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Prevalence of Tuberculosis among Public Service Bus Station Users in Lusaka District, Zambia: A Pilot Project

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Abstract

Background: Public transport bus stations in Lusaka, Zambia's capital city serve as a major transportation hub, connecting all provinces and international destinations. Given the high burden of tuberculosis (TB) in Zambia, this study aimed to estimate the prevalence of TB among public transport bus station users, including drivers, conductors, call boys, and commuters/traders. **Methods:** A descriptive quantitative study design was employed, screening 3967 participants from 5 public transport bus stations in Lusaka. Participants who met the TB screening criteria were considered presumptive cases and were subjected to further testing using GeneXpert MTB/RIF assay. Data analysis was performed using JASP statistical software to determine the prevalence of TB and identify associated factors. **Results:** Out of the 3967 participants screened, 670 TB presumptive cases were identified, and 26 cases were bacteriologically confirmed, yielding a positivity rate of 3.9%. This rate is significantly higher than the average estimated positivity rate. Notably, intercity routes had a higher burden of TB cases, including 2 cases of Rifampicin-Resistant TB, compared to local routes. Interestingly, the study found a higher proportion of TB cases among HIV-negative participants. **Conclusion:** This study reveals a significant prevalence of tuberculosis among public transport users in Lusaka, highlighting the need for targeted interventions to mitigate TB transmission in crowded public transportation settings, particularly in high-risk areas such as intercity routes. The findings underscore the importance of implementing TB control measures in public transport hubs to reduce the spread of the disease.

Keywords

Bus Drivers, Transmission, Risk Factor, Commuters, Rifampicin-Resistant

1. Introduction

Tuberculosis (TB) remains a significant global public health concern, with an estimated 134 cases per 100,000 population worldwide [1]. In high-burden countries like Zambia, the situation is even more dire, with a staggering 333 cases per 100,000 population [1]. Public transport, in particular, poses a potential risk for TB transmission due to the airborne nature of the disease and the close contact among passengers [2]-[4]. TB is an airborne-transmitted disease: the bacilli are transmitted by inhaling droplet nuclei from contagious individuals coughing, speaking, singing and sneezing [5] [6]. This risk is exacerbated in densely populated urban areas like Lusaka, which has a population of over 2.2 million people and serves as a hub for local, intercity, and international routes [7] [8]. Glynn *et al.* [9] add that whole genome sequencing shows a low proportion of tuberculosis disease is attributable to known close contacts in rural Malawi, which is less densely populated compared to urban settings.

Given the high burden of TB in Lusaka [7], it is essential to understand the prevalence of TB among public transport bus station users to inform targeted interventions [10] [11]. Research in this sector is limited in Lusaka, and studies have shown that public transport workers and users are at increased risk of TB transmission due to prolonged exposure to crowded and poorly ventilated environments [2]-[4] [10] [11]. By investigating the TB prevalence among public transport bus station users, policymakers and healthcare professionals can develop evidence-based strategies to reduce transmission and improve TB control in this high-risk population.

This study aimed to determine TB prevalence among Lusaka public transport bus station users (drivers, conductors, call boys, commuters, traders) and identify associated risk factors. Specifically, we sought to 1) estimate the prevalence of TB among public transport bus station users in Lusaka and 2) identify potential risk factors associated with TB transmission among public transport users.

2. Methods and Materials

2.1. Design

The study employed a descriptive quantitative research design cross-sectionally. This allowed for capturing a snapshot of the prevailing situation in the bus stations while maximizing the advantage of informing inferential discussion as suggested by Creswell [12] and Setia [13].

This study was exempted from ethical review as it was operational research conducted under the auspices of the Ministry of Health. Nonetheless, informed consent was obtained from all participants in accordance with the principles of the Declaration of Helsinki. Participants were fully informed about the purpose, procedures, and potential benefits of the study, and their participation was voluntary. All necessary measures were taken to ensure the confidentiality and anonymity of participant data.

2.2. Participants

The study was done in Lusaka, Zambia, particularly in five public service bus stations, namely Kulima Tower, Kamwala, Lumumba, City Market and Intercity Bus Terminals. Participants were conveniently selected provided they met the inclusion criteria of having worked or used the bus station for over a year and having consented to participating. Participants were predominantly from Kanyama constituency by residence, males and aged 18 - 38 years.

2.3. Instruments

The study on TB prevalence among Lusaka bus station users used standardized Ministry of Health, National Tuberculosis and Leprosy Program—Zambia, TB screening form and lab request form for sociodemographic and sample data collection. Participants were screened for TB using the WHO 4 symptom questionnaire to identify individuals with potential symptoms and further used the GeneXpert MTB/RIF assay for TB diagnosis and rifampin resistance detection. This assay, also used in recent studies [14]-[16], has shown potential in TB diagnosis.

2.4. Procedure

Prior to tuberculosis screening at Lusaka bus stations, the Lusaka District Health office consulted with Lusaka City Council and bus association managers over two 3-day meetings to raise awareness and strategize screening procedures, which were informed by bus managers. TB focal points and community volunteers from five health facilities were then stationed at the bus stations. Bus managers facilitated awareness and directed transport workers and commuters to screening points.

A screening tool was used to assess TB presumptive cases. All the participants found with at least 2 of the 4 typical symptoms of TB were considered as presumptive cases and further subjected to laboratory confirmation as per WHO [17] and CDC [18] guidelines. The sputum samples collected were analyzed at the laboratory facilities in Matero, Kanyama, Kamwala, Chawama and Chipata.

2.5. Data Analysis

This study analyzed data from Lusaka bus stations study participants to determine TB prevalence using GeneXpert, the WHO-recommended first-line test for diagnosing TB. Demographic data (age, residence, position, and bus station) were analyzed descriptively using frequencies and proportions. Pearson's correlation analysis was performed to examine the relationships between variables, assuming linearity, normality, and homoscedasticity of the data. Linear regression analysis was conducted to identify significant associations between risk factors and TB positivity, assuming linearity, independence, homoscedasticity, normality, and no multicollinearity of the residuals. Both correlation and regression analyses were performed in JASP 0.19.0.0, with a significance level set at $p < 0.05$.

3. Results

3.1. Prevalence of Tuberculosis

Table 1 reveals that among 1967 participants across five Lusaka bus stations, 34% were presumptive TB cases, and 3.9% were bacteriologically confirmed. Kamwala had the highest representation (61.7%) and presumptive TB cases (37.9%), while Kulima Tower had the least (3.8% and 8.8%, respectively). Two rifampicin-resistant cases were found at intercity, and 25 presumptive cases started treatment.

Table 1. Screening and diagnosis results for TB using GenXpert.

Station	No. Screened	Presumptive	Sent to Lab	Bact. Confirm	Rifampicin-Resistant Detected	Clinically Diagnosed	Initiated on Treatment
City Market	601	79	79	10	0	0	8
Intercity Bus Terminals	250	163	163	10	2	0	10
Kamwala	2446	254	254	3	0	1	4
Kulima Tower	150	59	59	1	0	0	1
Lumumba	520	115	115	2	0	0	2
Total	**3967**	**670**	**670**	**26**	**2**	**1**	**25**

3.2. Demographic Characteristics

Table 2 shows that of the 670 participants surveyed, 82.09% were male, and the 18 - 24 age group had the highest representation (21.79%). The majority of station users were from Kanyama (34.3%), while Lusaka Central was the least (3.134%). Drivers and Conductors constituted 40.3%, and Traders the largest role at 37.015%. HIV prevalence was 4.478%, and TB prevalence was 3.9% within this sample.

3.3. Correlation Analysis

Table 3 presents the correlation analysis, which revealed statistically significant relationships between variables. Notably, a significant negative correlation was found between sex and age ($r = -0.136$, $p < 0.001$), and a moderate positive correlation was observed between sex and role/position ($r = 0.502$, $p < 0.001$). Additionally, significant correlations were found between route type and sex ($r = 0.160$, $p < 0.001$), HIV status ($r = 0.094$, $p = 0.015$), and TB result ($r = 0.076$, $p = 0.049$).

3.4. Regression Analysis

The ANOVA results (Table 4) showed that the model was statistically significant (F-statistic = 3.241, p-value = 0.040). However, the small R-squared value indicated that the model explained very little of the variance in TB incidence. Regression coefficients indicated that being HIV negative was associated with a higher TB incidence ($\beta = 1.895$, $p < 0.05$), which was statistically significant.

Table 2. Social demographic characteristics of presumptive cases.

Variable	Indicator	Frequency	Percentage
Gender	Male	550	82.1
	Female	120	17.9
Age	18 - 24 years	146	21.8
	25 - 31 years	138	20.6
	32 - 38 years	133	19.9
	39 - 45 years	92	13.7
	46 - 52 years	78	11.6
	53 - 59 years	30	4.5
	60 years and above	53	7.9
Residential Address	Munali	51	7.6
	Mandevu	79	11.8
	Matero	90	13.4
	Kanyama	230	34.3
	Chawama	153	22.8
	Kabwata	46	6.9
	Lusaka Central	21	3.1
Occupation	Driver	130	19.4
	Conductor	140	20.9
	Call boy	152	22.7
	Trader	248	37.0
HIV Status	Positive	30	4.5
	Negative	640	95.5
TB Results	Positive	26	3.9
	Negative	644	96.1
Type of Route	Local Route	418	62.4
	Intercity Route	252	37.6

Table 3. Pearson's correlation.

Variable	1	2	3	4	5	6
Sex	—					
Age	−0.136***	—				
Role/Position	0.502***	−0.126**	—			
HIV Status	0.007	0.029	0.064	—		
TB Result	0.054	−0.014	0.014	0.069	—	
Route Type	0.160***	−0.022	−0.045	0.094*	0.076*	—

*p < 0.05, **p < 0.01, ***p < 0.001.

Table 4. ANOVA.

Model		Sum of Squares	df	Mean Square	F	p
	Regression	0.241	2	0.120	3.241	0.040
M_1	Residual	24.751	667	0.037		
	Total	24.991	669			

M_1 includes HIV status and route type.

4. Discussion

This study aimed to investigate the prevalence of tuberculosis (TB) among bus drivers and explore differences by sex. As reported previously [1] [7], the estimated TB incidence was at 0.333% and reporting Zambia as one of the top 30 high TB burden countries and with a failing system, Bus stations contributed significantly to this statistic as the prevalence stood at 3.9%. The study found a higher prevalence of TB among men (n = 24) compared to women (n = 2), consistent with global trends reported by the World Health Organization [19] and Amofa-Sekyi *et al.* [20]. The analysis identified a negative correlation between sex and age, suggesting that female participants tended to be younger than their male counterparts, which aligns with prior research [21] [22] reported a 53% higher overall risk of TB in males compared to females (risk ratio [RR] = 1.53; 95% confidence interval [CI], 1.12 - 2.09). A moderate positive correlation was observed between sex and role/position, indicating that males occupy certain roles more frequently than females, potentially reflecting societal norms [23].

The study assessed the association between route type and TB risk, including potential factors influencing this relationship. The study found that intercity routes carried a higher TB risk compared to local routes, potentially due to factors like population density and interactions with individuals from diverse areas. This contradicts Zamudio *et al.* [24] and Feske *et al.* [25], who observed a higher association between local routes and TB. The relationship between route type and TB risk is influenced by various factors, including local epidemiology, transportation system characteristics, and socio-economic conditions [26].

The study found correlations between route type and several health-related variables, including sex, HIV status, and TB result. For Andrews *et al.* [27], local routes, particularly mini buses had the highest infections contradicting our finding which show that intercity routes carry a higher TB risk compared to local routes, which may be attributable to factors like population density, travel duration, and interactions with individuals from diverse areas [5] [6] [28]. The relationship between HIV status and TB incidence was complex, with a weak positive correlation observed, consistent with existing literature [7]. Winter *et al.* [29] state that HIV positive individuals tend to be immunocompromised and tend to have a higher prevalence. However, we found more HIV negative individuals conformed with TB. The unexpected finding of higher TB incidence among HIV-negative individuals contradicts previous studies [30]-[32] and warrants further investigation. Higher TB prev-

alence among HIV-negative individuals is unexpected, as HIV is a known risk factor for TB [33]. However, similar findings have been reported in other studies. For example, a study in South Africa found that HIV-negative individuals accounted for a significant proportion of TB cases [34]. We also note that our sampling technique and other confounding factors could explain this finding and thus call for further investigation.

The study's findings highlight the complexity of TB transmission and prevalence within occupational groups like bus drivers. Further research employing detailed data on route characteristics, driver behavior, and potential exposure risks is needed to understand the mechanisms underlying the relationship between route type and TB incidence.

5. Limitations of the Study

Our study may underestimate the total burden through the indicated prevalence, as it excluded latent TB cases, which tend to be common. We solely focused on Lusaka district due to the city's high traffic. However, this potentially overlooks imported infections and limits generalization of the study findings to other cities in the country. The weak effect sizes observed in this study might be attributed to the pilot nature of the project, the use of convenience sampling, and the relatively small sample size. These limitations might have reduced the statistical power and representativeness of the sample, leading to weaker effects. Future studies with larger, more representative samples and more robust designs might be needed to detect stronger effects. Future research should incorporate qualitative methods to better understand drivers' experiences and social, economic, and behavioral factors influencing TB transmission and healthcare access. A mixed-methods approach would provide a more comprehensive analysis for targeted interventions.

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Authors' Contributions

MC drafted the manuscript and shared it with MJ, LN, SC and MAKY, who reviewed the research procedures and improved the flow of concepts. All researchers approved the study for publication and do take responsibility for the outcomes of this project.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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