



Analysis of Sociodemographic, Lifestyle and Environmental Characteristics of Newly Diagnosed Tuberculosis Patients in Windhoek, Namibia

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ABSTRACT

Background: Tuberculosis (TB) remains one of the leading infectious diseases worldwide, causing substantial morbidity and mortality despite the availability of prevention and treatment strategies. Namibia is a high TB-burden country, with an estimated TB incidence of approximately 450 cases per 100,000 populations and about 12,000 new cases reported annually. Understanding the sociodemographic, lifestyle, and environmental factors among newly diagnosed TB patients is essential for informing targeted public health interventions and strengthening tuberculosis prevention and control efforts

Objective: To analyse the sociodemographic, lifestyle, environmental, and clinical factors among newly diagnosed tuberculosis patients attending three selected public health facilities in Windhoek, Namibia.

Methodology: A quantitative analytical cross-sectional study was conducted among 111 newly diagnosed tuberculosis patients attending three selected public health facilities in Windhoek, Namibia. Participants were recruited using a non-probability convenience sampling technique. Data were analysed using IBM SPSS Statistics version 30, employing descriptive statistics and Chi-square tests, with statistical significance set at $p < 0.05$.

Results: Most participants were male (67.6%) and within the economically productive age group. Approximately 91.0% lived in one- or two-room houses, reflecting overcrowded living conditions, while 48.6% reported poor household ventilation. Significant associations were observed between age group and smoking ($p = 0.028$), gender and smoking ($p < 0.001$), age group and alcohol consumption ($p = 0.001$), and BCG vaccination status and type of tuberculosis ($p < 0.001$).

Conclusion: Newly diagnosed tuberculosis patients in Windhoek commonly exhibited adverse sociodemographic, lifestyle, and environmental characteristics, including overcrowded living conditions, poor household ventilation, cigarette smoking, and alcohol consumption. These findings highlight the need for comprehensive tuberculosis control strategies that integrate behavioural interventions, household infection prevention measures, and socioeconomic support to improve patient care and strengthen tuberculosis control programme.

Key Unique Contribution: This study is one of the first in Namibia in assessing the risk factors associated with newly diagnosed tuberculosis cases.

Key Recommendation: Tuberculosis control programmes should adopt integrated approaches that address behavioural risk factors, improve household environmental conditions, strengthen infection prevention practices, and provide appropriate socioeconomic support for newly diagnosed tuberculosis patients.

Keywords: Tuberculosis, Sociodemographic, Environmental factors, lifestyle factors, Windhoek, Namibia



INTRODUCTION

Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, remains one of the leading infectious diseases worldwide and continues to pose a major public health challenge despite the availability of effective prevention and treatment strategies. According to the World Health Organization (WHO), millions of people continue to develop TB each year, with the greatest burden occurring in low- and middle-income countries where poverty, overcrowding, food insecurity, and limited access to healthcare contribute to sustained transmission and poor treatment outcomes (WHO, 2024; Lönnroth et al., 2009). These socioeconomic and environmental conditions continue to impede global efforts to eliminate tuberculosis as a public health threat.

Namibia is among the high TB-burden countries, with an estimated TB incidence of approximately 450 cases per 100,000 populations, translating to about 12,000 new cases annually (WHO, 2024; Ministry of Health and Social Services [MoHSS], 2023). Although considerable progress has been made in strengthening national tuberculosis control programmes, TB remains a major public health concern in the country (MoHSS, 2024). The Khomas Region, which includes the capital city, Windhoek, contributes the largest proportion of the national TB burden. Rapid urbanisation, population growth, and the expansion of informal settlements have resulted in overcrowded living conditions and socioeconomic inequalities that may influence the epidemiology of tuberculosis within the region (MoHSS, 2023).

Tuberculosis is closely associated with several social, environmental, and behavioural determinants of health. Food insecurity contributes to undernutrition, which increases the risk of progression from latent tuberculosis infection to active disease and may adversely affect treatment outcomes (WHO, 2011). In addition, poverty, inadequate housing, poor ventilation, cigarette smoking, and harmful alcohol consumption have been identified as important factors influencing tuberculosis prevention and control (Lönnroth et al., 2009; Bates et al., 2007). These conditions frequently coexist among socioeconomically disadvantaged populations, further increasing the burden of disease and complicating patient management.

Namibia has a population of approximately three million people and continues to experience substantial socioeconomic challenges, including unemployment, poverty, and food insecurity (Namibia Statistics Agency, 2023; World Food Programme, 2024). Despite recent economic recovery, many households remain vulnerable, particularly within informal urban settlements. Existing literature has highlighted the complex relationship between socioeconomic conditions, environmental exposures, behavioural practices, and tuberculosis (Musuenge et al., 2020). However, there remains limited evidence describing these characteristics among newly diagnosed tuberculosis patients in Namibia, particularly within high-burden urban settings such as Windhoek. This study was therefore undertaken to analyse the sociodemographic, lifestyle, environmental, and clinical factors among newly diagnosed tuberculosis patients attending selected public health facilities in Windhoek, Namibia. By describing these characteristics and examining their associations, the study aims to generate evidence that may inform patient-centred tuberculosis care, strengthen public health interventions, and support tuberculosis prevention and control programmes in Namibia.



METHODS

Study Design and Setting

A quantitative analytical cross-sectional study was conducted among newly diagnosed tuberculosis (TB) patients receiving treatment at three selected public health facilities in Windhoek, Khomas Region, Namibia. The study was carried out at Katutura Health Centre, Havana Health Centre, and Okuryangava Health Centre, which provide Directly Observed Treatment (DOT) services for TB patients. These facilities were purposively selected because they manage a high burden of TB cases within the Khomas Region.

Study Population and Eligibility

The study population comprised newly diagnosed TB patients receiving treatment at the selected health facilities between September 2022 and March 2023. A total of 165 TB patients were registered during the study period. Of these, 111 eligible patients who met the inclusion criteria and provided written informed consent participated in the study. Eight eligible patients declined participation, while 25 patients with TB reinfection and 21 patients with major comorbidities were excluded from the study.

Sample Size and Sampling Procedures

A non-probability convenience sampling technique was employed. Eligible newly diagnosed TB patients who attended the selected health facilities on the days of data collection were invited to participate in the study. Recruitment continued throughout the study period until the end of the scheduled data collection period. As this was a facility-based convenience sample, no formal sample size calculation was performed which is consistent with the use of a non-probability convenience sampling design.

Data Collection Instruments, Procedures, and Quality Control

The pilot study was conducted one month before the commencement of the main study among ten (10) TB patients attending health facilities in the Khomas Region that were not included in the main study. These participants were excluded from the final study sample. The pretest was undertaken to assess the clarity, relevance, and comprehensibility of the questionnaire. The findings indicated that the questions were well understood, and no major modifications to the questionnaire were required prior to data collection.

Data Processing and Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 30. Descriptive statistics, including frequencies and percentages, were used to summarise participant characteristics. Chi-square tests of independence were performed to assess associations between selected sociodemographic, lifestyle, environmental, and clinical variables. Statistical significance was set at $p < 0.05$.



RESULTS

The highest proportion of participants was in the 40–49-year age group (48.0%, $n = 53$), followed by the 30–39-year age group (30.0%, $n = 34$). Participants younger than 20 years accounted for 1.0% ($n = 1$) of the study population.

Figure 1: Gender Distribution

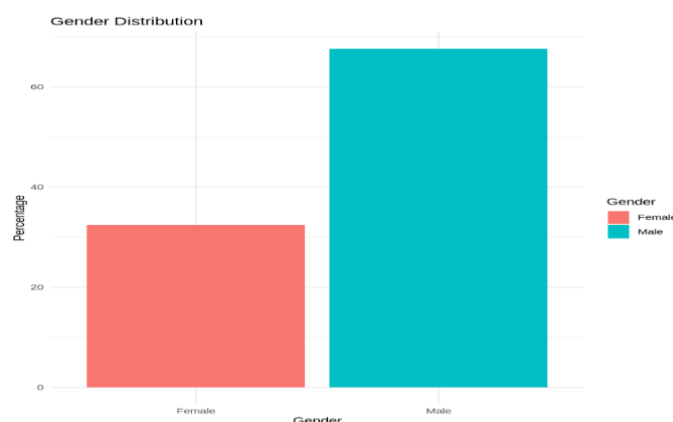


Figure 1 shows the gender distribution of the study participants. Males constituted 67.6% of the participants, while females accounted for 32.4%. The majority of respondents (80.2%) were single, with married individuals comprising 14.4%. Most respondents (41.5%) did not work. Among the employed, 33.3% worked 7 to 8 hours, while only 1.8% worked extended hours (8 to 10 hours). Sixty-four per cent (64%) of the employed earned from N\$600.00 to N\$1000.00 monthly, while 22.5% were the highest earners, with the range of N\$1100.00–N\$5000.00. Most employed respondents fell under “other” occupations, with a notable number of domestic workers and factory workers. Almost half (45%) of respondents attained a secondary school education level, while 43.2% ended at the primary level and 7.3% reached the tertiary level.

Table 1: Size of the family

Variables	Frequency	Valid Percent %
< 4	33	29.7%
5 -10	61	55.0%
11 – 15	3	2.7%
16 – 20	13	11.7%
21 – 30	1	0.9%
Total	111	100.0%

Table 1 presents the distribution of family size among the study participants. Families with 5–10 members were the most common (55.0%), followed by families with fewer than four members (29.7%).

Clinical Characteristics

Out of 111 respondents, 44 (39.6%) indicated that they were vaccinated with *Bacillus Calmette-Guerin* (BCG), a vaccine against tuberculosis, with the mean being 1.97 and a standard deviation



of ± 0.879 . 23.4% of respondents ($n = 26$) had not received the BCG vaccine, while 41 (36.9%) of the respondents were unsure of receiving BCG vaccination. In terms of type of TB, 73 respondents (65.8%) were diagnosed with pulmonary TB, with a mean of 1.34 and a standard deviation of 0.477, the most frequent and communicable form of disease. 38 respondents (34.2%) were diagnosed with extrapulmonary TB, which affects areas outside the lungs. Pulmonary TB (65.8%) is more prevalent than extrapulmonary TB (34.2%).

Table 2: Living conditions of TB patients in Windhoek

Variables	Frequency	Percentage %
Number of rooms		
One	36	32.4%
Two	65	58.6%
Three or more	9	8.1%
Five or more	1	0.9%
Total	111	100.0%
Mean = 1.77	Standard deviation = 0.628	
Number of windows		
Zero to One	54	48.6%
Two to Three	13	11.7%
None	44	39.6%
Total	111	100.0%
Mean = 2.31	Standard deviation = 1.949	
Duration of the window open in the house		
Whole Day	4	3.6%
Half Day	52	46.8%
Two to Three Hours	8	7.2%
Never	2	1.8%
Others	1	0.9%
Not Applicable	44	39.6%
Total	111	100.0%
Mean = 3.68	Standard deviation = 1.949	
House Ventilation		
Good	11	9.9%
Fair	57	51.4%
Bad	43	38.7%
Total	111	100.0%
Mean = 2.29	Standard deviation = 0.638	



Table 2: The housing and environmental characteristics of the participants

Respondents were primarily responsible for purchasing their own food (54.5%), followed by other household members, such as mothers or siblings. Twenty per cent of respondents reported struggling to obtain food. Slightly more than half (50.5%) reported experiencing difficulties purchasing food, while 36.9% reported no challenges and 12.6% reported experiencing such challenges occasionally. Stoves (60.4%) were the most commonly used cooking appliances, whereas microwaves (33.6%) and refrigerators (0.9%) were less commonly available. None of the respondents reported changes in their food habits.

Table 3: Lifestyle of TB patients in Namibia

Variables	Frequency	Percentage %
Cigarette smoking		
Yes	47	42.3%
No	64	57.7%
Total	111	100.0%
Mean = 1.58	Standard deviation = 0.496	
Number of cigarettes smoked per day		
< 5	3	2.7%
6 to 10	17	15.3%
11 to 20	26	23.4%
> 20	1	0.9%
Not applicable	64	57.7%
Total	111	100.0%
Mean = 3.95	Standard deviation = 1.296	
Type of cigarettes		
Dunhill	1	0.9%
Others	46	41.4%
Not Applicable	64	57.7%
Total	111	100.0%
Mean = 3.56	Standard deviation = 0.551	
Other types of cigarettes		
Tobacco	28	25.2%
Cigarette	19	17.1%
Not applicable	64	57.7%
Total	111	100.0%
Mean = 2.32	Standard deviation = 0.855	



Table 4: Lifestyle of TB patients in Namibia

Alcohol consumption		
Variables	Frequency	Percentage
Yes	86	77.5%
No	25	22.5%
Total	111	100.0%
Mean = 1.23	Standard deviation = 0.420	
Frequency of Drinking alcohol		
Twice a week	2	1.8%
Weekly	68	61.3%
Monthly	11	9.9%
Rarely	6	5.4%
Not Applicable	23	20.7%
When I have money	1	0.9%
Total	111	100.0%
Mean = 3.85	Standard deviation = 1.281	
Quantity of Drinking water		
< 500ml	64	57.7%
501ml to 1000ml	30	27.0%
1001ml to 2000ml	2	1.8%
Rarely	15	13.5%
Total	111	100.0%
Mean = 1.71	Standard deviation = 1.030	

Tables 3 and 4 presents insights into the lifestyle of TB patients in Namibia, covering cigarette smoking, alcohol consumption, water intake. Among the participants, 42.3% reported cigarette smoking, while 57.7% reported that they did not smoke. Among smokers, 23.4% reported smoking 11–20 cigarettes per day. Alcohol consumption was reported by 77.5% of participants. Among those who consumed alcohol, 61.3% reported drinking on a weekly basis. One-third of the participants reported living with another adult diagnosed with TB.



Variables Compared	χ^2	df	p-value	Cramer's V	Interpretation
Age Group $\times$ Smoking	9.125	3	0.028	0.287	Significant
Gender $\times$ Smoking	27.346	1	<0.001	0.496	Significant
Educational Status $\times$ Alcohol Consumption	6.526	4	0.163	0.242	Not significant
Employment Status $\times$ Alcohol Consumption	4.065	4	0.397	0.191	Not significant
Type of TB $\times$ Smoking	1.906	1	0.167	0.131	Not significant
House Ventilation $\times$ Household Members with TB	2.201	6	0.900	0.100	Not Significant
Age Group $\times$ Alcohol Consumption	15.905	3	0.001	0.379	Significant
Gender $\times$ Alcohol Consumption	6.849	1	0.009	0.248	Significant
Employment Status $\times$ Smoking	19.158	4	<0.001	0.415	Significant
Educational Status $\times$ Smoking	13.125	4	0.011	0.344	Significant
Monthly Income $\times$ Smoking	11.177	5	0.048	0.317	Significant
BCG Vaccination $\times$ Type of TB	15.366	2	<0.001	0.372	Significant

Table 5. Association between selected socio-demographic, lifestyle, and clinical factors among newly diagnosed tuberculosis patients (N = 111)

Chi-square tests of independence were conducted to examine the associations between selected socio-demographic, lifestyle, and clinical factors among newly diagnosed tuberculosis patients. Statistically significant associations were observed between age group and smoking ($p = 0.028$), gender and smoking ($p < 0.001$), age group and alcohol consumption ($p = 0.001$), gender and alcohol consumption ($p = 0.009$), employment status and smoking ($p < 0.001$), educational status and smoking ($p = 0.011$), monthly income and smoking ($p = 0.048$), and BCG vaccination status and type of tuberculosis ($p < 0.001$). No statistically significant associations were observed between educational status and alcohol consumption, employment status and alcohol consumption, type of tuberculosis and smoking, or house ventilation and household members with tuberculosis.

DISCUSSION

The findings demonstrated that participants were predominantly male and within the economically productive age group. Participants commonly exhibited sociodemographic, lifestyle, and socioeconomic characteristics, including cigarette smoking, alcohol consumption, unemployment, and low educational attainment. Similar demographic profiles have been reported among TB patient populations in Namibia and other sub-Saharan African countries, where tuberculosis disproportionately affects economically active adults and socially vulnerable populations (WHO, 2024; MoHSS, 2023).



The predominance of males and economically active adults among newly diagnosed TB patients observed in this study is consistent with the epidemiological profile of tuberculosis reported in Namibia and many other sub-Saharan African countries. Previous studies have similarly shown that TB disproportionately affects working-age adults, a pattern that has important implications for household income, workforce productivity, and the broader socioeconomic burden of the disease (WHO, 2024; MoHSS, 2023; Horton et al., 2016).

Overcrowded living conditions were common among the study participants and may present challenges for implementing effective household infection prevention practices, particularly where prolonged close contact occurs within confined indoor spaces. Although this analytical cross-sectional study was not designed to determine the causes of tuberculosis transmission, the findings emphasise the importance of household-centred interventions, including health education, improved household ventilation, and infection prevention measures as part of comprehensive TB care (WHO, 2024; Lönnroth et al., 2009).

A considerable proportion of participants also reported living with another household member diagnosed with tuberculosis. This finding highlights the importance of systematic household contact investigation, active case finding, and appropriate follow-up of close contacts within national TB control programmes. Similar household clustering has been reported in other high TB-burden settings and supports the integration of household-based screening and preventive interventions into routine tuberculosis services (Fox et al., 2013; WHO, 2024).

Lifestyle Characteristics

Cigarette smoking and alcohol consumption were common among the study participants, reflecting behavioural characteristics frequently reported among individuals receiving tuberculosis treatment in high-burden settings. Although this analytical cross-sectional study was not designed to determine whether these behaviours contributed to the development of tuberculosis, their high prevalence highlights important considerations for comprehensive patient management. Smoking has been associated with delayed recovery, impaired lung function, and unfavourable treatment outcomes, supporting the integration of smoking cessation counselling into routine tuberculosis care (WHO, 2024; Bates et al., 2007). Similarly, excessive alcohol consumption may interfere with treatment adherence, increase missed clinic appointments, and complicate clinical management through its effects on general health and liver function (WHO, 2024). These findings support the integration of behavioural counselling, smoking cessation programmes, and alcohol reduction interventions into routine patient-centred tuberculosis care.

The distribution of *Bacillus Calmette–Guérin* (BCG) vaccination among participants reflects the longstanding implementation of the BCG vaccination programme in Namibia. Although BCG vaccination provides protection against severe forms of tuberculosis in childhood, its protective effect against pulmonary tuberculosis in adults is variable (WHO, 2024; Mangtani et al., 2014).

The association between age and smoking suggests that smoking behaviour may differ across age groups among TB patients. Similar age-related variations in tobacco use have been reported in previous studies, where smoking prevalence and smoking intensity tended to increase with



adulthood before declining in older age groups. These differences may reflect variations in social behaviour, occupational exposure, and cumulative tobacco use over the life course (Bates et al., 2007; WHO, 2024). Integrating age-specific smoking cessation interventions into TB programmes may therefore improve the effectiveness of behavioural support during treatment.

The relationship between gender and smoking also provides useful insight into the behavioural profile of the study population. Previous research has consistently shown higher smoking prevalence among men than women in many high TB-burden settings, largely reflecting social and cultural differences in tobacco use (Bates et al., 2007; WHO, 2024). Where gender differences are evident, tailored smoking cessation strategies may enhance patient-centred TB care by addressing behavioural risk factors within specific population groups.

Similarly, the observed association between age and alcohol consumption indicates that alcohol use patterns may vary across different age groups. Previous studies have reported that alcohol consumption often differs according to age because of variations in lifestyle, employment, and social practices (WHO, 2024). Understanding these patterns can assist healthcare providers in identifying patients who may benefit from behavioural counselling and additional psychosocial support during anti-tuberculosis treatment.

The statistically significant association between gender and alcohol consumption suggests that alcohol use differed between male and female participants in this study population. Similar gender differences in alcohol consumption have been reported in previous studies and may reflect social, cultural, and behavioural factors that influence drinking patterns. These findings highlight the importance of incorporating gender-sensitive behavioural counselling and alcohol reduction interventions into routine tuberculosis care (WHO, 2024).

Furthermore, the present study demonstrated a statistically significant association between BCG vaccination status and the type of tuberculosis ($p < 0.001$). Although the biological mechanisms underlying this association cannot be established from this analytical cross-sectional study, the finding suggests that vaccination status differed between participants with pulmonary and extrapulmonary tuberculosis. This observation should be interpreted cautiously and warrants further investigation using longitudinal or prospective study designs to better understand the relationship between BCG vaccination and the clinical presentation of tuberculosis (Mangtani et al., 2014; WHO, 2024).

CONCLUSIONS

This study provides important evidence on the socio-demographic, housing and environmental, lifestyle, clinical, and behavioural characteristics of newly diagnosed tuberculosis patients receiving treatment in major public health facilities in Windhoek, Namibia. By examining these characteristics collectively, the study contributes to a broader understanding of the contextual factors that should be considered when planning patient-centred tuberculosis care.



The findings highlight the importance of integrating comprehensive patient assessment into routine tuberculosis services. Addressing behavioural factors such as cigarette smoking and alcohol consumption, strengthening household infection prevention strategies, and considering socio-demographic characteristics during patient management may enhance the effectiveness of tuberculosis control programmes. These findings support the need for multidisciplinary approaches that extend beyond pharmacological treatment to include health education, behavioural counselling, and household-level interventions.

Although the cross-sectional design does not permit causal inference, this study provides baseline evidence that can inform tuberculosis programme planning and future research in Namibia. Longitudinal and multicentre studies are recommended to further investigate how socio-demographic, behavioural, environmental, and clinical factors influence patient outcomes during the course of anti-tuberculosis treatment. Such evidence may support the development of targeted interventions aimed at improving treatment outcomes and strengthening national tuberculosis control efforts.

Ethical clearance

Ethical consent was obtained from Ministry of Health and Social Services in Namibia (reference 22/4/2/3), the director from Khomas Regional directorate in Windhoek, and the participants involved in this study. They were informed that the research was purely for academic purposes, and their participation was voluntary.

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Conflict of Interest

The authors declare that they have no competing interests.

Authors Contributions

Milka Musuuu conceived the study, developed the research protocol, collected and analysed the data, and drafted the manuscript. Omotayo Awofolu contributed to the conceptualisation of the research, supervised the study, refined the study objectives, critically reviewed the manuscript, and approved the final version for submission.

Availability of Data & Materials

The data sets on which conclusions were made from this study are available on request from the main author.



Artificial Intelligence Use Declaration

During the preparation of this manuscript, the authors used AI tools for language editing, grammar correction, readability improvement, manuscript organization, and formatting assistance. The authors carefully reviewed, revised, and verified all outputs generated by the tool and take full responsibility for the accuracy, originality, interpretation, and integrity of the manuscript content.

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