y}_{.j} - \hat{P}_{.}\right)^2}{\hat{P}_{.}\left(1 - \hat{P}_{.}\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.5)}$$

, where $\bar{Y}_{.j}$ is group average obtained as $\bar{Y}_{.j} = \frac{\sum_{i=1}^{n_j} Y_{ij}}{n_j}$ is the proportion of successes in group j which is an estimate for the group-dependent probability p_j and $\hat{P}_{.}$ is the overall average,

i.e. $\hat{P}_{.} = \bar{Y}_{..} = \frac{\sum_{j=1}^{g}\sum_{i=1}^{n_j} Y_{ij}}{n}$ is the overall proportion of successes. The decision is based on chi-square distribution with g-1 degrees of freedom (Agresti, 1996).

3.4.2.3. Estimation of between and within-group variance

Consider a population having two-levels, the basic data structure of two-level logistic regression analysis is a collection of N groups (units at level-two (departments)) and within group j (j= 1, 2, …, N) a random sample of n_j level-one units (students). The outcome variable is ordinal response and denoted by Y_{kij} (I = 1, 2…, $n_j, j = 1,2,\ldots,N, k = 1,2,\ldots,K-1$) for level-one unit i in group j. The total sample size is: $M = \sum_{j=1}^{N} n_j$

Then, the theoretical variance between the groups (departments) dependent probabilities, i.e., the population value of var (P_j), can be estimated by:

$\hat{\tau}^2 = S^2 between - \frac{S^2 within}{\tilde{n}}$, where $\tilde{n} = \frac{1}{N-1}\left(M - \frac{\sum_{j=1}^{N}(n_j)^2}{M}\right) = \bar{n} - \frac{s^2(n_j)}{N\bar{n}}$

They are given by the formula:

$$S^2 between = \frac{\hat{P}\left(1-\hat{P}\right)}{\tilde{n}(N-1)}\boldsymbol{\chi^2}$$

where, $\boldsymbol{\chi^2}$ is as given by equation (3.5), and the within- group variance in the ordinal case is a function of the group**:**

$$S^2 within = \frac{1}{M-N}\sum_{j=1}^{g} n_j\, P_j\left(1-P_j\right)$$

I. The Empty Logistic Regression Model

The empty level-2 model for an ordinal response variable refers to a population of groups (level-two units, i.e. departments) and specifies the probability distribution for group dependent probabilities Pj without taking further explanatory variables into account. Therefore, in this situation with three categories of response, there will be two logits and their corresponding intercepts simultaneously estimated, each of them indicating the probability of responding in or below a particular category. This model only contains random groups and random variation within groups. The equations necessary for estimating this model are presented below.

$$\eta_{1j} = \text{logit}(p_j \leq 1) = \beta_0 + u_{0j}$$
$$\eta_{2j} = \text{logit}(p_j \leq 2) = \beta_0 + u_{0j} + \delta_j \quad ------- (3.6)$$

, where δ is the difference between the two response categories and where, β_0 is the average of the ordered outcome variable (intercept) of the transformed probabilities and u_{0j} the random deviation from this average for group j. For the deviations u_{0j} is assumed to be independent random variables with a normal distribution with mean 0 and variance σ_0^2 $i.e.$ $u_{0j} \sim N(0, \sigma_0^2)$.

II. The Random Intercept Logistic Regression Model

In the random intercept logistic regression model the intercept is the only random effect meaning that the groups differ with respect to the average value of the response variable. It represents the heterogeneity between groups in the overall response. When dealing with ordinal response outcomes, multiple logits are simultaneously estimated (M-1 logits, where M = the number of response categories). Hence, in this situation with three categories of response, there will be two logits and their corresponding intercepts simultaneously estimated, each of them indicating the probability of responding in or below a particular category. The equations essential for estimating these models are shown as below.

$$\eta_{1ij} = \text{logit}\,(P_{ij} \leq 1) = \log\left\{\frac{P(P_{ij} \leq 1)}{1 - P(P_{ij} \leq 1)}\right\} = \beta_{0j} + \beta_{1j}x_{1ij} + \beta_{2j}x_{2ij} + \cdots + \beta_{kj}x_{kij}$$
$$= \beta_{0j} + \sum_{k=1}^{K} \beta_{kj}x_{kij}$$

$$\eta_{2ij} = \text{logit}(P_{ij} \leq 2)\log\left\{\frac{P(P_{ij}\leq 2)}{1-P(P_{ij}\leq 2)}\right\} = \beta_{0j} + \beta_{1j}x_{1ij} + \beta_{2j}x_{2ij} + \cdots + \beta_{kj}x_{kij} + \delta_j \quad \textbf{(3.7)}$$

$$= \beta_{0j} + \sum_{k=1}^{K} \beta_{kj}x_{kij} + \delta_j$$

where η_{ij} is the log odds of being at or below a knowledge, attitude and practice level towards HIV/AIDS for student *i* in department j. More specifically, η_{1ij} corresponds to the log odds of being at or below the not-knowledgeable level, unfavourable attitude level and poor practice level towards HI/AIDS for student *i* in department j and β_{0j} is the intercept or the average log odds of being at or below the knowledge, attitude and practice towards HI/AIDS levels of at department j, $x_{ij}$is a student-level predictor for student *i* in department j, and β_{1j} represents the slope associated with x_{ij}. Similarly, η_{2ij}represents the log odds of being at or below the next knowledge, attitude and practice towards HIV/AIDS level (i.e., basic) for student *i* in department j. In this case, the intercept term $\beta_{0j}$is assumed to vary randomly across the department, the difference between the logits (δ) remains fixed across department., and is given by the sum of an average intercept β_0 and group- dependent deviations u_{0j}. That is: $\beta_{0j} = \beta_0 + u_{0j}$. Then,

$$\eta_{1ij} = \text{logit}\left(P_{ij} \leq 1\right) = \beta_0 + \sum_{k=1}^{K} \beta_{kj}x_{kij} + u_{0j}$$

$$\eta_{2ij} = \text{logit}\left(P_{ij} \leq 2\right) = \beta_0 + \sum_{k=1}^{K} \beta_{kj}x_{kij} + u_{0j} + \delta_j$$

Note that the first part of the left-hand side incorporating the regression coefficients in both equations $\beta_0 + \sum_{k=1}^{K} \beta_{kj}x_{kij}$ is the fixed part of the model, because the coefficients are fixed. The remaining part $u_{0j}$is called the random part of the model.

It is assumed that the residual, u_{0j} are mutually independent and normally distributed with mean zero and variance σ_0^2. the above equations is considered as a mixed model because it has both fixed effects and random effects (Snijders and Bosker, 1999).

III. The Random Coefficients Logistic Regression Model

In the random intercept logistic regression model the intercept is the only random effect meaning that the groups differ with respect to the average value of the dependent variable. But we have assumed that the effects of the explanatory variables are the same for each department. This assumption is considered by allowing the difference between explanatory variables within a department to vary across departments. To allow for this effect, we will need to use a random coefficient for those explanatory variables. So, random coefficient model represents heterogeneity in relationship between the response and explanatory variables.

As stated above the response variables in the study, knowledge, attitude and practice towards HIV/AIDS, is ordinal and the statistical model employed is the two-level random coefficient logistic regression model. The model, with k level-1 predictors and p level-2 predictors, can be expressed as:

$$\eta_{1ij} = \text{logit}\left(P_{ij} \leq 1\right) = \log\left\{\frac{P(P_{ij}\leq 1)}{1-P(P_{ij}\leq 1)}\right\} = \beta_{0j} + \sum_{k=1}^{K}\beta_{kj}x_{kij} + \sum_{p=1}^{P}u_{pj}x_{pij} \quad (\mathbf{3.8})$$

$$\eta_{2ij} = \text{logit}\left(P_{ij} \leq 2\right) = \log\left\{\frac{P(P_{ij}\leq 2)}{1-P(P_{ij}\leq 2)}\right\} = \beta_{0j} + \sum_{k=1}^{K}\beta_{kj}x_{kij} + \sum_{p=1}^{P}u_{pj}x_{pij} + \delta_{j}$$

where, $\beta_{0j} = \beta_0 + u_{0j},\ u_{0j} \sim iid(0,\ \sigma_0^2)$ and $u_{pj} \sim iid(0,\ \sigma_p^2)$

Now the above equation is written as:

$$\eta_{1ij} = \text{logit}\left(P_{ij} \leq 1\right) = \beta_0 + \sum_{k=1}^{K}\beta_{kj}x_{kij} + u_{0j} + \sum_{p=1}^{P}u_{pj}x_{pij}$$

$$\eta_{2ij} = \text{logit}\left(P_{ij} \leq 2\right) = \beta_0 + \sum_{k=1}^{K}\beta_{kj}x_{kij} + u_{0j} + \sum_{p=1}^{P}u_{pj}x_{pij} + \delta_{j}$$

The first part of both equations, $\beta_0 + \sum_{k=1}^{K}\beta_{kj}x_{kij}$, is called the fixed part of the model and second part, $u_{0j} + \sum_{p=1}^{P}u_{pj}x_{pij}$, is called the random part (Snijders and Bosker, 1999).

3.4.2.4. Intraclass Correlation (ICC)

For a multilevel model, it is often of interest to express the cluster variance in terms of an intraclass correlation (ICC). The ICC indicates the proportion of unexplained variance that is at the cluster level, and is given by:

$\text{ICC} = \left(\frac{\sigma^2{}_\vartheta}{\sigma^2{}_\vartheta + \sigma^2}\right)$, where $\sigma^2{}_\vartheta$ is the cluster or level-2 (departments) variance and σ^2 is the level-1 (students) variance. For a logistic regression model (either binary or ordinal), the level-1

variance, which is not estimated, equals the variance of the standard logistic distribution $\frac{\pi^2}{3}$ (Agresti, 2002).

3.4.2.5. Parameter Estimation for Multilevel Logistic Regression Model

Parameter estimation for multilevel logistic regression model is not straightforward like the methods for classical logistic regression model. The most common methods to estimate the parameters in multilevel logistic regression model are based on the marginal maximum likelihood (MML) (Bock and Aitkin, 1981). This approach uses a fairly straightforward extension of the usual method of ML, but it is more complicated due to the need to perform numerical integration to obtain a marginal likelihood to maximize. So that approaches based on various approximations to MML are popular. These are referred to as quasi-likelihood approaches, the major variants being marginal quasi-likelihood (MQL) (Goldstein, 1991; Goldstein and Rasbash; 1996)) and penalized quasi-likelihood (PQL) (Laird, 1978; Breslow and Clayton, 1993). Both MQL and PQL are based on Taylor series expansion to achieve the approximation of parameter estimation. Based on the first and second term of Taylor expansion, MQL and PQL are often known as first order MQL and second-order MQL, respectively. After applying these quasi- likelihood methods, the model is then estimated using iterative generalized least squares (IGLS) or reweighted IGLS (RIGLS) (Goldstein, 2003).

4. Statistical Data Analysis and Results

This chapter consists of two sections; the descriptive and inferential analyses. Tables are used to describe the socio-economic, demographic and health related variables. Moreover, single level and multilevel-ordinal logistic regression models are used to identify the effect of these variables on knowledge, attitude and practice towards HIV/AIDS among youth students of selected public universities in Ethiopia. Data analysis is made using SPSS and STATA software

4.1. Descriptive Analysis

Descriptive analysis is concerned mainly with providing descriptions in the form of tables, diagrams line graph and summary calculations such as mean and standard deviation. In this study only tables are used to describe the data.

4.1.1. Description of Students' Knowledge, Attitude and Practice towards HIV/AIDS

A total of 2,176 sampled undergraduate graduating class students in selected Ethiopian public universities were included in the study. As shown in Table 4.1, out of the total public university students who were included in the study, 172 (representing 7.9%) were not- knowledgeable, 1056 (representing 48.5%) were fairly knowledgeable and 948 (representing 43.6%) were knowledgeable about HIV/AIDS. Likewise, out of 2,176 sampled students, 608 (representing 27.9%) had unfavourable attitude, 1,268(representing 58.3%) had fairly favourable attitude and 300 (representing 13.8%) had favourable attitude towards HIV/AIDS, respectively. Out of 2,176 sampled students, 1,073(49.3%) had poor practice, 656(30.1%) had medium practice and 447(20.5%) had good practice, respectively.

Table 4.1: Description of students' Knowledge, Attitude and Practice towards HIV/AIDS in Selected Public Universities

Response variable		Count	Percent	Total
Levels of Knowledge	Not knowledgeable	172	7.9	2,176
	Fairly Knowledgeable	1,056	48.5	
	Knowledgeable	948	43.6	
Levels of Attitude	Unfavourable Attitude	608	27.9	2,176
	Fairly favourable Attitude	1,268	58.3	
	Favourable Attitude	300	13.8	
Levels of Practice	Poor Practice	1,073	49.3	2,176
	Medium Practice	656	30.1	
	Good Practice	447	20.5	

4.1.2. Cross tabulation of Socio-economic, Demographic and Health related characteristics

Table 4.2 reveals that male and female students who were not-knowledgeable towards HIV/AIDS represented 5.3% and 11.3%, respectively. The proportion of male and female students who were fairly knowledgeable towards HIV/AIDS represented 46.1% and 51.8% respectively. Male and female students who were knowledgeable towards HIV/AIDS represented 48.6% and 37.0% respectively.

The table also shows that students whose place of residence of their family was rural area (representing 8.3%) were not-knowledgeable towards HIV/AIDS when compared with those whose families were from urban area (7.6%). Students whose place of residence of their family were urban areas (representing 46.9%) were knowledgeable towards HIV/AIDS when compared with those students whose families were from rural area (representing 38.8%) respectively.

Table 4.2: Cross tabulation of the levels of knowledge towards HIV/AIDS with predictor variables

Variable	Category	Levels of Knowledge about HIV/ADIS			Total	Chi-square	Df	P-value
		Not knowledgeable	Fairly Knowledgeable	Knowledgeable				
		Count (%)	Count (%)	Count (%)				
Sex	Male	66(5.3%)	570(46.1%)	601(48.6%)	1,237	44.055	2	.000
	Female	106(11.3%)	486(51.8%)	347(37.0%)	939			
Age	18-20	109(7.3%)	713(52.148.1%)	661(44.6%)	1,483	8.462	4	.046
	21-23	26(7.4%)	166(47.0%)	161(45.6%)	353			
	>=24	37(10.9%)	177(52.1%)	161(37.1%)	375			
Marital status	Single	162(8.0%)	964(47.7%)	896(44.3%)	2,022	13.098	6	.042
	Married	6(4.7%)	77(60.6%)	44(34.6%)	127			
	Divorced	2(10.5%)	11(57.95)	6(31.6%)	19			
	Widowed	2(25.0%)	4(50.0%)	2(25.0%)	8			
Religion	Orthodox	105(7.4%)	684(48.3%)	626(44.2%)	1,415	11.746	8	.163

	Muslim	28(8.3%)	170(50.4%)	139(41.2%)	337			
	Protestant	27(8.1%)	155(46.5%)	151(45.3%)	333			
	Catholic	8(19.5%)	22(53.7%)	11(26.8%)	41			
	Others	4(8.0%)	25(50.0%)	21(42.0%)	50			
Place of residence	Urban	97(7.6%)	581(45.5%)	599(46.9%)	1,277	14.146	2	.001
	Rural	75(8.3%)	475(52.8%)	349(38.8%)	899			
Living style in university	On the campus	154(7.9%)	965(49.6%)	828(42.5%)	1,947	8.663	2	.013
	Out of campus	18(7.9%)	91(39.7%)	120(52.4%)	229			
Family life status	Both are alive	98(6.8%)	68(52.3%)	664(45.5%)	1,451	22.613	6	.001
	Only mother alive	32(7.6%)	224(53.3%)	164(39.0%)	420			
	Only father alive	18(10.3%)	75(42.9%)	82(46.9%)	175			
	Both died	24(18.5%)	689(47.5%)	38(29.9%)	130			
Parent(s) occupation	Formal employee	66(7.8%)	281(47.3%)	270(45.5%)	594	45.039	8	.000
	Farmer	42(7.1%)	435(51.5%)	343(40.6%)	863			
	Casual laborer	23(18.7%)	68(52.3%)	38(30.9%)	97			
	Self-employed	27(6.1%)	193(44.2%)	217(49.7%)	440			
	Others	14(7.7%)	86(47.3%)	82(45.1%)	182			
Family average monthly income	<1,000 Birr	44(7.9%)	304(54.3%)	212(37.9%)	212	58.576	8	.000
	1,000-2,500 Birr	60(11.5%)	266(51.2%)	194(37.3%)	520			
	2,501-5,000 Birr	43(7.8%)	265(48.0%)	244(44.2%)	552			
	5,001-7,500 Birr	13(5.1%)	120(46.0%)	133(51.0%)	261			
	>7,500 Birr	17(6.0%)	101(35.7%)	165(58.3%)	283			
Students average monthly pocket money	<250 Birr	103(12.4%)	436(52.5%)	292(35.1%)	831	78.209	8	.000
	251-500 Birr	40(6.1%)	334(50.7%)	285(43.2%)	659			
	501-1000 Birr	20(5.1%)	164(42.6%)	209(54.3%)	385			
	1001-1500 Birr	10(5.4%)	75(40.3%)	101(54.3%)	186			
	>1500 Birr	7(6.1%)	47(40.9%)	61(53.0%)	115			
Sexual partner	Yes	98(12.9%)	398(52.6%)	261(34.5%)	757	63.250	2	.000
	No	74(5.2%)	658(46.4%)	687(48.4%)	1,419			
Mass-media Contribution	Yes	55(5.6%)	481(48.7%)	452(45.7%)	988	14.499	2	.001
	No	117(9.8%)	575(48.4%)	496(41.8%)	1,188			
Counseling and testing	Yes	101(8.3%)	591(48.5%)	527(43.2%)	1,219	.581	2	.748
	No	71(7.4%)	465(48.6%)	421(44.0%)	957			
Role of University	Yes	119(8.8%)	678(49.9%)	561(41.3%)	1,358	9.039	2	.011
	No	53(6.5%)	378(46.2%)	387(47.3%)	818			
Preferred source to get information	Mass- media	52(5.8%)	456(50.8%)	389(43.4%)	897	16.980	4	.002
	Health workers	68(10.1%)	333(49.6%)	271(40.3%)	672			
	Internet	52(8.6%)	267(44.0%)	288(47.4%)	607			
Peer pressure	Yes	44(4.7%)	399(42.5%)	496(52.8%)	939	66.537	2	.000
	No	128(10.3%)	657(53.1%)	452(36.5%)	1,237			
using drug	Yes	76(5.4%)	657(47.0%)	666(47.6%)	1,399	46.944	2	.000
	No	96(12.4%)	399(51.4%)	282(36.3%)	777			

The chi-square test result revealed that there was a statistically significant association between students' knowledge towards HIV/ADIS and the variables sex, age, place of residence, life style in university, family life status, parent(s) occupation, family average monthly income, students' average monthly income, sexual partner, media contribution in university, role of university, preferred sources to get information, peer pressure and using drug. Conversely, religion and

counseling and testing service have no statistically significant association with the levels of knowledge towards HIV/AIDS at 5% level of significant.

4.1.3. Cross tabulation of Socio-economic, Demographic and Health related characteristics

Table 4.3 shows that higher proportion of male students (representing 15.6%) had favourable attitude towards HIV/AIDS as compared to female students (representing 11.6%). Students who came from urban areas (representing 59.9%) had fairly favourable attitude towards HIV/AIDS when compared with students who came from rural areas (representing 56.0%).

Table 4.3: Cross tabulation of the levels of attitude towards HIV/AIDS with predictor variables

Variable	Category	Levels of Attitude about HIV/ADIS				Chi-square	Df	p-value
		Unfavouble Attitude	Fairly Favourable Attitude	Favourable Attitude	Total Count			
		Count (%)	Count (%)	Count (%)				
sex	Male	285(34.4%)	759(61.4%)	193(15.6%)	1,237	36.187	2	.000
	Female	323(23.0%)	509(54.2%)	107(11.6%)	939			
Age	18-20	103(32.6%)	170(53.8)	43(13.6%)	316	12.402	4	.015
	21-23	405(26.6%)	930(60.5%)	202(13.1%)	1,537			
	>=24	100(31.15)	168(52.0%)	55(17.0%)	323			
Marital status	Single	562(27.8%)	1175(58.1%)	285(14.15)	2,022	4.038	6	.672
	Married	37(29.1%)	76(59.8%)	14(11.0%)	127			
	Divorced	7(36.8%)	11(57.9%)	1(5.3%)	19			
	Widowed	2(25.0%)	6(75.0%)	0(0.0%)	8			
Religion	Orthodox	343(24.2%)	848(59.9%)	224(15.8%)	1,415	39.604	8	.000
	Muslim	111(32.9%)	191(56.7%)	35(10.4%)	337			
	Protestant	123(36.9%)	178(53.5%)	32(9.6%)	333			
	Catholic	18(43.9%)	21(51.25)	2(4.9%)	41			
	Others	13(26.0%)	30(60.0%)	7(14.0%)	50			
Family residence	Urban	249(27.7%)	765(59.9%)	147(16.4.0%)	1,277	8.758	2	.013
	Rural	359(28.1%)	503(56.0%)	153(12.0%)	899			
Life style in university	In the campus	548(28.1%)	1118(57.4%)	281(14.4%)	1,947	8.168	2	.017
	Out of campus	60(26.2%)	150(65.5%)	19(8.3%)	229			
Family life status	Both alive	68(25.8%)	950(60.3%)	218(13.8%)	1,575	15.715	6	.015
	Only mother	132(33.2%)	208(52.3%)	58(14.6%)	398			
	Only father	49(36.8%)	70(52.65)	14(10.5%)	133			
	Both are died	20(28.6%)	40(57.1%)	10(14.3%)	70			
Parent(s) occupation	Formal employee	165(27.8%)	362(60.9%)	67(11.3%)	594	36.579	8	.000
	Farmer	226(26.2%)	492(57.0%)	145(16.8%)	863			
	Casual laborer	48(49.5%)	38(39.2%)	11(11.3%)	97			
	Self-employment	116(26.4%)	264(60.0%)	60(13.4%)	440			
	Others	53(29.15)	112(61.5%)	17(9.3%)	182			
Family average monthly income	<1,000 Birr	158(28.2%)	334(59.6%)	68(21.1%)	560	50.330	8	.000
	1,000-2,500 Birr	166(31.9%)	277(53.3%)	77(14.8%)	520			
	2,501-5,000 Birr	188(34.1%)	284(51.4%)	80(14.5%)	552			
	5,001-7,500 Birr	42(16.1%)	180(69.0%)	39(14.9%)	261			

	>7,500 Birr	54(19.1%)	193(68.25)	36(12.7%)	283			
Students average monthly pocket money	<250 Birr	275(33.1%)	456(54.9%)	100(12.0%)	831	32.213	8	.000
	251-500 Birr	186(28.2%)	367(55.7%)	106(16.1%)	659			
	501-1000 Birr	89(23.1%)	241(62.6%)	55(14.3%)	385			
	1001-1500 Birr	37(191.9%)	125(67.2%)	24(12.9%)	186			
	>1500 Birr	21(18.3%)	79(68.7%)	15(13.05)	115			
Sexual partner	Yes	322(22.5%)	865(61.0 %)	232(16.3%)	757	64.706	2	.000
	No	322(22.7%)	865(61.0%)	232(16.3%)	1,419			
Mass- media contribution	Yes	286(37.8%)	403(53.2%)	68(9.0%)	988	26.949	2	.000
	No	386(32.55)	647(54.5%)	155(13.0%)	1,188			
Counseling and testing	Yes	349(28.65)	677(55.5%)	193(15.8%)	1,219	12.443	2	.002
	No	259(27.1%)	591(61.8%)	107(11.2%)	957			
University role	Yes	409(30.1%)	757(55.7%)	192(14.1%)	1,358	10.412	2	.005
	No	199(24.3%)	511(62.5%)	108(13.25)	818			
Preferred source	Mass- media	237(26.2%)	532(58.9%)	134(14.8%)	903	9.285	4	.054
	Health workers	212(31.6%)	366(54.55)	93(13.9%)	671			
	Internet	159(26.4%)	370(61.5%)	73(12.1%)	602			
Peer pressure	Yes	179(19.1%)	594(63.3%)	166(17.7%)	939	71.793	2	.000
	No	429(34.7%)	674(54.5%)	134(10.8%)	1,237			
Using drug	Yes	326(23.3%)	856(61.2%)	217(15.5%)	1,399	44.334	2	.000
	No	282(36.3%)	412(53.0%)	83(10.7%)	777			

The chi-square test revealed that there existed a significant association between attitude of students towards HIV/AIDS and variables sex, age, religion, family residence, life style in university, family life status, parent(s) occupation, family average monthly income, students average monthly pocket money, current sexual partner, contribution of mass-media, counseling and testing service in university, role of university in creating awareness, peer pressure and using drug at 5% level of significance. However, marital status and preferred source of information had no significant association with students' attitude towards HIV/AIDS at 5% of level significance.

4.1.4. Cross tabulation of Socio-economic, Demographic and Health related characteristics

Table 4.4 shows that male students (representing 54.8%) had poor practice towards HIV/AIDS as compared to female students (representing 45.1%). Students who came from rural areas (50.6%) had poor practice towards HIV/AIDS when compared with those students who came from urban areas (47.5%). The proportion of students whose average monthly pocket money was below Birr 250 (representing 51%) had poor practice towards practices that lead to HIV/AIDS when compared with students whose average monthly pocket money was greater than Birr 1,500 Birr (representing 47%).

Table 4.4: Cross tabulation of the levels of practice towards HIV/AIDS with predictor variables

Variable	Category	Level of Practice about HIV/ADIS				Chi-square	Df	p-value
		Poor Practice	Medium Practice	Good Practice	Total Count			
		Count (%)	Count (%)	Count (%)				
Gender	Male	515(54.8%)	379(30.6%)	300(24.3%)	1237	29.698	2	.000.
	Female	558(41.5%)	277(29.5%)	147(15.7%)	939			
Age	18-20	181(57.3%)	84(26.6%)	51(16.1%)	316	10.245	4	.036
	21-23	739(48.1%)	468(30.4%)	330(21.5%)	1537			
	>=24	153(47.4%)	104(32.2%)	66(20.4%)	323			
Marital status	Single	1008(49.9%)	607(30.0%)	407(20.1%)	2022	15.056	6	.026
	Married	47(37.0%)	42(33.1%)	38(29.9%)	127			
	Divorced	12(63.2%)	6(31.6%)	1(5.3%)	19			
	Widowed	6(75.0%)	1(12.5%)	1(12.5%)	8			
Religion	Orthodox	655(46.3%)	468(33.1%)	292(20.6%)	1415	31.319	8	.000
	Muslim	181(53.7%)	85(25.2%)	71(21.1%)	337			
	Protestant	180(54.1%)	83(24.9%)	70(21.0%)	333			
	Catholic	33(80.5%)	5(12.2%)	3(7.3%)	41			
	Others	24(48.0%)	15(30.0%)	11(22.0%)	50			
Family residence	Urban	427(47.5%)	365(28.6%)	266(20.8%)	1277	3.656	2	.161
	Rural	646(50.6%)	291(32.4%)	181(20.1%)	899			
Life style in university	In the campus	964(49.5%)	590(30.3%)	393(20.2%)	1947	1.452	2	.481
	Out of campus	109(47.6%)	66(28.8%)	54(23.6%)	229			
Family life status	Both are alive	754(47.9%)	485(30.8%)	336(21.3%)	1575	9.735	6	.136
	Only mother	220(55.3%)	110(27.6%)	68(17.1%)	398			
	Only father alive	70(52.6%)	37(27.8%)	26(19.5%)	133			
	Both are died	29(41.4%)	24(34.3%)	17(24.3%)	70			
Parent(s) occupation	Formal employee	315(53.0%)	157(26.4%)	122(20.5%)	594	23.429	8	.003.
	Farmer	387(44.8%)	290(33.6%)	186(21.6%)	863			
	Casual laborer	64(66.0%)	20(20.6%)	13(13.4%)	97			
	Self-employment	212(48.2%)	136(30.9%)	92(20.9%)	440			
	Others	95(52.2%)	53(29.1%)	34(18.75)	182			
Family average monthly income	<1,000 Birr	260(46.4%)	187(33.4%)	113(20.2%)	560	11.279	8	.186
	1,000-2,500 Birr	249(47.9%)	162(31.2%)	109(21.0%)	520			
	2,501-5,000 Birr	300(54.3%)	152(27.5%)	100(18.1%)	552			
	5,001-7,500 Birr	125(47.9%)	76(29.1%)	60(23.0%)	261			
	>7,500 Birr	139(49.1%)	79(27.9%)	65(23.0%)	283			
Student average monthly pocket money	<250 Birr	424(51.0%)	263(31.6%)	144(17.3%)	831	10.242	8	.248
	251-500 Birr	321(48.7%)	184(27.9%)	154(23.4%)	659			
	501-1000 Birr	187(48.6%)	116(30.1%)	82(21.3%)	385			
	1001-1500 Birr	87(46.8%)	59(31.7%)	40(21.5%)	186			
	>1500 Birr	54(47.0%)	34(29.6%)	27(23.5%)	115			
Sexual partner	Yes	384(50.7%)	226(29.9%)	147(19.4%)	757	1.218	2	.544
	No	689(48.6%)	430(30.3%)	300(21.1%)	1419			
Mass- medias contribution	Yes	431(43.6%)	314(31.8%)	243(24.6%)	988	27.944	2	.000
	No	642(54.0%)	342(28.8%)	204(17.2%)	1188			
Counseling and testing in university	Yes	602(49.4%)	357(29.3%)	260(21.3%)	1219	1.519	2	.468
	No	471(49.2%)	299(31.2%)	187(19.5%)	957			
Universities role	Yes	676(49.8%)	402(29.6%)	280(20.6%)	1358	.527	2	.769
	No	397(48.5%)	254(31.1%)	167(20.4%)	818			

Preferred source on HIV/AIDS	Mass- media	431(47.75)	277(30.7%)	195(21.6%)	903	3.915	4	.418
	Health workers	334(49.8%)	211(31.4%)	126(18.8%)	671			
	Internet	308(51.2%)	168(27.9%)	126(20.9%)	602			
Peer pressure	Yes	412(43.9%)	292(31.1%)	235(25.0%)	939	26.556	2	.000
	No	661(53.4%)	364(29.4%)	212(17.1%)	1,237			
Using drug	Yes	654(46.7%)	429(30.7%)	316(22.6%)	1,399	13.546	2	.001
	No	419(53.9%)	227(29.2%)	131(16.9%)	777			

Table 4.4 reveals that sex, age, marital status, religion, parent(s) occupation, mass-media contribution, peer pressure and using drug (chat, alcohol, and others) had significant association with students' practice towards HIV/AIDS at 5% level of significance. However, place of residence, life style in university, family average monthly income, students average monthly pocket money, current sexual partner and role of university had no significant association with students' practice towards HIV/AIDS at 5% level of significance.

We should identify statistically significant independent variables and determine the relationship between the dependent and independent variables using single level and multilevel ordinal logistic regression analyses.

4.2. Single-Level Ordinal Logistic Regression Analysis

In this study, ordinal logistic regression analysis is used to examine the effect of an independent variable on the levels of knowledge, attitude and practice towards HIV/AIDS in the ordinal logistic regression model for public university students, while controlling the other independent variables constant.

4.2.1 Univariable Ordinal logistic Regression model for Knowledge, Attitude and Practice

In this study, univariable analysis has been conducted in order to incorporate the variables into the final model at 25% level of significance. The enter method of variable selection procedure in SPSS was employed to select the important determinants of youth students' knowledge, attitude and practice towards HIV/AIDS.

4.2.2. Model adequacy checking for knowledge, Attitude and Practice towards HIV/AIDS

Test of Parallel Lines Assumption

In ordinal logistic regression models, there is an assumption which belongs to ordinal odds. According to this assumption parameters should not change for different categories. In other words, location parameters (slope coefficients) are the same across response categories.

Table: 4. 5: Result of test of parallel lines

		Model	-2 Log Likelihood	Chi-Square	Df	P-value
Response Variables	**Knowledge**	Null hypothesis	3,458.1992	33.5665	24	.093
		General	3,424.627			
	Attitude	Null hypothesis	705.948	14.497	8	.070
		General	691.451			
	Practice	Null hypothesis	2,308.084	15.075	14	.373
		General	2,293.009			

Note: The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

Here, the test of parallel lines in knowledge, attitude and practice indicate that the assumption is satisfied. Non-significance of test of parallel lines implies proportional odds model is good for the data. Equality of the following hypothesis shows that the test whether β_k coefficients of independent variable are equal or not for every single category.

H_o: $\beta_{1j} = \beta_{2j} = \ldots = \beta_{(k-1)j}$, where $j = 1, 2, \ldots, J$ versus H_1: at least one $\beta_j$is different and k represents parameters or slope coefficients across categories

As displayed in Table 4.5, we do not reject the null hypothesis at 5% level of significance. This shows that there is no sufficient evidence to reject the null hypothesis, indicating that the model is a good fit.

Likelihood Ratio Test

The difference between -2log-likelihood for model fitted with independent variables and -2log-likelihood for null model (at step 0, before any variables have been added to the model) is distributed chi-square with degrees of freedom equal the difference between the numbers of parameters in the full and null models.

4.2.3 Goodness of Fit

Assessing goodness of fit involves investigating how the predicted values a closer to the observed values.

Table: 4.6: Summary Statistics of the LRT and model fitting criteria

Dependent variables	Model fit	Model fitting criteria			LRT		
		-2 Log Likelihood	AIC	BIC	Chi-Square	Df	P-value
Knowledge	Null model	3,975.328	3,979.328	3,990.698	263.235	26	
	Full model	3,712.093	3,764.093	3,911.91			.0000
Attitude	Null model	4,108.9206	4,112.921	4,124.291	227.36	10	.0000
	Full model	3,912.8502	3,932.85	3,989.703			
Practice	Null model	4,505.4032	4,509.403	4,520.774	130.86	16	.0000
	Full model	4,374.5462	4,406.546	4,497.51			

Before proceeding to examine the individual coefficients, we want to look at the overall test of the null hypothesis that all coefficients for all of the independent variables in the model are zero. We can base this on the changes in –2 log-likelihood when the variables are added to a model that contains only the intercept. Accordingly, in our model the difference between the two log-likelihoods for knowledge, attitude and practice towards HIV/ADIS (i.e., a Chi-square value of 263.235, 227.36 and 130.86, respectively) is found to be significant at 5% level of significance. This means that we can reject the null hypothesis that the model with independent variables is better than the model without independent variables.

The model with the smallest values of AIC and BIC is considered as the best fit. The value of AIC and BIC for knowledge, attitude and practice towards HIV/AIDS for null model were 3,979.328 and 3,990.698; 4,112.921 and 4,124.291; 4,509.403 and 4,520.774 and for full model were 3,764.093 and 3,911.91; 3,932.85 and 3,989.703; 4,406.546 and 4,497.51, respectively. Hence, the final model fits the data well which indicates that the independent variables had significant effect on the dependent variables.

4.2.4 Model Estimation Results

Table: 4.7: Parameter estimates of the proportional odds model

Knowledge Categories	Categories	Estimate	S.E	Z-value	P-value	AOR	95% C.I for OR	
Variables	Intercept						Lower	Upper
		-1.992	.2434					
		.9769	.2382					
Sex	**Male (Ref)**							
	Female	-.5286	.0916	-5.77	**0.000***	.589	.4925	.7053
Age group	**18-20 (Ref)**							
	21-23	.1112	.1211	0.92	0.358	1.116	.8815	1.4169
	>=24	-.2634	.1238	-2.13	**0.033***	.768	.6028	.9794
Family residence	**Urban (Ref)**							
	Rural	.2835	.1042	2.72	**0.007***	1.329	1.0825	1.6287
Family life status	**Both alive (Ref)**							
	Only mother alive	.6725	.2024	3.32	**0.001***	1.959	1.3176	2.9134
	Only father alive	.7576	.2347	3.23	**0.001***	2.133	1.3464	3.3793
	Both died	.6167	.1871	3.30	**0.001***	1.853	1.2841	2.6736
Parent occupation	**Formal employee (Ref)**							
	Farmer	-.1129	.1305	-0.87	0.387	.893	.6917	1.1536
	Casual laborer	-.0072	.1361	-0.05	0.958	.993	.7604	1.2964
	Self-employment	-.2049	.1761	-1.16	0.245	.815	.5769	1.1505
	Other	-.4778	.2004	-2.38	**0.017***	.620	.4187	.9186
Family Average monthly income	**< 1000 (Ref)**							
	1,000-2,500 Birr	.2231	.1346	1.66	0.097	1.249	.9601	1.6271
	2,501-5,000 Birr	-.0579	.1267	1.66	0.46	.944	.7362	1.2097
	5,001-7,500 Birr	.5034	.1811	2.78	**0.005***	1.654	1.1599	2.3592
	>7,500 Birr	.3005	.1709	1.76	0.079	1.350	.9661	1.8877
Students average pocket money	**<250 (Ref)**							
	251-500 Birr	.2499	.1139	2.19	**0.028***	1.284	1.0271	1.6050
	501-1000 Birr	.5955	.1418	4.20	**0.000***	1.814	1.3739	2.3949
	1001-1500 Birr	.4865	.1875	2.60	**0.009***	1.627	1.1264	2.3487
	>1500 Birr	.3151	.2266	1.39	0.164	1.370	.8789	2.1366
Current sexual partner	**Yes (Ref)**							
	No	.4237	.0980	4.32	**0.000***	1.528	1.2606	1.8513
Mass-media contribution	**Yes (Ref)**							
	No	.2277	.0833	2.73	**0.006***	1.256	1.0666	1.4786
University role	**Yes (Ref)**							
	No	.2551	.0858	2.97	**0.003***	1.291	1.0908	1.5268
Peer pressure	**Yes (Ref)**							
	No	-.4752	.0905	-5.25	**0.000***	.622	.5207	.7423
Using drug	**Yes (Ref)**							
	No	-.3374	.0953	-3.54	**0.000***	.714	.5921	.8601

*Significant <0.05 **Ref = Reference category**

Table 4.7 reveals that the independent variables sex, age, family place of residence, family life status, family average monthly income, student's pocket money, current sexual partner, mass-media contribution, role of university, peer pressure and using drug were found to be statistically significant.

The adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable for female students was 0.589 (95% CI: 0.4925, 0.7053) times less than that of male students, keeping other variables in the model constant. Likewise, for female students, the adjusted odds of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the category of knowledgeable was 0.589 (95% CI: 0.4925, 0.7053) times less than that of male students, keeping other variables in the model constant.

The likelihood of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable was lowest for the age group ≥24 years (aOR = .768; CI = .6028, .9794) compared to the age groups lies between18-20 years while holding other variables in the model constant. The likelihood of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category was lowest for age group >=24 (aOR = .768; CI =.6028, .9794) as compared to the age groups lies between 18-20 while holding other variables in the model constant

The adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable for students whose family are living in rural area was highest [aOR = 1.328; CI=1.0825, 1.6287] as compared to students whose family is living in urban area, while holding other variables in the model constant. Likewise, for students whose family are living in rural area, the adjusted odds of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS was 1.328 [CI=1.0825, 1.6287] times more than students whose family living in urban area, keeping other variables in the model constant.

The adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable for students whose family live status are only mother alive, only father alive and both are died were 1.959[CI = 1.3176, 2.9134], 2.133[CI = 1.3464, 3.3793] and 1.853[CI = 1.2841, 2.6736] times higher than students whose both family are alive, keeping other variables in the model constant, respectively. Similarly, the adjusted odds of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category for students whose family live status, only mother alive, only father alive and both died were highest as compared to those whose both family are alive, holding all other variables in the model constant.

The adjusted odds ratio for the students whose parent's occupation is others was .620[CI = .4187, .9186]. This shows that the adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories namely fairly knowledgeable and knowledgeable for students whose parent occupation is other was 38% less than students whose parents have formal employment, keeping other variables in the model constant. Similarly, the adjusted odds of being not-knowledgeable and fairly knowledgeable versus the knowledgeable category for students whose parent occupation is other was 38% less than students whose parents have formal employment, holding other variables in the model constant.

The adjusted odds ratio for students whose family average monthly income lies between Birr 5,001-7500 was 1.654[CI = 1.1599, 2.3592], indicating the adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable for students whose family average monthly income lies between Birr 5,001-7,500 was 65.4% more than the odds for students whose family average monthly income is less than 1,000 birr, keeping other variables in the model constant. Likewise, the adjusted odds of being not- knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category for students whose family average income lies between 5,001-7,500 birr was 65.4% more than students whose family average monthly income is less than 1000 birr, keeping other variables in the model constant.

The adjusted odds for students whose average monthly pocket money lies between 251-500 Birr, 501-1,000 Birr and 1,001-1,500 Birr were 1.284 [CI = 1.0271, 1.6050], 1.814[CI = 1.3739, 2.3949] and 1.627[CI = 1.1264, 2.3487], respectively. They imply that the adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable for students whose average monthly pocket money lies between Birr 250-500, Birr 501-1,000 and Birr 1,001-1,500 were 1.284 [CI = 1.0271, 1.6050], 1.814[CI = 1.3739, 2.3949] and 1.627[CI = 1.1264, 2.3487] more than the odds for students whose monthly pocket money was less than 250 birr, respectively, keeping other variables in the model constant. The adjusted odds of being not- knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category for student whose monthly pocket money lies between Birr 250-500, Birr 501-1,000 and Birr 1,001-1500 were 28.4%, 81.4% and 62.7%, respectively, higher than

students whose monthly pocket money were less than 250 birr, keeping other variables in the model constant.

The adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable for students who hadn't current sexual partner was higher (aOR= 1.528; 95% CI= 1.2606, 1.8513) as compared to students who had current sexual partner, keeping the other variables in the model constant. The adjusted odds of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category for students who hadn't current sexual partner was higher (aOR= 1.528; 95% CI= 1.2606, 1.8513) compared to students who had current sexual partner, keeping the other variables in the model constant.

The adjusted odds ratio for students who have denied the contribution of mass- media was 1.256(CI = 1.0666, 1.4786), indicating that the adjusted odds being not-knowledgeable towards HIV/AIDS versus the combined categories namely fairly knowledgeable and knowledgeable for students who have denied the contribution of mass-media was 25.6% more likely than students who have supported the contribution mass-media, keeping other variables in the model constant. Likewise, the adjusted odds of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category for students who have denied the contribution of mass-media were about 25.6% more likely than students who have supported the contribution of mass-media, holding other variables in the model constant.

The adjusted odds ratio for students who have not benefited from the role of universities in giving awareness on HIV/AIDS was 1.2905 (CI = 1.0908, 1.5268). This implies that, the adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories namely fairly knowledgeable and knowledgeable for students who have not benefited from the role of universities was 29.05% more likely than students who have benefited from the role of universities, keeping other variables in the model constant. Similarly, the adjusted odds of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category for students who have not benefited from the role of universities were about 29.05% more likely than students who have benefited from the role of universities, keeping other variables in the model constant.

The adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable for students who haven't engaged in different sexual activities by peer pressure was [aOR = .622; CI = .5207, .7423] less likely than students who have engaged in different sexual activities under the influence their friends, keeping other variables in the model constant. Likewise, the adjusted odds of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category for students who haven't engaged in different sexual activities by peer pressure was 37.8% less than students who have engaged in different sexual activities under the influence their friends, keeping other variables in the model constant.

The adjusted odds ratio for students who haven't used drug was .714[CI = .5921, .8601], shows that the adjusted odds of being not-knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable for students who haven't used drug was 28.6% less likely than students who have used drug, keeping other variables in the model constant. Correspondingly, the adjusted odds of being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category for students who haven't used drug was 28.6% less than students who have used drug, holding other variables in the model constant.

4.2.5 Model Estimation Results

Table: 4.8: Parameter estimates of the proportional odds model

Attitude categories	Categories	Estimate	S.E	Z-value	P-value	AOR	95% C.I for OR	
	Intercepts						Lower	Upper
		-.5891	.2154					
		2.3876	.2202					
Sex	**Male (Ref)**							
	Female	-.4434	.0873	-5.08	**0.000***	.6419	.5409	.7616
Family life status	**Both alive (Ref)**							
	Only mother alive	.9159	.2036	4.50	**0.000***	2.4989	1.6766	3.7246
	Only father alive	.6774	.2332	2.91	**0.004***	1.9687	1.2466	3.1091
	Both died	.9934	.1867	5.32	**0.000***	2.7003	1.8728	3.8935
Current sexual partner	**Yes (Ref)**							
	No	.4441	.0959	4.63	**0.000***	1.5590	1.2919	1.8814
Mass-media contribution	**Yes (Ref)**							
	No	.2759	.0868	3.18	**0.001***	1.3178	1.1116	1.5623
Peer pressure	**Yes (Ref)**							
	No	-.5357	.0906	-5.91	**0.000***	.5852	.4899	.6989
Using drug	**Yes (Ref)**							
	No	-.3189	.0944	-3.38	**0.001***	.7268	.6041	.8746

*Significant (<0.05) **Ref = Reference category**

The result from Table 4.8 depict that all the independent variables namely, sex, family life status, current sexual partner of students, mass-media contribution, peer pressure and using drug were found to be statistically significant predictor for attitude of students towards HIV/AIDS.

The adjusted odds of having unfavourable attitude towards HIV/AIDS versus the joint categories of fairly favourable attitude and favourable attitude for female students was lowest [aOR = .6419; CI = .5409, .7616] compared to male students while keeping other variables in the model constant. Likewise, the adjusted odds of having unfavourable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category for female students were 35.81% less than male students, holding other variables in the model constant.

The adjusted odds ratio for students whose family life status are only mother alive, only father alive and both are died were 2.4989[CI = 1.6766, 3.7246], 1.9687[CI = 1.2466, 3.1091] and 2.7003[CI = 1.8728, 3.8935], respectively. This implies that the adjusted odds of having unfavourable attitude towards HIV/AIDS versus the combined categories of fairly favourable attitude and favourable attitude for students with only mother alive, only father alive and both died were 2.4934 times, 1.9687 times and 2.7003 times more than students whose both family were alive, respectively, keeping other variables in the model constant. Similarly, the adjusted odds of having unfavourable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category for students whose only mother alive, only father alive and both died were 2.4989, 1.9687 and 2.7003, respectively, times more than students whose both family were alive holding other variables in the model constant.

Furthermore, the adjusted odds ratio for students who hadn't sexual partner currently was 1.559[CI = 1.2919, 1.8814]. This indicates that the odds of having unfavourable attitude towards HIV/AIDS versus the joint categories of fairly favourable attitude and favourable attitude for student who hadn't sexual partner currently was 55.9% more than students who had sexual partner currently while holding other variables in the model constant. Likewise, the adjusted odds of having unfavourable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category for student who hadn't sexual partner currently was 55.9% more than student who had sexual partner currently, keeping other variables in the model constant.

The adjusted odds ratio for students who have denied the contribution of mass-media was 1.3178[CI = 1.1116, 1.5623]. This shows that the adjusted odds of having unfavourable attitude towards HIV/AIDS versus the combined categories of fairly favourable attitude and favourable attitude for students who have denied the contribution of mass-media was 31.78% more likely than students who have supported the contribution of mass-media, keeping other variables in the model constant. Similarly, the adjusted odds of having unfavourable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category for students who have denied the contribution of mass-media was 31.78% more likely than students that have supported the contribution of mass-media, holding other variables in the model constant.

Result from Table 4.8 also revealed that the adjusted odds of having unfavourable attitude towards HIV/AIDS versus the joint categories of fairly favourable attitude and favourable attitude for students who haven't engaged in different sexual activities by peer pressure were .5852[CI = .4899, .6989] times less likely than student who have engaged in different sexual activities under the influence of their friends, keeping other variables in the model constant. Similarly, the adjusted odds of having unfavourable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category for students who haven't engaged in different sexual activities by peer pressure was 41.48% less than students who have engaged in different sexual activities by peer pressure, keeping other variables in the model constant.

Lastly, the adjusted odds of having unfavourable attitude towards HIV/AIDS versus the combined categories of fairly favourable attitude and favourable attitude for students who haven't used drug was .7268[CI = .6041, .8746] times less likely than students who have used drug, keeping other variables in the model constant. Likewise, the adjusted odds of having unfavourable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category for students who haven't used drug was 27.3% less than for students who have used drug, holding other variables in the model constant.

4.2.6 Model Estimation Results

Table: 4.9: Parameter estimates of the proportional odds model

Practice categories	Categories	Estimate	S.E	Z-value	P-value	AOR	95% C.I for OR	
	Intercept						**Lower**	**Upper**
		-.7099	.2201					
		.7344	.2201					
Sex	**Male (Ref)**							
	Female	-.2898	.0871	-3.33	**0.001***	.7484	.6309	.8877
Age	**18-20 (Ref)**							
	21-23	.0062	.1139	0.05	0.956	1.0062	.8049	1.2579
	>=24	-.4934	.1244	-3.97	**0.000***	.6105	.4784	.7790
Family life status	**Both alive (Ref)**							
	Only mother alive	-.0496	.2002	-0.25	0.804	.95165	.6826	1.4794
	Only father alive	.3391	.2236	1.52	0.129	1.4036	.9055	2.1758
	Both died	.4829	.1796	2.69	**0.007***	1.6208	1.1398	2.3048
Parent occupation	**Formal employee (Ref)**							
	Farmer	-.1624	.1041	-1.56	0.119	.8501	.6932	1.0425
	Casual laborer	-.1012	.1128	-0.90	0.369	.9037	.7244	1.1273
	Self-employment	-.2241	.1589	-1.41	0.159	.7993	.5853	1.0914
	Other	-.7017	.2084	-3.37	**0.001***	.4957	.3295	.7459
Current sexual partner	**Yes (Ref)**							
	No	-.1314	.0925	-1.42	0.155	.8768	.7315	1.0511
Mass-media contribution	**Yes (Ref)**							
	No	.4077	.0833	4.89	**0.000***	1.5033	1.2769	1.7699
Peer pressure	**Yes (Ref)**							
	No	-.3641	.0859	-4.24	**0.000***	.6948	.5871	.8222
Using drug	**Yes (Ref)**							
	No	-.1859	.0913	-2.04	**0.042**	.8303	.6943	.9931

*Significant (<0.05) **Ref = Reference category**

As shown in Table 4.9, the independent variables namely, sex, age, family life status, parent occupation mass-media contribution, peer pressure and using drug were found to be statistically significant with practice of students towards HIV/AIDS.

For females, the adjusted odds ratio of having poor practice towards HIV/AIDS versus the combined categories of medium practice and good practice was .7484 (95% CI = .6309, .8877) times less likely than for males, keeping other variables in the model constant. Similarly, the adjusted odds ratio of having poor practice and medium practice towards HIV/AIDS versus the good practice category for females was .7484 (95% CI = .6309, .8877) times less than males, keeping other variables in the model constant.

The adjusted odds ratio for students whose age groups are greater or equal to 24 years was .6105[CI = .4784, .7790], implies that the adjusted odds of having poor practice towards HIV/AIDS versus the combined categories of medium practice and good practice for students

whose age groups are greater or equal to 24 years were 38.95% less likely than students whose age groups lies between 18-20 years, keeping other variables in the model constant. Likewise, the adjusted odds of having poor practice and medium practice towards HIV/AIDS versus the good practice category for students whose age groups are greater than or equal to 24 years was 38.95% less likely than students whose age groups lies between 18-20 years, keeping other variables in the model constant.

The adjusted odds ratio for students whose family life status with both died was 1.6208[CI = 1.1398, 2.3048]. This implies that the adjusted odds of having poor practice towards HIV/AIDS versus the combined categories of medium practice and good practice for students whose both mother and father died were 62.08% more likely than students whose both mother and father alive, keeping other variables in the model constant. Correspondingly, the adjusted odds of having poor practice and medium practice towards HIV/AIDS versus the good practice category for students whose both mother and father died were 62.08% more likely than students whose both mother and father alive, holding other variables in the model constant.

The adjusted odds of having poor practice towards HIV/AIDS versus the combined categories of medium practice and good practice for students whose parent's occupation others was .4957[CI = .3295, .7459] times less than for students whose parent's occupation have formal employment while holding other variables in the model constant. Correspondingly, the adjusted odds of having poor practice and medium practice towards HIV/AIDS versus the good practice category for students whose parent's occupation others was about half less likely than students whose parent's occupation have formal employment, keeping other variables in the model constant.

The adjusted odds of having poor practice towards HIV/AIDS versus the combined categories of medium practice and good practice for students who have not benefited from the contribution of mass-media was 1.5033[CI = 1.2769, 1.7699] times more than students who have benefited from the contribution of mass-media, keeping other variables in the model constant. Similarly, the adjusted odds of having poor practice and medium practice towards HI/AIDS versus the good practice category for students who have not benefited from the contribution of mass media was about 50.33% more likely than students who have benefited from the contribution of mass media, keeping other variables in the model constant.

The adjusted odds ratio for students who haven't engaged in different sexual activities under the influence of their friends was .6948[CI = .5871, .8222], shows that the adjusted odds of having poor practice towards HIV/AIDS versus the combined categories of medium practice and good practice for students who haven't engaged in different sexual activities by peer pressure was about 30.52% less likely than students who have engaged in different sexual activities under the influence of their friends, keeping other variables in the model constant. Similarly, the adjusted odds of having poor practice and medium practice towards HIV/AIDS versus the good practice category for students who haven't engaged in different sexual activities by peer pressure were about 30.52% less likely than students who have engaged in different sexual activities under the influence of their friends, keeping other variables in the model constant.

The adjusted odds ratio for students who haven't used drug was .8303[CI = .6943, .9931]. This shows that the adjusted odds of having poor practice towards HIV/AIDS versus the combined categories namely medium practice and good practice for students who haven't used drug was about 16.97% less likely than students who have used the drug, keeping other variables in the model constant. Likewise, the adjusted odds of having poor practice and medium practice towards HIV/AIDS versus the good practice category for students who haven't used drug was about 16.97% less likely than students who have used the drug, keeping other variables in the model constant.

4.3 Results of the Multilevel Ordinal Logistic Regression Model

In this study, multilevel ordinal logistic regression model was employed to compare the existence of variation with regard to the levels of knowledge, attitude and practice within public universities students towards HIV/AIDS among departments'. There were 37 departments that have been included as the second-level units. A total of 2,176 students were considered as first level units. The empty model with random intercept, the random intercept with fixed effects model and the random coefficient with random coefficient model were used at both levels.

4.3.1. Results of multilevel ordinal logistic regression model

i. Test of Heterogeneity

Before proceeding to the multilevel approach, there is a need to check for the heterogeneity of knowledge, attitude and practice towards HIV/ADIS among departments. A Chi-square test was employed to assess heterogeneity among 37 departments. The test yields a Chi-square value 344. 575 with P-value= 0.000; Chi-square value 315.619 with P-value =0 .000 and Chi-square value 146. 216 with P-value = 0.000 for knowledge, attitude and practice towards HIV/ADIS, respectively. Hence, there was evidence for heterogeneity with respect to students' knowledge, attitude and practice towards HIV/AIDS across departments. As we did in the single level ordinal logistic regression model, we should assess the overall significance of the multilevel models before interpreting the coefficients.

ii. Goodness of fit test

The deviance and AIC criteria were used to select the more appropriate fitting model among the three fitted two level ordinal logistic regression models. The deviance of the null model for knowledge is 3,834.138 and for random intercept with fixed coefficient model is 3,630.902. This indicates that the random intercept with fixed coefficient model is better than the null model. The deviance of the random coefficient model (3,633.418) shows that the random intercept with fixed coefficient model is better than the random coefficient model.

Similarly, for attitude, the deviance of the null model are 3,992.7 and random intercept with fixed coefficient model is 3,849.654, showing that random intercept with fixed effect coefficient is better than the null model. Conversely, the deviance for random intercept with fixed coefficient model is greater than for random intercept with random coefficient model. This implies that random intercept with random coefficient is better than for random with fixed coefficient.

For practice, the deviance for null model and random intercept with fixed coefficient are 4,468.156 and 4,348.222, respectively, implying that random intercept with fixed coefficient is better fit than null model. Likewise, the deviance for random intercept with random coefficient is 4,353.118, showing that random intercept with fixed coefficient showing better fit compared with random coefficient model.

AIC was used to make an overall comparison of the three models. For levels of knowledge, the computed AIC value for empty model with random intercept model, (AIC = 3,840.173) was greater than for the random intercept with fixed effect model, (AIC = 3,687.148). This indicates that random intercept with fixed effect model was better fit as compared to empty model with random intercept. The value of AIC for random intercept with fixed effect model, (AIC = 3,687.418) was less than for the random intercept with random coefficient model, (AIC = 3,688.902), showing that the random intercept with fixed coefficient was better fit compared with random intercept with random coefficient model.

For attitude, the AIC value for empty model with random intercept model, (AIC = 3,998.699) was greater than for the random intercept with fixed effect model, (AIC = 3,871.653), implying that random intercept with fixed effect model is better fit. The value of AIC for random intercept with fixed effect model, (AIC = 3,871.653) was greater than for random intercept with random coefficient model (AIC = 3865.432). This implies that the random intercept with random coefficient was a better fit in compared to the random intercept with fixed effect model.

Lastly, for practice, the AIC value for empty model with random intercept, (AIC = 4,474.156) was greater than for random intercept with fixed effect model (AIC = 4,386.222), indicating that random intercept with fixed effect model was better fit when compared with empty model with random intercept. The value of AIC for random intercept with fixed effect model, (AIC = 4,386.222) was less than for the random intercept with random coefficient model, (AIC = 4,387.118), suggesting that the random intercept with fixed coefficient was better fir as compared to the random intercept with random coefficient model. Here, we note that in case of attitude levels the random intercept with random coefficient was a better fit whereas in levels of knowledge and practice the random intercept with fixed coefficient model is better fit.

Table: 4.10: Summary results of model selection criteria for knowledge, attitude and practice

Dependent variables	Fitted model	Multilevel null model	Multilevel Random Intercept Model	Multilevel Random Coefficient Model
Levels of knowledge	Deviance-based chi-square	141.19(0.000)	78.68(0.000)	81.19 (0.000)
	Deviance	3834.138	3,630.902	3,633.418
	AIC	3840.137	3687.418	3688.902
Levels of attitude	Deviance-based chi-square	116.22(0.000)	63.20 (0.000)	66.18 (0.000)
	Deviance	3,992.7	3,849.654	3,839.432
	AIC	3,998.699	3,871.653	3865.432
Levels of practice	Deviance-based chi-square	37.25 (0.000)	21.43 (0.000)	26.32 (0.000)
	Deviance	4,468.156	4,348.222	4,353.118
	AIC	4,474.156	4,386.222	4,387.118

In all the three dependent variables knowledge, attitude and practice towards HIV/AIDS, the significant deviance-based chi-square value for the empty model, as shown in Table 4.10, indicates that a null model with random effect was better than an empty model without random effect. Also, the deviance-based chi-square test for significance of the random intercept model with the fixed coefficient and random coefficient model indicated that the random intercept model with the fixed coefficient were a better fit as compared to the random coefficient model in the case of knowledge and practice towards HIV/AIDS whereas random coefficient model is a better fit as compared to fixed coefficient model in case of attitude towards HIV/AIDS.

iii. Results of multilevel null model with random intercept for knowledge, attitude and practice towards HIV/AIDS

We first fitted an empty model with no independent variables (intercept-only model) that predicts the probability of students being not-knowledgeable towards HIV/AIDS versus the combined categories namely fairly knowledgeable and knowledgeable, having unfavourable attitude towards HIV/AIDS versus the combined categories namely fairly favourable attitude and favourable attitude and having poor practice towards HIV/AIDS versus the combined categories namely medium practice and good practice. Likewise, we proceed to the being not-knowledgeable and fairly knowledgeable towards HIV/AIDS versus the knowledgeable category, having unfavourable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category and having poor practice and medium practice towards HIV/AIDS versus the good practice category. The simplest non-trivial specification of the

hierarchical linear model is a model in which only the intercept varies between level-two units and with no independent variables are entered in the model..

Table 4.11: Summary results of the null model for knowledge, attitude and practice towards HIV/AIDS

Null models for knowledge levels	**Fixed part**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for est.**	
						Lower	**Upper**
	β_{01} = intercept of C1	-2.6032	.17028	-15.29	0.000	-2.9369	-2.2695
	β_{02} = intercept of C2	.3296	.1559	2.11	0.035	.02398	.63522
	Random effect	**Estimate**	**S.E**	**Wald type approximation 95% C.I**			
	Between-department variance ($\hat{\sigma}^2{}_u$)	.7636	.2235	.4303		1.3552	
Null models for attitude levels	**Fixed part**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for est.**	
						Lower	**Upper**
	β_{01} = intercept of C1	-1.0349	.1431	-7.23	0.000	-1.3154	-.7546
	β_{02} = intercept of C2	1.9280	.1480	13.02	0.000	1.6379	2.2182
	Random effect	**Estimate**	**S.E**	**Wald type approximation 95% C.I**			
	Between-department variance ($\hat{\sigma}^2{}_u$)	.6119	.1797	.3442		1.0879	
Null models for practice levels	**Fixed part**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for est.**	
						Lower	**Upper**
	β_{01} = intercept of C1	.0037	.0817	0.05	0.964	-.1564	.1638
	β_{02} = intercept of C2	1.4219	.0879	16.17	0.000	1.2495	1.5943
	Random effect	**Estimate**	**S.E**	**Wald type approximation 95% C.I**			
	Between-department variance ($\hat{\sigma}^2{}_u$)	.14522	.0572	.0671		.3143	

As shown in Table 4.11, the log-odds of being not- knowledgeable towards HIV/AIDS versus the combined categories of fairly knowledgeable and knowledgeable given in all departments under investigation, on average, were estimated as $\hat{\beta}_{01}$ = -2.602. Likewise, the log-odds of being not-knowledgeable and fairly knowledgeable versus the knowledgeable category given in all departments under investigation, on average, were estimated as $\widehat{\beta}_{02}$ = .3296. In addition, the between-department intra-class correlation coefficient (ICC) obtained from the empty model with random intercept was (0.7636)/ (.7636+3.29) = .188. This ICC value is interpreted as that about 18.8% of the variation in the knowledge towards HIV/AIDS can be explained by grouping the students with respect to their departments. The remaining value, 81.2%, of the variation in knowledge towards HIV/AIDS can be explained within individuals (lower level units, i.e students).

Furthermore, the log-odds of having unfavourable attitude towards HIV/AIDS versus the combined categories of fairly favourable attitude and favourable attitude given in all departments under study, on average, were estimated as $\hat{\beta}_{01}$ = -1.0349. The log-odds of having unfavourable

attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category given in all departments under investigation, on average, were estimated as $\hat{\beta}_{02} = 1.9280$. The between-department intra class correlation coefficient obtained from empty model with random intercept was (.6119)/(.6119+3.29) = 0.157. This value is interpreted as that about 15.7% of the variation in the attitude towards HIV/AIDS can be explained by grouping the students with respect to their department. The remaining 84.3% of the variation in attitude towards HIV/AIDS can be explained by with individual (students, i.e., lower level units).

Lastly, the log-odds of having poor practice towards HIV/AIDS versus the combined categories namely medium practice and good practice given in all departments under study, on average, were estimated as $\hat{\beta}_{01} = .0037$. Likewise, the log-odds of having poor practice and medium practice towards HIV/AIDS versus the good practice category given in all departments under study, on average, were estimated as $\hat{\beta}_{02} = 1.4219$. The between-department intra class correlation coefficient obtained from empty model with random intercept was (.14522)/(0.14522+3.29) = 0.0423. This value is interpreted as that 4.23% of the variation in practice towards HIV/AIDS can be explained by grouping the students with respect to their department. The remaining 95.77% of the variation in practice towards HIV/AIDS can be explained by students.

Random effect tests examine hypothesis that whether or not the random intercept or between-department variance is needed for these data or statistically:

$$H_0: \sigma_{uo}^2 = 0$$

$$H_1: \sigma_{u0}^2 > 0$$

Because the constrained variance component test lies on the boundary of the parameter space, the likelihood ratio test can break down asymptotically. It has been shown that tests for a single variance component can be carried out using mixtures of chi-square distributions. In this study, we show that the null distribution of this one sided LRT statistic converges to a 50:50 mixture of chi-square distributions with 0 and 1 degree of freedom given as $0.5\chi_0^2 + 0.5\chi_1^2$

The p-values for knowledge, attitude and practice towards HIV/AIDS are given as follows:
P-value = $0.5\ P(\chi_{0:1}^2 > \text{LRT}) = 0.5P(\chi_0^2 > 141.19) + 0.5P(\chi_1^2 > 141.19)$;

P-value = 0.5 $P(\chi^2_{0:1} > LRT) = 0.5P(\chi^2_0 > 116.22) + 0.5P(\chi^2_1 > 116.22)$ and

P-value = 0.5 $P(\chi^2_{0:1} > LRT) = 0.5P(\chi^2_0 > 37.25\ ) + 0.5P(\chi^2_1 > 37.25\ )$, respectively.

The likelihood ratio test statistic is equal to twice the difference of the log likelihoods, that is

$$LRT = -2\{l(y|H_0) - l(y|H_1)\}.$$

$l(y|H_0)$ and $l(y|H_1)$ are the log likelihoods under the null and alternative hypotheses evaluated at their maximum likelihood estimates, respectively. The critical value for $\alpha = 0.05$ test using this mixture distribution is 2.71, indicating we would reject Ho for LRT> 2.71. This is shows that adding the random intercept or between-department variance in the model is necessary in order to detect the effect of knowledge, attitude and practice towards HIV/AIDS among selected public universities students.

4.3.1.1. Result of Multilevel ordinal logistic regression analysis for students' knowledge towards HIV/AIDS with random intercept model.

To assess the effect of independent variables on students' knowledge towards HIV/AIDS with respect to its categories, we considered a random intercept model.

Table: 4.12: Summary results of the random intercept multilevel ordinal logistic regression model

Estimation of Fixed effect							
Knowledge categories	**Categories**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for est.**	
	Intercept					**Lower**	**Upper**
		-2.2874	.2439	-7.65	**0.000***	-2.8371	-1.738
		.8409	..2740	3.07	**0.002***	.3038	1.3781
Sex	**Male (Ref)**						
	Female	-.4104	.0981	-4.18	**0.000***	-.6026	-.2182
Age	**18-20 (Ref)**						
	21-23	.0269	.1259	0.21	0.830	-.2198	.2738
	>=24	-.1979	.1305	-1.52	0.130	-.4537	.0579
Family residence	**Urban (Ref)**						
	Rural	.1917	.1073	1.79	0.074	-.0187	.4021
Family life status	**Both alive (Ref)**						
	Only mother alive	.5158	.2084	2.48	**0.013***	.1074	.9241
	Only father alive	.6674	.2398	2.78	**0.005***	.1974	1.1374
	Both died	.5326	.1934	2.75	**0.006***	.1535	.9116
Parent occupation	**Formal employee (Ref)**						
	Farmer	-.0969	.1342	-0.72	0.470	-.36001	.1662
	Casual laborer	-.0007	.1398	-0.01	0.996	-.2732	.2747
	Self-employment	-.1926	.1813	-1.06	0.288	-.5478	.1627
	Other	-.4106	.2057	-2.00	**0.046***	-.8138	-.0074
Family Average monthly income	**1000 (Ref)**						
	1,000-2,500 Birr	.1319	.1393	0.95	0.343	-.1410	.4049
	2,501-5,000 Birr	-.1189	.1304	-0.91	0.362	-.3745	.1366

	5,001-7,500 Birr	.3596	.1870	1.92	0.055	-.0070	.7263
	>7,500 Birr	.2354	.1769	1.33	0.183	-.1114	.5822
Students average pocket money	**<250 (Ref)**						
	251-500 Birr	.2591	.1169	2.22	**0.027***	.0299	.4882
	501-1000 Birr	.6024	.1471	4.10	**0.000***	.3141	.8907
	1001-1500 Birr	.5126	.1936	2.65	**0.008***	.1332	.8922
	>1500 Birr	.2759	.2337	1.18	0.238	-.1821	.7339
Current sexual partner	**Yes (Ref)**						
	No	.4151	.1011	4.10	**0.000***	.2168	.6133
Mass-media contribution	**Yes (Ref)**						
	No	.2419	.0865	2.80	**0.005***	.0724	.4114
University role	Yes (Ref)						
	No	.1986	.0892	2.23	**0.026***	.0239	.3733
Peer pressure	**Yes (Ref)**						
	No	-.4948	.0938	-5.27	**0.000***	-.6789	-.3108
Using drug	**Yes (Ref)**						
	No	-.3558	.0979	-3.63	**0.000***	-.54766	-.1638
Estimation of Random effect							
	Estimate	Standard error	Wald type approximate 95% C.I				
Between-department variance($\hat{\sigma}_u^2$)	.4647	.1534	.2434	.8873			

Table 4.12 shows that fixed parameter estimates of independent variables namely gender, family life status, students average pocket money, current sexual partner, mass-media contribution, role of university, peer pressure and using drug were found to be statistically significant. We note that the values had been slightly changed when compared to the single level logistic regression analysis. Moreover, the estimated coefficients and odds ratio had similar interpretation with that of single level logistic regression analysis just mentioned in Table 4.7.

The results displayed in Table 4.12 also show that the intra-class correlation coefficient (ICC) is estimated as $\hat{\rho} = .4647/(.4647+3.29) = .124$, which is statistically significant at 5% level of significance. This means about 12.4% of the total variability in levels of knowledge is due to differences across the departments, with the remaining unexplained 87.6% variation attributable to individual (students) differences.

We see that the inclusion of level-one covariates reduced department variations from .7636 (level-two variance without covariates) to 0.4647, it indicating that there is a significant variation between department in the levels of knowledge.

4.3.1.2. Results of multilevel ordinal logistic regression analysis for attitude of students towards HIV/AIDS with random intercept and random coefficients model

Estimates of this model showed that the estimated variance of random slopes for family life status does not included zero. This indicates that only the effects of family life status on attitude towards HIV/AIDS varied across departments whereas the effect of other covariates for attitude towards HIV/AIDS remain fixed across departments.

Table: 4.13: Summary results of random coefficient multilevel ordinal logistic regression model

Estimation of Fixed effect							
Attitude categories	**Categories**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for est.**	
	Intercept					**Lower**	**Upper**
		-.7419	.2963	-2.50	**0.012***	-1.3226	-.1612
		2.3867	.2994	7.97	**0.000***	1.7991	2.9729
Gender	**Male (Ref)**						
	Female	-.3749	.0942	-3.98	**0.000***	-.5597	-.1901
Family life status	**Both alive (Ref)**						
	Only mother alive	.8387	.2279	3.68	**0.000***	.3919	1.2855
	Only father alive	.6795	.2709	2.51	**0.012***	.1486	1.2104
	Both died	.8895	.2552	3.48	**0.000***	.3893	1.3897
Current sexual partner	**Yes (Ref)**						
	No	.3891	.0995	3.91	**0.000***	.19401	.5842
Mass-media contribution	**Yes (Ref)**						
	No	.2780	.0893	3.11	**0.002***	.1029	.4531
Peer pressure	**Yes (Ref)**						
	No	-.4976	.0938	-5.30	**0.000***	-.6815	-.3137
Using drug	**Yes (Ref)**						
	No	-.2892	.0977	-2.96	**0.003***	-.4807	-.0976

Estimation of Random effect				
	Estimate	**Standard error**	**Wald type approximate 95% C.I**	
Between- department variance($\hat{\sigma}^2_{u2j}$)	1.2673	.6079	.4949	3.2452
$\hat{\sigma}^2_{u2j}$= var(Family life status)	.0593	.0325	.0203	.1734
$\hat{\sigma}_{u02j}$ = cov (cons, Family life status)	-.2247	.1332	-.4857	.0363

In the random effect part, the value of 1.2673 and 0.593 are the estimated variance of intercept (department) and family life status of students' attitude towards HIV/AIDS. The log-odds of having unfavourable attitude towards HIV/AIDS versus the combined categories of fairly favourable attitude and favourable attitude in an average, department ($u_{oj} = 0$) is estimated as $\hat{\beta}_{01}$= -.7419 that is shared by all department. Likewise, the log odds of having unfavourable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category in an average department ($u_{1j} = 0$) is estimated as $\hat{\beta}_{02} = 2.3867$ that is also shared by all departments.

The log-odds of the probability of unfavourable attitude towards HIV/AIDS versus the combined categories namely fairly favourable attitude and favourable attitude for department j is given by $-.7419 + \hat{u}_{oj}$ where the variance of the intercepts across department is estimated as $var(u_{oj})$ = 1.2673, which is referred to as the between-department variance (or simply the level-2 variance) adjusted for explanatory variables. The log-odds of the probability of having unfavorable attitude and fairly favourable attitude towards HIV/AIDS versus the favourable attitude category for department j is given by $2.3867 + \hat{u}_{1j}$ where the variance of the intercept across department is estimated as $var(u_{0j})$ = 1.2673, which is referred to as the between-department variance (or simply the level-2 variance) adjusted for explanatory variables. The intra class correlation coefficient or between department variations in the random coefficient model increased by 23.54% as compared to the empty random intercept model. This value implied that only 27.81% (1.2673/ (1.2673+3.29) = 0.2781) of the variation in the attitude towards HIV/AIDS can be explained by family life status between departments.

4.3.1.3. Result of multilevel ordinal logistic regression analysis for practice of students towards HIV/AIDS with random intercept model.

To identify the effect of independent variables on students' practice towards HIV/AIDS with respect to its categories, we considered random intercept model.

Table 4.14: Summary results of multilevel ordinal logistic regression analysis with random intercept model

Estimation of Fixed effect							
Practice categories	**Categories**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for est.**	
	Intercept					**Lower**	**Upper**
		-.7478	.2315	-3.23	**0.001***	-1.2015	-.2939
		.7233	.2313	3.13	**0.002***	.2699	1.1767
Sex	**Male (Ref)**						
	Female	-.2612	.0903	-2.89	**0.004***	-.4383	-.0841
Age	18-20 (Ref)						
	21-23	.0040	.1163	0.03	0.972	-.2238	.2319
	>=24	-.4661	.1282	-3.64	**0.000***	-.7173	-.2148
Family life status	Both alive (Ref)						
	Only mother alive	-.0953	.2033	-0.47	0.639	-.4937	.3032
	Only father alive	.2463	.2298	1.07	0.284	-.2042	.6967
	Both died	.3911	.1838	2.13	**0.033***	.0308	.7514
Parent occupation	**Formal employee (Ref)**						
	Farmer	-.1703	.1061	-1.60	0.109	-.3784	.0377
	Casual laborer	-.1227	.1151	-1.07	0.286	-.3484	.1029
	Self-employment	-.2351	.1616	-1.45	0.146	-.5519	.0817
	Other	-.7598	.2120	-3.58	**0.000***	-1.1754	-.3442
Current sexual partner	**Yes (Ref)**						
	No	-.1564	.0941	-1.66	0.097	-.3409	.0281
Mass-media contribution	**Yes (Ref)**						
	No	.4238	.0844	5.02	**0.000***	.2585	.5892

Peer pressure	**Yes (Ref)**						
	No	-.3563	.0874	-4.08	**0.000***	-.5276	-.1849
Using drug	**Yes (Ref)**						
	No	-.2423	.0923	-2.63	**0.009***	-.4232	-.0614
Estimation of Random effect							
	Estimate	**Standard error**	**Wald type approximate 95% C.I**				
Between-department variance($\hat{\sigma}_u^2$)	.0968	.0441	.0396	.2365			

As can be seen from Table 4.14 the fixed parameter estimates of independent variables namely sex, age, family life status, parent occupation, mass-media contribution, peer pressure and using drug were found to be statistically significant, although the values had been slightly changed when compared to the single level logistic regression analysis. Likewise, the estimated coefficients and odds ratio had similar interpretation with that of single level logistic regression analysis just mentioned in Table 4.9. The results displayed on Table 4.14 also shown that the intra-class correlation coefficient (ICC) is estimated as $\hat{\rho} = .0968/(.0968+3.29) = 0.029$, which is statistically significant at 5% level of significance. This means about 2.9% of total variability in levels of practice is due to differences across the departments, with the remaining unexplained 97.1% variations due to individual (students) differences.

5. Discussion

This study intended to identify determinants of knowledge, attitude and practice towards HIV/AIDS among youth students from selected public universities in Ethiopia. The descriptive results showed that out of 2,176 sampled undergraduate graduating class students selected of public universities, 172(representing 7.9%), 1,056(representing 48.8%) and 948 (representing 43.6%) were not-knowledgeable, fairly knowledgeable and knowledgeable towards HIV/AIDS, respectively. Furthermore, on attitudes out of 2,176 sampled students, 608 (representing 27.9%) had unfavourable attitude, 1,268(representing 58.3%) had fairly favourable attitude and 300 (representing 13.8%) had favourable attitude towards HIV/AIDS, respectively. Regarding practice of students towards HIV/ADIS, out of 2,176 sampled students, 1,073(49.3%) had poor practice, 656(30.1%) had medium practice and 447(20.5%) had good practice, respectively.

The Chi-square test was carried out to determine the association between knowledge, attitude and practice towards HIV/AIDS with individual independent variables. Sex, age, marital status, place of residence, students life style in university, family life status, parent(s) occupation, family average monthly income, students' average monthly income, sexual partner, media contribution in university, role of university, preferred sources to get information, peer pressure and using drug were statistically significantly associated with students' knowledge towards HIV/AIDS. Whereas Religion and counseling and testing service had no statistically significant association with students' knowledge towards HIV/AIDS at 5% level of significant.

The chi-square test revealed that there is statistically significant association between students' attitude towards HIV/AIDS and sex, age, religion, family residence, life style in university, family life status, parent(s) occupation, family average monthly income, students average monthly income, current sexual partner, contribution of mass-media, counseling and testing service in university, role of university in creating awareness, peer pressure and using drug at 5% level of significance. However, marital status and preferred source of information had no statistical association with students' attitude towards HIV/AIDS at 5% level of significance.

Moreover, chi-square test showed that there exists statistically significant association between students' practice towards HIV/AIDS and sex, age, marital status, religion, parent(s) occupation, mass-media contribution, peer pressure and using drug at 5% level of significance. Place of residence, life style in university, family average monthly income, students average monthly

pocket money, current sexual partner, role of university in HIV/AIDS prevention and preferred source to get information, had no statistically significant association with students' practice towards at 5% level of significance.

Both single level and multilevel ordinal logistic regression analysis were employed to identify factors that affect students' knowledge, attitude and practice towards HIV/AIDS. Single level and multilevel ordinal logistic regression analysis revealed that sex, family life status, mass-media contribution and peer-pressure had found to be statistically significant effect on students' knowledge, attitude and practice towards HIV/AIDS. The study indicated that students' knowledge and practice towards HIV/AIDS was higher for older students. This result was in line with the findings of Beryl (2015) who conducted research works on multiple sexual partner practice towards HIV/AIDS.

Furthermore, our finding is different from the findings of Wondemagegn et.al (2014) who had conducted research focused on students' knowledge, attitude and practice towards HIV/AIDS in which they mainly studied on knowledge of male and female students' towards HIV/AIDS. In our case, females are more knowledge than males; in their study, it was reverse. According to our finding, female students had favourable attitude and good practice compared to male students towards HIV/AIDS which is in line with the finding of Wondemagegn et al. (2014).

Our finding is in line with the finding of Nambatya Diana (2010) who had conducted research on youths' knowledge, attitude and practice towards HIV/AIDS in which the variables age, sex, residence and parent occupation had significant effect on youths' knowledge, attitude and practice towards HIV/AIDS.

Multilevel ordinal logistic regression model allows for comparison of variations between departments. Before the analysis of data using multilevel approach, heterogeneity of the levels of knowledge, attitude and practice towards HIV/AIDS with regard to departments was checked first using chi-square test and it was statistically significant. In multilevel ordinal logistic regression models with fixed effects of the explanatory variables had similar interpretation as that of the logistic regression model discussed above whereas the random parts of the intercept and the coefficients provided additional information. Results obtained based on the empty model the overall variance of the constant term suggest that student's knowledge, attitude and practice

towards HIV/AIDS differed across departments. In addition to null the model, two other models, one with random intercept and fixed slope model and another with random coefficient model were used. The overall variance constant term in both models was found to be statistically significant for attitude towards HIV/AIDS. For students' knowledge and practice towards HIV/AIDS only the overall variance of random intercept and fixed slope model was found to statistically significant, implying that, knowledge, attitudes and practice towards HIV/AIDS differed across departments.

The random coefficient model showed that the random effects of family life status on attitude towards HIV/AIDS vary across departments in explaining the attitude towards HIV/AIDS whereas the random intercept with fixed coefficient shown to be good fit on students' knowledge and practice towards HIV/ AIDS.

6. Conclusions and Recommendations

6.1. Conclusions

- ☑ Knowledge, attitudes and practices (KAP) studies are very useful tools prior to any intervention to assess the extent to which individuals or communities are ready to adopt risk-free behaviors towards HIV/AIDS.
- ☑ Results of the descriptive analysis showed that most university students were fairly knowledgeable, had fairly favourable attitude and poor practice towards HIV/AIDS.
- ☑ The single-level ordinal logistic regression analysis revealed that the independent variables that affect the knowledge of students towards HI/AIDS were "sex", "age", "family place of residence", "family life status", "family average monthly income", "student's pocket money", "current sexual partner", "mass-media contribution", "role of university", "peer pressure", "and using drug".
- ☑ The single-level ordinal logistic regression analysis showed that the variables that affect students' attitude towards HIV/AIDS were "sex", "family life status", "current sexual partner of the student", "mass-media contribution", "peer pressure" and "using drug".
- ☑ The single-level ordinal logistic regression also showed that the variables that affect students' practice towards HIV/AIDS were "sex", "age", "family life status", "parent occupation", "mass-media contribution", "peer pressure" and "using drug".
- ☑ The multilevel logistic regression analysis revealed that there were significant variations with regard to students' knowledge, attitude and practice towards HIV/AIDS across the departments.
- ☑ Results of both single-level multiple logistic regression and multilevel logistic regression analyses indicated that females were more likely to be knowledgeable, had favourable attitude and had good practice towards HIV/AIDS than males.

6.2. Recommendations

Based on the findings of the study, we forward the following recommendations:

- ☑ Universities and other concerned bodies in Ethiopia should give great emphases to creating awareness on knowledge, attitude and practice towards HIV/AIDS to students. The media should give awareness related to towards HIV/AIDS.
- ☑ Further studies should be conducted by taking three level ordinal logistic regressions into account to assess the effect of knowledge, attitude and practice towards HIV/AIDS across colleges and university levels.
- ☑ Further investigations should be conducted on the basis of multivariate multilevel ordinal logistic regression model by taking the three response variables together.

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Appendices

Appendix A: STATA code for single level ordinal logistic regression analysis

ologit Knoweldge_cat i.Sex i.Age_student i.Family_residence i.Family_lifestatus i.Poccupation i.Familyave_monthlyinc i.Stu_moincome i.Csexual_partner i.Massmed_cont.University_role i.Ppressure i.Druguser

ologit Attitude_Cat i.Sex i.Family_lifestatus i.Csexual_partner i.Massmed_cont i.Ppressure i.Druguser

ologit Practice_cat i.Sex i.Age_student i.Family_lifestatus i.Poccupation i.Csexual_partner i.Massmed_cont i.Ppressure i.Druguser

Appendix B: STATA code for multilevel ordinal logistic regression analysis

Meologit Knoweldge_cat i.Sex i.Age_student i.Family_residence i.Family_lifestatus i.Poccupation i.Familyave_monthlyinc i.Stu_moincome i.Csexual_partner i.Massmed_cont i.University_role i.Ppressure i.Druguser, ||Department:, covariance(unstructured)

meologit Knoweldge_cat i.Sex i.Age_student i.Family_residence i.Family_lifestatus i.Poccupation i.Familyave_monthlyinc i.Stu_moincome i.Csexual_partner i.Massmed_cont i.University_role i.Ppressure i.Druguser, ||Department: Csexual_partner , covariance(unstructured)

meologit Attitude_Cat i.Sex i.Family_lifestatus i.Csexual_partner i.Massmed_cont i.Ppressure i.Druguser, ||Department:, covariance(unstructured)

meologit Attitude_Cat i.Sex i.Family_lifestatus i.Csexual_partner i.Massmed_contr i.Ppressure i.Druguser, ||Department: Family_lifestatus, covariance(unstructured)

meologit Practice_cat i.Sex i.Age_student i.Family_lifestatus i.Poccupation i.Csexual_partner i.Massmed_contr i.Ppressure i.Druguser,||Department:, covariance(unstructured)

meologit Practice_cat i.Sex i.Age_student i.Family_lifestatusi.Poccupation i.Csexual_partner i.Massmed_cont i.Ppressure i.Druguser,||Department:Ppressure, covariance(unstructured)

Appendix C: Results for Random intercept with random coefficients model for knowledge towards HIV/AIDS

Table 4.13: summary of results of random coefficient multilevel ordinal logistic regression model

Estimation of Fixed effect							
Knowledge categories	**Categories**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for esti**	
	Intercept					Lower	Upper
		-2.2919	.2851	-8.04	0.000	-2.8506	-1.7332
		.8559	.2783	3.08	0.002	.31051	1.4014
Gender	**Male (Ref)**						
	Female	-.4034	.0989	-4.08	0.000	-.5972	-.2096
Age	**18-20 (Ref)**						
	21-23	.0296536	.1265	0.23	0.815	-.21820	.2775
	>=24	-.2007	.1316	-1.53	0.127	-.4586	.0572
Family residence	**Urban (Ref)**						
	Rural	.1944	.1078	1.80	0.071	-.0169	.4057
Family life status	**Both alive (Ref)**						
	Only mother alive	.5359	.2105	2.55	0.011	.1233	.9485
	Only father alive	.6656	.2407	2.76	0.006	.1937	1.1375
	Both died	.5435	.1952	2.78	0.005	.1608	.9261
Parent occupation	**Formal employee (Ref)**						
	Farmer	-.1114	.1354	-0.82	0.410	-.37671	.1539
	Casual laborer	-.0019	.1406	-0.01	0.989	-.27746	.273745
	Self-employment	.1949	.1819	-1.07	0.284	-.5514	.1616
	Other	-.4291	.2075	-2.07	0.039	-.8357	-.0225
Family Average monthly income	**< 1000 (Ref)**						
	1,000-2,500 Birr	.1398	.1403	1.00	0.319	-.1353	.4149
	2,501-5,000 Birr	-.13424	.1315	-1.02	0.307	-.3920	.1235
	5,001-7,500 Birr	.36181	.1879	1.93	0.054	-.0064	.7301
	>7,500 Birr	.228172	.1778	1.28	0.199	-.1204	.5767
Students average pocket money	**<250 (Ref)**						
	251-500 Birr	.2667	.1177	2.27	0.023	.0361	.4973
	501-1000 Birr	.5967	.1479	4.04	0.000	.3069	.8865
	1001-1500 Birr	.5081	.1944	2.61	0.009	.1271	.8891
	>1500 Birr	.2742	.2349	1.17	0.243	-.1862	.7346
Current sexual partner	**Yes (Ref)**						
	No	.4314	.1318	3.27	0.001	.1732	.6897
Mass-media contribution	**Yes (Ref)**						
	No	.2047	.0885	2.31	0.021	.0311	.3783
University role	**Yes (Ref)**						
	No	.1305	.0918	1.42	0.155	-.0493	.3104
Peer pressure	**Yes (Ref)**						
	No	-.4950	.0945	-5.24	0.000	-.6803	-.3098
Drug user	**Yes (Ref)**						
	No	.3603	.0985	-3.66	0.000	-.5533	-.16721

Estimation of Random effect				
	Estimate	**Standard error**	**Wald type approximate 95% C.I**	
Between- department variance($\hat{\sigma}^2_{u8j}$)	.7346	.4997	.1937	2.7862
$\hat{\sigma}^2_{u8j}$= var(cspartner)	.1682	.1532	.0282	1.0032
$\hat{\sigma}^2_{u08j}$=cov(cspartner,_cons)	-.2110	.2420	-.6854	.2634
$\hat{\sigma}^2_e$= 3.29				

Appendix D: Results for Random intercept with random coefficients model for practice towards HIV/AIDS

Table 4.14: Summary results of the random intercept multilevel ordinal logistic regression model

Estimation of Fixed effect							
Attitude categories	**Categories**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for est.**	
	Intercept					**Lower**	**Upper**
		-.7613	.252	-3.02	0.003*	-1.2554	-.2671
		2.3431	.2555	9.17	0.000*	1.8423	2.8439
Sex	**Male (Ref)**						
	Female	-.3776	.0953	-3.96	0.000*	-.5644	-.1908
Family life status	**Both alive (Ref)**						
	Only mother alive	.8245	.2105	3.92	0.000*	.4118	1.2371
	Only father alive	.6327	.2415	2.62	0.009*	.1593	1.1061
	Both died	.8397	.1944	4.32	0.000*	.4586	1.2209
Current sexual partner	**Yes (Ref)**						
	No	.4083	.0985	4.14	0.000*	.2151	.6015
Mass-media contribution	**Yes (Ref)**						
	No	.2837	.0887	3.20	0.001*	.1099	.4575
Peer pressure	**Yes (Ref)**						
	No	-.4912	.0931	-5.28	0.000*	-.6737	-.3088
Drug user	**Yes (Ref)**						
	No	-.3131	.0968	-3.24	0.001*	-.5027	-.1234
Estimation of Random effect							
	Estimate	Standard error		Wald type approximate 95% C.I			
Between- department variance($\hat{\sigma}_u^2$)	.4289	.1394		.2269		.8109	

Appendix E: Results for Random intercept with random coefficients model for practice towards HIV/AIDS

Table: 4.16: summary results of random coefficient multilevel ordinal logistic regression model

Estimation of Fixed effect							
Practice categories	**Categories**	**Estimate**	**S.E**	**Z-value**	**P-value**	**95% C.I for est.**	
	Intercept					**Lower**	**Upper**
		-.7898	.2343	-3.37	0.001*	-1.2491	-.3306
		.6897	.2337	2.95	0.003*	.2317	1.1477
Gender	**Male (Ref)**						
	Female	-.2649	.0909	-2.92	0.004*	-.4431	-.0868
Age	**18-20 (Ref)**						
	21-23	.0068	.1168	0.06	0.953	-.2222	.2358
	>=24	-.4759	.1288	-3.69	0.000*	-.7284	-.2234
Family life status	**Both alive (Ref)**						
	Only mother alive	.0971	.2043	-0.48	0.635	-.4974	.3033
	Only father alive	.2436	.2308	1.06	0.291	-.2087	.6959
	Both died	.3441908	.1853	1.86	0.063	-.0190	.7074
Parent occupation	**Formal employee (Ref)**						
	Farmer	-.1148	.1158	-0.99	0.321	-.3417	.1121
	Casual laborer	-.1148	.1158	-0.99	0.321	-.3417	.1121
	Self-employment	-.2493	.1626	-1.53	0.125	-.5680	.0695
	Other	-.7394	.2126	-3.48	0.001*	-1.1561	-.3226
Current sexual partner	**Yes (Ref)**						
	No	-.1579	.0947	-1.67	0.095	-.3435	.0277
Mass-media contribution	**Yes (Ref)**						
	No	.4251	.0849	5.00	0.000	.2585	.5917
Peer pressure	**Yes (Ref)**						
	No	-.4000	.1187	-3.37	0.001*	-.6327	-.1673
Drug user	**Yes (Ref)**						
	No	.1691	.0931	-1.82	0.069	-.3516	.0132

Estimation of Random effect				
	Estimate	**Standard error**	**Wald type approximate 95% C.I**	
Between-depar'nt variance($\hat{\sigma}_u^2$)	.3527	.3511	.0501	2.4823
$\hat{\sigma}_{u7j}^2$= var(Ppressure)	.1559	.1253	.0323	.7535
$\hat{\sigma}_{u07j}^2$=cov(Ppressure,_cons)	-.2053	.2036	-.6045	.1938
$\hat{\sigma}_e^2$=	3.29			