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Prevalence of Toxoplasmosis in HIV/AIDS Patients in Mettu Karl Hospital

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Abstract: Toxoplasma gondiiis food and waterborne opportunistic pathogen that causes severe disease in immunocompromised patients. It is caused by an obligatory intracellular protozoon. It causes a wide range of diseases with toxoplasma encephalitis commonly encountered in HIV/AIDS patients. It has been estimated that one-third of the human population is infected with this parasite. A sample of 120 HIV/AIDS patients has been taken from Mettu Karl Hospital. In this study logistic regression is applied for binary response data. To assess whether the model adequately fit to the data different model checking and model diagnostic have been applied. The study indicates that the prevalence of toxoplasmosis for HIV\AIDS patients in the study area was 60%. The analysis shows that some health, economic and risk behavior factors influence exposure of patients to toxoplasmosis. Further, the study shows that the risk factors of Toxoplasmosis are education, marital status, house toilet, tap water and washing hand and raw meat. The factor that influences toxoplasmosis status can be grouped as risk behavior factors (hand washing and raw meat), demographic and health factors (Education, marital status and house toilet) and economic factors (tap water). Under such grouping we can state that patients who are involved in risky behaviors will have higher risk of contracting toxoplasmosis.

Keywords: Prevalence, Toxoplasmosis, HIV/AIDS

1. Introduction

Toxoplasmagondii is one of the most important diseases of human and other livestock. It is a protozoan parasite (Techalew, et al., 2009) which is an endemic worldwide organism. It has been estimated that one-third of the world human population is infected with this parasite (Fong, et al., 2010). It has gradually evolved over the past decades to be among the most common opportunistic diseases in HIV/AIDS in developing countries (Monotoya, et al., 2000). Toxoplasmosis is a sort of serious disease that has the capacity to result in morbidity and mortality in immunocompromised patients. It affects mostly acquired immunodeficiency syndrome (AIDS) patients. Toxoplasma gondiican bring systemic disease with multiple sites of infection. It can also contaminate one organ preferentially. Pulmonary toxoplasmosis, estimated to account for 4% of all cases of pneumonia in AIDS patients is the second or third most frequent form of toxoplasmosis, after toxoplasmic encephalitis (Luft, et al., 1988). Extrapolating from the current findings, over a quarter of the HIV positive patients will be at risk of developing cerebral toxoplasmosis. Study in the USA showed that about 30% of AIDS patients previously exposed to toxoplasma and suffered from a cerebral reactivation (Navia, et al., 1986). Consequently, it may be calculated that 8 % of AIDS patients in South East England will experience a life threatening episode of cerebral disease following secondary reactivation of toxoplasmosis. In addition to this 0.5-1 % of these patients may acquire primary toxoplasmosis associated with AIDS each year reflecting the incidence of toxoplasma infection in this group (Holliman, 1990). The study in Iran showed that seroprevalence of latent Toxoplasmainfection in HIV infected individuals to be 18.2% (Davarpanah, et al., 2007). Geographical variation of prevalence of toxoplasmosis has been found: 50% in Mexico (Boto, et al., 1998), 36.7% in Spain (Wanachiwanawinm, et al., 2001), 53.7% in Thailand (Falusi, et al., 2002). Human toxoplasmosis has been well studied elsewhere in Africa. The estimated seroprevalences in Africa as comparable to many other reports from exposed group was 45.7% (Swaiet al.,

2009). For instance, seroprevalences of 42.6% and 52.4% were reported from slaughter house workers in Djibouti and Egypt, respectively (Chantal, et al., 1996; Ibrahim, etal., 1997). Occupational contacts including butchers, slaughter house workers, milers, and cow attendants in one state of Joss area, Nigeria revealed 22.6% were infected (Osiyemi, et al., 1985). In contrast, cattle breeders and abattoir personnel from Benin gave 87% positives (Fayomi, et al., 1987) and high-risk groups from city of Pointe-Noire in Congo and Addis Ababa in Ethiopia showed a seroprevalence between 41.9% and 80%, respectively (Candolfi, et al., 1993; Woldemichael, et al., 1998).

The HIV prevalence for the adult of Ethiopia national in 2003 was 4.4%. Out this figure, 12.6% is urban and 2.6% rural and higher prevalence is higher among women (5.0%) than men (3.8%). The 2003 estimate of PLWHA (people living with HIV/AIDS) is 1.5 million, including 96,000 children. There were also 197,000 new infections, 98,000 new AIDS cases, and 90,000 AIDS deaths in the adult population in 2003. A total of 128,000 HIV positive pregnancies and an estimated 35,000 HIV-positive births occurred. Among children aged 0-14 years, there were 35,000 new infections, 25,000 new AIDS cases and 25,000 new AIDS deaths. A total of 4.6 million children fewer than 17 in the country are estimated to be orphans for different reasons. From this figure, 537,000 were due to AIDS reported from MHDPC (EDHS, 2006).

1.1. Statement of the Problem

Human infection may be acquired by ingestion of undercooked infected meat containing Toxoplasma cysts, ingestion of the oocyst from focally contaminated hands or food, organ transplantation or blood transfusion, transplacental transmission and accidental inoculation of tachyzoites.

However, most of the researches in our country focused on the prevention, on the factors that increase the chance of contracting the disease etc, all dealing on how to prevent it before a person is HIV positive. So less attention was given for researches dealing with improving the situation of HIV positives that taking ART. It is this fact that little has been done on the factors that influence the survival/death status of a person given s/he is already HIV positive and is under the follow up of ART that motivated this study.

Thus, this study, tries to apply binary logistic regression to find out the factors that expose HIV /AIDS patients to toxoplasmosis. An outcome like toxoplasmosis (positive or negative), however, have only two values: negative (0) and positive (1). The ordinary linear regression fails for such binary outcome that is why binary logistic regression model is considered.

1.2. Significance of the Study

This study will have a great significance and importance in providing relevant information about toxoplasmosis for the proper management of HIV/AIDS patients. On top of this, the result of the study will enable clinicians and policy makers to enhance the awareness of the society about factors which increase the probability of death in HIV patient. The result of this study can also be used as a source of information to other researchers in the future.

1.3. Objective of the Study

- To establish the prevalence of toxoplasmosis in HIV positive patients.
- To investigate the socio-economic &demographic risk factors associated with T. gondii infection
- To provide appropriate recommendation for respective stakeholders and policy makers.

2. Materials and Methods

2.1. Data Collection

The data was obtained from Mettu Karl Hospital that is found in Mettu town; the capital city of IlluAbabora zone. It is located around 265Km away from Jimma city.A cross sectional study with systematic random sampling technique was used. The study included 120 subjects from all HIV/AIDS patients who came to Mettu Karl Hospital laboratory for CD4 count and ART monitoring during the study period. The data were collected by assessing the patient's socio-economic, demographic and nutritional conditions using structural questionnaire. Second the physician collected the relevant clinical data of manifested toxoplasmosis before sending the patient for sample collection for the documentation of the clinical aspect of the study.

2.2. Variables Included in the Study

2.2.1. Dependant Variable

The dependant variable was dichotomous random variable of "toxoplasmosis positive/negative Status" (negative=0, positive=1) for an HIV positive person.

2.2.2. Independent Variables

The variables that are assumed to influence the prediction of positive/negative status are presented in the Table below.

Table 1. *Independent variables involved in the study, Mettu Karl Hospital, 2014.*

No.	Variable	Code of the Variables
1	Sex of the patient	X_1
2	Age of the patient	X_2
3	Place of Residence	X_3
4	Education	X_4
5	Marital status	X_5
6	No of family members	X_6
7	Presence of tap water	X_7
8	Compound latrine	X_8
9	House toilet	X_9
10	Cat presence	X_{10}
11	Habit of eating raw meat	X_{11}
12	Habit of washing hand	X_{12}
13	Habit of washing fruit	X_{13}
14	Feeling Fever	X_{14}
15	Presence of eye disease	X_{15}

2.3. Methodology

2.3.1. Binary Logistic Regression Model

Binary Logistic Regression is a modeling framework that can be used to describe the relationship of several explanatory variables (in this case the risk factors, X's) to a dichotomous (binary) dependent variable (presence of toxoplasmosis, Y). The outcome variable Yi (i=1,.....n) follows a Bernoulli probability function that takes value 1 when toxoplasmosis present with probability p_i and takes the value 0 when toxoplasmosis is absent with probability 1-pi .

In this study, 15 risk factors are considered as explanatory variables to describe the probability of presence of toxoplasmosis among HIV/AIDS patients. The model is given for the logit link functions as follows:

2.3.2. Logit Model

Using the Logit link function, the model is described in the form of logit (natural logs of the odds):

$$Logit(P(Y_i=1)) = Log\left(\frac{P(Y_i=1)}{1-P(Y_i=1)}\right) = \beta_0 + \beta_1 X_{i1} + .. + \beta_{15} X_{i15} = \sum_{j=0}^{16} \beta_j X_{ij}, X_{i0} = 1, \quad (1)$$

i=1,2,…,n

Where X_j is the j^{th} risk factor β_0 is the constant (intercept) of the logit model β_j is the estimated coefficient for each riskfactor j for the logit model. $P(Y_i=1)$ is the probability that the i^{th} patient will develop toxoplasmosis.

(i) Model Building Strategies/Variable Selection

In modeling with many independent variables, one is usually concerned with the goal of selecting those variables that result in the "best" model within the scientific context of the problem. Having a basic plan to follow in selecting the variables for the model, assessing the adequacy of the model both in terms of the individual variables and from the point of view of the overall fit of the model is required for achieving this "best" model. It is also highlighted inHosmer, et al. (2000) that successful modeling of a complex data set is part science, part statistical methods, and part experience and common sense.

The logistic regression modeling approach used in our case, is a forward stepwise likelihood ratio method using R software (version 2.13.1), which begins by selecting the strongest candidate predictor (risk factor), then testing additional candidate predictors (risk factors), one at a time, for inclusion in the model. This stepwise procedure continues until all the candidate risk factors have been thoroughly tested for inclusion and removal. Sometimes the goal of the analysis may be broader, and models containing more variables are sought to provide a more complete picture of possible models. In these cases, use of p-value=0.25 or even larger might be a reasonable choice. Whatever the choice for the variable using p-value judged important enough to include in the model if it is less than 0.25. (Hosmer, et al, 2000).

(ii) Interpretation of the Parameters

From $Logit(P(Y_i=1)) = \beta_0 + \beta_1 X_{i1} + .. + \beta_{15} X_{i15}$, the odds are an exponential function of X. This provides a basic interpretation of the magnitude of β. Note $\frac{P(Y_i=1)}{1-P(Y_i=1)} = e^{\beta_0+\beta_1 X_{i1}+..+\beta_{15}X_{i15}}$ is the odds of developing toxoplasmosis for the ith patient. For every one unit increase in X the odds increases multiplicatively by e^{β_j} . Thus, e^{β_j} is an odds ratio, the odds at category 1 divided by the odds at the reference category.

3. Result

3.1. Summary statistics

The overall prevalence of toxoplasmosis in the study area was around 60%.Toxoplasmosis proportions for the HIV/AIDS patient that came to Mettu Karl Hospital for ART treatment shows that the prevalence in urban residence was 58.3%. The proportion of toxoplasmosis in the absence of tap water is 86.1% as compared to the presence of tap water 13.9%. From occupation categories; unemployed has higher percentage 44.4% of toxoplasmosis positive and merchant has less percentage 2.8% as compared to other groups. The prevalence of Toxoplasmosis for Males group was 26(36.1%) as compared to Females 46(63.9%). Age group between 30-41 has a proportion of 16.7%, but the other groups have the same proportion of toxoplasmosis positive. The illiterate and 9+ groups show a proportion 36.1%, 33.3% respectively. The data revealed that the risk behavior of eating raw meat has higher proportion (70%) of toxoplasmosis positive than not eating raw meat. The proportions of toxoplasmosis among those with habit of washing hand and fruit regularly are 48.8% and 46.9%, respectively.

3.2. Bivariate Analysis

To see the association between one of the risk factors (independent variables) and the dependent variable (toxoplasmosis) (by taking each of the independent variable at a time), the Pearson Chi-square (χ^2) test is used.

Table 2. *Test of association between Dependent &Independent variables under the study, Mettu Karl Hospital, 2014.*

No	Variable	Pearson Chi-square	
		Value	p-value
1	Sex of the patient	5.363	0.021*
2	Age of the patient	2.903	0.407
3	Place of Residence	$2.0736e^{-30}$	0.9999
4	Occupation	10.903	0.028*
5	Marital status	5.736	0.057
6	Education	12.907	0.005*
7	Presence of tap water	18.495	0.000*
8	Compound latrine	8.318	0.004*
9	House toilet	6.843	0.009*

No	Variable	Pearson Chi-square	
		Value	p-value
10	Cat presence	2.2857	0.1306
11	Habit of eating raw meat	5	0.025*
12	Habit of washing hand	13.582	0.000*
13	Habit of washing fruit	9.844	0.002*
14	Eye Disease	2.651	0.104
15	Feeling Fever	0.098	0.755

*significant (p-value < 0.05)

3.3. Results from Binary Logistic Regression Analysis

After forward stepwise variable selection mechanism; the variables that were significant education, marital status, tap water, house toilet, raw meat & hand washing.

Table 3. *Parameter Estimates of the Binary Logistic Regression for the last considered model Using Logit Link Function, Mettu Karl Hospital, 2014.*

Variables	Estimate	Std.Error	Wald	P-value	Odd ratio
Education			15.872	0.001	
Edu_{1-4}	1.069	1.062	1.014	0.314	2.912
Edu_{5-8}	-3.458	1.164	8.828	0.003	0.031
Edu_{9+}	0.998	0.953	1.097	0.295	2.714
Maritalstatus			15.859	0.000	
$Mar_{married}$	-4.084	1.032	15.645	0.000	0.017
Mar_{others}	-0.360	1.545	0.054	0.816	0.698
$Handwashing_{sometimes}$	3.251	0.973	11.153	0.001	25.818
$Housetoilet_{no}$	2.056	0.884	5.415	0.020	7.816
$Rawmeat_{no}$	-1.738	0.774	5.043	0.025	0.176
$Tapwater_{no}$	4.085	1.116	13.394	0.000	59.434
Constant	-1.051	1.356	0.600	0.439	0.350

The variables found to be significant in the logit models are Education, marital status, tap water, house toilet and hand washing and raw meat. And this was in effect in line with the results obtained from the bivariate analysis. The value of the Wald statistic for individual β coefficients support that the estimated values ($\hat{\beta}$) are significantly different from zero.All the above six categorical variable as compared to the reference groups are significant.

3.4. Model Checking and Diagnostic

For the above logit model of the toxoplasmosis data, the log likelihood value, ℓ_0 , for the model with no explanatory variable (null model) was-79.8388 (df=1) and that of the log likelihood value, ℓ_1 , for full model was-38.46087 (df=7) which implies a model chi-square of χ^2_{LR} = -2 (-41.37793) = 82.75586 (df=6) with corresponding p-value 2.647882e-13 which signifies significant increase in the likelihood thereby implying a good fit of the model. The Pearson and Deviance test values were 67.354 and 76.922 with their corresponding p-values 0.99965 and 0.9942783respectively. This indicates that there was no evidence to suggest that the data did not come from population that follows the logistic regression (no evidence for a lack of fit of the model).

Pseudo R2 value for this model was (ℓ_0 - ℓ_1)/ ℓ_0 = 0.51 indicating a reasonable fit of the model. The estimated dispersion parameter, for the logit model was around 0.6929887, which was essentially bellow one and thus there was also no evidence of over dispersion.

3.5. Discussion

The data shows that the prevalence of toxoplasmosis was 60% (72) of the HIV/AIDS patient. The prevalence of latent toxoplasma infection in Ethiopia was 93.3% (154/165) among HIV positive and 86.7% (143/165) among HIV negative participants (Techalew, et al., 2009). The study revealed that toxoplasmosis positive was not depending on gender. The distribution of toxoplasmosis in HIV/AIDS patient is not different for male and female. The infection rate does not depend on the patient's sex or age (Assob, et al., 2011). This means that HIV-death is equally distributed in all age and gender groups both in rural and urban areas. As we can see many researches specified that the main factor of toxoplasmosis was cat. Such as Wallace, et al. (1993); Moura, et al. (2002); Techalew, et al. (2009) reported that the exposure of cat for toxoplasmosis seropositive was significant (P-value<0.05). But in this study cat does not show a significant effect in binary logistic regression model. The married group from marital status category shows less likely to develop toxoplasmosis (Odds Ratio=0.018 CI=[0.0024: 0.1323]) than the single groups. Less toxoplasmosis present in the educational groups of 5-8 (Odds Ratio=0.019, CI= [0.0025: 0.1401] than that of the reference illiterates groups. Because illiterate persons has less knowledge about HIV/AIDS and the risk factors of toxoplasmosis. From the study shows that; the person who had house toiletless affected by toxoplasmosis parasite (Odds Ratio= 0.097, CI= [0.0175: 0.5465]) than the person who has not house toilet. It is the main mode of transmission by using cat and soil related practices. The person who use tap water less likely to develop toxoplasmosis (Odds Ratio=0.024, [0.0037: 0.1573]) than the person who do not use tap water. In addition to this the person who wash his hand some time after any activity without door and during eating food has (Odds Ratio= 23.033, CI= [3.3313: 159.2444]) more likely to develop toxoplasmosis. The result of the analysis specified that raw meat (Odds Ratio=6.165, CI=

[1.6115: 23.5805]) is the main risk factors of toxoplasmosis gondii in HIV/AIDS patients.

4. Conclusion

The prevalence of Toxoplasmosis on the HIV/AIDS patients become high(60%). The severity of the disease becomes high when the HIV patients reached on AIDS stage. In general the binary logistic regression model showed that using the link function logit based on the data from the Metu Karl Hospital the factors that affect the prevalence of toxoplasmosis among HIV/AIDS patients include marital status, educational status, tap water, house toilet, hand washing and habit of eating raw meat. And since the rest of the variables do not have significant contribution on the prevalence of toxoplasmosis. The factors that influence exposure to toxoplasmosis can be grouped as risk behavior factors (hand washing and raw meat), demographic and health risk factors (education, marital status and housetoilet) and an economic factors is tapwater. Under such grouping we can state that patients involved in risky behaviors will have higher risk of toxoplasmosis. So the person who eats raw meat and washing hand sometimes after any activity has a high probability to present toxoplasmosis on him/her. The married group in marital status is less likely affected by toxoplasmosis parasite. The absence of house toilets and tape water means less hygienic conditions at home thus exposing the inhabitants to T. Gondii infection. One of the possible transmissions of toxoplasmosis is due to water born parasites.The high prevalence of HIV/AIDS in Ethiopia calls again the high distribution of T. gondii. This problem needs serious attention from government and non-government organizations.Recommendations on the prevention of human toxoplasmosis have been suggested and new research could perhaps focus on finding means to reduce the spread of T.gondii to humans. Prevalence rates of infection on the presence of cat and soil were not significant in my study, but many researchers out of my country stated that these variables were highly distributing T.gondii. So, new researchers should consider these variables to identify whether they are really agents for the prevalence of T.gondii or not on the best of my knowledge.

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