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Prevalence of active Tuberculosis among adults with Human Immunodeficiency Virus who completed Isoniazid prophylaxis at Mitooma Health Center IV: A cross-sectional- descriptive study

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RESEARCH

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ABSTRACT

Background

People living with HIV/AIDS are at a higher risk of developing TB due to their compromised immune system. Isoniazid (INH) preventive therapy is a recommended strategy for preventing tuberculosis (TB) among people living with HIV (PLHIV). However, active TB may still occur after INH completion.

Aims and objectives

This present study aimed to assess the prevalence of active tuberculosis among adults with HIV that had completed Isoniazid prophylaxis at the Mitooma Health Centre IV in 2022.

Methodology

A cross-sectional descriptive design study was carried out to assess the prevalence of active tuberculosis in HIV adults who completed Isoniazid prophylaxis at Mitooma Health Center IV at an HIV care clinic. Descriptive statistics were used to summarize the data, and correlation analysis was performed to identify the prevalence of active tuberculosis among adults with human immunodeficiency virus who completed Isoniazid prophylaxis at Mitooma Health Center IV and factors associated with active TB after INH completion.

Results

This study found a low prevalence of active TB (25 per cent) among adults with HIV/AIDS before starting Isoniazid prophylaxis. Significant correlations were found between co-morbidities (hypertension, diabetes mellitus, and cryptococcal meningitis) and active TB after INH completion ($r=0.557$, $p<0.05$). However, no significant correlations were found between socio-economic and pre-disposing factors and active TB after INH completion.

Conclusion

Overall, the study suggests that Isoniazid prophylaxis is effective in reducing the risk of active TB among adults with HIV and positive significance between co-morbidities and active TB after INH completion. Therefore, we recommend that the health authorities in Mitooma Health center should intensify more INH therapy among PLWHA at Mitooma district. Also, sexual education and reproductive health as well as counseling programs about HIV should be implemented by the health authorities in Uganda among the community members in Mitooma district about the potential risks associated with co-morbidities of HIV/AIDS and the importance of adherence to preventive measures such as INH.

Key Words

Isoniazid, Tuberculosis, HIV, Co-morbidities, Preventive therapy, Uganda

Introduction

Tuberculosis (TB) remains a major public health concern globally, with an estimated 10 million cases and 1.4 million deaths in 2019 [1]. People Living with HIV/AIDS (PLWHA) are at a higher risk of developing TB due to their compromised immune system[2]. Isoniazid (INH) preventive therapy is a recommended strategy for preventing TB among PLWHA[3].

The therapy involves a six to 36-month course of daily oral medication and has been shown to reduce the incidence of TB by 90 per cent[4].

Globally, TB is the leading cause of death among infectious diseases, with an estimated 10 million incident TB cases and 1.5 million TB deaths occurring in 2018 [5]. India alone accounted for an estimated one-quarter of all TB cases worldwide among people living with HIV (PLHIV), followed by Indonesia[6]. In 2019, Africa accounted for 24.5 per cent of the 10 million global TB burdens, with over 1.4 million cases notified and 608,000 death[7]. Tanzania had the highest prevalence of TB among PLWHA at 42.2 per cent, followed by Kenya and Uganda[8]. Kenya is listed by the World Health Organization (WHO) as among the high burden countries facing the burden of TB/HIV co-infection[9]. In the recently conducted Uganda National TB Prevalence Survey, the overall incidence of TB in Uganda is 234/100,000, with an alarmingly high number of new cases occurring every year, of which only 50 per cent are detected[10].

Despite the benefits of INH therapy, active TB may still occur after INH completion. Several factors may contribute to this, including non-adherence to INH therapy, drug resistance, and co-morbidities[11]. Identifying factors associated with active TB after INH completion among PLWHA is crucial for preventing TB and improving health outcomes in this population[12]. Tuberculosis is a bacterial infection caused by mycobacterium tuberculosis that can affect any body part except nails and hair[13]. TB is primarily spread through the air by coughing or speaking and can result in chronic cough, chest pain, coughing blood, and even death if not treated early[14]. Treatment includes a combination of drugs such as isoniazid, rifampicin, ethambutol, and pyrazinamide[15]. To our best knowledge, no previous studies about active TB among adults with HIV in Mitooma district in Uganda. Therefore, carrying out this present study would go a long way in determining the prevalence of active TB among adults with HIV at Mitooma Health Center IV which could then improve the knowledge of the policy-makers in Uganda about optimization of INH therapy for PLWHA in Mitooma district. The aim of this study is to determining the prevalence of active Tuberculosis among adults with Human Immunodeficiency Virus who completed Isoniazid Prophylaxis at Mitooma Health Center IV.

Methodology

Study area

The study was conducted at an HIV care clinic of Mitooma Health Center IV, Western Uganda. Mitooma District is a district in Western Uganda, named after its main municipal, administrative and commercial center, Mitooma. (Wikipedia, 2023) Mitooma District is bordered by Bushenyi District to the North, Sheema District to the East, Ntungamo District to the South, and Rukungiri District to the West. By estimates in 2012, the national population census gave a population of approximately 196,300 in Mitooma district. Mitooma Health centre IV is found in Mitooma Town Council along Mitooma Rukungiri Road, approximately 1m from the main road within Mitooma District in Western Uganda. The facility lies approximately 80 kilometers (53 miles), west of Mbarara District, the largest city in the Ankole sub-region.

Study design

A cross-sectional descriptive study was used for this study.

Study population

The study population comprised both adult males and females living with HIV/AIDS.

Inclusion criteria

Adult males and females living with HIV/AIDS had TB disease and had completed INH for 6 months receiving HIV/ART care at Mitooma Health Centre IV's ART clinic from October 4th 2022, to November 27th 2022.

Exclusion criteria

Patients who were not living with HIV/AIDS.

Sample size determination

We used fishers' al1990

$$n = (\frac{(z^2 pq)}{\delta^2})$$

Where n= desired sample size

z=Standard normal deviation taken as 1.96 at a confidence level of 95 per cent

p=Proportion of target population estimated to have similar characteristics

If there is no measurable estimate, we used 50 Per cent (constant) or 0.5, therefore p=0.5, q=1-p

In this case 95 Per cent confidence level had 10 per cent errors; therefore 0.1 was a level of significance.

$$n = (\frac{(1.96)^2 \times 0.5 \times 0.5}{(0.1)^2})$$

n= 96

Sampling technique

Simple random sample technique was used through random selection of a subset of each respondent from the patients attending the HIV clinic. Each respondents were assigned odd numbers (1,3, and 5) and then selected at random from the patients.

Data collection methods

A structured questionnaire was used as a data collection instrument. The study questionnaire contained 2 sections with the first section that comprised of demographic

information of respondents such as age, gender, address, religion, occupation and marital status. The second section comprised of clinical information such as duration on therapy, Co-morbidities and other social behaviors. The questionnaire was written and developed in English and interpreted to non-speaking English respondents.

Data collection tool

An observational checklist was used as a tool to collect data. Data on socio-economic, health-related, and pre-disposing factors were collected using a structured questionnaire. Socioeconomic factors included age, gender, marital status, religion, and occupation. Health-related factors included co-morbidities (hypertension, diabetes mellitus, and cryptococcal meningitis), duration of ART, viral load before and after INH initiation, and TB before INH initiation. Pre-disposing factors included alcohol consumption and tobacco smoking.

Data collection procedure

We abstracted data from the Intermittent Preventive Therapy (IPT), Antiretroviral Therapy (ART), and TB treatment registers using a standardized data abstraction tool using the variables collected by all the registers (IPT, ART, and TB)[11-13]. No personal identification information was collected from the registers. We reviewed the medical records of PLHIV who received IPT at the health center between October 4th, 2022 and November 27th 2022.

We retrieved information on patient demographics, health services received, and other patient clinical factors. We employed a purposeful random sampling technique using computer-generated random numbers until we reached our target sample size of 96.

Study variables

Dependent variables (Outcome variables): Outcome variables were IPT interruption (answered as 'yes' or 'no') and IPT completion (answered as 'yes' or 'no'). A client was considered to have interrupted IPT if there was evidence of pausing IPT for any reason but later continued and/or completed the IPT past the expected 6-month treatment period. A client was considered to have completed IPT if there was evidence of continuous uptake of a daily single dose of Isoniazid for six consecutive months.

Independent variables (Exposure variables): Exposure variables included the client's age group (18-40,41-55, 56 and above), gender (male or female), Religion (catholic, protestant, Muslim or others), Marital status (single, married, divorced, widowed), duration of ART(<5years or >5years), TB Before INH Initiation (yes or no), Viral Load Before INH Initiation (suppressed or unsuppressed), INH Completion in the first 6 Months(yes or no), other co-morbidities(Diabetes mellitus, hypertension, cryptococcal meningitis) and predisposing factors (alcohol consumption and tobacco smoking).

Data Analysis

Quantitative data were entered into EPI-DATA manager version 4.4 software and then exported to STATA version (Stata Corp, 2015). Data were backed up daily to mitigate possible loss and kept under key and lock with restricted access.

Results and data representation

Demographic and clinical characteristics of people living with HIV (PLHIV) on isoniazid preventive therapy (IPT) at Mitooma Health Centre IV, Uganda, in 2022 are presented in Table1. The study included a total of 96 subjects, with varying age groups and gender distribution.

This present study found that the majority of PLHIV on IPT were between the ages of 41 and 55, accounting for 42.7 per cent of the study sample. As for ages 18-40, the percentage was 20.8 per cent in our sample. Male patients formulated the majority of participants with 64.6 per cent. On the Religious aspect, 34.4 per cent of PLHIV patients were protestants, 21.9 per cent were Catholic, 10.4 per cent were Muslims, and 33.3 per cent were of other religions. As for marital status, 57.3 per cent of the participants were married, 19.8 per cent were widowed, 16.7 per cent were divorced, and 6.2 per cent were single.

The majority (86.5 per cent, n=83) of the respondents were found to be taking antiretroviral medication, showing a high usage rate (Table 2). In contrast, 13.5 per cent (n=13) of the study population was not on ARV medication. In terms of ART duration, a considerable number of people (82.3 per cent, n=79) had been on it for more than 5 years, whereas 17.7 per cent (n=17) had been on it for less than 5 years.

Of individuals in the study sample, in terms of TB history, 25 per cent (n=24) had a previous diagnosis of TB before initiating INH. Also, the majority of participants (74 per cent, n=71) had a viral load that was suppressed upon examination of the viral load status before INH is initiated, indicating effective control of HIV replication. Also, the majority of patients were found to have successfully completed INH therapy during the first 6 months of treatment. Whereas only 18 individuals did not finish the entire course of INH, indicating a possible disparity in adherence and completion rates.

After completing INH, 9.4 per cent (n=9) of individuals acquired tuberculosis, but the overall majority (90.6 per cent, n=87) did not. Analyzing viral load status after INH completion, 78.1 per cent (n=75) of individuals achieved viral suppression, indicating successful control of HIV replication. Only 21 patients in our sample still had an unsuppressed viral load.

As for the individuals' co-morbidities, a minority of respondents had diabetes (5.2 per cent, n=5) and hypertension (6.2 per cent, n=6). That being said, the majority of patients in our study (88.5 per cent, n=85) had no extra co-morbidities. And although a considerable fraction (72.9 per cent, n=70) did not have any known TB risk factors, alcohol consumption was reported by 21.9 per cent (n=21) of participants, whereas tobacco smoking was recorded by 5.2 per cent (n=5).

This study provided the findings of a correlation study that looked at the association between socioeconomic characteristics and the prevalence of active TB following INH. This is summarized in Table 3. Age, gender, marital status, employment, and religion were all included in our study.

A correlation coefficient of -0.029 related to age was, demonstrating a very modest negative association between age and the incidence of active TB following INH completion. The p-value of 0.782, however, showed a statistically non-significant association. Correlation coefficients of gender, marital status, occupation and religion for active TB after completion of INH showed weak positive associations (r=0.014, 0.055, 0.077 and 0.080 respectively). However, none of these correlations were statistically significant as reflected by the p-values (p=0.892, 0.594, 0.455, and 0.436, respectively).

Table 4 examines the association between health-related factors, especially comorbidities such as hypertension, diabetes and cryptococcosis, and the development of tuberculosis after completing INH. The analysis revealed a significant correlation coefficient (r-value) of 0.557, indicating a strong positive association between comorbidities and the incidence of active TB after completing INH. This correlation was statistically significant (p-value=0.000), suggesting that individuals with comorbidities, such as hypertension, diabetes, and cryptococcosis are more likely to develop active tuberculosis after completing INH treatment.

Finally, Table 5 investigates the association between predisposing variables, such as alcohol use and cigarette smoking, and the development of active TB after INH completion. A correlation value of -0.104 was obtained in the correlation study, demonstrating a very weak negative association between predisposing variables and the prevalence of active TB, however, this was statistically insignificant (p-value 0.315). Thus, suggesting that there is no substantial link between alcohol intake and cigarette smoking and the development of active TB following INH.

Discussion

This cross-sectional descriptive study aimed to access the prevalence of active Tuberculosis among adults with HIV who had completed Isoniazid prophylaxis at Mitooma Health Centre IV. The results presented in Tables 1 to 5 show various socio-economic, health-related, and pre-disposing factors that may be associated with active TB after completing Isoniazid prophylaxis. The study sample consisted of 96 adults with HIV who completed Isoniazid prophylaxis. The majority of participants were between the ages of 41-55, males, Protestants and married. This finding is similar to another local study in Uganda[7]. Although the prevalence of HIV is known to be higher among females than males in Sub-Saharan Africa (SSA) because of different surveys to socio-demographic risk factors, sexual activities, awareness and attitude towards HIV/AIDS prevention[16,17]. The implication of this present finding is that there would be low productivity among the age groups affected, males, hence reducing the economic development of the country, and the married ones, which would decrease the reproductive rates in the country.

This study found that the he duration of Antiretroviral Therapy (ART) was >5 years for more than eighty percent of the participants. The prevalence of active TB among adults with HIV/AIDS before starting Isoniazid prophylaxis was 25 per cent. This is different from a study in Kampala slums, Uganda (11.4 per cent), the capital of Botswana (12.7 per cent), Tanzania (19.0 per cent)[18-20].These differences might be due to the different study areas. Our study was a hospital-based study while the other previous studies were community-based studies. The public health implication of this finding is that HIV-TB co-infection is still rampant among the Ugandans including other African countries posing more health issues to them[24]. This study found that more than seventy percent respondents had a suppressed viral load before starting Isoniazid prophylaxis. This might be that some of the respondents have been taking cotrimoxazole prophylaxis as indicated in a local study in Kampala, where 40 per cent of the respondents with HIV/AIDS were on cotrimoxazole prophylaxis[18].This study also found that eighty-one percent of the participants completed Isoniazid prophylaxis within the first 6 months of starting, and only 9.4 per cent developed active TB after completing Isoniazid prophylaxis (TB Prevalence). Conversely in a study at Fre Semaetat primary Hospital, Hawzien districts, Tigray, northern Ethiopia, it was found that about 62 per cent of the respondents took and completed their INH therapy for 6 months. From those who completed INH prophylaxis therapy, about 4 per cent of the respondents developed active TB[21]. Although a

prospective cohort study in Cambodia and a cross-sectional study in Swaziland revealed a high prevalence of 78 per cent and 89.4 per cent which are likely in keeping with this present study[22,23]. The Ethiopian study believed that the discrepancies in the prevalent rate of the respondents who had completed INH therapy could be due to the lack of reinforcement by local health authorities and stakeholders working in TB centers thus affecting the implementation of the IPT policy[21].

This present study found that most of the participants (78.1 per cent) had a suppressed viral load after completing Isoniazid prophylaxis. This is a good sign that respondents with HIV/AIDS had good attitude towards HIV/AIDS treatment which could then limit HIV complications and improve their quality of life.

Furthermore, this study found that only a small proportion of participants had co-morbidities such as hypertension (6.2 per cent) and diabetes mellitus (5.2 per cent). Also, the most common pre-disposing factor associated with active TB among HIV respondents was alcohol consumption (21.9 per cent). Similar findings were found in a cross-sectional study conducted in Butebo, Uganda and South-Africa, where male respondents were reported to be drinking alcohol frequently[7,24]. Alcohol consumption among TB patients with HIV/AIDS could damage some other organs in the body such as the liver, pancreas, kidneys, as well as the reproductive organs which could lead to superimposed diseases like hepatitis, renal failure, infertility, etc.

Out of the 96 participants, more than eighty-five percent were on antiretroviral therapy (ART), and more than eighty percent had been on ART for more than 5 years. This is keeping with a 2020 report about HIV/AIDS in Uganda which stated that out of over 1.4 million people living with HIV in the country, the use of ART has increased to more than 90 per cent. (UNAIDS, 2020) The benefits of early ART among the respondents shows high awareness and positive perception about HIV treatment, as well as compliance and adherence to treatment, even though strict adherence to ART prescription is challenging[25]. Adherence with ART among HIV individuals had been associated with advanced age, high educational status and family cohesion in studies in Southern Uganda and the Gambia[26,27]. Individuals with high educational status are more likely to read and comprehend health-related information. Therefore, making it easier for them to understand the reasons for the ART usage[27]. Twenty-five percent had a history of TB before Isoniazid initiation, and 74 per cent had a suppressed viral load. Eighty-one percent completed Isoniazid prophylaxis within the first six months, and 9.4 per cent developed active TB after Isoniazid completion.

Pearson- Chi Square analysis showed no statistically significant associations between age, gender, marital status, occupation, and religion with active TB after Isoniazid completion p (>0.05) The differs from a study in Ethiopia which found that female, social drug use, age, marital status was associated with IPT after active TB[21]. This present study investigated the relationship between health-related factors and active TB after Isoniazid completion. The results showed a significant positive correlation between co-morbidities (hypertension, diabetes mellitus, and cryptococcal meningitis) and active TB after Isoniazid completion as p value was less than 0.05. Statistical analysis between pre-disposing factors and active TB after Isoniazid completion showed no significant correlation between alcohol consumption, tobacco smoking, and active TB after Isoniazid completion as p value was greater than 0.05.

Study Limitations

1. The study included a total of 96 subjects, which may limit the generalizability of the findings. A larger sample size would provide more robust and reliable results.
2. The presented demographic characteristics only include age groups, gender, religion, and marital status. Additional demographic information such as educational level, socioeconomic status, and occupation could provide a more comprehensive understanding of the study population.
3. The study design is cross-sectional, which means that it provides a snapshot of the data at a specific point in time. This design limits the ability to establish causal relationships between variables and makes it difficult to determine the temporal sequence of events.
5. The data presented in the tables rely on self-reporting by the participants, which can introduce recall bias or social desirability bias. Participants may not accurately recall or report certain information, leading to potential inaccuracies in the data.
6. The discussion highlights correlations between variables, but some of these correlations are not statistically significant. This suggests that the associations may be weak or due to chance, and caution should be exercised in drawing firm conclusions based on these findings.
7. The study was conducted at a single health center in Uganda, which may limit the generalizability of the findings to other populations or settings. Factors specific to the study location, such as healthcare infrastructure or patient demographics, could influence the results.

Recommendations

Based on the study findings, the following recommendations are suggested:

1. Healthcare providers in Mitooma Health center should regularly screen HIV positive clients with co-morbidities for TB to ensure early detection and treatment. This should be done using sophisticated laboratory tools such as Polymerase Chain Reaction (PCR), rapid antigen-antibody reaction tests and nucleic acid tests (NAT) for HIV. Antigen-antibody tests can detect HIV between 18 to 45 days after exposure. While NAT can detect the HIV viral load within a few minutes.
2. The health authorities in Mitooma Health center through the district head in Mitooma should intensify INH therapy among PLWHA at Mitooma district.
3. Sexual education and reproductive health as well as counseling programs should be implemented by the health authorities in Uganda in collaboration with the United Nations Population Fund (UNFPA). This could be achieved through the medical doctors, nurses, pharmacists including the psychologists as well as the social workers in Mitooma Health center to raise more awareness among the community members especially those living with HIV/AIDS in Mitooma district about the potential risks such as alcohol and cigarette consumption, high salt intake, lack of exercise etc, associated with co-morbidities of HIV/AIDS and the importance of adherence to preventive measures such as INH.
4. Further longitudinal and experimental research should be conducted by the physicians in Mitooma health center to identify other potential risk factors that may impact the incidence of active TB after INH completion among HIV positive clients.

Conclusion

This present study found a low prevalence of active TB among adults with HIV who completed Isoniazid prophylaxis at Mitooma Health Center IV. The study did not find a significant association between socio-economic and pre-disposing factors with active TB after Isoniazid completion. However, the study found a significant positive association between co-morbidities and active Tuberculosis.

The study suggests that co-morbidities have a significant impact on the incidence of active TB after completion of INH among HIV positive clients. Therefore, healthcare providers should be aware of the potential risk factors and closely monitor clients with co-morbidities. Additionally, the high percentage of clients achieving viral suppression after INH completion is encouraging and highlights the importance of INH as an effective preventive measure against active TB among HIV positive clients.

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PROVENANCE AND PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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APPENDIX

Ethics approval and consent to participate

This study was approved by St Francis School of Health Sciences Research Ethics Committee (#REC REF 2020–082), and permission to carry out the study was then sought from the District Health Officer of Mitooma District and the senior medical officer Mitooma Health Centre IV. Participation was voluntary and free from coercion. All experimental protocols were approved by St Francis School

of Health Sciences Research Ethics Committee review board and were performed in accordance with the Declaration of Helsinki. We used routinely collected aggregate surveillance data that did not have any personal identifiers. No personal identification information was collected from any of the records sources. Written informed consent was obtained from all respondents.

Availability of data and materials

For confidentiality reasons, the datasets are not publicly available. However, the datasets can be made available upon reasonable request from the principal researcher (Nathan Mugenyi, Email: mugenyinathan31@gmail.com).

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Tables

Table 1: Socio-demographic and clinical characteristics of the respondents.

Variable	Frequency (per cent)
Age Group (years)	
18–40	20 (20.8 per cent)
41–55	41 (42.7 per cent)
56 and above	35 (36.5 per cent)
Gender	
Male	62 (64.6 per cent)
Female	34 (35.4 per cent)
Religion	
Protestant	33 (34.4 per cent)
Catholic	21 (21.9 per cent)
Muslim	10 (10.4 per cent)
Other	32 (33.3 per cent)
Marital Status	
Single	6 (6.2 per cent)
Married	55 (57.3 per cent)
Divorced	16 (16.7 per cent)
Widowed	19 (19.8 per cent)
TOTAL	96 (100 per cent)

Table 2: Showing clinical information of the respondents.

Variable	Frequency (n)	Percentage (per cent)
Client on ARVs		
Yes	83	86.5
No	13	13.5
Duration of ART		
<5 Years	17	17.7
>5 Years	79	82.3
TB Before INH Initiation		
Yes	24	25
No	72	75
Viral Load Before INH Initiation		
Suppressed	71	74
Unsuppressed	25	26
INH Completion in the first 6 Months		
Yes	78	81.2
No	18	18.8
TB After INH Completion		
Yes	9	9.4
No	87	90.6
Viral Load After INH Completion		
Suppressed	75	78.1
Unsuppressed	21	21.9
Other Co-morbidities		
Diabetes Mellitus	5	5.2
Hypertension	6	6.2
Cryptococcal Meningitis	0	0
None	85	88.5
Pre-disposing Factors		
Alcohol Consumption	21	21.9
Tobacco smoke	5	5.2
None	70	72.9
Total	96	100

Table 3: Relationship between socio-economic factors and Active TB after INH completion.

Socio-Economic Factors	r-value	p-value*
Age	-0.029	0.782
Gender	0.014	0.892
Marital Status	0.055	0.594
Occupation	0.077	0.455
Religion	0.08	0.436
*Correlation is significant at p<0.05		

Table 4: Relationship between Health-Related factors and Active TB after INH completion.

Health Related Factors	r-value	p-value
Co-Morbidities (Hypertension, Diabetes Mellitus, Cryptoccus)	0.557	0.00*
*Correlation is significant at p <0.05		

Table 5: Relationship between Pre-disposing factors and Active TB after INH completion.

Variables	r-value	p-value
Pre-disposing Factors (Alcohol consumption, Tobacco smoking)	-0.104	0.315
*Correlation is significant at p=0.315		

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