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PREVALENCE AND RISK FACTORS ASSOCIATED WITH TUBERCULOSIS OCCURRENCE AMONG PATIENTS ATTENDING MUHIMA DISTRICT HOSPITAL, NYARUGENGE DISTRICT, RWANDA

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Abstract:
Tuberculosis (TB) is one the serious public health problems globally and locally and killed at least eight million in 2018 (WHO, 2019). TB is a curable disease if well treated and followed. One of the most key considerations for tracking and evaluating TB prevention and control programs is the prevalence and related risk factors. The study adopted a quantitative approach and a cross-sectional retrospective design to collect data from the respondents. A systematic sampling technique was used and secondary data recorded in the laboratory were collected. Specific objectives were: to determine the prevalence of tuberculosis among patients attending Muhima District Hospital in Nyarugenge District, and to identify behavioral factors associated with TB occurrence among patients attending Muhima District Hospital in Nyarugenge District. Descriptive and analytical statistics were used to analyze the data. The total number of respondents was 2161 patients. The majority, were male 1524(70.5%) and female were 637(29.5%). For the age, those less than 9 years were 19(.9%), between 10-17 years 76(3.5%), between 18-35 years 1185(54.8%), between 36-59 years 843(39.0%), and above 60 years 38(1.8%). Those who were married were 1014(47%), singles were 977(45.2%), and widower were 57(2.6%). For employment, 883(40.9%) were unemployed, 845(39.1%) were employed, 206(9.5%) were students, and 227(10.4%) were prisoners. Based on location, 1181(54.7%) were from urban areas, and 980(45.3%) were from rural areas. The prevalence of TB was 7.2%, out of which the females were 53(34.0%) and males were 103(66.0%). The prevalence of TB among HIV patients was 32.6%. For behavior practices, drinking alcohol was found

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among 908(42.0%) and smokers were 186(8.6%). For all the predictors of TB occurrence, none of them was statistically associated with TB occurrence. These include demographic characteristics, behavioral factors including use of alcohol, smoking and use of tobacco products, and serology. The prevalence of TB among patients attending Muhima District was higher than the National TB prevalence estimates reported by the World Health Organization (WHO, 2019), respectively 7.2% versus 5.2%. All predictors of TB occurrence including demographic characteristics and behavioral factors none of them was associated with TB occurrence. It is worth recommending a further study to understand in-depth risk factors for TB occurrence in the era of epidemiological transition.

Keywords: prevalence, risk factors, Tuberculosis occurrence

1. Introduction

Tuberculosis (TB) is a disease caused by *Mycobacterium tuberculosis* that is spread through airborne transmission it is one of the top ten leading causes of death worldwide, with 3 million deaths annually throughout the world. Infected individuals are classified as either having latent tuberculosis infection (LTBI) or active TB disease (ATB) (Demers., 2016) LTBI occurs when a person is infected with *M. tuberculosis*, but does not have TB disease the person is asymptomatic and cannot pass the MTB bacilli on to other people. Active TB is a condition in which the body's immune system is unable to fight off or defend against MTB bacilli; it is characterized by the presence of clinical symptoms and the person can pass the MTB bacilli to other people (O'Garra, 2013) According to the World Health Organization (WHO), about a third of the world's population has latent TB and 5%–15% of these people will suffer from reactivation of TB during their lifetime (Ruan., 2016).

LTBI is reactivated when the immune response fails in some way and the dormant *M. tuberculosis*, seeded at the time of exposure, proliferates and progresses to cause active TB disease (Alavi-Naini., 2012). The main target groups considered by WHO to be most at risk of reactivation include people: who have had recent contact with an infectious patient; HIV infected people; persons who have been or who are in prison; homeless people; and other individuals who have certain clinical conditions which compromise their immune system, such as diabetes, and chronic renal failure (Getahun, 2015) in addition, (Narasimhan et al, 2013) suggested other risk factors such as people who were recently infected with *M. tuberculosis*, people with a history of untreated or inadequately treated TB disease, people who are receiving immunosuppressive therapy such as tumor necrosis factor-alpha (TNF) antagonists, systemic corticosteroids, or immunosuppressive drug therapy following organ transplantation; some hematological disorders(e.g.: leukemia, lymphomas) and malignancies; people who have had a gastrectomy by pass and children under five years a person is said to have TB case; if the person has a large

amount of active TB bacteria in his/her body, may spread TB bacteria to others, may have symptoms such as a cough, fever, and/or weight loss (Chiappini, 2015).

The laboratory results of an active TB are smear-positive, culture-positive or there is detection of *Mycobacterium tuberculosis* using molecular test (GeneXpert). People with active tuberculosis may require respiratory isolation (Ryan et al, 2014). It is against this background that the study intends to determine the clinical conditions that contribute to the activation of latent TB to active TBin 2017, an estimated 10 million incident cases of TB occurred (133 cases per 100,000 population) (WHO, 2018). The WHO regions of South-East Asia and Africa accounted for nearly 70% of overall global TB. Although total case numbers were higher in South-East Asia, the overall incidence was similar in both regions (226 per 100,000 (South-East Asia), 237 (Africa)). Most high-incidence countries in 2017 were located in these two regions; however, the proportion of TB cases among persons with HIV infection in Africa (27%) was higher than that in South-East Asia (3%). Although the overall incidence of TB in the WHO European region was relatively low, the proportion of TB cases with RR or MDR TB in this region (40%) was substantially higher than that in all other regions (range = 3.6%–6.3%) (WHO, 2018).

For Rwanda, the TB prevalence and incidence rates were estimated at 114 and 86 per 100,000 populations respectively, in that year Rwanda notified 6,208 TB cases, 63.3% of the 9,800 estimated incident TB cases. The observed disparity raised the question whether the disease exists at lower levels than estimated by WHO or whether the observed gap results from low TB case detection or underreporting of TB cases (Patrick, 2020).For less immunocompetent persons or more exposed people, there is the proliferation of a previously dormant bacterium i.e. active tuberculosis. The bacterial replication is not controlled, the tubercle enlarges and the bacilli enter local draining lymph nodes. This leads to lymphadenopathy, a characteristic clinical manifestation of active tuberculosis. The bacilli may spread way of lymphatic channels or through the bloodstream to more distant tissues and organs and cause extrapulmonary TB (Demers, 2016).

Millions of people continue to fall sick with tuberculosis each year in all countries and all age groups are being affected (WHO, 2018). Globally, 10 million people developed tuberculosis, of which 90% were adults (aged ≥ 15 years), 9% were people living with HIV among them 72% have been in Africa. TB caused an estimated 1.3 million deaths among HIV-negative and 300,000 deaths among HIV-positive people. The African Region continues to bear a significant proportion of the global burden of tuberculosis and accounts for 28% of the estimated 9.6 million incident tuberculosis cases that occurred worldwide in 2019. (WHO, 2019), the severity of the TB epidemic varies widely among countries, the TB incidence in Rwanda is 7000 thousand new TB cases. In Rwanda, the deaths caused by HIV-associated TB are lower than those in HIV-negative people. Mortality in HIV negative is 600 deaths whereas mortality in HIV positive is 320 deaths (WHO, 2018). Therefore, a study on the assessment of prevalence and associated risk factors for tuberculosis occurrence among patients attending Muhima District Hospital is needed in order to improve the TB treatment outcome by preventing death among the

patients under TB treatment. In addition, the researchers, the policymakers and TB program, in general, will also have enough information on TB mortality risk factors which will lead them to put in place strategies, based on evidence, for reducing TB mortality among TB patients.

2. Methodology

The study was conducted at one of the district hospitals located in Nyarugenge District, Kigali City. Our target population was all TB patients who attended MDH in the period of 1st January 2019 to 31st December 2020. "*Plan your work and work your plan*" is the suggestion of Napoleon Hill; for a scientific research one has to prepare a research design. It should indicate the various approaches to be used in solving the research problem, sources and information related to the problem, time frame and the cost budget. Essentially, the research design creates the foundation of the entire research work. The design will help to perform the chosen task easily and in a systematic way. Once the research design is completed the actual work can be initiated (Rajasekar, 2012). The study used a cross-sectional design and a quantitative approach. Cross-sectional studies that are carried out at a one-time point or over a short period are usually conducted to estimate the prevalence of the outcome of interest for a given population, commonly for the purposes of public health planning (Levin, 2006).

3. Results and Discussion

3.1 Data Presentation and Analysis

3.1.1 Socio-Demographic Characteristics of the Patients

The total number of participants who attended the health center was 2161 (Table 4.1) Over half of the participants were male 1524(70.5%) and female 637(29.5%). Age group was variant in all stages, less than 9 years 19(.9%), between 10-17 years 76(3.5%), between 18-35 years 1185(54.8%), between 36-59 years 843(39.0%) and above 60 years 38(1.8%). The majorities were married 1014(47%) while singles were 977(45.2%) and widower were 57(2.6%). Furthermore, on economic 883(40.9%) were classified as unemployed, 845(39.1%) were employed, 206(9.5%) were student while 227(10.4%) were prisoner, based on location 1181(54.7) were urban, 980(45.3) rural.

Table 4.1: Socio-Demographic Characteristic

Characteristic	Frequency	Percentage (%)
Gender		
Male	1524	70.5
Female	637	29.5
Age		
Less than 9 years	19	.9
Between 10-17 years	76	3.5
Between 18-35 years	1185	54.8
Between 36-59 years	843	39

Above 60 years	38	1.8
Marital Status		
Single	977	45.2
Married	1014	47.0
Widower	57	2.6
Occupation		
Unemployed	883	40.9
Employed	845	39.1
Student	206	9.5
Prisoner	227	10.5
Location		
Urban	1181	54.7
Rural	980	45.3

3.1.2 Prevalence of Tuberculosis

Table shows the prevalence of patients who were TB positive and who were TB negative when tested for TB. Patients with TB positive female were 53(34.0%) and male were 103 (66.0%) in all having a prevalence of 7.2% which is lower than the prevalence TB negative which is 92.8% where female were 1154(58.0%) and male were 851(42.0%).

Table 4.2: Prevalence of Patients with TB Status

Year	**TB Positive**		**TB Negative**	
	Female	**Male**	**Female**	**Male**
2019	28	58	480	271
2020	25	45	674	580
Frequency and Percentage	**53 (34%)**	**103 (66%)**	**1154 (58%)**	**851 (42%)**
Grand Total and Percentage	**156 (7.2%)**		**2005 (92.8%)**	

3.1.3 Prevalence of HIV Status in TB-Positive Participants

The table below shows the prevalence of HIV negative who were positive when tested for TB. HIV-negative patients with TB have a prevalence of 67.4% which is higher than the prevalence of HIV-positive with TB which is 32.6%.

Table 4.3: Prevalence of HIV Status in TB-Positive Participants

	Frequency	**Prevalence (%)**
HIV Status		
HIV Negative	105	67.4
HIV Positive	51	32.6
Total	**156**	**100**

3.1.4 Risk Factors for TB Occurrence

The table below shows factors that are associated with TB activation. The factors include: drinking alcohol 908(42%) where non-use of alcohol were 1253 (58%) and smokers were 186 (8.6%) and non-smokers were 1925(91.4%).

Table 4.4: Behavioral Practices

Characteristic	Frequency (n=2161)	Percentage (%)
Drink alcohol		
Yes	908	42.0
No	1253	58.0
Smoke		
Yes	186	8.6
No	1925	91.4

3.1.5Immunity and Tuberculosis

Table below illustrates the immunity and tuberculosis where those who was first time diagnosis were 2029(93.9) and who weren't 132(6.1), those who were HIV positive 656(30.4%), HIV negative1505 (69.6%) and TB positive were 156(7.2%), TB negative 2005(92.8).

Table 4.5: Immunity and Tuberculosis

Characteristic	Frequency (n=2161)	Percentage (%)
First-time diagnosis		
Yes	2029	93.9
No	132	6.1
HIV Status		
Positive	656	30.4
Negative	1505	69.6
TB status		
Positive	156	7.2
Negative	2005	92.8

3.1.6 Associations between Risk Factors and TB Occurrence

The table shows the relationship between risk factors and TB occurrence. Specifically, it provides association factors of TB according to the clinical characteristics of TB patients. A chi-square test was used to establish a relationship between different variables. The chi-square shows that there was not a statistically significant relationship between Age and TB occurrence with a Chi-square value of 1.899 and p-value of 0.754, and sex was not associated with Tb occurrence, the chi-square value of 0.032 and p-value of 0.142, whereas marital status was not statistically significant with TB occurrence with chi-square value of 1.596 and p-value of 0.660, the location was not statistically significant with TB occurrence with chi-square value of 0.142 and the p-value is 0.707, and occupation was not statistical significant with TB occurrence with chi-square value of 95^{a} with a p-value of 0.73. Serological status was not associated with TB occurrence with a Chi-square value of 0.014with a p-value of 0.907, use of alcohol was not associated with TB occurrence chi-square value of 0.016 and p-value of 0.561, use of tobacco was not associated with TB occurrence with chi-square value of 0.016 and p-value of 0.899.

Table 4.6: Association of Different Factors with TB Occurrence

	Age		Sex		Marital status		Residence location		Occupation		Serology		Use of alcohol		Use of tobacco	
Tuberculosis occurrence	**(χ2) value**	**p-value**	**(χ2) value**	**p-value**	**(χ2) value**	**p-value**	**(χ2) value**	**p-value**	**(χ2) value**	**p-value**	**(χ2) value**	**p-value**	**(χ2) value**	**p-value**	**(χ2) value**	**p-value**
	1.899[a]	.754	.032[a]	.142	1.596[a]	.660	.142[a]	.707	95[a]	.730	.014[a]	.907	.016[a]	.561	.016[a]	.899

Pearson's Chi-square Test was used with Fisher Exact Tests where appropriate Significance was set at $p<.05$ at 95 CI.

4. Discussion of the Findings

The study has considered different risk factors that might play a role in tuberculosis occurrence such as behavioral factors including alcohol consumption, smoking, and demographic characteristics including age, sex, marital status, resident location, marital status, occupation, and serological status, Chi-squared was used to compute the P value and to ascertain the degree of association between these risk factors and TB occurrence by means of SPSS.

The current study showed a higher prevalence (7.2%) compared to the National TB estimates (5.2%) reported by the World Health Organization (WHO, 2019), and HIV patients with TB as a co-infection was higher (32.6%) than the prevalence found in a systematic review and meta-analysis study that examined same prevalence (25.59%) (Tesfaye, 2018).

The present study showed that 908(42.0%) of that drinking alcohol and 186(8.6%) smokers were not significantly associated with TB occurrence where this is contradictory with previous studies conducted including a larger systematic review (Imtiaz, 2017) and another study conducted in Iran(Alavi-Naini, 2012)that both noted that these factors impact the body's immune system and make it more susceptible to TB infection. This could be due to the low prevalence of smoking in our study population and social desirability bias whereby smokers denied their smoking status. However, in a case-control study carried out in Ethiopia, both factors alcohol consumption and smoking were not associated with active TB (Kelemu Tilahun Kibret, 2013).

Age and sex are also found to be not associated with TB occurrence which is contradictory with studies conducted by (Marçôa, 2018) that noted that men are more affected and stated that different factors have been proposed to explain this gender gap. And also, for age, there elderly people and infants have weak immune hence are more exposed to TB activation (Schaaf, 2010).

The factors such as marital status, residence location, and occupation are also found to be not associated with tuberculosis occurrence contradictory to a study conducted by (Narasimhan, 2012) that noted that these factors increase exposure to TB bacilli and places have poor indoor air ventilation hence increasing the risk of TB infection to the people that live in the collective housing and prisons but these factors we found that are not associated with tuberculosis occurrence.

5. Summary of Findings

The total number of participants who attended the health center was 2161. Over half of the participants were male 1524(70.5%) and female 637(29.5%). Age group was variant in all stages, less than 9 years 19(.9%), between 10-17 years 76(3.5%), between 18-35 years 1185(54.8%), between 36-59 years 843(39.0) and above 60 years 38(1.8%). The majorities were married 1014(47%) while singles were 977(45.2%) and widower were 57(2.6%). Furthermore, on economic 883(40.9%) were classified as unemployed, 845(39.1%) were employed, 206(9.5%) were student while 227(10.4%) were prisoner, based on location 1181(54.7) were urban, 980(45.3) rural.

The prevalence of patients who were TB positive and who were TB negative when tested for TB. Patients with TB positive female were 53(34.0%) and male were 103(66.0%) in all having a prevalence of 7.2% which is lower than the prevalence TB negative which is 92.8% where females were 1154(58.0%) and male were 851(42.0%). the prevalence of HIV negative who were positive when tested for TB. HIV-negative patients with TB have a prevalence of 67.4% which is higher than the prevalence of HIV-positive with TB which is 32.6%.

For the behavior practices such as drinking alcohol 908(42%) where non- use of alcohol were 1253(58%) and smokers were 186(8.6%) and non-smokers were 1925(91.4%). the immunity and tuberculosis where those who were first-time diagnosis were 2029(93.9) and who weren't 132(6.1), those who were HIV positive 656(30.4%), HIV negative1505 (69.6%) and TB positive were 156(7.2%), TB negative 2005(92.8).

The relationship between risk factors and TB occurrence. Specifically, it provides association factors of TB according to the clinical characteristics of TB patients. A chi-square test was used to establish a relationship between different variables. The chi-square shows that there was not a statistically significant relationship between Age and TB occurrence with a Chi-square value of 1.899 and p-value of 0.754, and Sex was not associated with Tb occurrence, the Chi-square value of 0.032 and p-value of 0.142, whereas marital status was not statistically significant with TB occurrence with chi-square value of 1.596 and p-value of 0.660, the location was not statistically significant with TB occurrence with chi-square value of 0.142 and the p-value is 0.707, and occupation was not statistically significant with TB occurrence with chi-square value of 95^{a} with a p-value of 0.73. serological status was not associated with TB occurrence with a Chi-square value of 0.014with a p-value of 0.907, use of alcohol was not associated with TB occurrence chi-square value of 0.016 and p-value of 0.561, use of tobacco was not associated with TB occurrence with chi-square value of 0.016 and p-value of 0.899.

6. Conclusion

The objectives of the study were to determine the prevalence of tuberculosis among patients and to identify behavioral factors associated with TB occurrence among patients. As known TB can exist in two types: latent (LTBI) or active (ATB). For TB to progress

from latent TB to active TB there are factors that are associated with its progression. This has found that serological status (HIV status), age, sex, smoking, drinking, collective housing such as schools and being in prisoner are not associated with TB occurrence. And the prevalence of TB-positive patients with HIV status was found to be 156 (7.2%). The prevalence of TB among patients attending Muhima District was higher than the National TB prevalence estimates reported by the World Health Organisation (WHO, 2019), respectively 7.2% versus 5.2%. HIV patients had a higher prevalence (32.6%) compared to those without HIV. All predictors of TB occurrence including demographic characteristics and behavioral factors none of them was associated with TB occurrence. It is worth recommending a further study to understand in-depth risk factors for TB occurrence in the era of epidemiological transition.

Conflict of Interest Statement

The authors declare no conflicts of interest.

About the Authors

Elysee Hitayezu holds a Master's degree in Medical Biochemistry from Periyar University and a Bachelor's degree in Medical Laboratory Technology from Lovely Professional University (India). As an experienced professional in the field of Biomedical sciences, he has a strong academic background and expertise in biochemistry and medical laboratory technology. His research interests lie in the areas of medical biochemistry, diagnostics, and laboratory techniques. His research work focuses on exploring the biochemical mechanisms underlying various diseases and developing innovative diagnostic methods to improve patient care and outcomes. He joined Kibogora Polytechnic since 2017 as an Assistant Lecturer of Clinical Chemistry, Biochemistry and Other Biological Sciences in three faculties: General Medicine and Health Sciences, General Nursing and Education. He taught different modules related to Clinical Chemistry and Biological Sciences and he supervised undergraduate research projects. He has actively participated in scientific conferences, symposiums, and workshops related to medical biochemistry and laboratory technology. He is currently an Assistant Lecturer at University of Rwanda, College of Medicine and Health Sciences.

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