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Evaluation of Factors Contributing to Low TB Detection Rate in Selected Facilities of Ndola District

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ABSTRACT: Tuberculosis (TB) remains a major global public health challenge, particularly in low- and middle-income countries where case detection rates remain below international targets. In Zambia, the TB detection rate remains significantly lower than the 75% target recommended by the World Health Organization (WHO), posing a threat to effective TB control. This study evaluated the factors contributing to low TB detection rates in selected health facilities in Ndola District, Copperbelt Province of Zambia. A quantitative cross-sectional study design was employed. Data were collected from 93 respondents comprising health care workers and community members selected from 33 health facilities providing TB services. Structured questionnaires and face-to-face interviews were used to gather information on demographic characteristics, knowledge of TB symptoms, availability of diagnostic services, and barriers to TB detection. Data were analysed using the Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics such as frequencies and percentages were used to summarise the data. The findings revealed that inadequate laboratory equipment was the most frequently reported factor contributing to low TB detection (55.9%), followed by limited community awareness of TB disease (24.7%). Other factors identified included TB-related stigma (7.5%), shortage of skilled laboratory personnel (6.5%), and long distances to health facilities (5.4%). The study further established that cough was the most widely recognised TB symptom among respondents, while awareness of other symptoms such as fever and night sweats was relatively low. The study concludes that low TB detection in Ndola District is influenced by both health system constraints and community-related factors. Strengthening diagnostic capacity, increasing public awareness of TB symptoms, addressing stigma, and improving access to diagnostic services are critical interventions for improving TB case detection. Enhancing these strategies will contribute to early diagnosis, improved treatment outcomes, and reduced transmission of tuberculosis within the community.

KEYWORDS: Tuberculosis, case detection, diagnostic capacity, stigma, health-seeking behaviour

1.1 INTRODUCTION

Human tuberculosis (TB) is an infectious bacterial disease caused by *Mycobacterium tuberculosis* and is transmitted from person to person through inhalation of respiratory droplets expelled by individuals with active pulmonary disease during coughing or sneezing. TB remains a major global public health concern, ranking among the leading causes of death from a single infectious agent, second only to the human immunodeficiency virus (WHO, 2016). Control of the disease largely depends on passive case finding, whereby individuals self-present to health care facilities and are diagnosed through clinical assessment or laboratory methods such as sputum smear microscopy and GeneXpert testing (WHO, 2016).

Globally, an estimated 10.0 million people developed TB in 2017, with Africa and Asia bearing the greatest burden of the disease (WHO, 2018). Approximately 1.7 billion people, representing about 23% of the world's population, are estimated to have latent TB infection and are therefore at risk of developing active disease during their lifetime. The likelihood of progression from infection to active TB is significantly higher among people living with HIV and those affected by risk factors such as undernutrition, diabetes, smoking, and alcohol consumption (WHO, 2016). Of those infected, about 10–12% will progress to active TB over a period ranging from weeks to decades (Gregory et al., 2016). While TB can affect any part of the body, pulmonary TB is the most common form, with infections occurring outside the lungs classified as extra-pulmonary TB. The disease remains of considerable public health importance, with one-third of the global population infected and approximately two million TB-related deaths occurring each year (Gregory et al., 2016).

Tuberculosis is caused by members of the *Mycobacterium tuberculosis* complex, which includes *Mycobacterium tuberculosis*, *Mycobacterium bovis*, *Mycobacterium Africanum*, *Mycobacterium caprae*, *Mycobacterium microti*, *Mycobacterium pinnipedii*, and

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Mycobacterium canettii. Sub-Saharan Africa continues to experience the highest annual TB incidence, a situation that has been exacerbated by the HIV and AIDS epidemic (WHO, 2013). Despite global and regional efforts to strengthen TB control, case detection rates remain suboptimal. Globally, TB case detection has stagnated at around 60%, falling short of the 75% target set by the World Health Organization, with sub-Saharan Africa reporting even lower rates of approximately 52% (Kik et al., 2008).

In Zambia, TB detection and notification continue to pose a significant challenge to the health system. The country has recorded a TB detection rate of about 49%, far below the WHO target of 75%, despite the introduction of improved diagnostic technologies such as GeneXpert (Monde, Munyeme and Malama, 2016). Ndola District, located in the Copperbelt Province, is among the districts that have struggled to improve TB detection rates. The district has 44 health facilities where TB-related activities are conducted; however, reported TB notification rates have declined over time, from 581 per 100,000 population in 2013 to 362 per 100,000 population in 2016 (Verver et al., 2018). This downward trend may not necessarily indicate a true reduction in TB burden but could reflect low levels of case detection across health facilities in the district.

Low TB detection has serious public health implications, as undiagnosed cases continue to transmit the disease within communities. Each untreated infectious TB case has the potential to infect between 10 and 15 people per year, contributing to sustained transmission and high prevalence rates. Although reductions in HIV prevalence and increased coverage of highly active antiretroviral therapy (HAART) may have contributed to declining TB incidence, evidence suggests that the Zambian health system is still unable to detect and notify all TB cases effectively (Monde, Munyeme and Malama, 2016). Factors such as limited diagnostic capacity, inadequate laboratory equipment, and suboptimal screening practices have been identified as contributors to low TB detection rates.

Early diagnosis and prompt initiation of effective treatment are critical components of TB control, as they reduce transmission, morbidity, and mortality, while also lowering the cost of health service delivery. Case detection, defined as the diagnosis of TB in a patient and subsequent reporting within the national surveillance system and to the World Health Organization, is therefore central to effective TB control. The case detection rate is calculated as the number of notified cases divided by the estimated number of cases in a given year, expressed as a percentage. Understanding the factors contributing to low TB detection is in line with the Sustainable Development Goals and global TB control strategies, which emphasize early identification and treatment of infectious cases.

Against this background, this study was conducted to evaluate the factors contributing to low TB detection rates in selected health facilities in Ndola District. By examining diagnostic capacity, health system practices, and existing challenges, the study aimed to generate evidence to inform decision-making in TB management, support improvements in case detection, and contribute to the broader body of academic knowledge on TB control in high-burden settings.

LITERATURE REVIEW

2.0 Overview

This chapter reviews existing literature related to tuberculosis (TB) detection, with particular emphasis on factors contributing to low TB detection rates. The review draws on global, regional, national, and district-level evidence to compare, contrast, and synthesize findings from previous studies. It further examines diagnostic and treatment practices, theoretical underpinnings, and conceptual relationships relevant to TB detection. The chapter narrows from a global perspective to the regional African context, the Zambian situation, and finally focuses on Ndola District, where the current study is situated.

2.1 Global Perspective on Tuberculosis

Globally, tuberculosis remains a leading cause of morbidity and mortality despite sustained efforts to strengthen detection and treatment. In 2019, approximately 7.1 million people with new or relapse episodes of TB were diagnosed and notified to national TB programmes and reported to the World Health Organization (WHO, 2020). Although this represented an increase from previous years, the number still fell short of the annual targets required to achieve the United Nations High-Level Meeting goal of diagnosing and treating 40 million people between 2018 and 2022. The combined total of 14.1 million people notified in 2018 and 2019 represented only 35% of the five-year target (WHO, 2020).

The global scale-up of TB treatment has also progressed, with the number of people treated for TB increasing from about six million in 2015 to over seven million in 2019. Treatment coverage for multidrug-resistant or rifampicin-resistant TB has similarly increased, though it remains insufficient relative to the burden of disease (WHO, 2020). Despite these gains, TB continues to be the leading

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infectious disease killer worldwide and one of the top ten causes of death overall. In 2019 alone, TB caused an estimated 1.4 million deaths, including 208,000 among people living with HIV. While TB mortality has declined globally, the reduction has been slower than required to meet End TB Strategy milestones, with only a 14% decline achieved between 2015 and 2019 (WHO, 2020).

2.3 Regional Perspective on Tuberculosis

Sub-Saharan Africa bears a disproportionate burden of TB, recording some of the highest incidence rates globally. In 2012, the region reported more than 255 new TB cases per 100,000 population, with nine countries included among the 22 highest TB burden countries worldwide (Alimuddin, 2015; Kapata et al., 2015). Although a few African countries have achieved reductions in TB incidence, others have experienced substantial increases, largely influenced by the HIV epidemic.

The true magnitude of TB in sub-Saharan Africa remains uncertain due to weaknesses in laboratory infrastructure, diagnostic capacity, surveillance systems, and reporting mechanisms (Alimuddin, 2015). Early case detection and treatment remain the cornerstone of TB control and are promoted through the Directly Observed Treatment Short Course (DOTS) strategy (Kapata et al., 2014). However, many countries in the region continue to fall short of the WHO target of detecting 75% of new smear-positive cases, undermining TB control efforts.

In Zambia, TB detection performance remains suboptimal. While the WHO estimates a case detection rate of approximately 80%, national data indicate that a significant proportion of cases remain undiagnosed, with an estimated 12,000 cases missed annually (Mane et al., 2008). The dual burden of TB and HIV further complicates detection efforts, as HIV co-infection reduces the sensitivity of conventional diagnostic methods such as smear microscopy.

2.4 Diagnosis of Tuberculosis in Zambia

In Zambia, TB diagnosis relies predominantly on sputum smear microscopy using the Ziehl-Neelsen staining technique, which is rapid, inexpensive, and highly specific (Bates, 2011). However, its sensitivity is limited, particularly among patients co-infected with HIV, requiring a high bacillary load for detection. To address this limitation, Zambia has expanded the use of LED fluorescent microscopy in many diagnostic centres. Mycobacterial culture, considered the gold standard for TB diagnosis, is more sensitive but is restricted to a few reference laboratories due to infrastructure and biosafety requirements.

Drug susceptibility testing is conducted mainly for retreatment cases, treatment failures, and defaulters, using both solid and liquid culture methods. In recent years, molecular diagnostic techniques such as GeneXpert MTB/RIF and Line Probe Assays have been introduced to enhance rapid detection of TB and drug resistance. Despite WHO endorsement of these technologies, their implementation in Zambia remains phased and limited to selected facilities due to high costs, infrastructural demands, and human resource constraints (MOH, 2014).

Zambia remains among the high TB burden countries globally, with prevalence and incidence rates estimated at 388 and 427 per 100,000 population respectively in 2013 (WHO, 2013). TB notification rates are particularly high among vulnerable populations, including people living with HIV, pregnant women, children, and prisoners. The high national HIV prevalence continues to fuel the TB epidemic, with an estimated 70% of TB patients co-infected with HIV (Malama, 2013).

2.5 Treatment of Tuberculosis in Zambia

The standard treatment regimen for new TB cases in Zambia follows WHO guidelines, consisting of a two-month intensive phase using four first-line drugs, followed by a four-month continuation phase with two drugs (MOH, 2014). Treatment outcomes have improved substantially over the past two decades, with cure and treatment success rates increasing significantly. Studies indicate that treatment success rates improved from about 66% in 2000 to over 85% by 2009, reflecting strengthened TB control efforts and improved patient support mechanisms (Kapata et al., 2014; Mukonka, 2011).

2.6 Tuberculosis Situation in Ndola District

Ndola District, located in the Copperbelt Province, is one of Zambia's major urban centers with a population exceeding 450,000. TB notification rates in the district declined steadily from 2013 to 2016, raising concerns about low detection rather than a true reduction in disease burden (TB Care I, 2012). The district has 44 health facilities, including primary health centres, referral hospitals, and an infectious disease reference laboratory. Although most facilities provide TB diagnosis and treatment, sputum smear microscopy remains the primary diagnostic tool, limiting detection of smear-negative cases.

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Studies conducted in Ndola have demonstrated high levels of recent TB transmission, emphasizing the need for early diagnosis and timely treatment (Mulenga et al., 2010). However, limited diagnostic capacity, inadequate laboratory infrastructure, and restricted access to culture and molecular testing continue to hinder effective TB control in the district (Malama, 2013).

2.7 Theoretical Framework

This study is guided by Germ Theory, which posits that infectious diseases are caused by microorganisms that invade the human body. The theory provides a foundation for understanding TB transmission, diagnosis, and control. TB detection is influenced by individual factors such as knowledge, attitudes, stigma, and health-seeking behavior; sociocultural factors including beliefs, gender norms, and reliance on traditional medicine; and structural factors such as accessibility of health facilities, availability of diagnostic tools, and skilled personnel. These factors collectively shape how and when individuals seek care, ultimately influencing TB detection rates.

2.8 Conceptual Framework

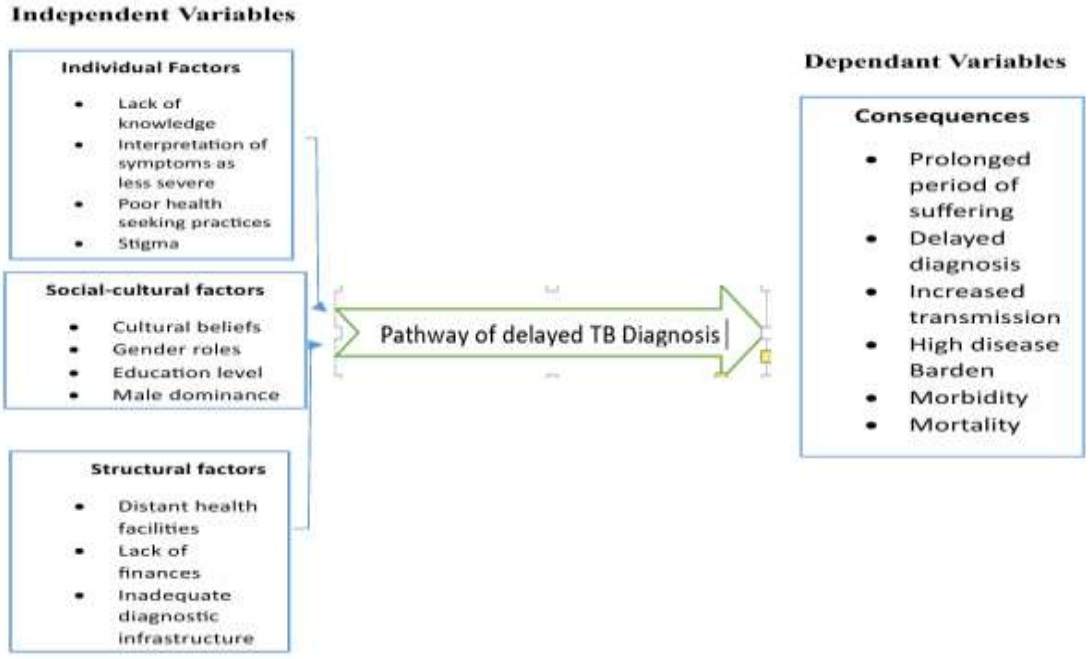

Figure 1 illustrates how various factors contribute to delayed tuberculosis (TB) diagnosis and the resulting consequences. The framework shows that delayed TB diagnosis is influenced by three main groups of factors: individual, socio-cultural, and structural factors. Individual factors include lack of knowledge about TB, misinterpretation of symptoms, poor health-seeking behaviour, and stigma. Socio-cultural factors such as cultural beliefs, gender roles, education level, and male dominance in decision-making may also influence when individuals seek healthcare. Structural factors, including long distances to health facilities, limited financial resources, and inadequate diagnostic infrastructure, can further limit access to timely diagnosis.

These factors collectively contribute to delays in TB diagnosis, which may lead to prolonged suffering, delayed treatment, increased transmission of the disease, higher disease burden, and increased morbidity and mortality.

RESEARCH METHODOLOGY

3.0 Overview

This chapter presents the research methodology employed in the study. It outlines the research design, study area, target population, sample size and sampling techniques, data collection instruments and procedures, data analysis methods, data quality assurance measures, and ethical considerations adopted to investigate factors influencing low tuberculosis (TB) detection rates in Ndola District.

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3.1 Study Design
The study adopted a quantitative cross-sectional research design. Data were collected at a single point in time using structured questionnaires and face-to-face interviews. This design was appropriate because it enabled the examination of relationships between selected independent variables, namely gender roles, lack of knowledge, long distance to health facilities, and inadequate diagnostic equipment, and the dependent variable, which was low TB detection rates.

3.2 Study Area
The study was conducted in Ndola District, located in the Copperbelt Province of Zambia. The district has several public health facilities that provide TB diagnostic and treatment services. These facilities serve both urban and peri-urban populations and play a critical role in TB control and management within the district.

3.3 Target Population
The target population comprised health care workers and local residents in proximity to selected health facilities in Ndola District. Health care workers included TB focal point persons and laboratory technicians involved in TB screening and diagnosis, while local residents provided community-level perceptions and experiences related to TB detection services.

3.4 Study Sample
The study sample consisted of 99 respondents, of whom 66 were health care workers drawn from 33 selected health facilities, and 33 were community members residing near these facilities. Targeting both health care workers and community members ensured the inclusion of perspectives from both service providers and service users.

3.5 Sample Size Determination
The sample size was determined using a finite population correction formula. At a 95 percent confidence level, with a margin of error of 5 percent, an assumed proportion of 0.5, and a population size of 99, the calculated sample size was approximately 79 respondents.

3.6 Sampling Technique
A purposive sampling technique was employed to select the 33 health facilities offering TB services in Ndola District. Within these facilities, TB focal point persons and laboratory technicians were selected based on their roles in TB diagnosis and management. Community members residing near the selected health facilities were also purposively selected due to their presumed knowledge and experiences related to TB screening and health-seeking behaviour. This approach ensured that respondents with relevant information were included in the study.

3.7 Data Collection Instruments
Data were collected using a structured questionnaire comprising both closed-ended and open-ended questions. The questionnaire captured information on demographic characteristics, availability of TB diagnostic services, barriers to TB screening, and factors influencing TB detection rates. An interview guide was used during face-to-face interviews to maintain consistency and clarity in data collection.

3.8 Data Collection Procedure
Prior to data collection, appointments were arranged with respondents. On the agreed dates and venues, the researcher administered the questionnaires and conducted interviews. Respondents were guided through the questions to ensure accurate understanding and reliable responses.

3.9 Data Analysis
Collected data were manually checked for completeness and then entered into the Statistical Package for Social Sciences (SPSS) version 16 for analysis. Descriptive statistics, including frequencies and percentages, were used to summarise the data. Inferential analysis was conducted using the Chi-square test to determine associations between the independent variables and the dependent variable. Statistical significance was determined at a p-value of less than 0.05.

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3.10 Data Quality Assurance

To ensure data quality, completed questionnaires were checked daily for completeness and consistency. Coding was used instead of participants' names to maintain confidentiality. All collected data were securely stored to prevent unauthorised access.

3.11 Ethical Considerations

Ethical clearance was obtained from the University of Lusaka Research Ethics Committee prior to the commencement of the study. Permission was also sought from the Ndola District Health Office. Written informed consent was obtained from all participants before data collection. Confidentiality and anonymity were ensured through the use of codes instead of names, and interviews were conducted in private settings. All data were kept securely under lock and key.

RESEULTS AND DISCUSSIONS

This chapter presents and discusses the findings of the study on factors contributing to low tuberculosis (TB) detection rates in selected health facilities of Ndola District. The results are presented using tables and descriptive statistics, followed by an in-depth discussion in relation to existing literature, national TB control guidelines, and the conceptual framework guiding the study.

4.1 Demographic Characteristics of Respondents

4.1.1 Sex Distribution of Respondents

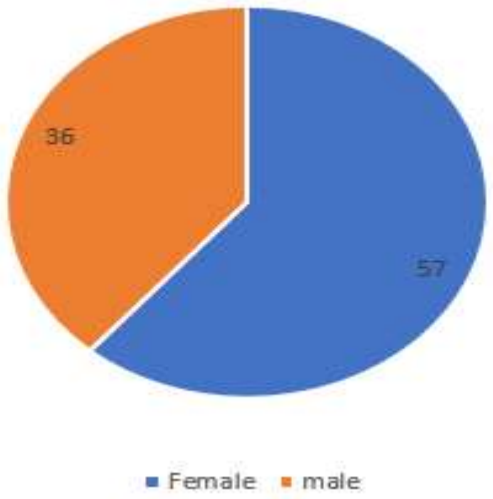

Figure 2, presents the sex distribution of respondents who participated in the study.

The results presented in Figure 2 indicate that females constituted the majority of respondents (61.3%), while males accounted for 38.7%. This distribution suggests that women were more represented in the study population, possibly because they interact more frequently with healthcare services and community health programmes. Women often assume primary caregiving responsibilities within households, which increases their contact with health facilities and their participation in health-related activities.

Similar patterns of higher female engagement with healthcare services have been reported in previous studies. For example, Sialubanje et al. (2015) investigated factors influencing the use of maternal health services and home deliveries in rural Zambia. Their study found that women regularly interact with health facilities through maternal and child health services, which increases their exposure to health education and preventive healthcare programmes. Although their research focused on maternal health service utilisation rather than tuberculosis detection, the findings highlight how frequent contact with health services may contribute to higher female participation in health-related studies.

Comparable findings were reported in Ethiopia by Datiko and Lindtjørn (2010), who evaluated the impact of community health extension workers on tuberculosis case detection and treatment outcomes. The study demonstrated that women were more likely to participate in community-based TB awareness and screening activities compared to men. This increased participation was largely

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attributed to women's involvement in household health decision-making and their greater presence within community health programmes. However, the study did not extensively examine the structural or socio-economic barriers limiting male participation in TB services.

Gender differences in tuberculosis service utilisation have also been documented in broader epidemiological studies. A systematic review and meta-analysis conducted by Horton et al. (2016) examined sex differences in tuberculosis burden and case notifications across low- and middle-income countries. Their findings indicated that men often experience delays in seeking TB diagnosis and treatment due to work-related obligations, social norms, and stigma associated with illness. These barriers frequently result in late diagnosis and under-detection of TB cases among men.

Similarly, the World Health Organization (WHO, 2023) reports that men account for a substantial proportion of undiagnosed or late-diagnosed TB cases globally. The report attributes this disparity to lower healthcare utilisation among men and delays in accessing diagnostic services. Such patterns suggest that gender differences in health-seeking behaviour may significantly influence tuberculosis detection rates.

The lower proportion of male participants observed in this study therefore reflects broader patterns of reduced male engagement with healthcare systems. This has important implications for TB control programmes, as delayed healthcare-seeking behaviour among men may contribute to lower TB detection rates and continued transmission within communities. Targeted community outreach and male-focused TB awareness strategies may therefore be necessary to improve early diagnosis and treatment uptake.

4.1.2 Age Distribution of Respondents

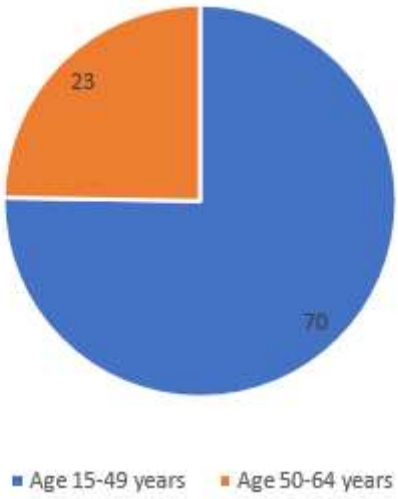

Figure 3. illustrates the age distribution of respondents who participated in the study

The results presented in Figure 3 show that the majority of respondents (75.3%) were aged between 15 and 49 years, while 24.7% were aged between 50 and 64 years. This indicates that most participants belonged to the economically productive age group, which is typically characterised by higher mobility, broader social interaction, and greater exposure to public health information and healthcare services. Individuals within this age range are therefore more likely to engage in health surveys, screening programmes, and other health-related activities.

This age distribution is consistent with global tuberculosis epidemiology. According to the World Health Organization (WHO, 2023), the burden of tuberculosis is highest among adults aged 15–49 years, largely due to their increased exposure to social and occupational environments that facilitate disease transmission. Frequent movement in workplaces, public transport systems, and densely populated urban settings increases the likelihood of exposure to infectious diseases such as tuberculosis.

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Similar findings have been reported in country-level epidemiological studies. For example, Loveday et al. (2018) examined the epidemiology of tuberculosis in South Africa and found that TB prevalence was highest among economically active adults. The study attributed this pattern to increased exposure to crowded environments such as workplaces and public transport systems, which create favourable conditions for TB transmission.

Comparable trends have also been documented in studies examining health-seeking behaviour among TB patients. Oladimeji et al. (2017) investigated healthcare utilisation among tuberculosis patients in Nigeria and Kenya and reported that adults aged 15–49 years were more likely to seek healthcare services compared to older adults. This increased engagement with health services was associated with greater exposure to public health campaigns and TB awareness programmes targeting economically active populations.

The predominance of respondents within the 15–49-year age group in this study therefore reflects broader epidemiological and behavioural patterns observed in TB research. Since individuals in this age group are socially and economically active, they may play a critical role in the transmission dynamics of tuberculosis within communities. Strengthening TB awareness, early screening, and workplace health interventions targeting this population group could therefore contribute significantly to improving TB detection and prevention efforts.

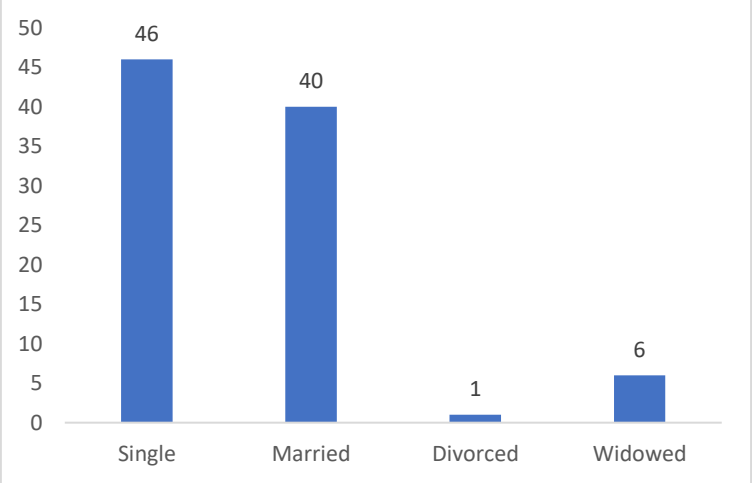

Figure 4. presents the marital status distribution of respondents.

The results presented in Figure 4 show that nearly half of the respondents were single (49.5%), followed by those who were married (43.0%). Smaller proportions were widowed (6.5%) and divorced (1.1%). Marital status is an important socio-demographic factor that can influence health-seeking behaviour, access to healthcare services, and social support during illness. Individuals who are married often benefit from spousal and family support, which may encourage timely healthcare utilisation and early diagnosis of diseases such as tuberculosis.

The influence of marital relationships on healthcare utilisation has been documented in several studies. For example, Mrisho et al. (2009) examined factors influencing healthcare utilisation in rural Tanzania and found that married individuals were more likely to seek medical care due to support from spouses and family members, including assistance with decision-making, financial resources, and transport to health facilities. Such support structures may facilitate early engagement with healthcare services.

Similar findings were reported in Zambia by Sialubanje et al. (2015), who investigated factors affecting the use of maternal health services in rural communities. Their study showed that household decision-making and family support within marital relationships significantly influenced the utilisation of formal health services. This suggests that social support within households can play an important role in encouraging individuals to access healthcare services when needed.

The marital status distribution observed in this study therefore highlights the potential role of household and social support systems in influencing health-seeking behaviour. Individuals with stronger family support networks may be more likely to access healthcare services promptly, which could contribute to improved disease detection and treatment outcomes. Understanding how marital and

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household dynamics influence health-seeking behaviour may therefore be important for designing effective tuberculosis awareness and case detection strategies at the community level.

4.2 History of Tuberculosis and Knowledge of TB Symptoms

Table 1: presents respondents' history of tuberculosis and their knowledge of common TB symptoms

History of TB	Cough	Night Sweats	Fever	Other Symptoms	Total
Yes	12	2	6	4	24
No	39	12	4	14	69
Total	51	14	10	18	**93**

The results presented in Table 1 indicate that cough was the most commonly recognised symptom of tuberculosis, identified by 51 respondents (54.8%). In contrast, fewer respondents recognised other symptoms, including night sweats reported by 14 respondents (15.1%), fever by 10 respondents (10.8%), and other symptoms by 18 respondents (19.4%). The higher recognition of cough suggests that respondents possessed basic knowledge of tuberculosis, as persistent cough is widely recognised as a key symptom of pulmonary TB and is commonly emphasised in TB screening programmes. However, the relatively low recognition of other symptoms such as fever and night sweats indicates limited awareness of the broader clinical presentation of tuberculosis, which may contribute to delays in health-seeking behaviour and diagnosis.

These findings are consistent with global TB screening guidelines, which emphasise persistent cough lasting two weeks or more as the primary symptom used for identifying suspected TB cases (WHO, 2023). Because cough is the most frequently highlighted symptom in TB awareness campaigns and case detection strategies, communities often recognise it more readily than other symptoms of the disease.

Similar patterns have been reported in community-based TB studies conducted in Africa. For example, Datiko and Lindtjørn (2010) evaluated the impact of community health extension workers on tuberculosis case detection in Ethiopia and reported that cough was the most commonly recognised symptom among community members, while awareness of other symptoms such as fever and night sweats remained relatively low. Limited recognition of these additional symptoms was associated with delayed healthcare seeking among suspected TB patients.

Comparable findings were also reported by Banda et al. (2014) in Malawi, who examined community knowledge, attitudes, and practices regarding tuberculosis. Their study similarly found that cough was the most frequently recognised symptom of TB, whereas fewer respondents identified other symptoms such as fever, night sweats, and weight loss.

Therefore, these findings indicate that although awareness of cough as a TB symptom is relatively high among respondents (54.8%), knowledge of other important symptoms remains limited. This knowledge gap may reduce the likelihood that individuals seek medical care when experiencing symptoms other than cough, potentially contributing to delayed TB diagnosis and continued transmission within communities. Strengthening community education programmes to promote awareness of the full range of TB symptoms may therefore improve early detection and treatment of tuberculosis.

4.3 Factors Contributing to Low TB Detection

Table 2: presents the factors identified by respondents as contributing to low tuberculosis detection

Factor	Frequency	Percentage
Lack of laboratory equipment	52	55.9
Lack of information on TB disease	23	24.7
Fear of stigma	7	7.5
Lack of skilled laboratory personnel	6	6.5
Long distance to health facility	5	5.4
Total	93	100

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The findings presented in Table 2 indicate that lack of laboratory equipment was the most frequently reported factor contributing to low tuberculosis (TB) detection, identified by 55.9% of respondents. Other factors reported included lack of information about TB disease (24.7%), fear of stigma (7.5%), lack of skilled laboratory personnel (6.5%), and long distance to health facilities (5.4%). These results suggest that both health system limitations and community-level barriers contribute to reduced TB case detection.

The high proportion of respondents identifying lack of laboratory equipment (55.9%) highlights the importance of diagnostic capacity in effective TB control. Adequate laboratory infrastructure is essential for timely detection and confirmation of TB cases. Similar challenges have been reported globally, where limited access to diagnostic equipment continues to hinder TB detection in many low- and middle-income countries (WHO, 2023). Diagnostic shortages, including insufficient microscopy facilities and molecular testing technologies such as GeneXpert, can delay confirmation of TB cases and reduce case detection rates.

Comparable findings have been reported in Zambia. Monde et al. (2016) examined challenges affecting TB diagnosis and treatment services in Zambian health facilities and found that inadequate laboratory equipment and shortages of trained laboratory personnel significantly limited TB diagnostic capacity. Such constraints often lead to delayed testing and missed TB cases, particularly in resource-limited health systems.

In addition to health system factors, the findings also highlight community-level barriers. Nearly one-quarter of respondents (24.7%) reported lack of information about TB disease as a factor contributing to low TB detection. Limited knowledge about TB symptoms, transmission, and treatment can delay health-seeking behaviour and reduce the likelihood that individuals seek early diagnosis. Public awareness therefore plays a critical role in improving case detection.

Fear of stigma was also reported by 7.5% of respondents as a barrier to TB detection. TB-related stigma may discourage individuals from seeking testing or disclosing symptoms due to fear of discrimination or social exclusion. Previous research has shown that stigma associated with TB can delay diagnosis and treatment, particularly in communities where TB is linked with HIV infection (Courtright & Turner, 2010). Overall, the findings of this study indicate that low TB detection is influenced by a combination of diagnostic infrastructure limitations and community-level challenges. Addressing shortages of laboratory equipment and trained personnel, while simultaneously strengthening community awareness and stigma reduction initiatives, may significantly improve TB detection and early diagnosis.

4.4 Good Practices to Improve TB Detection

Table 3: presents respondents' suggestions on good practices that could improve tuberculosis (TB) detection in selected health facilities in Ndola District.

Good Practice	Frequency	Percentage
Provide/upgrade diagnostic laboratory equipment	52	55.9
Intensify community TB sensitization	23	24.7
Strengthen anti-stigma campaigns	7	7.5
Recruit/train skilled laboratory personnel	6	6.5
Improve access through outreach/mobile services	5	5.4

The results presented in Table 3 indicate that the most frequently suggested strategy for improving tuberculosis (TB) detection was the provision or upgrading of diagnostic laboratory equipment, reported by 55.9% of respondents. Other strategies suggested included intensifying community TB sensitization (24.7%), strengthening anti-stigma campaigns (7.5%), recruiting and training skilled laboratory personnel (6.5%), and improving access through outreach or mobile diagnostic services (5.4%). These findings suggest that respondents recognize the need for both health system strengthening and community-based interventions to improve TB case detection.

The high proportion of respondents recommending improved diagnostic laboratory equipment (55.9%) highlights the importance of diagnostic capacity in effective TB control. Strengthening laboratory infrastructure enables timely and accurate detection of TB cases, which is essential for reducing transmission and improving treatment outcomes. This finding is consistent with global TB control recommendations, which emphasize the expansion of reliable diagnostic technologies such as sputum smear microscopy and molecular diagnostic tools including GeneXpert to improve case detection (WHO, 2023).

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Community sensitization was the second most frequently suggested strategy, reported by 24.7% of respondents. Increasing public awareness about TB symptoms, transmission, and treatment options can encourage early health-seeking behaviour and increase community participation in TB screening programs. Similar observations were reported by Kapata et al. (2016), who examined the role of community health workers in TB control in sub-Saharan Africa and found that community-based education programmes significantly improved TB awareness and early diagnosis.

Another strategy identified by respondents was strengthening anti-stigma campaigns (7.5%). TB-related stigma may discourage individuals from seeking testing or disclosing symptoms due to fear of discrimination or social exclusion. Evidence from previous research shows that stigma reduction interventions can improve willingness to undergo TB screening and treatment (Courtright & Turner, 2010).

Recruiting and training skilled laboratory personnel (6.5%) and expanding access through outreach or mobile diagnostic services (5.4%) were also identified as important strategies. Strengthening human resource capacity and improving service accessibility can enhance diagnostic coverage, particularly in underserved communities where access to health facilities may be limited.

Overall, the findings of this study suggest that improving TB detection requires a combination of strengthening diagnostic infrastructure, increasing community awareness, addressing stigma, and expanding access to TB diagnostic services. Implementing these strategies together may significantly improve early TB diagnosis and support national TB control efforts.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study evaluated the factors contributing to the low tuberculosis (TB) detection rate in selected health facilities in Ndola District. The findings indicate that several health system and community-related factors continue to hinder effective TB case detection. The study established that inadequate laboratory equipment was the most significant factor affecting TB detection, followed by limited community awareness of TB symptoms and transmission. Other factors identified included TB-related stigma, shortage of skilled laboratory personnel, and long distances to health facilities. These factors collectively contribute to delays in diagnosis, missed TB cases, and continued transmission of the disease within communities.

The results further revealed that although many respondents recognized cough as a key symptom of tuberculosis, knowledge of other TB symptoms such as fever and night sweats was relatively low. This limited knowledge may delay health-seeking behaviour and reduce early diagnosis of the disease. The study also found that strengthening diagnostic infrastructure, increasing community awareness, addressing stigma, and improving access to diagnostic services are essential strategies for improving TB detection.

Overall, the study concludes that improving TB detection in Ndola District requires strengthening health system capacity and enhancing community engagement in TB prevention and control programs. Addressing these challenges will contribute to early diagnosis, improved treatment outcomes, and reduced transmission of tuberculosis within the community.

5.2 Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Improve TB diagnostic capacity by providing and upgrading laboratory equipment in health facilities.
2. Strengthen community awareness programs to improve knowledge of TB symptoms and encourage early health-seeking behaviour.
3. Reduce TB-related stigma through targeted community education and sensitization campaigns.
4. Increase the number of trained laboratory personnel through recruitment and continuous professional training.
5. Expand outreach and mobile TB screening services to improve access to diagnosis, particularly for communities located far from health facilities.

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