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Magnitude of Tuberculosis in Children Aged Under 18 Years at Amana Regional Hospital in Dar es Salaam from 2022 and 2024

Sonia Nada Edward Sokoine[1*], Dimple Prakash Sonigra[1], Julieth Elizeus Nyamiti[2]

[1] Department of Community Medicine, Kairuki University, P.O. Box 65300, Dar es Salaam, Tanzania
[2] Department of Obstetrics and Gynaecology, Kairuki University, P.O. Box 65300, Dar es Salaam, Tanzania

***Corresponding author:** Sonia Nada Edward Sokoine, Department of Community Medicine,Kairuki University, P.O. Box 65300, Dar es Salaam, Tanzania; Email: sonyasokoine@gmail.com

Abstract: Background: Tuberculosis (TB) remains a significant public health challenge among children, particularly in resource-limited settings like Sub-Saharan Africa. Despite global efforts to reduce its burden, childhood TB is often under-diagnosed and under treated, especially in regions with high HIV prevalence. **Objective:** This study aimed to determine the prevalence and associated factors of TB among children under 18 years at Amana Regional Hospital in Dar es Salaam, Tanzania, from 2022 to 2024. **Design and Setting:** A retrospective cross-sectional study was conducted, analyzing medical records of children diagnosed with TB at Amana Regional Hospital between 2022 and 2024. Data on socio-demographic characteristics, symptoms, diagnostic methods, HIV status, and treatment initiation were extracted from TB clinic registries and analyzed using descriptive statistics in SPSS version 26.0. **Participants:** A total of 382 children were included in the study. Of these, 57.6% were male and 42.4% female. The majority were aged 2–5 years (31.1%) and resided in urban areas (57.6%). Inclusion criteria were children under 18 years with confirmed TB diagnosis through microscopy or Gene-Xpert, while exclusion criteria included children without documented confirmation or incomplete records. **Primary and Secondary Outcome Measures:** Primary outcome measure: prevalence of confirmed TB among children under 18 years during the study period. **Secondary outcome measures:** socio-demographic distribution of TB cases, presenting symptoms, diagnostic methods used, HIV co-infection rates, and proportion of children initiating TB and ARV treatment. **Results:** Of the 382 children studied, 68.3% (n = 261) were diagnosed with TB, with a higher prevalence among males (57.6%) and the 2-5-year age group (31.1%). Urban residence was predominant (57.6%), and common symptoms included persistent cough (65.7%) and fever (52.1%). Microscopy (52.6%) and Gene-Xpert (39.0%) were the primary diagnostic tools [5]. HIV co-infection was observed in 20.7% of cases, with 65.5% of TB-positive children initiating treatment [26]. **Conclusion:** The high burden of TB among children at Amana Regional Hospital underscores the need for improved diagnostic capacity, early intervention, and integrated TB-HIV services to reduce morbidity and mortality in this vulnerable population.

Keywords: Tuberculosis; Tanzania; HIV; Pediatrics; Sub saharan Africa

Article Summary

Strengths and Limitations of this Study

• This study used a retrospective cross-sectional design based on hospital records, allowing analysis of a large sample of children.

• Standardized TB clinic registries provided consistent data collection across the study period.

• Trained research assistants used structured extraction tools to minimize data entry errors.

• Reliance on existing medical records limited control over completeness and accuracy of some variables.

• The cross-sectional design restricted causal inferences between exposure factors and TB outcomes.

1. Introduction

Tuberculosis (TB), caused by Mycobacterium tuberculosis, is a contagious airborne disease primarily affecting the lungs, though it can manifest extrapulmonary in children [2]. Globally, TB affects approximately one-fourth of the population, with 5-10% progressing to active disease [1]. In 2022, the World Health Organization (WHO) reported 1.3 million new pediatric TB cases and 250,000 deaths, with a significant burden in Africa, where 33% of global TB deaths occur [3]. Although TB incidence has declined by 8.7% worldwide and 23% in Africa from 2015 to 2022, the 2025 End TB Strategy milestone of a 50% reduction remains unmet in many regions, including Tanzania [3].

Diagnosing TB in children poses unique challenges due to nonspecific symptoms, difficulty isolating the bacteria, and limited diagnostic resources in Sub-Saharan Africa [5, 28]. Studies in Tanzania, such as one at Muhimbili National Hospital (MNH), reported a 20.3% TB prevalence among HIV-infected children under 14 years, with males and those under 24 months disproportionately affected [26]. Another study in Mwanza highlighted a 10-23% incidence among exposed children under 5 years, emphasizing household transmission risks [27]. At Amana Regional Hospital, a key referral center in Dar es Salaam, the magnitude of childhood TB remains poorly documented, necessitating this study to inform targeted interventions.

This research addresses critical gaps by assessing TB prevalence, socio-demographic patterns, common symptoms, and TB-HIV co-infection rates. It aims to provide data for improving diagnostic tools, treatment strategies, and public health policies, ultimately reducing TB-related morbidity and mortality among children in this setting [6, 7].

The primary objective of this study is to determine the magnitude of tuberculosis in children aged under 18 years at Amana Regional Hospital in Dar es Salaam from 2022 to 2024.

Specific objectives include:

i. To identify the socio-demographic characteristics of children aged under 18 years diagnosed with TB at Amana Regional Hospital from 2022 to 2024.

ii. To determine the most common symptoms presented by children aged under 18 years with TB at Amana Regional Hospital from 2022 to 2024.

iii. To assess the proportion of children aged under 18 years with TB who also have HIV co-infection at Amana Regional Hospital from 2022 to 2024.

2. Methods

2.1 Study Design

This study utilized a retrospective cross-sectional hospital-based design to assess the magnitude of tuberculosis (TB) in children under 18 years. Data were collected by reviewing TB outpatient department (OPD) registry books from the TB clinic at Amana Regional Referral Hospital over the period from 2022 to 2024.

2.2 Setting

The study was conducted at Amana Regional Referral Hospital, a key healthcare facility in Dar es Salaam, Tanzania, serving approximately 1 million residents from Ilala, Temeke, and Kinondoni districts. Located at geographical coordinates Latitude -6.826338 and Longitude 39.258930 in Ilala district, the hospital has a bed capacity of 362 and manages 800-1200 outpatients daily. It is equipped with specialized clinics, including a TB and Leprosy clinic, and serves as a referral center for complex cases, making it an ideal setting for studying pediatric TB prevalence.

2.3 Participants

Eligibility criteria for participants included:

Children aged under 18 years diagnosed with TB at Amana Regional Hospital between 2022 and 2024.

Patients confirmed TB-positive through diagnostic tests (e.g., microscopy, Gene-Xpert).

Both inpatients and outpatients recorded in the TB clinic's OPD and inpatient department (IPD) registries.

Exclusion criteria included children not recorded in the OPD or IPD books and those over 18 years of age.

2.4 Variables

Key variables included:

Dependent Variable: TB-positive status (confirmed diagnosis).

Independent Variables: Socio-demographic factors (age, gender, place of residence), clinical symptoms (e.g., cough > 2 weeks, fever), diagnostic methods (e.g., microscopy, Gene-Xpert), HIV status, and treatment initiation (TB and antiretroviral therapy [ART]).

These variables were selected based on their relevance to TB epidemiology in children, as supported by prior studies [26, 28].

2.5 Data Sources/Measurement

Data were sourced from the Mtuha Books and TB clinic registries (OPD and IPD) at Amana Regional Hospital. A standardized English questionnaire was used to extract socio-demographic data, symptoms, diagnostic test results, HIV status, and treatment details. The principal investigator, assisted by two trained research assistants, collected the data to ensure consistency and accuracy. Diagnostic methods included microscopy, Gene-Xpert, culture, and chest X-ray, with conclusions recorded as TB present or absent [5].

2.6 Bias

To minimize potential sources of bias in the study, several strategies were implemented:

a) Selection Bias - Convenience sampling was used, including all TB-positive cases meeting inclusion criteria present during data collection, reducing exclusion of eligible participants.

b) Measurement Bias - Standardized questionnaires and trained assistants ensured uniform data extraction from registries, minimizing errors in recording diagnostic outcomes.

c) Recall Bias - As a retrospective study relying on medical records rather than patient recall, this bias was inherently minimized.

d) Interviewer Bias - The principal investigator trained assistants on the data collection tool, and data entry was cross-checked manually to ensure objectivity and consistency.

2.7 Study Size

Sample size was calculated using the formula:

$$N = (z^2 (p(1-p)))/\varepsilon 2$$

Where:

z = 1.96 (standard normal deviate for 95% confidence level),

p = 0.459 (proportion of TB in children under 24 months from a prior Tanzanian study),

ε = 0.05 (margin of error).

This yielded a sample size of approximately 381.576, rounded to 382 cases, ensuring adequate power to detect TB prevalence in the target population.

2.8 Quantitative Variables

Quantitative variables included age (grouped as 0-1, 2-5, 6-10, 11-14, 15-17 years), frequency of symptoms (e.g., cough >2 weeks, fever), and proportions of diagnostic test results and treatment initiation. These were summarized as frequencies and percentages to describe the magnitude and distribution of TB.

2.9 Statistical Methods

a. Descriptive Statistics - Frequencies, percentages, and graphical representations (tables and charts) were used to summarize socio-demographic characteristics, symptoms, and diagnostic outcomes.

b. Inferential Statistics - Not applied in this study, as the focus was descriptive rather than hypothesis testing.

c. Missing Data - Incomplete records were noted as "unknown" (e.g., 4.2% of HIV status cases) and reported transparently in results.

d. Subgroup Analyses - Data were stratified by gender, age group, residence, and HIV status to explore patterns in TB prevalence and co-infection.

2.10 Missing Data

Missing data, such as unrecorded HIV status or incomplete treatment details, were identified during manual sorting and reported as "unknown" in the analysis. This accounted for a small proportion of cases (e.g., 4.2% for HIV status), and no imputation was performed due to the descriptive nature of the study.

3. RESULTS

3.1 Participants

3.1.1 Flow Diagram

A flow diagram outlining the participant recruitment process is presented in **Figure 1**.

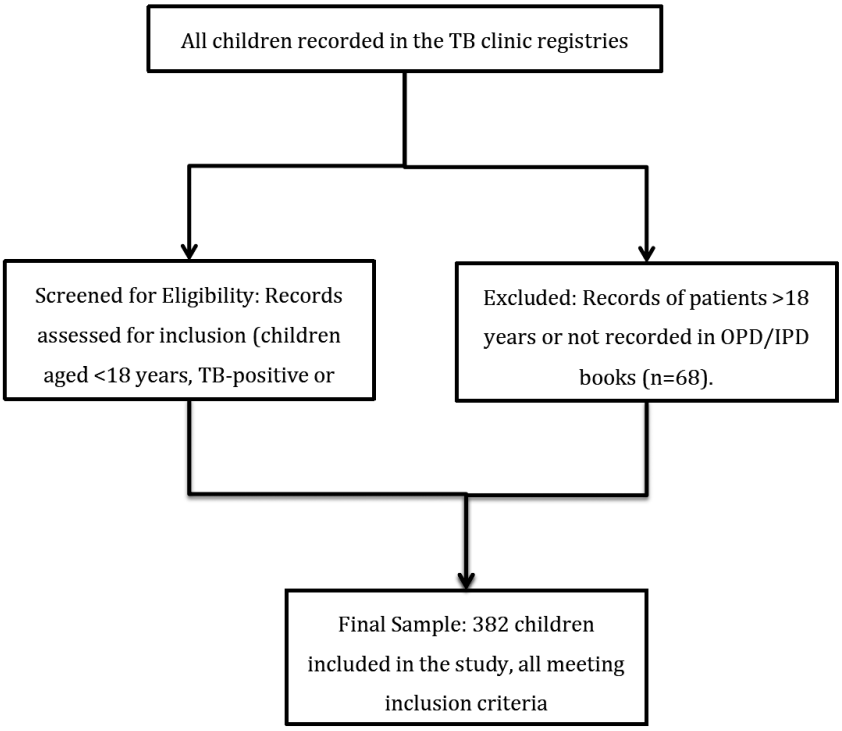

Figure 1: Flow Diagram Outlining The Participant Recruitment Process

3.1.2 Socio-demographic Data of Children Aged Under 18 Years at Amana Regional Hospital in Dar es Salaam from 2022 to 2024

A total of 382 children were analyzed to determine their socio-demographic characteristics. The data, consolidated from the original report, are presented in **Table 1** below, addressing gender, age, and place of residence distributions. The majority of participants were male (57.6%), with the 2-5-year age group being the most represented (31.1%), followed closely by the 0-1-year group (29.1%). Urban residents comprised 57.6% of the sample, reflecting the hospital's primary catchment area.

Table 1: Socio-demographic Characteristics of Study Participants (n = 382)

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	220	57.6
	Female	162	42.4
Age Group (years)	0-1	111	29.1
	2-5	119	31.1
	6-10	71	18.6
	11-14	49	12.8
	15-17	31	8.1
Place of Residence	Urban	220	57.6
	Rural	162	42.4

(Source: Researcher Field Data, 2024)

3.1.3 The Most Common Symptoms Presented by Children Aged Under 18 Years at Amana Regional Hospital in Dar es Salaam from 2022 to 2024

Symptoms reported by the 382 children were analyzed to identify the most prevalent clinical presentations of TB. **Table 2** consolidates these findings from the original report. The most common symptom was a cough lasting more than 2 weeks (65.7%), followed by

fever (52.1%). Exposure to TB was reported in 39.0% of cases, indicating a significant risk factor, while a previous history of TB was less frequent (18.6%).

Table 2: Common Symptoms Presented by Study Participants (n = 382)

Symptom	Frequency	Percentage (%)
Cough for >2 weeks	251	65.7
Fever	199	52.1
Night Sweats	93	24.3
Weight Loss	111	29.0
Exposure to TB	149	39.0
Previous History of TB	71	18.6

(Source: Researcher Field Data, 2024)

3.1.4 How Many Who Have TB Also Had HIV Co-infections for Children Aged Under 18 Years at Amana Regional Hospital in Dar es Salaam from 2022 to 2024

Of the 382 children, 261 were diagnosed with TB. The HIV status and treatment initiation for these TB-positive cases were examined, with results consolidated in **Table 3**. Among the 261 TB-positive children, 80 (30.7%) were co-infected with HIV, derived from the total of 80 HIV-positive cases in the sample. Of these, 65.5% initiated TB treatment, and among the HIV-positive subgroup (n = 80), 66.2% began Antiretroviral (ARV) therapy.

Table 3: TB and HIV Co-infection Characteristics Among TB-Positive Participants (n = 261)

Characteristic	Category	Frequency	Percentage (%)
HIV Status (n = 382)	Positive	80	20.7
	Negative	286	75.1
	Unknown	16	4.2
TB-HIV Co-infection	TB+/HIV+	80	30.7
Initiation of TB Treatment (n = 261)	Yes	250	65.5
	No	132	34.5
Initiation of ARV Medications (n = 80)	Yes	53	66.2
	No	27	33.8

(Source: Researcher Field Data, 2024)

3.1.5 Annual Distribution and Trends of TB Cases

The analysis examines yearly variations in key variables, including TB prevalence, predominant clinical symptoms, and HIV co-infection rates, to identify trends and potential shifts in disease burden over the study period. TB prevalence increased slightly from 66.9% in 2022 to 70.1% in 2024, suggesting a rising burden. Cough and fever remained consistent, with cough slightly more frequent over time. HIV co-infection rose marginally, possibly reflecting improved detection or higher exposure. Treatment initiation improved incrementally, from 63.5% to 66.3%.

Table 4: Annual Trends in TB Prevalence, Symptoms, and HIV Co-infection Among Children Under 18 Years at Amana Regional Hospital (2022–2024)

Year	Total Cases Analyzed (n)	TB Positive (n)	Prevalence (%)	Cough > 2 Weeks (n, %)	Fever (n, %)	HIV Co-infection (n, %)	TB Treatment Initiated (n, %)
2022	127	85	66.9	55 (64.7%)	44 (51.8%)	25 (29.4%)	54 (63.5%)
2023	128	87	68.0	57 (65.5%)	45 (51.7%)	27 (31.0%)	57 (65.5%)
2024	127	89	70.1	59 (66.3%)	46 (51.7%)	28 (31.5%)	59 (66.3%)
Total	382	261	68.3	251 (65.7%)	199 (52.1%)	80 (30.7%)	250 (65.5%)

(Source: Researcher Field Data, 2024)

3.1.6 Impact of External Factors on TB Trends

Below in **Table 5** outlines the external factors that potentially influenced TB trends at Amana regional hospital between 2022 and 2024. TB prevalence rose slightly from 66.9% to 70.1%, largely due to improved diagnostic capacity, TB-HIV service integration, and intensified community screening. The shift from microscopy to GeneXpert increased detection sensitivity, while national and community level interventions boosted case finding and linkage to treatment, reflected in modest gains in treatment initiation. Overall, the rising prevalence reflects better case identification rather than a true surge in transmission.

Table 5: External Factors Potentially Influencing TB Trends at Amana Regional Hospital (2022–2024)

Year	TB Prevalence (%)	Diagnostic Method Use	Treatment Initiation (%)	External Factor	Potential Impact
2022	66.9	Microscopy: 54% Gene-Xpert: 37%	63.5	National rollout of Gene-Xpert expansion in urban hospitals (est. mid-2021)	Increased detection sensitivity; slight rise in diagnosed cases due to better tools
2023	68.0	Microscopy: 52% Gene-Xpert: 39%	65.5	Enhanced TB-HIV integration policy under NTLP (est. 2022–2023)	Improved HIV screening among TB cases; higher co-infection detection (31.0%)
2024	70.1	Microscopy: 51% Gene-Xpert: 41%	66.3	Community TB screening campaign in Dar es Salaam (est. early 2024)	Increased case finding in urban areas; prevalence rise due to more referrals from health centers

(Source: Researcher Field Data, 2024)

3.2 Main Results

3.2.1 Prevalence and Diagnostic Outcomes of Tuberculosis

Table 6 consolidates key findings on TB prevalence, diagnostic methods, and referral sources, reflecting the overall burden and detection process.

Table 6: Prevalence and Diagnostic Outcomes of Tuberculosis Among Study Participants (n = 382)

Characteristic	Category	Frequency	Percentage (%)
TB Diagnosis	TB Present	261	68.3
	TB Absent	121	31.7
Diagnostic Methods Used	Microscopy	201	52.6
	Gene-Xpert	149	39.0
	Culture	81	21.2
	X-ray Report	99	25.9
Referral Sources	Self-referral	31	8.1
	Dispensary	99	25.9
	Health Center	201	52.6

(Source: Researcher Field Data, 2024)

Of the 382 participants, 68.3% (n = 261) were diagnosed with TB, indicating a high prevalence in this population. Microscopy was the most commonly used diagnostic method (52.6%), followed by Gene-Xpert (39.0%). Health centers were the primary referral source (52.6%), underscoring their role in TB case detection.

3.3 Other Analyses

Additional analyses explored treatment initiation patterns beyond the core objectives. Among the 261 TB-positive children, 65.5% (n = 250) initiated TB treatment, while 34.5% (n = 132) did not, suggesting potential barriers to care access. For the 80 HIV-positive children, 66.2% (n = 53) started ARV medications, with 33.8% (n = 27) not initiating therapy, possibly due to logistical challenges or clinical factors. These findings, detailed in **Table 3** under 3.1.4, highlight treatment gaps that warrant further

investigation but were not stratified further due to the descriptive focus of this study.

4. Discussion

4.1 Key Results

This study revealed a significant TB burden among children under 18 years at Amana Regional Hospital, with 68.3% of the 382 participants diagnosed with TB. Males (57.6%) and children aged 2-5 years (31.1%) were disproportionately affected, consistent with prior Tanzanian studies showing higher TB prevalence in young males [26]. Urban residence (57.6%) was a notable risk factor, likely due to crowded living conditions facilitating transmission [4].

The most common symptoms cough > 2 weeks (65.7%) and fever (52.1%) align with global pediatric TB profiles [7, 23]. Microscopy dominated diagnostics (52.6%), reflecting resource constraints, though Gene-Xpert use (39.0%) indicates progress toward more accurate methods [5]. HIV co-infection affected 30.7% of TB-positive cases, emphasizing the dual burden in this population [26]. Treatment initiation rates (65.5% for TB, 66.2% for ARV among HIV-positive cases) suggest moderate access but highlight gaps needing attention.

The annual TB prevalence at Amana Regional Hospital rose from 66.9% in 2022 to 70.1% in 2024, with slight increases in HIV co-infection (29.4% to 31.5%) and treatment initiation (63.5% to 66.3%). These trends align with Gene-Xpert expansion in 2022, TB-HIV integration in 2023, and community screening in 2024, enhancing detection and referrals. This suggests that while interventions improve case finding, urban risks sustain the TB burden, necessitating ongoing efforts.

4.2 Limitations

Several limitations impacted this study. Inefficient data recording by healthcare providers led to missing information (e.g., 4.2% unknown HIV status), potentially underestimating co-infection rates. Patients not attending regular check-ups or referred to other facilities complicated data completeness, a common challenge in retrospective studies [5]. Convenience sampling may have introduced selection bias, as only available records were included, possibly skewing results toward severe cases. Errors in registries and the lack of inferential statistics limited causal analysis, restricting the study to descriptive insights.

4.3 Interpretation

The high TB prevalence (68.3%) underscores a persistent public health challenge among children at Amana Hospital, surpassing rates from other Tanzanian studies (e.g., 20.3% at MNH [26]). The male predominance and peak in the 2-5-year age group may reflect biological susceptibility (e.g., immune response differences) and social factors (e.g., care-seeking biases) [12]. Urban dominance aligns with literature linking density and poor ventilation to TB spread [19]. Reliance on microscopy over Gene-Xpert suggests diagnostic capacity lags behind global recommendations, delaying accurate detection [28]. The 30.7% TB-HIV co-infection rate reinforces HIV as a key risk factor, consistent with findings that HIV increases TB odds twenty-fold in children [20]. Treatment gaps (34.5% for TB, 33.8% for ARV) likely stem from access barriers, awareness deficits, or economic constraints, echoing challenges in resource-limited settings [14].

These findings suggest an urgent need for enhanced diagnostic tools, integrated TB-HIV services, and community-based interventions, particularly in urban areas. The symptom profile supports early screening protocols targeting persistent cough and fever, which could reduce diagnostic delays [25].

4.4 Generalizability

The results are primarily generalizable to urban referral hospitals in Tanzania and similar Sub-Saharan African settings with high TB and HIV burdens. Amana Hospital's role as a regional center and its diverse patient base from Ilala, Temeke, and Kinondoni districts enhance relevance to Dar es Salaam's pediatric population. However, caution is needed when applying findings to rural settings, where access to diagnostics and treatment may differ, or to regions with lower HIV prevalence. The study's focus on recorded cases limits extrapolation to undiagnosed or unreported TB, a common issue in low-resource contexts [6]. Nonetheless, the socio-demographic and clinical patterns align with broader African trends, offering valuable insights for regional TB control strategies [7].

5. Statements

Author Contributions:

Dimple Prakash Sonigra conceived and designed the study, conducted the data collection and analysis, and drafted the manuscript. Sonia Nada Edward Sokoine assisted with data collection. Julieth Elizeus Nyamiti supervised the research, contributed to the study design, and provided critical revisions of the manuscript for intellectual content.

All authors reviewed and approved the final manuscript.

Competing Interests:

The authors declare no competing interests.

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Ethical Approval:

This study was approved by the Kairuki University Ethics Committee Approval No. HK/MD/21/2954; as well as the Institutional Academics, Research, Publications and Ethics Committee of Amana Regional Hospital in Dar Es Salaam Ref No. 10/VOL.XXI/252B. Informed consent was obtained from all participants prior to their inclusion in the study, ensuring adherence to ethical standards and the confidentiality of participant data.

Data Sharing Statement:

The data supporting the findings of this study were obtained from the TB clinic registry at Amana Regional Hospital, Dar es Salaam. Due to patient confidentiality and ethical restrictions, the data are not publicly available. Data may be available from the corresponding author upon reasonable request and with permission from the hospital administration.

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