



## Original Research Article

# PREVALENCE BETWEEN PEDIATRICS TUBERCULOSIS AND ALLERGY AMONG THE CHILDREN AGED 5-12 YEARS

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**ABSTRACT**

**Background:** The study aimed to find out the occurrence of allergy among Tuberculosis infected Pediatric patients of age group 5-12 years and to find out the factors associated between allergy and Pediatric tuberculosis.

**Materials and Methods:** The study was conducted as a cross-sectional observational study on 70 children belonging to age group of 5-12 years presenting with Tubercular disease on Anti Tubercular therapy and 70 controls with age and sex matched children seeking care for other illness at Department of Paediatrics, tertiary care centre in central India during the study period of 18 months. Burlingtonent clinical scoring system was used for the assessment of the Allergy in these children.

**Results:** Cases and controls were compared with respect to socio-demographic variables such as age, sex and socioeconomic status. Study reflects no significant association between gender and age in the both control and cases. We reported a negative association between Allergy and Tuberculosis, i.e. the probable Allergy and Allergy very likely was documented in significantly higher proportions of controls as compared to cases ( $p < 0.05$ ). Among various factors, allergy was significantly associated with higher socioeconomic status in patients with Tuberculosis ( $p < 0.05$ ).

**Conclusion:** Those group of patient who are more prone to Allergic condition have less chances of Tubercular infection Vice versa, reduced burden of infectious disease may increase the burden of allergic conditions. Socioeconomic status plays an important role in predisposing an individual to risk of allergies in Tuberculous patients.

**Keywords:** Tuberculosis, allergy, Burlingtonent Clinical Allergy Questionnaire, atopy.

**INTRODUCTION**

Tuberculosis still remains one of the major public health problem globally.<sup>[1,2]</sup> According to World Health Organization (2021), TB affect about 1.2 million children below 15 years of age each year and around 67 million children each year are infected with TB and are at risk of developing tuberculosis in future.<sup>[3]</sup> Globally, people of all age groups are affected by tuberculosis (TB). As per the Global TB report 2020, approximately 12% of children become ill with TB each year worldwide.<sup>[4]</sup> However, India contribute to 28% of the global childhood tuberculosis burden with affecting an

estimated 3.33 lakh children belonging to age range of less than 14 years.<sup>[5]</sup>

Tuberculosis is primarily a disease of developing countries whereas allergy is increasingly being observed in developed countries.<sup>[6]</sup> Strachan in 1989 proposed a hypothesis that children who experienced less childhood infections have an increased risk of allergy.<sup>[7]</sup> Literature suggest a protective effect of immune response against Mycobacterium tuberculosis on development of allergic conditions including asthma and atopic diseases, which is called hygiene hypothesis.<sup>[8,9]</sup> The infection with Mycobacterium tuberculosis is known to induce a strong immune response of T-helper

type 1 (Th1) cells.<sup>[10,11]</sup> The imbalance of Th1/Th2 response has been linked with the hygiene hypothesis, which leads to reduced suppression of immune response by the regulatory T cells.<sup>[12,13]</sup> Recently enormous attention has paid to elicit the link between infection with Mycobacterium Tuberculosis and allergy, wherein the infection with Mycobacterium Tuberculosis has been observed to be protective for the allergic conditions.<sup>[6]</sup> Literature suggest that the prevalence of allergic conditions is increasing in developing countries and decline in the incidence of tubercular infection may be one of the underlying factor responsible for this.<sup>[14,15]</sup> Though previous studies documented an inverse association of MTB infection induced positive tuberculin sensitivity test with atopic disease, the linear relationship is yet to be investigated. Also, the studies eliciting association of allergic conditions with tuberculosis (TB) in developing countries are lacking. The present study was therefore conducted at tertiary care center to find out the occurrence of allergy among Tuberculosis infected Pediatric patients of age group 5-12 years and to find out the factors associated between Pediatric allergy and Pediatric Tuberculosis.

## MATERIAL AND METHODS

The study was conducted as a cross-sectional observational study on 70 children belonging to age group of 5-12 years presenting with Tubercular disease on Anti-Tubercular therapy and 70 control with age and sex matched children seeking care for other illness at Department of Paediatrics, tertiary care centre in central India during the study period of 18 months i.e. from March 2021-September 2022. The inclusion criteria for Tubercular group was children presenting with Tubercular disease age group 5-12 years and currently taking anti Tubercular therapy whereas children not on anti-Tubercular therapy seeking care for other illness were taken as control. Children having preexisting respiratory infection and any congenital malformation or disease was excluded from the study.

Initially the ethical clearance was obtained from the Institutes ethical committee. All the children fulfilling the inclusion criteria were enrolled in both the groups after getting informed and written consent from their parents or guardians. A detailed history was taken including demographic details, clinical history, and other relevant history using proforma. All the patients were then subjected to detailed clinical examination and findings were documented. Children were then subjected to relevant investigations including hemoglobin,

Montoux Test, Chest X-Ray, Gastric Aspirate, Sputum Smear, CBNAAT and ESR.

Burlingtonent clinical scoring system,<sup>[16]</sup> developed in west Burlington Iowa was used for the assessment of the allergy in these children. This system contains 15 questions that enquires about clinical symptoms of the children and children were categorized as.

Allergy category	Score
Allergy unlikely	<8
Possible allergy	8 to 12
Probable allergy	13 to 20
Allergy very likely	>20

## Statistical Analysis

Data was compiled using MsExcel and analysed using IBM SPSS software version 20. Categorical variables were expressed as frequency and proportion whereas continuous variables were expressed as mean and standard deviation. Cases with TB and control without TB were compared for presence of allergies and other variables. Association of allergy with various factors was observed using chi square test. P value of less than 0.05 was considered statistically significant.

## RESULTS

A total of 70 cases and 70 controls were included in the study. Cases and controls were compared with respect to socio demographic variables such as age, sex and socioeconomic status ( $p>0.05$ ). However significantly higher proportions of patients with tuberculosis had positive history of contact with TB patients, positive montoux and CBNAAT tests, abnormal findings in X ray and poor nutritional status ( $p<0.05$ ) as shown in table 1. [Table 1]

Burlingtonent clinical scoring system was used to identify the patients with allergy. We reported a negative association between allergy and tuberculosis, i.e. the probable allergy and allergy very likely was documented in significantly higher proportions of controls as compared to cases ( $p<0.05$ ). [Table 2]

For comparison, allergy unlikely was considered as allergy unlikely whereas possible allergy, probable allergy and allergy very likely were considered as allergy likely. Table 3 depicts factors associated with allergy in Tubercular cases. Amongst various factors, allergy was significantly associated with lower socioeconomic status in patients with Tuberculosis ( $p<0.05$ ). [Table 3]

In controls, we observed no significant association between allergy and various factors ( $p>0.05$ ) described in table 4. [Table 4]

**Table 1: Comparison of cases and control according to baseline variables**

Baseline variables		Cases (n=70)	Control (n=70)	P value
Age (years)	5-9	25 (35.7%)	28 (40%)	0.61
	10-12	45 (64.3%)	42 (60%)	
Sex	Female	34 (48.6%)	32 (45.7%)	0.74

	Male	36 (51.4%)	38 (54.3%)	
Socioeconomic status	Lower middle	37 (52.9%)	40 (57.1%)	0.88
	Upper lower	25 (35.7%)	23 (32.9%)	
	Lower	8 (11.4%)	7 (10%)	
Contact H/O TB	No	48 (68.6%)	66 (94.3%)	0.001
	Yes	22 (31.4%)	4 (5.7%)	
Parent H/O allergy	No	9(12.9%)	17(24.3%)	
	Yes	61(8.1%)	53(75.7%)	
Hemoglobin	<11	28 (40%)	20 (28.6%)	0.15
	>11	42 (60%)	50 (71.4%)	
Montoux	Not done	25 (35.7%)	69 (98.6%)	0.001
	<10mm	34 (48.6%)	1 (1.4%)	
	>10mm	11 (15.7%)	0 (0%)	
CBNAAT	Positive	7 (10%)	0 (0%)	0.001
	Negative	32 (45.7%)	1 (1.4%)	
	Not done	31 (44.3%)	69 (98.6%)	
Chest Xray	Normal	62 (88.6%)	9 (12.9%)	0.001
	Abnormal	8 (11.4%)	0 (0%)	
	Not done	0 (0%)	61 (87.1%)	
BMI	Median to -1 SD	0 (0%)	1 (1.4%)	0.001
	-1 to -2 SD	1 (1.4%)	23 (32.9%)	
	-2 to -3 SD	42 (60%)	34 (48.6%)	
	<-3SD	27 (38.6%)	12 (17.1%)	

**Table 2: Association of allergy with Tuberculosis**

Allergy	Cases (n=70)	Control (n=70)
Allergy unlikely	59 (84.3%)	46 (65.7%)
Possible allergy	8 (11.4%)	19 (27.1%)
Probable allergy	3 (4.3%)	3 (4.3%)
Allergy very likely	0 (0%)	2 (2.7%)
P value	0.01	

**Table 3: Association of allergy with various factors in cases**

Baseline variables	Allergy unlikely (n=59)	Allergy likely (n=11)	P value	
Age (years)	5-9	23 (39%)	2 (18.2%)	0.19
	10-12	36 (61%)	9 (81.8%)	
Sex	Female	30 (50.8%)	4 (36.4%)	0.38
	Male	29 (49.2%)	7 (63.6%)	
Socioeconomic status	Lower middle	30 (50.8%)	8 (72.7)	0.04
	Upper lower	22 (37.3%)	3 (27.3%)	
	Lower	7 (11.9%)	0 (0%)	
Contact H/O TB	No	43 (72.9%)	5 (45.5%)	0.078
	Yes	16 (27.1%)	6 (54.5%)	
Parent H/O allergy	No	6(10.2%)	3 (27.3%)	0.06
	Yes	53 (89.8%)	8 (72.7%)	
Hemoglobin	<11	26 (44.1%)	2 (18.2%)	0.11
	>11	33 (55.9%)	9 (81.8%)	
Montoux	Not done	22 (37.3%)	3 (27.3%)	0.82
	<10mm	28 (47.5%)	6 (54.5%)	
	>10mm	9 (15.3%)	2 (18.2%)	
CBNAAT	Positive	7 (11.9%)	0 (0%)	0.45
	Negative	27 (45.8%)	5 (45.5%)	
	Not done	25 (42.4%)	6 (54.5%)	
Chest Xray	Normal	51 (86.4%)	11 (100%)	0.19
	Abnormal	8 (13.6%)	0 (0%)	
Weight/ height or BMI	Median to -1 SD	0 (0%)	0 (0%)	0.82
	-1 to -2 SD	1 (1.7%)	0 (0%)	
	-2 to -3 SD	36 (61%)	6 (54.5%)	
	<-3SD	22 (37.3%)	5 (45.5%)	

**Table 4: Association of allergy with various factors in controls**

Baseline variables	Allergy unlikely (n=46)	Allergy likely(n=24)	P value	
Age (years)	5-9	19 (41.3%)	9 (37.5%)	0.76
	10-12	27 (58.7%)	15 (62.5%)	
Sex	Female	20 (43.5%)	12 (50%)	0.60
	Male	26 (56.5%)	12 (50%)	
Socioeconomic status	Lower middle	27 (58.7%)	13 (54.2%)	0.29
	Upper lower	15 (32.6%)	8 (33.3%)	
	Lower	4 (8.7%)	3 (12.5%)	

Contact H/O TB	No	45 (97.8%)	21 (87.5%)	0.08
	Yes	1 (2.2%)	3 (12.5%)	
Parent H/O allergy	No	8 (17.4%)	9(37.5%)	0.34
	Yes	38(82.6%)	15 (62.5%)	
Hemoglobin	<11	13 (28.3%)	7 (29.2%)	0.94
	>11	33 (71.7%)	17 (70.8%)	
BMI	Median to -1 SD	0 (0%)	1 (4.2%)	0.45
	-1 to -2 SD	14 (30.4%)	9 (37.5%)	
	-2 to -3 SD	23 (50%)	11 (45.8%)	
	<-3SD	9 (19.6%)	3 (12.5%)	

## DISCUSSION

Strachan in 1989 proposed a hypothesis suggesting increase in incidence of allergy with reduction in childhood infections.<sup>[7]</sup> As tuberculosis is a most primitive respiratory infection, which still is a major public health problem, its association with allergy was explored in our study. We used a validated scale for assessment of allergy in cases as well as controls.<sup>[16]</sup> As per this scale, allergy was unlikely in 71.3% cases with tuberculosis and 58% controls without tuberculosis. However, possible allergy was noted in 25.9% cases and 24.5% controls. Probable allergy and allergy very likely was noted in 16.1% and 1.4% control without tuberculosis respectively as compared to 2.8% and 0% cases of tuberculosis. We thus reported significantly higher rate of allergy in controls suggesting the protective role of infection against allergy.

Our study findings were supported by the findings of Anlar et al, in which the authors reported significantly higher allergic reactions in children with inactive Tuberculosis as compared to active Tuberculosis ( $p < 0.05$ ).<sup>[17]</sup> Conversely Yii et reported reduced risk of active Tuberculosis in patients with history of asthma.<sup>[18]</sup> Zhao et al also reported a potential correlation between early childhood BCG vaccination and reduced risk of developing atopic diseases.<sup>[19]</sup> Our study findings were also supported by findings of Shirakawa et al<sup>[8]</sup> and vonMutius et al<sup>[9]</sup> where the authors documented the role of immune response against Mycobacterium tuberculosis (MTB) in protection against development of asthma, atopy and other allergic conditions.

The possible mechanism of protection against allergic conditions in presence of MTB infection is its capability to induce strong T helper type 1 (Th1) immune response along with the production of interferon gamma (IFN-g).<sup>[10,11]</sup> Apart from this, the MTB infection strengthen the memory of Th1 cell. However, the role of Th2 is postulated in the allergic conditions, This altered Th1/ Th2 response play an important role in protection against allergy in Tuberculous infected patients.<sup>[12,13]</sup> It has been postulated that reduced childhood infections due to reduction in infectious diseases resulted in increased TH2 response in predisposed individuals.<sup>[20]</sup>

In our study, we also aimed to study the factors associated with allergy . We reported that among cases, socioeconomic status was significantly

associated with allergy whereas we reported no significant association of allergy with various factors in non-tubercular subjects ( $p > 0.05$ ). O'Connell et al. reported genetic predisposition, exposure to allergens early during childhood period, Viral infections, maternal smoking during pregnancy, air pollution, and Th2-prone immunologic predisposition to be significantly associated with childhood allergies.<sup>[21]</sup> Li et al. in another study, documented breastfeeding, sleep disorders, obesity, parental snoring history, and household income per capita as significant risk factors associated with allergy in children.<sup>[22]</sup>

Our study had certain limitations, first allergy was assessed using Burlingontent scale, confirmation of allergy using SPT and AEC could not be done. Second, the study was conducted as a cross sectional study, the role of ATT before and after the completion of ATT in allergy could not be assessed. As the study reflects, as the incidence of infectious disease is on decreasing trend .As countries health system is improving there is more chances of acquiring non communicable diseases. So we should be more aware about change in the trend in the health system of our country.

## CONCLUSION

Those group of patient who are more prone to Allergic condition have less chances of Tubercular infection. Vice versa, reduced burden of infectious disease may increase the burden of allergic conditions. Socioeconomic status plays an important role in predisposing an individual to risk of allergies in tuberculous patients.

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