Research Article

Risk Factors for Tuberculosis in the Kaniama Health Zone, Democratic Republic of Congo

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Background: Tuberculosis is an infectious disease with human-to-human transmission which constitutes a major public health problem, both in developed and developing countries, due to its magnitude and its strong association with mortality.The aim of this study is to identify the risk factors for susceptible tuberculosis in the Kaniama health zone in order to better target measures to combat this pathology.

Methods: This is a case-control study carried out at CDT KASESE and MWADI-KAYEMBE during a period from January 2 to April 2, 2024.In the univariate analyzes we exhaustively took all 42 cases of susceptible tuberculosis recorded during our study period. In bivariate analyses, each case of susceptible tuberculosis was matched to 2 controls.

Results:After analyzing the data, we obtained the following results:The risk factors for TPM+ in our study environment are male gender (ORa=2.576, 95% CI: [1.008-6.585]), lack of education (ORa=6.478, 95% CI [2.838-14.791]]), household size>5 people(aOR=82.042, 95% CI [31.167-215.962]), as well as active smoking (aOR=5.023, 95% CI [1.966-12.835]).

Conclusion:This study therefore showed that in addition to non-modifiable risk factors, certain important factors remain accessible. Well-targeted and coordinated education and awareness actions on subsidized factors must be undertaken.

Introduction

Tuberculosis is an infectious disease transmitted between humans due to the pathogenic effects of a bacillus belonging to the tuberculosis complex which brings together four mycobacteria:

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Mycobacterium tuberculosis or Koch bacillus, by far the most often responsible; Mycobacterium bovis; Mycobacterium africanum; Mycobacterium avium[1].

Tuberculosis remains the largest infectious disease in the world. According to the World Health Organization, 219 million cases and 660 thousand deaths are reported each year. The majority of deaths occur in sub-Saharan Africa where living conditions are very precarious. In this continent, tuberculosis and whooping cough are responsible for the deaths of more than 3,000 children, the majority of whom are under 5 years old[2].

According to estimates from the World Health Organization, each year there are around 9 million new cases of tuberculosis and almost 2 million people die from this disease. From this, it is appropriate to point out that each year, nearly 440,000 people contract multi-resistant tuberculosis and 150,000 of them die from it[3]. Treatment remains difficult and expensive due to poor response to conventional treatment with first-line drugs. Cure rates for multi-drug resistant tuberculosis are low (between 50% and 70%)[4].

In Europe, tuberculosis was responsible for 25% of deaths. The decline in its incidence began even before the appearance of anti-tuberculosis drugs, thanks to improved living conditions. During 2006, 8.6 million people contracted tuberculosis disease and 1.3 million died from it. Currently, with a third of the population infected, it still represents a considerable burden on a global scale[5].

According to the United Nations Development Program (UNDP), the disease has killed around 584,000 people, mainly children under 5 years old in sub-Saharan Africa. In most African countries, the disease disproportionately affects poor and disadvantaged groups, who have limited access to healthcare facilities and can barely afford recommended treatment. Between 2001 and 2013, the significant scale-up of TB interventions helped reduce global mortality rates by 47%, preventing an estimated 4.3 million deaths. In the WHO African Region, this rate fell by 58%. In the same period, the global incidence of tuberculosis fell by 30%[6].

Africa, with its 11% of the world's population, alone bears 27% of the global burden of tuberculosis. The incidence of tuberculosis increases each year by 6% and the HIV epidemic is the main cause of this increase. In fact, around 30 to 50% of tuberculosis patients in Africa are co-infected with HIV[7].

In Niger, tuberculosis and tetanus are the sixth cause of mortality and morbidity among pregnant women and children under 5 years old. To combat them, the country has opted for prevention by committing to a vaccination policy (BCG, DPT and VAT)[8].

In Ivory Cost, tuberculosis is the fourth major pathology due to its high frequency, its severity and its significant socio-economic consequences (MPD, 2010).In Chad, from 2000 to 2012, mortality due to tuberculosis was estimated at 42%. Suspected cases of tuberculosis increased from 528,454 in 2020 to 1,272,841 in 2021 then to 1,513,772 cases in 2022 with 1,720 deaths[9].

The Democratic Republic of Congo (DRC), with an estimated population in 2020 of 95,326,410 inhabitants and an incidence of all forms of TB cases of 211 cases per 100,000 inhabitants. It is among the 30 countries with a high burden of TB and the 14 countries simultaneously having a high burden of susceptible TB, co-infection-HIV and drug-resistant TB (PRTB). It reported 202,145 cases of susceptible TB, including 22,342 children, 12,041 HIV-TB cases and 1,023 cases of PRTB. The COVID-19 pandemic risks reversing recent progress in the first five years of the Sustainable Development Goals (SDGs). A significant drop in the notification of TB cases with an increase in cases of death was noted during the year 2020[10].

To better understand this problem, the different risk factors should be noted. The purpose of this work is to identify risk factors for susceptible tuberculosis in the Kaniama health zone in order to better target the fight against this pathology.

Materials and Methods

Study framework: This study was carried out in the Democratic Republic of Congo, in the province of Haut-Lomami, precisely in two (2) CDTs in the Kaniama health zone namely CDT KASESE and MWADI-KAYEMBE.

Type, period and study population: This is a case-control study, covering patients suffering from susceptible tuberculosis and their contacts during the period fromJanuary 2 to April 2, 2024. A case was defined as anytuberculosis patient (old and new cases) recorded in the CDT TB registerKASESE and MWADI-KAYEMBEduring the period of our study.And a control was defined as any person free of susceptible tuberculosis living in the same household and/or sharing the same living conditions with the index case. For this study, we comprehensively took all 42 cases of susceptible tuberculosis recorded during our study period. Each case of susceptible tuberculosis was matched to 2 controls, which gave us a sample of 126 subjects.

Inclusion and exclusion criteria: For this study, we included two groups of subjects: For the case group, we included all tuberculosis patients (old and new cases) registered in the TB register of

KASESE and MWADI-KAYEMBE during our study period. For the control group, we included all people free of susceptible tuberculosis living in the same household and/or sharing the same living conditions with the index case. All people who did not meet the inclusion criteria are excluded from this study.

Data Collection and Analysis:To collect the data, we used the direct interview technique enriched by a data collection sheet configured on the ODK Aggregate server. The data collection activities were preceded by verbal authorization from the political-administrative and health authorities after explaining to them the merits of the study. For this study, we recruited 8 RECO-investigators and 2 supervisors selected on the basis of their capacities, their knowledge of the field and their ability; training followed by a pre-survey was organized for them. Data collection took a period of two (2) months.

The data collected was downloaded in Excel format before being analyzed using SPSS version 25 software.Descriptive and analytical statistical analyzes were carried out successively. The Pearson chi-square test allowed us to objectify the degree of significance of the association measure. The significance level used was $p<0.05$. The odds ratio and its 95% confidence interval were calculated to measure the association between random variables. Subsequently, ascending logistic regression using the Wald step-by-step method made it possible to detect the risk factors for TPM+ and to measure the strength of association of each factor (adjusted odds ratio) at the p-value significance threshold. adjusted<0.2.

Ethical considerations: For the respect of our respondents, none of their identity or image appeared in the presentation of the results and we are obliged to maintain the confidentiality of personal data and to only use the data for purposes of study.

Results

Variables	Frequency (%)
Age	
0-14 years	8 (6.3)
15-49 years old	28 (22.2)
50 and over	90 (71.4)
Sex	
Male	106 (84.1)
Feminine	20 (15.9)
Instruction	
Uneducated	79 (62.7)
Educated	47 (37.3)
Household size	
> 5 people	100 (79.4)
≤ 5 people	26 (20.6)
Diabetic	
Yes	5 (4.0)
No	121 (96.0)
Renal failure	
Yes	33 (26.2)
No	93 (73.8)
Alcoholism	
Yes	36 (28.6)
No	90 (71.4)
Active smoking	

Variables	Frequency (%)
Yes	44 (34.9)
No	82 (65.1)
Passive smoking	
Yes	28 (22.2)
No	98 (77.8)

Table 1. Sociodemographic characteristics and co-morbidity (n=126)

It appears from this table 1 that the majority of our respondents, 90%, were aged 50 and over, 8Z4.1% were male, 79.4% lived in a household where the size was greater than 5 people. In relation to comorbidity, we observed that 4% of respondents were diabetic, 26.2% had kidney failure, 28.6% were alcoholics, 34.9% were active smokers and 22.2% were passive smokers.

Parameters studied	*Case* n=42(%)	*Witnesses* n=84(%)	OR [CI 95%]	P
Age				
0-14 years	4(9.5)	4(4.8)	6.000 [1.049-34.318]	0.034
15-49 years old	4(9.5)	24(28.6)	1	
50 and over	34(81.0)	56(66.7)	3.642 [1.163-11.402]	0.036
Sex				
Male	40(95.2)	66(78.6)	5.454 [1.201-24.759]	0.031
Feminine	2(4.8)	18(21.4)		
Instruction				
Uneducated	34(80.9)	45(53.6)	3.683 [1.525-8.893]	0.002
Educated	8(19.1)	39(46.4)		
Household size				
> 5 people	39(92.9)	61(72.6)	4.902 [1.378-17.427]	0.00
≤ 5 people	3(7.1)	23(27.4)		
Number of bedrooms in household				
< 3 Bedrooms	18(42.9)	46(54.8)	0.620 [0.294-1.308]	0.208
≥ 3 Bedrooms	24(57.1)	38(45.2)		

Table 2. Relationship between TPM+ and sociodemographic characteristics

Reading this table 2 shows that there is a statistically significant association between susceptible tuberculosis and age ≤ 14 years and ≥ 50 years. We also noted that the risk of tuberculosis is very high among uneducated subjects than among educated ones. A statistically significant link was established between TPM+ and household size > 5 people.

Parameters studied	*Case* n=42(%)	*Witnesses* n=84(%)	OR [CI 95%]	P
Diabetic				
Yes	1(2.4)	4(4.8)	0.488 [0.053-4.507]	0.519
No	41(97.6)	80(95.2)		
Renal failure				
Yes	8(19.1)	25(29.8)	0.555 [0.226-1.367]	0.197
No	34(80.9)	59(70.2)		
Alcoholism				
Yes	22(52.4)	14(16.7)	5.500 [2.388-12.667]	0.00
No	20(47.6)	70(83.3)		
Active smoking				
Yes	21(50.0)	23(27.4)	2.652 [1.225-5.739]	0.00
No	21(50.0)	61(72.6)		
Passive smoking				
Yes	18(42.9)	10(11.9)	5.550 [2.257-13.647]	0.00
No	24(57.1)	74(88.1)		

Table 3. Relationship between TPM+ and co-morbidity

Table 3 showed a statistically significant association between susceptible tuberculosis and alcoholism, active smoking as well as passive smoking.

Risk factors	B	ES	Wald	ORa [95% CI]	P
Sex (Male vs Female)	.946	.479	3.905	2.576[1.008-6.585]	0.04
Instruction (uneducated vs educated)	1.868	.421	19.679	6.478[2.838-14.791]	0.00
Household size (> 5 prs vs ≤ 5 prs)	4.407	.494	79.650	82.042[31.167-215.962]	0.00
Active smoking (Yes vs No)	1.614	.479	11.374	5.023[1.966-12.835]	0.00
Constant	-6.361	.808	62.032		0.02

Table 4. Logistic regression of different risk factors

Table 4 explains that the risk factors for TPM+ in our study environment are male gender (ORa=2.576; 95% CI: [1.008-6.585]), lack of education (ORa=6.478; 95% CI [2.838-14.791]]), household size>5 people(aOR=82.042; 95% CI [31.167-215.962]), as well as active smoking (aOR=5.023; 95% CI [1.966-12.835]).

Discussion

In our study, men are more exposed to susceptible tuberculosis than women. Our results are identical to those of other studies[11]carried out in certain countries of the world and of which an analysis of lifestyles could be evoked in the face of difficult working conditions in a context of generalized poverty could be an element of explanation. Note that the work of housewives, less exposed to difficult conditions outside the home, would be a protective factor for women. This result agrees with those of[12] [12]and those of[13]. This can also be linked to the toxicological habits of the male gender. On the other hand, other works mention the vulnerability of the female sex to tuberculosis following exposure to smoke during cooking and the accumulation of a large quantity of dust during house maintenance or of the plot[2]. But according to other literature, there is no significant difference depending on gender[14]. This notion is therefore very controversial.

Extreme ages (<15 years and ≥50 years) were significantly affected by susceptible tuberculosis. This result corroborates that found in[15]. This predominance at extreme ages could be explained by

immature immune capacities in children under 15 years of age and by immuno-senescence in the elderly. This makes these people susceptible to developing the crude clinical presentations of tuberculosis, represented largely by tuberculosis. This result is in the same direction as the results found by other authors[16].

According to the literature, 20 to 60% of tuberculosis cases occur significantly in uneducated people[17]. In our statistical series, a statistically significant association was observed between TPM+ and the non-education of the subjects. The association between literacy and tuberculosis could be explained by the fact that literacy allows ease of reading and understanding of awareness messages. Illiteracy was associated with tuberculosis in Ghana, Burkina Faso, Ivory Coast, and Guinea. Indeed, illiterate subjects had a high risk of being positive for tuberculosis compared to educated ones[18]. [14]also found a significant association between lack of education and the occurrence of susceptible tuberculosis (OR = 3.8 95% CI = [2.71-7.43]). However,[19]did not find a statistically significant association between tuberculosis and lack of education (p=0.91).

Let us say again that household size greater than 5 people plays an important role in the occurrence of susceptible tuberculosis. Housing conditions are used as socioeconomic indicators of health and well-being[20]. Poor housing quality and overcrowding are associated with poverty, certain ethnic groups and increased susceptibility to disease[21]. Overcrowding, poor indoor air quality due to inadequate ventilation, and the presence of mold and smoke generally contribute to the deterioration of respiratory health and have been implicated in the spread of tuberculosis (TB) and outcome[8]. Overcrowding has been identified as a risk factor for TB transmission. In communities where people with active TB live, overcrowded housing contributes to an increased risk of exposure to M. tuberculosis. The risk of exposure is also amplified if there is little air circulation in a confined space. Lienhardt summarized a number of studies that show that crowding is a risk factor for infection and increases the risk of infection progressing to disease[22]. In a Canadian study, an increase of 2 people per room (PPP) was found to increase the risk of two or more cases of TB in a community by 40%[23].

Active smoking was found to be a factor associated with tuberculosis in our setting. According to[24], smoking and tuberculosis are two major public health issues worldwide, particularly in emerging countries. Tobacco smoke promotes Mycobacterium tuberculosis infection by several mechanisms: impairment of mucocilar clearance, reduction in the performance of alveolar macrophages, immunosuppression of pulmonary lymphocytes, reduction in the cytotoxic activity of natural killer

cells, alteration of activity of pulmonary dendritic cells. Smoking constitutes one of the risk factors favoring the occurrence of this disease[23].showed that the incidence of tuberculosis increased with tobacco consumption, and that this risk was multiplied by 4 from consumption of more than 20 cigarettes per day. According to[25], smoking, through its irritant effect on the respiratory tract, also influences local immune defense mechanisms and has long been suspected of increasing the risk of developing tuberculosis, but the evidence available until recent years was anecdotal. In older studies, the relationship between tobacco and tuberculosis was often masked by the association with other risk factors such as alcohol abuse, adverse socioeconomic conditions, or increased risk of environmental exposure[26]. Recently, two systematic reviews of the literature clarified the relationships between tobacco and tuberculosis and reached similar conclusions. International Union Against Tuberculosis and Lung Disease has published a document that reviews the interactions between tobacco and tuberculosis and proposes an action plan. According to the same source, tobacco disrupts the activity of mucosal defenses responsible for controlling bronchial infections through an increase in the production of bronchial secretions, a reduction in mucociliary purification and an inhibition of macrophage activity. This results in a reduction in the adhesion of bacteria to the surface of macrophages, a reduction in phagocytosis capacity, a reduction in the release of proinflammatory cytokines, a reduction in intracellular bactericidal and a reduction in the release of TNF-α. and NO production. Alteration of immune defense mechanisms is considered responsible for the increased risk of pneumococcal pneumonia observed in smokers[27].

Conclusion

At the end of this case control study on the risk factors for susceptible tuberculosis in the Kaniama health zone during a period from January 2 to April 2, 2024, we drew the following conclusions: The risk factors for TPM+ in our study environment are male gender (ORa=2.576, 95% CI: [1.008-6.585]), lack of education (ORa=6.478, 95% CI [2.838-14.791]), household size>5 people(aOR=82.042, 95% CI [31.167-215.962]), as well as active smoking (aOR=5.023, 95% CI [1.966-12.835]).

Statements and Declarations

Conflicts of interest

The authors report no conflicts of interest for this work.

Author contributions

François Kalenga Luhembwe, Phacochere Kabwe, Valentin Masengo Kazadi, Mindje Kolomba and Michel Kabamba Nzaji designed this study; Data collection and analysis were carried out by François Kalenga Luhembwe and Valentin Masengo Kazadi. The interpretation of the results and the writing of the article were done by François Kalenga Luhembwe, Phacochere Kabwe, Valentin Masengo Kazadi, Mindje Kolomba and Michel Kabamba Nzaji. The translation of the manuscript into English was done by Mindje Kolomba. All authors read and approved the final version of the manuscript.

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Declarations

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