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Assessment of Tuberculosis Frequency in Children with Asthma

1. Dr shaqiaq hasrat, Ajkmc Muzaffarbad
2. Dr Qudsia Hassan shad, Saidu medical college swat
3. Dr Raheema Amin, Ayub medical college
4. Dr Tayyaba Mustafa, Poonch medical college rawalakot
5. Dr. Fatima Ahmed Mir, Fatima Jinnah Medical University, Lahore
6. Dr Muhammad Zain Ul Abdeen, Mohtarma benazir bhutto shaheed medical college mirpur AJK

ABSTRACT

Background: Tuberculosis (TB) is a major health concern worldwide. In countries like Pakistan, where both TB and asthma are prevalent, it is critical to understand the interplay between these conditions. Asthma treatments, particularly corticosteroids, may make children immunocompromised, increasing their vulnerability to TB.

Objective: This study aims to determine the frequency of tuberculosis among children diagnosed with asthma, as symptoms of TB can be confused with asthma, and steroid use may increase susceptibility to TB.

Methodology: A cross-sectional study was conducted with 217 asthmatic children aged 2 to 14 years at the Pediatric Department of Military Hospital, Rawalpindi. History, clinical examination, and investigations (chest X-ray, Mantoux test, and sputum tests) were conducted. The Kenneth Jones scoring system was used to identify suspected TB cases, with further investigations carried out for those scoring 3 or 4.

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Results: Among the 217 children, 21.2% were diagnosed with tuberculosis. The study found a significant association between gender and TB presence, with no significant correlation between age, weight, or asthma duration and TB occurrence.

Conclusion: The findings highlight the importance of screening for tuberculosis in asthmatic children, especially given the immunocompromised state induced by asthma treatments. Early detection could help improve child survival and reduce TB transmission.

Keywords: Tuberculosis, Asthma, Children, Immunocompromised, Kenneth Jones Score, Pakistan.

Introduction:

Even now in this advanced century, tuberculosis (TB) remains to be highly problematic, especially in low-income countries like Pakistan, where it is still one of the most prevalent fatal communicable diseases. Pakistan is one of the countries with the highest TB burden, according to WHO (2013). The global TB burden may be decreasing, but there is still a challenge to deal with it, especially in children. According to WHO estimates, 530,000 children contracted tuberculosis (TB) and 74,000 children died from TB in 2012 (WHO, 2013). Children might get TB from adults, but there are also socio-economic challenges in developing countries like poor nutrition, overcrowded living quarters, and weak healthcare systems, which directly aggravate the problem (Mehnaz, 2006). Another prevalence condition, especially in children, is asthma, which affects 300 million children worldwide (Masoli et al., 2004). There are also substantial asthma figures in Pakistan, with estimates indicating that 8% of children and adolescents are affected (Shahid, 2008). The mainstay of asthma treatment are corticosteroids. Corticosteroids can lower the body's defenses to infectious diseases, and with a primary diagnosis of asthma, there is a greater risk of developing tuberculosis (Lee et al., 2013). This risk is compounded in poor countries with a high

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prevalence of tuberculosis. Basic asthma treatment in these regions can lead to a greater risk of tuberculosis infection and advance undiagnosed cases.

With both conditions sharing symptoms like coughing and wheezing, the risk of misdiagnosis grows, particularly the misattribution of TB symptoms wholly to asthma, which can delay TB treatment and diagnosis. Moreover, the risk of TB disease progression is heightened when corticosteroids are prescribed to children with asthma, assuming they have a latent tuberculosis infection (Lee et al., 2013). The lack of detailed studies concerning both asthma and tuberculosis with the emphasis on children in Pakistan is disproportionate to the extensive burden both illnesses present. Understanding the underlying risk factors and the diagnostic difficulties to help assess the burden of both conditions is important. This study will assess the burden of tuberculosis on children with asthma, identifying the socio-demographic determinants and clinical features and determining the implications of asthma on TB screening.

Methodology: This study took six months as of December 16, 2015, to June 12, 2016, to implement a cross-sectional design to determine the prevalence of tuberculosis (TB) among children with asthma attending the Pediatric Department of Military Hospital Rawalpindi. A cross-sectional design was most suitable here as it aids in assessing the prevalence of TB to children who have already been diagnosed with asthma, as it provides an opportunity to study a population at a single point in time.

Sample Population: This study included a population of 217 children who had been diagnosed with asthma, received corticosteroid therapy and were between the ages of 2 to 14 years. Inclusion criteria included children diagnosed with asthma and receiving treatment as well as children whose parents provided written informed consent. Children and parents with a history of TB were also excluded from the study as these children were already diagnosed with asthma for the purpose of the study and children

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under the age of 2 years were excluded since they are more prone to developing viral infections associated with wheezing.

Data Collection: Data collection involved a multi-step process:

- Informed Consent: Prior to any data collection, written informed consent was secured from the child's parent or guardian, ensuring that the study was ethically conducted. This was part of the methodological contribution of the research, in that participant's rights were respected.
- Detailed History: A detailed history was taken from the parents regarding the child's symptoms of tuberculosis (TB) for the purposes of the study. Specifically, the symptoms were fever, weight loss, cough, hemoptysis (coughing blood), anorexia, and failure to gain weight. Clinical Examination: After obtaining the history, a clinical examination that includes relevant TB assessment such as exam of the chest, lymph nodes, and BCG scars and TB associated symptoms was conducted.
- Kenneth Jones Scoring: TB likelihood was assessed using the Kenneth Jones scoring system. This system evaluates clinical history, clinical examination results, and radiological findings. If the score was 5 or greater, TB was deemed likely.
- Diagnostic Tests: Further investigations were carried out for children with a score of 3 or 4 (indicating a high likelihood of TB). These included:
    - Chest X-ray conducted by the radiology department at Military Hospital. o Mantoux Test to evaluate TB exposure.
    - Erythrocyte Sedimentation Rate (ESR) as an inflammatory marker. o Sputum and Gastric Aspirate for Acid-Fast Bacilli from the Armed Forces Institute of Pathology (AFIP) for microbiological confirmation.

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Data from history, examination, and investigations were recorded by the primary investigator on a predesigned proforma, ensuring consistency and accuracy in data collection.

Statistical Analysis: The collected data were analyzed using Statistical Package for Social Sciences (SPSS) version 16.0. Descriptive statistics were used to summarize quantitative variables such as age, weight, and duration of asthma. These were presented as mean ± standard deviation (SD). For categorical variables such as gender and the presence of tuberculosis, frequencies and percentages were calculated.

To assess the relationship between various factors (age, weight, gender, and duration of asthma) and the presence of TB, stratification was performed. Chi-square tests were applied to determine any significant associations between these factors and the outcome (presence of TB). A p-value of ≤0.05 was considered statistically significant.

Results: In total, 217 asthmatic children were included in the study, with 105 males (48.4%) and 112 females (51.6%) participating. The mean age of the study participants was 7.33 ± 3.02 years, with the age of the children ranging from 2 to 14 years. The children were stratified into two age groups: ≤7 years (n=123, 56.7%) and >7 years (n=94, 43.3%). The majority of the children (57%) were in the ≤7 years' age group, while 43% were older than 7 years (Figure 1).

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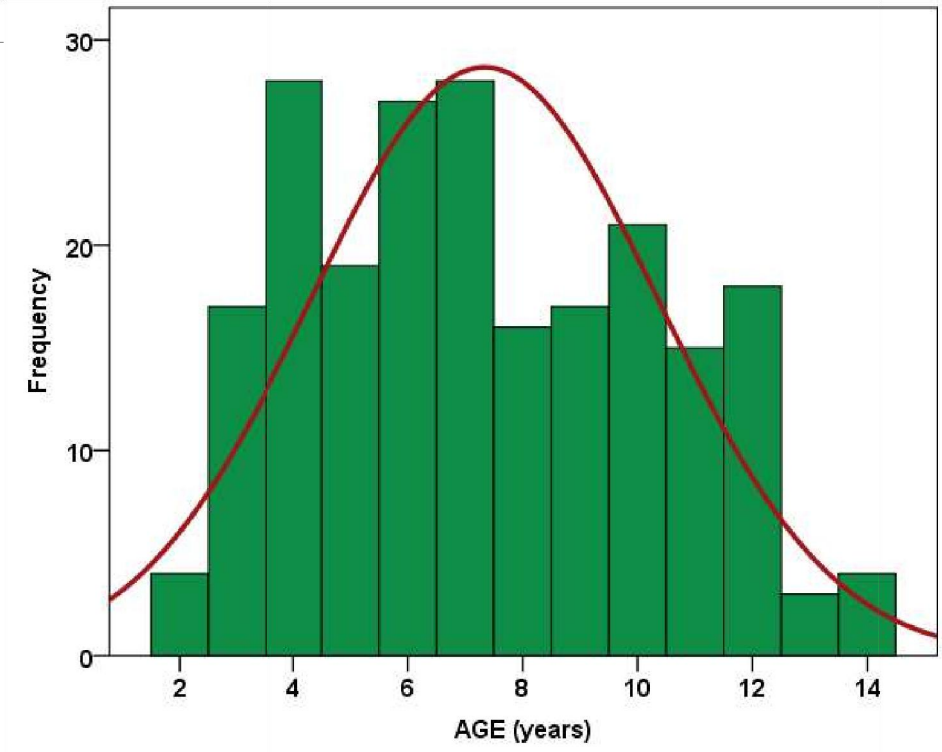

Figure 1: HISTOGRAM PRESENTING FREQUENCY DISTRIBUTION OF AGE

The mean weight of the participants was 24.64 ± 8.64 kg, with a range of 12.1 to 44.0 kg. Stratification of the weight revealed that 115 children (53.0%) weighed ≤24 kg, while 102 children (47.0%) weighed >24 kg (Figure 2).

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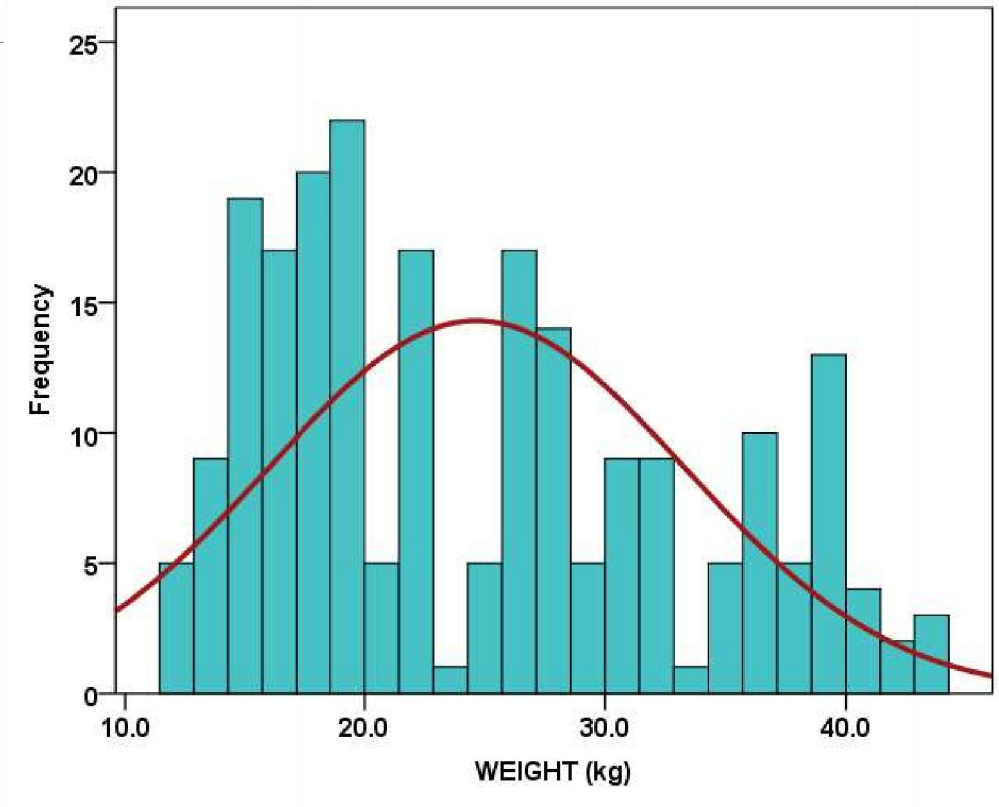

Figure 2: HISTOGRAM PRESENTING FREQUENCY DISTRIBUTION OF WEIGHT

Regarding the duration of asthma, the mean duration was 6.97 ± 0.79 months. Stratification by asthma duration showed that 153 children (70.5%) had asthma for ≤7 months, while 64 children (29.5%) had asthma for >7 months (Table 1).

Table 1: DESCRIPTIVE STATISTICS OF DURATION OF ASTHMA (months)

Mean ±SD	6.97±0.79
95%CI	6.86 To 7.07

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Median (IQR)	7.00 (2)
Range	2

Minimum	6
Maximum	8

Frequency of Tuberculosis: Out of the 217 asthmatic children, 46 (21.2%) tested positive for tuberculosis, as identified through the Kenneth Jones scoring system (Figure 3). These children had clinical features and diagnostic findings consistent with TB.

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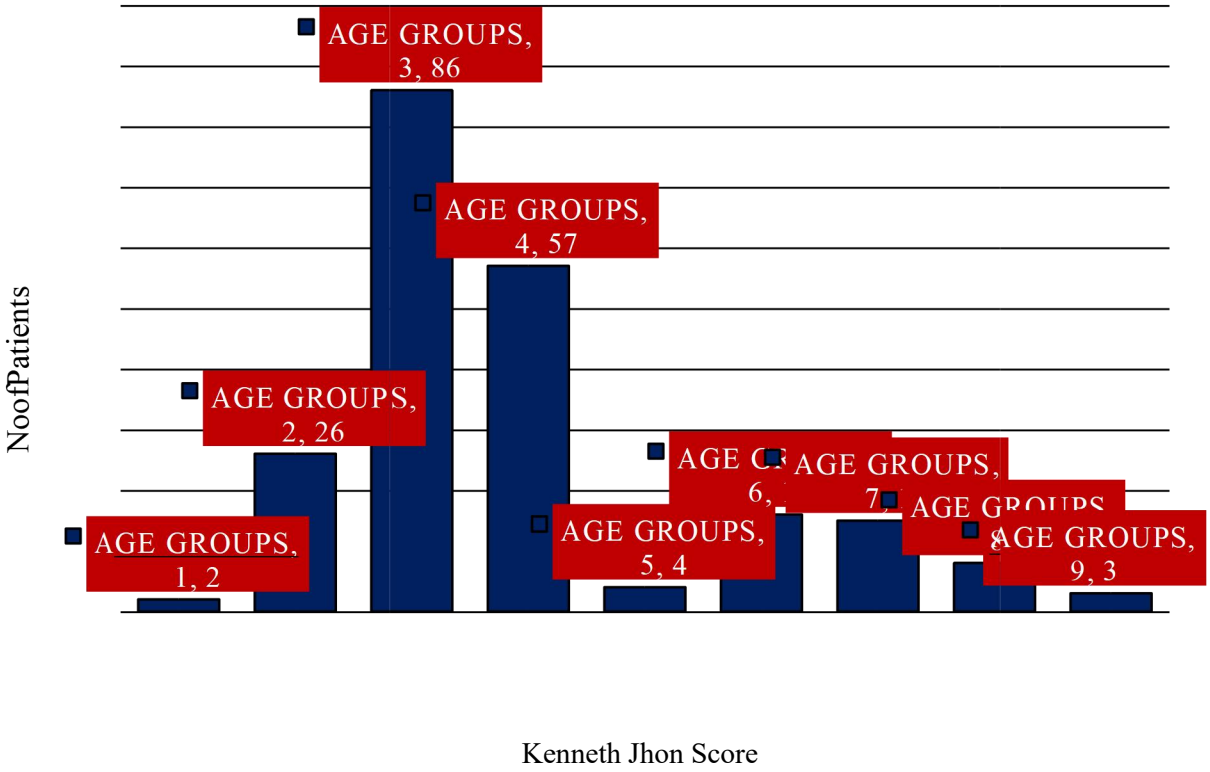

Figure 3: FREQUENCY DISTRIBUTION OF KENNETH JOHN SCORE (n=217)

Demographic Associations: The study examined the association between tuberculosis and various demographic factors, including gender, age, weight, and duration of asthma.

- Gender: A significant association was observed between gender and the presence of tuberculosis, with 31 males (29.5%) and 15 females (13.4%) diagnosed with TB. The p-value was 0.004, indicating a statistically significant difference in TB frequency between males and females (Table 22).
- Age: No significant association was found between age and the presence of TB (p=0.089). While 21 children in the ≤7 years group (17.1%) and 25 children in the >7 years group (26.6%) had TB, the difference was not statistically significant (Table 2).

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Table 2: FREQUENCY AND ASSOCIATION OF TUBERCULOSIS ACCORDING TO AGE (n=217)

	TUBERCULOSIS		TOTAL	P-Value
	YES (n=46)	NO (n=171)		
≤ 7 years (n=123)	21	102	123	0.089**
> 7 years (n=94)	25	69	94	
TOTAL	46	171	217	

Chi Square Test was applied.

P-value ≤0.05 considered as Significant

** Not Significant at 0.05 level

Weight: Similarly, no significant association was observed between weight and TB occurrence (p=0.145). Among the 115 children weighing ≤24 kg, 20 (17.4%) had TB, while 26 (25.5%) of the 102 children weighing >24 kg was diagnosed with TB (Table 3).

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Table 3: FREQUENCY AND ASSOCIATION OF TUBERCULOSIS ACCORDING TO WEIGHT

	TUBERCULOSIS		TOTAL	P-Value
	YES (n=46)	NO (n=171)		
≤ 24 Kg (n=115)	20	95	115	0.145**
> 24 Kg (n=102)	26	76	102	
TOTAL	46	171	217	

Chi Square Test was applied.

P-value ≤0.05 considered as Significant

** Not Significant at 0.05 level

Duration of Asthma: There was also no significant association between the duration of asthma and TB. Of the 153 children with asthma duration ≤7 months, 31 (20.3%) had TB, while 15 (23.4%) of the 64 children with asthma duration >7 months had TB (p=0.602).

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Non-Specific Symptoms and TB Risk: The study also explored the presence of non-specific symptoms as potential indicators of TB in children with asthma. The most common symptoms were cough/hemoptysis, which were present in 100% of patients. Other symptoms included fever (80.2%), failure to gain weight (65.9%), anorexia (32.7%), and weight loss (23%) (Table 11). Additionally, 40.2% of the children had a history of TB contact, and 30.4% had a history of measles/whooping cough (Tables 12 and 13).

BCG Scar, Lymph Node, and Chest Examination: Examination findings were also collected. 71.4% of the children had a BCG scar, 87.1% had a lymph node examination, and 87.1% underwent a chest X-ray.

The study found that 21.2% of asthmatic children were diagnosed with tuberculosis. Gender was significantly associated with TB occurrence, while no significant associations were observed with age, weight, or asthma duration. These findings emphasize the need for routine screening for tuberculosis in children with asthma, particularly in areas with a high TB burden, to prevent delayed diagnoses and improve patient outcomes.

Discussion: Asthma and tuberculosis (TB) are two chronic diseases that are highly prevalent globally and affect global morbidity and mortality, especially in children. The current study sought to assess the frequency of tuberculosis in children with asthma and the relationships with certain demographic and clinical factors. This study documented a considerable burden of TB in children with asthma, with 21.2% of the study population having a diagnosis of TB. This underscores the need for TB screening in children with asthma, particularly in countries like Pakistan where the burden of TB is high.

Asthma affects approximately 300 million people across the globe, and the problem has been getting worse (Masoli et al., 2004). In Pakistan, the problem is also sizable. Research shows about 8% of the country's children have asthma (Shahid, 2008). Infections often lead to asthma flare-ups, and there is convincing evidence showing that some infections, especially TB, can contribute to the development of

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asthma and to exacerbations as well (Kutlu et al., 2008). The TB risk is especially higher because of the immunosuppressive effects of the corticosteroids widely prescribed to control asthma, one of the many

reasons children with asthma get TB (Lee et al., 2013). That risk is likely even greater with corticosteroid use, as TB is much more likely to develop. The present study concludes that because of the corticosteroid therapy that children with asthma are likely receiving, TB is likely to develop.

Multiple studies have examined the connection between TB and asthma but have yielded inconsistent results. Some studies have said that developing TB in the past puts an individual at risk of developing obstructive pulmonary diseases in the future (Jordan et al., 2010). Other studies have said that mycobacterial infections, even the BCG vaccine, can affect the immune system and promote the risk of developing allergic diseases, including asthma (Scrannegard et al., 1998). In this study, the fact that 24% of the children who had received TB treatment and had reversible airflow obstruction, and alignment with asthma, supports the idea that TB is an antecedent in childhood asthma. Also, the fact that younger children are at greater risk of developing asthma following TB infection is consistent with studies that have indicated that TB infection at a young age is a risk factor for developing asthma (Popescu et al., 2005).

In the studied population, a clear difference emerged in the incidence of TB in children with asthma based on gender ($p < 0.05$) 31 males (29.5%) and 15 females (13.4%) had TB. This is in line with the literature, where males are noted more than females in TB cases (WHO, 2013). The regression performed did not show any significant associations with regards to age, weight, asthma duration. This may indicate that other risk factors not captured in this study (e.g. socioeconomic conditions, environmental, and nutritional

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status, etc.) may be at play. This may explain the lack of significant associations, which may be due to the small sample size or the study's single-center nature.

While this study provides informative insights, there are limitations. The small sample size and singlecenter study nature may be the reasons for the findings' lack of generalizability. The noted sample's bias, with females being predominant in the sample, is another bias. In order to validate findings on TB and asthma and to capture the TB-asthma relationship in cohorts, there is a need for larger, multicenter studies with more representative populations.

5.0 Conclusion: Tuberculosis should be considered in any child with a persistent productive cough, particularly if there are systemic features such as fever, weight loss or general malaise. Since most tuberculosis infections are transmitted by inhalation, primary lesions occur in the lungs in over 95% of infected children. We found a high burden of pulmonary TB (21.2%) in children admitted with Asthma. In conclusion, our study showed that TB is a common problem in children with history of Asthma. The data highlighted the need for TB screening in children admitted with Asthma so as to improve TB case finding and child survival.

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