FACTORS AFFECTING THE HIV/AIDS EPIDEMIC IN RWANDA BY USING DHS DATA.

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Abstract

This research concentrates on HIV/AIDS as one of devastating epidemics around the world; but it emphasizes on the case of Rwanda where the use of Demographic Health Survey (DHS) data enable us to know its infection among individual background characteristics with the main objective of identifying its potential risk factor in Rwanda. To achieve this objective logistic regression model especially through odds ratio and chi-square distribution are used. Null and alternative hypotheses are investigated. The null hypothesis is that there is no association between HIV prevalence and individual background and alternative hypothesis is that there is association between HIV prevalence and individual background. Descriptive statistics was performed to determine the characteristics of the participants and univariate and multivariate logistic regression was used to determine the factors influence the uptake of HIV tests.

Among the total individuals tested for HIV/AIDS, 10241(96.7) were HIV/AIDS negative and 349(3.3) were HIV/AIDS positive, having place of residence, level of education, gender, province and age group as variables. The results shows that the p-values and the 95% confidence interval show that there is association between place of residence and region with HIV/AIDS. The obtained odd ratio(3.602)for place of residence indicates that the probability of being infected by HIV/AIDS is 3.602 times more likely in urban areas compared to rural, and the obtained odds ratio for provinces are interpreted compared to Kigali and show that the odd of being infected by HIV/AIDS is 0.315 times less likely in north province and the probability of getting HIV/AIDS is 0.383 times less likely in southern province and the probability of getting HIV/AIDS is 0.317 times less likely in East province and the odds of infecting by HIV/AIDS is 0.474 times less likely in West province. In general, the most affected province is Kigali and the least affected is the Eastern province. For gender, level of education and age group factors their respective p-values (0.374;(0.372, 0.293, 0.088), 0.486) are greater than 0.05 at 5% level of significance which means that there is no association between these variables and HIV/AIDS. Hence, they are not factors. After analysis we conclude that the potential risk factors for HIV/AIDS in Rwanda are province and place of residence.

Keyword: *Factors, HIV/AIDS Epidemic, Rwanda, DHS Data.*

Introduction

Acquired immune deficiency syndrome (AIDS) remains the number devastating epidemics in the world. It is caused by the human immunodeficiency virus (HIV) which attacks the body's immune system and makes it to be weak. Sub-Sahara Africa region where our country RWANDA is located is counted among the highest HIV prevalence UNAIDS (2010) .Recently AIDS was considered as one of the most devastating public health problems in Rwanda, but now its speed has been reduced because of the supply chain management policy of health commodities and campaign against new HIV/AIDS infection that slowdown the infection of HIV. Despite much effort made by the government of Rwanda HIV keeps being a public health problem due to many risks among others age, gender (Mwumvaneza et al, 2010).

The transmission of HIV/AIDS can be done from individual to another through body fluids such that blood, semen and through genital fluids. Different ways have been shown to contribute to HIV like Sexual Transmission by intercourse as the main way of HIV/AIDS transmission. Sexual intercourse by different methods added to genital has been identified. We talk about Oral and anal sex that whom practitioners are increasing. Apart from sexual contamination, blood is another way of getting HIV infection. It is transmitted by unsterile or dirty instruments used for circumcision and many other ways. This route can also affect people who give and receive tattoos and piercings. The United Nations General Assembly estimates that approximately 2.5% of all HIV infections in sub-Saharan Africa are transmitted through unsafe healthcare injections(George M. Shaw and Eric Hunter, 2012). Mother-to-child transmission (MTCT) of HIV is one of the major causes of HIV infection in children. The transmission of the virus from the mother to the child can occur in utero during the last weeks of pregnancy and at childbirth. In the absence of treatment, the transmission rate between a mother and her child during pregnancy, labor and delivery is 25%. UNAIDS (2014).

HIV is prevented by typical condom use which can reduce the risk of heterosexual HIV transmission by approximately 80%. Also community health workers have been shown to reduce the disease by education and information which enhance abstinence among couples and use of precautions method when handling community health care activities. Among them we say gloves,

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masks, to protective eye, and gowns or aprons which prevent exposure of the skin or mucous membranes to blood borne pathogens. Mother to child transmission is done by weaning the baby earlier as possible and make sure delivery is done in health facilities(Juan Ambrosioni et al, 2011).

There were approximately 36.9 million people worldwide living with HIV/AIDS in 2017.Of these, 1.8 million were children (<15 years old). An estimated 1.8 million individuals worldwide became newly infected with HIV in 2017 – about 5,000 new infections per day. This includes 180,000 children (<15 years)(Amuche, Emmanuel & Innocent, 2017). Most of these children live in sub-Saharan Africa and were infected by their HIV-positive mothers during pregnancy, childbirth or breast feeding. Approximately 75% of people living with HIV globally were aware of their HIV status in 2017. The remaining 25% (over 9 million people) still need access to HIV testing services(Amuche, Emmanuel & Innocent, 2017)

Sub-Saharan Africa has essentially the most severe HIV and AIDS epidemic in the world, although the burden of the epidemic continues to differ greatly between nations and regions. The eastern and southern regions of Africa are the most affected areas in the continent. In Rwanda, surveillance showed high prevalence in urban areas with widely disseminated into rural areas by 1986 and 1996 but between 1988 and 1996 ,HIV prevalence among pregnant women ranged from 21% to 33% in Kigali ,from 2 % to 22% in other urban settings ,and from 2% rural settings and from 2% to 12% in rural settings. (Kayirangwa, Hanson, Munyakazi & Kabeja, 2006). Recent surveillance among pregnant women has demonstrated more moderate prevalence, with urban differences narrowing slightly. Between 1998 and 2003,HIV prevalence has declined in urban areas ,whereas rural areas appear to have remained stable(Nsanzimana et al, 2017).

Among factors associated with HIV increase in sub-Saharan Africa we include gender and cultural such as male dominance vs female submissiveness; age of first sexual encounter; gender based violence (Van Staden A & Badenhorst G, 2009)(Chapotera G, Jayachandran V & Phuka J, 2010); contraception; circumcision; financial status; myths all these added to unprotected sex, multiple partners and sugar-daddy practices. In some settings stigma towards people with HIV is prevalent due to ignorance, lack of awareness and misconception about

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transmission of the disease and most people think that the disease is connected with homosexual, sex workers and drug users (Mohamed BA &Mahfouz MS, 2013)(Moodley Y & Govender K, 2015). In African adolescents young age of sexual intercourse and multiple sexual partners are most prevalent factors(Kembo J, 2012). In Rwanda many factors are associated with the pandemic(Umwungerimwiza DY, 2015).Among them gender based violence in women, lack of awareness and knowledge about HIV/AIDS. There is also association between increased rate of HIV and stigma of those living with HIV/AIDS and their families as sociocultural factor. Multiple sexual partners in sex workers and drug abusers play a very important role in HIV transmission(J. B, E. M, J.M. F, 2018).This study helps to elaborate more factors that are leading to increased HIV status using DHS data in Rwanda and give recommendations about prevention and treatment. It also determines HIV prevalence and measure its distribution among different individual's background characteristics based on DHS data.

II. Methods and materials

II.1. Study site and the sample size.

The study is concerned with the whole country of Rwanda, where the choice of the sample to represent our population in study was drawn in each province of Rwanda. Rwanda has 4 provinces (South, North, East and West) and the capital of the country, Kigali. A sample of 10,624 was included in the study as presented in table 1

Table 1 Data Sample

Serial number	Region	Blood test result	Place of residence	Gender	Sex	Level of education	Province
1	3	0	2	2	2	1	14
2	.	0	.	.	.	.	.
3	3	0	2	2	2	1	14
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
10622	.	0	.	.	.	.	.
10623	4	0	2	2	1	1	14
10624	4	0	2	2	2	1	14

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Descriptive statistics was performed to determine the characteristics of the participants and univariate and multivariate logistic regression was used to determine the factors influence the uptake of HIV tests.

II.2. Data source and method of data collection.

The data used were provided by National Institute of Statistics of Rwanda (NISR), primary data collected during research data collection phase and administrative data.

II.3. Method of statistical data analysis

Odds ratio is among powerful techniques used by researchers interested in different public health discipline. In order to identify the risk factors for HIV/AIDS in Rwanda, logistic regression model is applied. The determination of HIV/AIDS prevalence in Rwanda using DHS data is attained by counting positive among total individuals tested for HIV/AIDS. The identification of potential risks factors of HIV/AIDS in Rwanda among different individuals background characteristics, logistic regression model is used by calculating the odds ratios that help to identify the association between factors and outcomes. The logistic regression model was used as it is the appropriate model to be used for dichotomous outcome; in the study HIV positive and HIV negative are dichotomous. The measurement of HIV/AIDS distribution among various individuals' background characteristics is attained by calculating chi-square for 2xn contingency table and by looking at the row percentage distribution which shows us how each group is affected. We prefer to use chi square because it is appropriate when we are measuring the association between two variables with one being categorical. In our case, the status: HIV positive or negative is categorical, which explain the use of chi square. Here, the results from various statistical packages are compared to confirm the results.

II.4. The Logistic Model Formula.

The logistic model formula computes the probability of the selected response as a function of the values of the predictor variables. If a predictor variable is categorical variable with two values, then one of the values is assigned the value 1 and the other is assigned the value 0. Note that DTREG allows you to use any value for categorical variables such as "Male" and "Female", and it converts these symbolic names into $\frac{0}{1}$values. So you don't have to be concerned with recoding categorical values.

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If a predictor variable is a categorical variable with more than two categories, then a separate dummy variable is generated to represent each of the categories except for one which is excluded.

The value of the dummy variable is 1 if the variable has that category, and the value is 0 if the variable has any other category; hence, no more than one dummy variable will be 1. If the variable has the value of the excluded category, then all of the dummy variables generated for the variable are 0. DTREG automatically generates the dummy variables for categorical predictor variables; all you have to do is designate variables as being categorical. In summary, the logistic formula has each continuous predictor variable, each dichotomous predictor variable with a value of 0 or 1, and a dummy variable for every category of predictor variables with more than two categories less one category.

The form of the logistic model formula is:

$$P = 1/(1+\exp(-(B_0 + B_1*X_1 + B_2*X_2 + ... + B_k*X_k)))$$

Where B0 is a constant and Bi are coefficients of the predictor variables (or dummy variables in the case of multi-category predictor variables) (Alexander et al, 1974). The computed value, P, is a probability in the range 0 to 1. The exp () function is e raised to a power. You can exclude the B0 constant by turning off the option "Include constant (intercept) term" on the logistic regression model property page.

III. Results

Among the total individuals tested in this study for HIV/AIDS in Rwanda, 349(3.3%) were HIV/AIDS positive and 10241(96.7) were HIV/AIDS negative. Based on the distribution of individuals tested for HIV/AIDS by province Kigali individuals are more affected,38(11.0) compare to North, South, East and West which are 39(3.8),44(4.5),39(3.8),37(5.6) respectively. This shows that people in Kigali are the most affected and those in Eastern province are the least affected by HIV/AIDS among all provinces as shown in table 2.

Table 2 Distribution of HIV status by different background characteristics

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Background Characteristics	HIV STATUS		Total
	Positive n(%)	Negative n(%)	
PROVINCES			
Kigali	38(11.0)	306(89.0)	344
North	39(3.8)	998(96.2)	1037
South	44(4.5)	924(95.5)	968
East	39(3.8)	991(96.2)	1030
West	37(5.6)	628(94.4)	665
Total	197(4.9)	3847(95.1)	4044
LEVELOF EDUCATION			
No education	46(4.0)	1108(96.0)	1154
Primary	110(4.6)	2269(95.4)	2379
Secondary	38(8.7)	399(91.3)	437
Higher	1(1.6)	60(98.4)	61
Total	195(4.8)	3836(95.2)	4031
GENDER			
Male	47(3.8)	1174(96.2)	1221
Female	59(4.6)	1234(95.4)	1293
Total	106(4.2)	2408(95.8)	2514
PLACE OF RESIDENCE			
Urban	93(10.8)	765(89.2)	858
Rural	104(3.3)	3082(96.7)	3186
Total	197(4.9)	3847(95.1)	4044
AGE GROUP			
Under 18	0	64(100.0)	64
18 and above	179(5.0)	3385(95.0)	3564
Total	179(4.9)	3449(95.1)	3628

The individuals tested for HIV/AIDS distribution by level of education shows that secondary individuals are more affected, 38(8.7) than the other level such as no education, 46(4.0) and primary, 110(4.6) and university, 1(1.6). The observation of individuals tested for HIV/AIDS by age group under 18 showed that none is affected compare to age group >=18,179(5.0).The distribution of individuals tested for HIV/AIDS by gender female individuals are more affected, 59(4.6) than male individuals,

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47(3.8) and the distribution of individuals tested for HIV/AIDS by place of residence Urban individuals are more affected, 93(10.8) than Rural individuals, 104(3.3).

Table 3 Logistic regression analysis result to identify potential risk factors for HIV/AIDS

Back ground characteristics	HIV STATUS			
	Positive n(%)	Negative n(%)		
PROVINCES				
Kigali	38(11.05)	306(88.95)	1	
North	39(3.76)	998(96.24)	0.315(0.198,0.501)	0
South	44(4.54)	924(95.45)	0.383(0.244,0.603)	0
East	39(3.78)	991(96.24)	0.317(0.199,0.504)	0
West	37(5.56)	628(94.44)	0.474(0.296,0.761)	0.002
EDUCATION				
No education	46(3.98)	1108(96.01)	1	
Primary	110(4.62)	2269(95.40)	1.1677(0.8216007,1.659661)	0.372
Secondary	38(8.70)	399(91.30)	2.2939(1.470592,3.5788433)	0.293
Higher	1(1.64)	60(98.40)	0.4014(0.054433,2.960733)	0.088
GENDER				
Male	47(3.85)	47(3.85)		
Female	59(4.56)	59(4.56)	1.194(0.566,1.239)	0.374
AGE GROUP				
Under age 18		64(100)		0.486
Age 18 or older	179(5.02)	3385(94.97)	0.005(0.000,13952.079)	
RESIDENCE				
Urban	93(10.84)	765(89.16)	3.602(2.694,4.818)	0
Rural	104(3.26)	3082(96.74)		

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The odds ratio is used in order to compare whether the probability of any event is the same for two groups. The hypotheses to be tested are there is no association between HIV/AIDS and individual background characteristics; and there is association between HIV/AIDS and individual background characteristics null and alternative hypothesis respectively.

The table 3represents association between HIV/AIDS status by various characteristics of respondents through odds ratio, taking Kigali as reference. The p-value for HIV/AIDS results by province is less than 5% level of significance, therefore it shows that there is significant association between HIV/AIDS results and Province and the obtained odds ratio with 95% confidence interval do not include 1 indicating that there are statistically significant and odds ratio are interpreted as follows: The odds of infecting by HIV/AIDS results is 0.315 times less likely among individuals living in north province compare to those who are living in Kigali. The probability of getting HIV/AIDS results is 0.383 times less likely among individuals living in southern province compare to those who are living in Kigali. The probability of getting HIV/AIDS results is 0.317 times less likely among individuals living in East province compare to those who are living in Kigali. The odds of infecting by HIV/AIDS results is 0.474 times less likely among individuals living in West province compare to those who are living in Kigali.

In general, the most affected province is Kigali and the least infection is in the Eastern province. Hence the ascending order of HIV/AIDS infection in provinces is as follows: East, North, South, West and then Kigali.

The table 3 shows the obtained odds ratio with 95% confidence interval indicating that the p-value for HIV/AIDS results by education is greater than 5% level of significance, therefore it shows that it is not significant and we conclude that there is no enough evidence to say that there is no association between HIV/AIDS results and level of education and the odds ratio are interpreted as: The probability of being infected by HIV/AIDS is 1.1677 times more likely among individuals with primary education compare to those who are not educated. The odds of getting HIV/AIDS positive is 2.2939 times more likely among individuals with secondary education compare to those who are not educated. The probability of infecting by HIV/AIDS is 0.4014 times less likely among individuals

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with higher education compare to those who are not educated.

The obtained odds ratio with 95% confidence interval indicate that the p-value for HIV/AIDS results by sex is greater than 5% level of significance, therefore it shows that it is not significant and we conclude that we do not have enough evidence to say that there is no association between HIV/AIDS results and being male or female and also the confidence interval including 1 indicates that there is no association between HIV/AIDS and gender. The corresponding odds ratio of 1.194 indicates that the probability of being infected by HIV/AIDS is 1.194 times more likely among female compare to male. The probability of being infected by HIV/AIDS results is 0.05 times less likely among individuals with age under 18 years, compare to individuals with age >=18.At 5% level of significance, since the p-value is less than 0.05 indicates us that it is statistically significant and the confidence interval does not include 1 which indicate that there is association between HIV/AIDS results and place of residence and odds ratio is interpreted as: the probability of being infected by HIV/AIDS is 3.602 times more likely among individuals living in Urban compared to those who are living in Rural residence. Mariam (2015)revealed significant association of knowledge, attitude, gender, level of education, socio-economic factors with ever testing for HIV on univariate analysis.

Table 4: Chi-square test to measure distribution of HIV/AIDS among different individual background

background characteristics	HIV Status		CHI-SQUARE	P-VALUE
	Positive n (%)	Negative n (%)		
PROVINCES				
Kigali	38(11.05)	306(88.95)		
North	39(3.76)	998(96.24)	34.593	0
South	44(4.54)	924(95.45)		
East	39(3.78)	991(96.24)		
West	37(5.56)	628(94.44)		
EDUCATION				
No education	46(3.98)	1108(96.01)		
Primary	110(4.62)	2269(95.40)		
Secondary	38(8.70)	399(91.30)	17.539	0.001
Higher	1(1.64)	60(98.40)		

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Total	195(4.84)	3836(95.20)		
GENDER				
Male	47(3.85)	47(3.85)		
Female	59(4.56)	59(4.56)	0.792	373
AGE GROUP				
Under age 18		64(100)		
Age 18 or older	179(5.02)	3385(94.97)	3.381	0.066
Total	179(4.9)	3449(95.06)		
RESIDENCE				
Urban	93(10.84)	765(89.16)		
Rural	104(3.26)	3082(96.74)	86.696	0
Total	197(4.87)	3847(95.13)		

The hypotheses to be tested through chi-square are there is no association between HIV/AIDS distribution and individual background. And there is association between HIV/AIDS distribution and individual background. The table 4 shows that the p-value for provinces is 0.000 which is less than 0.05 then we conclude that at 5% level of significant, there is association between HIV/AIDS distribution and provinces. Since for gender the chi-square calculated at 1 degree of freedom is 0 .792 less than the tabulated chi-square at 5% level of significance which is 3.841 and the p-value is 0.373 which is greater than 0.05 , then we do not have enough evidence to conclude that there is no significant association between HIV/AIDS distribution and gender.

Taking our factor to be level of education, we see from our results that the p-value .000 is less than .05 and chi-square calculated at 3 degree of freedom is 17.539 greater than the chi-square tabulated which is7.815; we conclude that there is association between HIV/AIDS distribution and level of education of respondents. The calculated value of chi-square at 1degree of freedom by considering place of residence as factor is 83.696 which is greater than the value from the table at 5% level of significance is 3.841 then we conclude that HIV/AIDS distribution depends on individuals' place of residence. For age group, the value of chi-square calculated at 1 degree of freedom and the value of chi-square tabulated from the table which are 3.381 and 3.841 respectively, we observe that the calculated value is less than the tabulated value; also the p-value

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calculated 0.06 is greater than 0.05 level of significance. Hence we conclude saying that there is no enough evidence to say that there is no significant association between HIV/AIDS distribution and age of individuals. (Sarah Staveteig et al, 2016). In the countries studied, we find that between 23 percent and 71 percent of PLHIV are estimated to know their status. Several gaps in HIV testing coverage still exist, particularly among adolescents, rural residents, and the poorest. While the need continues to target demographic groups at greatest risk of HIV, additional interventions focused on reaching the most socially vulnerable populations are essential.

IV. Discussion

The main statistical data analysis done in this study is to identify potential risk factors for HIV/AIDS in Rwanda by using DHS data. The HIV/AIDS status (positive/negative) is considered as dichotomous outcome dependent variable and the background characteristics considered are Region(provinces), Gender (Male/Female), Education (no education, primary, secondary, and high), Place of residence (Urban/ Rural) and Age group (Under 18 and >=18) as independent variables.

From both logistic regression model and chi-square Test, the observation shows that there is significant association between HIV/AIDS status with their place of residence and province. According to the obtained p-values at 5% level of significance for both place of residence and province from table 1 are less than 0.05 which indicates that there is association between HIV/AIDS results and their living province and place of residence. Table 2 shows the p-value (0.001) at 5%level of significance for level of education is less than 0.05, this implies that there is significant association between HIV/AIDS distribution and level of education.

The table 2. shows the logistic regression result for odds ratio at 95% confidence interval for place of residence is 3.602 and its corresponding p-value (0.000) less than 0.05 which is statistically significant. This implies that the probability of being infected by HIV/AIDS is 3.602 times more likely among individuals living in urban compare to those who are living in rural residence. Hence, we conclude that among the five variables the risk factors for HIV/AIDS in Rwanda are region (province) and place of residence of the individuals.

By comparing our study with the others of Ethiopia country entitled “identifying factors

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for HIV/AIDS using logistic regression model through odds ratio" this pandemic demonstrates that it has hit Ethiopia with catastrophic results. The HIV prevalence rate is officially 6.6% (but 16% in Addis Ababa), and 2.2 million Ethiopians are infected by HIV/AIDS (which is the third highest number of people infected around the world). The highest prevalence is seen in the age group 15 - 24, representing "recent" infections for these two decade-old pandemics. The age and gender distribution of reported AIDS cases shows that about 91% of infections occur among adults of age 15 to 49. The number of female infected between 15 - 19 years is much higher than the number of male in the same age group ("Worldwide AIDS & HIV Statistics". AVERT. 31 December 2009). According to a country report presented to the United Nations General Assembly Special Session on HIV/AIDS (UNGASS 2008), Kenya adult HIV prevalence has reduced by a half from about 10% in 1997/1998 to about 5% by end of 2006. The decline has been attributed to greater awareness, behavior change and higher mortality rates, among other factors (John Owuor, 2009).

V. Conclusion

All p-values in table 2for provinces and type of residence are less than 0.05at 5% level of significance which indicates there is association between HIV/AIDS and respondents provinces and type of residence. The odd ratio of 3.60 for type of residence indicates that probability of being HIV/AIDS positive is 3.60 times more likely among people that are living in urban areas compared to those existing in rural areas. The p-values for level of education, gender and age group of respondents are all greater than 0.05 at 5% level of significance which indicates that we conclude that we do not have enough evidence to conclude that there is no association between HIV/AIDS and the level of education, gender and age group of respondents and this should be investigated further by making a statistically significant difference between the different types of these individual background characteristics.

The calculated chi-squares from the table4 shows their respective values for provinces, level of education and type of residence which are 34.593, 17.539 and 86.696, are greater than their tabulated chi-squares 9.488, 7.815 and3.841 respectively; and their p-values are all less than 0.05 at 5% level of significance; then from these chi-squares and p-values we conclude that HIV/AIDS

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distribution depends on the province, level of education and the type of residence of the respondent. Also table 3 shows chi-square values for gender and age group are 0.792 and3.381 respectively which are less than the chi-square tabulated at 1 degree of freedom which is 3.841 for the two; and their respective p-values are all greater than 0.05 at 5% level of significance. Hence the chi-square and p-values for gender and age group indicate that the distribution of HIV/AIDS is dependent of gender and age group of respondents. The results revealed that respondent's province and their type of residence are factors for HIV/AIDS infection in Rwanda.

VI. Recommendation

The recommendation reflects the way to reduce HIV/AIDS infection in urban areas. This can be done by encouraging married couples to stay in fidelity. i.e. to avoid sexual intercourse with someone else other than your wife/husband; for government policymakers we recommend to establish a new policy that will help to reduce the number of prostitutes in urban areas and emphasize on the use of condoms for those who are not married yet. Generally, the HIV/AIDS prevalence of 3% has to be reduced. For this reason the government and the health communities in charge of HIV/AIDS have to instruct people about the transmission and prevention of HIV/AIDS in order to reduce the risk of being infected.

VII. Acknowledgment

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