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# Risk factors associated with tuberculosis in adults: a case control study at Ndola Central Hospital, Zambia

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## ABSTRACT

**Background:**Tuberculosis (TB) is an air born condition that affects many systems of the human body, usually the lungs first. TB is one of the leading causes of morbidity and mortality in Zambia. The objective of the study was to determine risk factors associated with TB. **Method:** A case-control study was performed among 81 TB patients at Ndola Central Hospital (NCH) and 79 controls.All participants completed a questionnaire regarding socio-demographic and lifestyle variables.Chi-square test was used to determine significant associations anda result yielding a p value of less than 5% was considered statistically significant. Independent factors associated with the outcome were established using a multivariate logistic regression. Adjusted odds ratios(AOR) and their 95% confidenceintervals (CI) are reported.**Results:** Independent risk factors which were significantly associated with TB were marital status (AOR=0.51; 95% CI[0.21,0.91]),HIV (AOR=2.09; 95% CI[1.34,3.27]),alcohol(AOR=1.71; 95% CI [1.11, 2.63]), smoking (AOR=2.33;95% [1.23, 4.44]), family history (AOR=1.53;95% CI [1.02, 2.29]) and working in mines (AOR=2.64;95%CI [1.29,5.39]). **Conclusion:** Interventions such as early HIV counselling, testing and initiation of antiretroviral therapy, as well as providing health education on life style risk factors that are associated with TB may prevent TB disease.

**Key words:** Tuberculosis,Risk factors, Ndola Central Hospital, Zambia

## Introduction

TB is a communicable chronic granulomatous disease caused by mycobacterium tuberculosis(MTB) which usually affects the lungs but may affect any organ or tissue in the body [1]. As the bacteria try to spread to other parts of the body they are intercepted by the body's immune system. The immune system forms scar tissue or fibrosis around the bacterium, which helps fight the infection and prevents it from spreading within the body and to other people [1]. If the bacteria manage to break through the scar tissue the disease returns to an active state, pneumonia develops and there is damage to kidneys, bones and the meninges that line the spinal cord and brain[1]. The epidemic of TB that affected the northern industrialized countries in 1900s was mainly associated with social, economic, and environmental factors, including increasing population density, urbanization and poor nutrition[2].The current epidemic, mainly involves developing countries and appears to result from the complex interplay of old socio-economic determinants and new factors, like HIV, the emergence of antimicrobial drug resistance andpossibly more virulent strains[2]. TB is associated with poverty, overcrowding, alcoholism, stress, drug addiction and malnutrition. The disease spreads easily in overcrowded, badly ventilated places and among people who are undernourished. This has led to TB being known as a disease of poverty [3]. Non-compliance to TB treatment has also contributed to this rise in incidence and prevalence because it isone of the principal causes of treatment failure, other causes are inappropriate treatment regimens and poorly planned and managed TB control programs[4]. However, TB control activities in Zambia were initiated by the

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colonial administration and the Government of the Republic of Zambia in 1964 launched the National TB Control Programme [4]. TB is one of the leading causes of morbidity and mortality in Zambia. Further, high notification rate of TB poses a challenge for Zambia today [4]. Therefore, this current study was designed to determine risk factors associated with TB among TB patients reporting to NCH by evaluating the potential demographic, HIV status, lifestyle (smoking and alcohol) and level of knowledge, associated with TB.

**Methods**

**Study area and design**

The study area was at Ndola Central Hospital, the second largest referral hospital in Zambia, is located in Ndola city which is in the Copperbelt province. The design was a case control study. Cases were TB patients who were smear positive for sputum and referred to NCH between 2015 October to June 2016. Controls were patients in the same hospital without signs and symptoms of TB.

**Sample size and sampling**

The following widely used formula for calculating sample sizes for two independent groups was used [5]:

$$n = \frac{(P1(100 - P1) + P2(100 - P2)) * f(\alpha, \beta))}{(P1 - P2)^2}$$

where: n=case sample size=control sample size, we used smoking as the risk factor to compute the sample size where P1=case prevalence size=25.7% and P2=control prevalence size=3.6%,$f(\alpha, \beta)$was taken as =7.85 at power 80% and significance level at 5%, and it gave a minimum of 45 as sample size (n). Consecutive samples were drawn until the sample sizes were achieved.

**Definitions of Variables**

A standardized questionnaire was developed from questionnaires that had been previously used in similar studies. Questions elicited risk factors associated with TB. Knowledge was assessed by asking questions on the risk factors that can predispose one to have TB and TB symptoms. Smoking was defined as current smoking or former use of at least 100 cigarettes in a life time[6]. Alcohol use was defined current or history of drinking alcohol at least three times a week, while overcrowding was defined as two or more adult persons who are not of opposite sex sharing a room[6].

**Ethical consideration**

Ethical approve was obtained from Tropical Disease Research Centre (TDRC) Ethical Review Committee. Meanwhile, permission to conduct this study was obtained from the Copperbelt University School of Medicine and NCH.

**Data entry and analysis**

Data was entered through the use of Epi Data software version 3.1. It was screened in terms of consistency checks and was double entered. Then the data was exported to SPSS windows version 16.0 for analysis. The Chi-square test was used to determine associations in bivariate analyses at the 5% significance level. Independent factors associated with TB were established using the multivariate logistic regression analysis. Adjusted odds ratios(AOR) and 95% confidence interval (CI) are reported.

**Results**

Totals of 81 cases and 79 controls participated in the study. Table 1 show socio-demographic factors associated with TB in bivariate analyses: sex, age, marital status and level of education. All of these factors were significantly associated with TB. Table 2 shows disease and life style factors associated with TB in bivariate analyses: HIV, DM, hypertension,exposure to TB, alcohol, smoking and working in mines. All of these factors were significantly associated with TB.There was no significant association between overcrowding and TB (mean difference=0.142; 95% CI [-0.210, 0.494]). Knowledge on TB risk factors was not associated with TB (mean difference=0.361; 95% CI [-0.607, 0.538]).Table 3 shows independent factors associated with TB. Marital status, HIV positive, exposure to TB, alcohol, smoking and working in mines were independently associated with TB. Married respondents were 49% (AOR=0.51, 95% CI [0.29, 0.91]) less likely to have TB compared to those who were once married. HIV positive participants were 2.09 (95% CI [1.34, 3.27]) times more likely to have TB compared to HIV negative patients. Compared to respondents who were not exposed to TB, those who were exposed to TB were 53% (AOR=1.53; 95% CI [1.02, 2.29]) more likely to have TB. Participants who consumed alcohol were 71% (AOR=1.71; 95% CI [1.11, 2.63]) more likely to have TB compared to those participants who did not consume alcohol. Smoking was independently positively associated with TB (AOR=2.33; 95% CI [1.23, 4.44]). Working in mines was independently positively associated with TB (AOR=2.64; 95% CI [1.29, 5.39]).

**Discussion**

This case control study of 81 cases and 79 controls demonstrated that the risk factors associated with TB are multifaceted. The once married participants were more likely to have TB than the married ones. This result is similar to a result from a study done in Denmark which showed the rates were twice as high among single and widowed men, and four times higher among divorced men. Among women, the same pattern was observed; although the differences were smaller [7].HIV has been known to be a risk factor of one acquiring TB. In this present study, it showed that HIV patients were more than twice likely to have TB compared to those who were negative. This present result is similar to what was reported by a study done in three west African countries in which it was found that those with HIV were two times more likely to have TB than those without HIV[8].This association is similar to the study done in Burkina Faso where patients who were HIV positive were found to be 20 to 40 times more likely to develop active TB than those not infected with HIV living in the same country [9].HIV co-infection is the most potent immune-suppressive risk factor for developing active TB disease[10].Hence it is very important to screen every HIV patient for tuberculosis in order to reduce the risk of progression to TB disease among high risk individuals. In the present study, patients who had family history of active TB patients were likely to develop TB than those who had never stayed(family history)with TB patients at their homes. The result in this present study corresponds with the result reported by Lienhardt et al [8] and Kirenga et al [6] in Uganda. It is for this reason that people caring for TB patients should exercise all measures that can reduce the risk of them acquiring TB disease. They should follow the direct observed therapy (DOT) preventive measures recommended by the World Health Organization. In the current study, patients who smoked were more than twice likely to have TB than those who never smoked. This finding accords that of Lienhardt et al [8] who indicated that smoking results in histological changes in the lower respiratory tract, leading to alterations in the epithelial function; thus decreasing clearance of inhaled substances such as smoke. This in turn increases the risk of TB that has been reported to be as much as 3-folds[11].Therefore, it is essential that all patients are discouraged from smoking to avoid developing TB. Other than smoking as a life style, alcohol was also significantly independently associated with TB. Those who consumed alcohol were almost twice as likely to develop TB as those who never took alcohol. Alcohol has been recognized as a strong risk factor for TB disease [12]. The association of alcohol intake to having TB has also been shown in a study by Lonnroth et al [12] who concluded that active tuberculosis is substantially elevated in people who drink more than 40g alcohol per day and or have an alcohol use disorder. Therefore, regular alcohol intake more than what is recommended lowers the immune system and puts one at risk of acquiring infections. The study also showed that people who worked in the mines were more than twice as likely to develop tuberculosis as those who had never worked before in the mines. This is partly due to continuous dust inhalation in the mines which damages the lungs. This result conforms to that of a study done in sub-Saharan Africa where it was reported that mining production was associated with higher population of TB incidence rates [13].Mining employers need to provide readily available medical services to their employees on regular occasions so that those working in high risk areas are moved to working areas with little or no dust.

**Table 1: Socio-demographic factors associated with tuberculosis**

| Factors | Totals | Cases (n) | Controls (n) | p value |
|---|---|---|---|---|
| **Age** | | | | 0.005 |
| 17-29 | 46 (28.8) | 14 (17.3) | 32 (40.5) | |
| 30-34 | 20 (12.5) | 11 (13.6) | 9 (11.4) | |
| >35 | 94 (58.) | 56 (69.1) | 38 (48.1) | |
| **Gender** | | | | 0.016 |
| Male | 70 ( 43.75) | 43(53.1%) | 27(34.2%) | |
| Female | 90 ( 56.25 ) | 38(46.9%) | 52(65.8%) | |
| **Marital status** | | | | 0.005 |
| Single | 49 | 19(23.8) | 30(38.0) | |

| | | | | |
|---|---|---|---|---|
| Married | 78 | 37 (46.2) | 41 (51.9) | |
| Once married | 32 | 24(30.0) | 8(10.1) | |
| **level of education** | | | | 0.009 |
| **None** | 13 (8.3) | 10 (12.3) | 3 ( 4.0) | |
| Primary | 23 (14.7) | 12 (14.8) | 11 (14.7) | |
| Secondary | 70 (44.9) | 28 (37.3) | 28 (37.3) | |
| Tertiary | 50 (32.1) | 17 (21.0) | 33 (44.0) | |
| **Working in mines** | | | | <0.001 |
| Yes | 22 (14.0) | 19 (23.8) | 3 ( 3.9 ) | |
| No | 132 (84.1) | 61 (76.2) | 71 (92.2 ) | |

**Table 2: Disease factor and life styles associated with tuberculosis**

| Factors | Total n (%) | Cases n (%) | Control (%) | p value |
|---|---|---|---|---|
| **HIV** | | | | 0.003 |
| Yes | 88 ( 55.0) | 54 (66) | 34 (43.0) | |
| No | 72 ( 45.0) | 27 (33.3) | 45 (57.0) | |
| **Diabetes** | | | | 0.020 |
| Yes | 20 (12.5) | 15 (18.5) | 5 (6.3) | |
| No | 140 ( 87.5) | 66 (81.5) | 74 (93.7) | |
| **High blood pressure** | | | | 0.041 |
| Yes | 21 (13.1) | 15(18.5) | 6 (7.8) | |
| No | 139 (86.9) | 66 (81.5 | 73 (92.4 | |
| **Exposure to TB** | | | | 0.036 |
| Yes | 70 (43.8) | 42 (51.9) | 28 (35.4) | |
| No | 90 (56.2) | 39 (48.1) | 51 (64.6) | |
| **Alcohol** | | | | 0.001 |
| Yes | 76 (47.8) | 49 (60.5) | 27 (34.6) | |
| No | 83 (52.2) | 32 (39.5) | 51 (65.4) | |
| **Smoking** | | | | <0.001 |
| Yes | 30 (19.4) | 24 (30.8) | 6 (7.8) | |
| No | 125 (80.5) | 54 (69.2) | 71 (92.2) | |

**Table 3: Independent factors associated with tuberculosis**

| **Factor** | **Adjusted Odds Ratio (95 % CI)** |
|---|---|
| **Marital status** | |
| Single | 0.61 (0.33, 1.14) |
| Married | 0.51 (0.29, 0.91) |
| Once married | 1 |
| **HIV** | |
| Positive | 2.09 (1.34, 3.27) |
| Negative | 1 |
| **Exposure to TB** | |
| Yes | 1.53 (1.02, 2.29) |
| No | 1 |
| **Alcohol** | |
| Yes | 1.71 (1.11, 2.63) |
| No | 1 |
| **Smoking** | |

| | |
|---|---|
| Yes | 2.33 (1.23, 4.44) |
| No | 1 |
| **Working in mines** | |
| Yes | 2.64 (1.29, 5.39) |
| No | 1 |

**Study limitations**

The study bias might arise as the study was undertaken at a referral central hospital which received complicated cases from district hospital outside Ndola district. Therefore, the results may not be generalized to other areas, as people in different places may differ in terms of knowledge, living conditions and social economic factors.

**Conclusion**

Interventions such as early HIV counselling, testing and initiation of antiretroviral therapy, as well as providing health educating on life style risk factors that are associated with TB may prevent TB disease.

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