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A Study on Association Between Passive Smoking and Childhood Tuberculosis in Surat City: A Case Control Study

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ABSTRACT

Background: Factors contributing to the high burden of childhood TB in the country are not yet fully understood. Hence the present study was undertaken to determine the risk factors, including passive smoking, for TB in children between 0-14 years of age in Surat city.

Methodology: The present study was a case-control study conducted on eligible cases and controls in a ratio of tuberculous cases to non-tuberculous controls of 1:2. Case is defined as incident cases of TB in children between the age group of 0-14 years residing in Surat city. The data was collected using pre-designed structured questionnaire developed with the help of all the stake holders. This questionnaire was filled up by oral interview technique.

Results: The study found 39 children with family history of smoker, of which passive smoking was found in 53.8% cases and 73.0% controls. The study could not find statistically significant association between passive smoking and childhood tuberculosis. No immunization with BCG was found in 26.2% cases compared to 10.8% controls [OR=2.93 (1.25-6.90), p <0.05].

Conclusion: Age of more than 10 years, nuclear family, absence of BCG vaccination and past history of tuberculosis are significantly associated with cases of childhood tuberculosis compare to non-tuberculous children. The present study could not found association between passive smoking and childhood tuberculosis.

Keywords: Passive Smoking, Childhood Tuberculosis, Case-Control Study, BCG Vaccination

INTRODUCTION

Tuberculosis in children is different from the adults as far as its mode of clinical presentation, severity of disease, infectiousness, diagnosis, treatment and overall outcome is concerned. Childhood TB reflects recent transmission, and therefore the childhood TB provides an accurate measure of the level of TB control achieved in a particular community.[1] The percentage of TB cases occurring in children (0-14 years) varies between 15 percent in developing and underdeveloped countries and below 5 percent in developed countries of total TB cases.[1] In 2012, an estimated 530 000 cases (range 510 000- 550 000) equivalent to about 6% incident cases and

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74 000 deaths (8 % of global deaths among HIV-negative) among children were attributed to tuberculosis.[2] The number of paediatric TB cases in India has shown an increasing trend in the past five years accounting for 7% of all cases. Expectedly, smear negative and EP cases were predominated.[3]

More than 20% of TB cases worldwide are attributable to smoking.[2] In India, 40% children were exposed to passive smoking.[2] Passive smokers are also exposed to similar toxic substances as active smokers but concentration level is different for both the groups.[4] Passive smoking may have particularly harmful effects in children compared with adults because children's respiratory and immune systems are not fully developed.[5] At least 5-10% of children infected with tubercle bacilli develop active tuberculosis, particularly those infected by a smear positive case.[6]

Factors contributing to the high burden of childhood TB in the country are not yet fully understood. There are only few studies conducted in India to determine the effect of passive smoking (second hand tobacco smoke exposure) on childhood tuberculosis. Hence the present study was undertaken to determine the risk factors, including passive smoking, for TB in children between 0-14 years of age in Surat city.

MATERIALS AND METHODS

The present study was a case-control study conducted over a period of four months from April-2022 to July 2022 at Surat city where all of the eligible cases and controls, selected without matching as per eligibility criteria of the study objectives, were contacted within the defined study period. Using Epi. Info software and a ratio of tuberculous cases to non-tuberculous controls of 1:2 and the prevalence of passive smoking among control 15.8% [7]; sample size of 65 cases & 130 controls was calculated to give 80% power to estimate an Odds Ratio of 2.68 for presence or absence of passive smoke exposure.

Case is defined as incident cases of TB in children between the age group of 0-14 years residing in Surat city of South Gujarat, diagnosed at Designated Microscopy Centre, SMIMER. Control was defined as child between 0-14 years of age without any symptoms suggestive of TB immediate weeks before the data collection (persistent fever and/or cough >2 weeks and/or loss of weight/no weight gain and/or history of contact with infectious TB case) or diagnosed as TB or any other respiratory condition (disease). Any other symptoms or signs suggestive of extra-pulmonary TB like lymph node enlargement or pyrexia of unknown origin were excluded from control selection.

The childhood tuberculosis (0-14 years) cases registered at DMC (Designated Microscopy Centre) constituted the sampling frame for the present study. Sampling was done by simple random sampling method with the help of random number table after preparing a line-listing of those paediatric TB patients 0-14 years of age registered at DMC within last 6 months. Two controls were recruited for each case from neighbourhood of case without matching to maintain the ratio of case to control 1:2.

The tools used for collection of data comprised of a pre-designed and pre-tested semi structured questionnaire developed with the help of all the stake holders. This questionnaire was filled up by oral interview technique. The children fulfilled the inclusion criteria were visited at their home. The parents who were to be interviewed were explained about the aims and objectives of the study, and also the likely benefits which would acquire from this study. The questionnaire consisted of questions pertaining to socio-demographic profile, biological factors like weight, height, immunization and recent & past illness, housing condition & environmental factors, indoor air pollution, smoking history of family members, exposure to passive smoke etc. The same questionnaire was used for both Case and Control. The additional data regarding clinical profile, diagnosis and treatment were also taken from childhood tuberculosis cases.

Ethical considerations: Permission was obtained from the Institutional Ethical Committee before conducting the study. The parents were convinced to participate in study by ensuring them about the strict confidentiality during the process of data collection, compilation and report writing. Informed written consent was obtained of the parents who were willing to participate in the study.

Data Analysis: The categorical variables were assessed using Pearson chi-square and Fisher exact test. Quantitative data was analysed using Student t-test. Mantel Hanzel Odds Ratio (OR) and corresponding 95% Confidence Interval (CI) were calculated for dichotomous variables. Statistical significance was measured at 95% confidence interval.

RESULTS

A total of 195 children (65-cases and 130 controls) were studied in the present study. The association between socio-demographic profile and childhood tuberculosis is as described in table 1.

In 56.9 % cases, children were belonged to 10-14 years of age-group while in age groups of 0-9 years represented with 43.1 cases respectively. This difference between age-group and childhood tuberculosis was statistically significant (p=0.001). Even though more male children were having tuberculosis, there was no statistically significant difference between gender and childhood tuberculosis (P=0.611). Statistically significant association was found between family type and childhood tuberculosis (p=0.01). Though more children were having childhood tuberculosis from OBC and General category, there was no statistically significant difference between caste and childhood tuberculosis (P=0.39).

Table 1: Association between socio-demographic profile of children and childhood tuberculosis (n=195)

Variables	Case (%)	Control (%)	Total (%)	P value
Age of children (years)				
0-4	5 (7.7)	74 (56.9)	79 (40.5)	0.001
5-9	23 (35.4)	37 (28.5)	70 (35.9)	
10-14	37 (56.9)	19 (14.6)	56 (28.7)	
Gender of Children				
Male	34 (52.3)	73 (56.2)	107 (54.9)	0.61
Female	31 (47.7)	57 (43.8)	88 (45.1)	
Type of family				
Nuclear	46 (70.8)	55 (42.3)	101 (51.8)	0.001
Joint	19 (29.2)	75 (57.7)	94 (48.2)	
Caste				
Scheduled Tribe	8 (12.3)	22 (16.9)	30 (15.4)	0.39
Scheduled Caste	0 (0)	5 (3.8)	5 (2.6)	
OBC (other backward class)	29 (40.3)	43(33.1)	72 (36.9)	
General	28 (31.8)	60 (46.2)	88 (45.1)	
Socio-economic status (Modified Prasad's Classification**)**				
II	2 (3.1)	5 (3.8)	7 (3.6)	0.52
III	14 (21.5)	18 (13.8)	32 (16.4)	
IV	34 (52.3)	69 (53.2)	103 (52.8)	
V	15 (23.1)	38 (29.2)	53 (27.2)	
Family history of TB				
Yes	25 (38.5)	35 (26.9)	60 (30.8)	0.10
No	40 (61.5)	95 (73.1)	135 (69.2)	

Table 2: Association between housing conditions and childhood tuberculosis (n=195)

Variables	Case (%)	Control (%)	Total	OR (95% CI)
Type of house				
Pucca	60 (92.3)	111 (85.4)	171 (87.7)	2.054 (0.730-5.776)
Semi-pucca	5 (7.7)	19 (14.6)	24 (12.3)	Ref
Ventilation				
Adequate	36 (55.4)	77 (59.2)	113 (57.9)	0.854(0.468-1.559)
Inadequate	29 (44.6)	53 (40.8)	82 (42.1)	Ref
Cross-ventilation				
Present	16 (24.6)	33 (25.4)	49 (25.1)	0.960(0.482-1.911)
Absent	49 (75.4)	97 (74.6)	146 (74.9)	Ref
Overcrowding				
Present	57 (87.7)	121 (93.1)	178 (91.3)	Ref
Absent	8 (12.3)	9 (6.9)	17 (8.7)	1.887 (0.692-5.145)
Indoor smoke exposure				
Yes	29 (44.6)	47 (36.2)	76 (39.0)	1.423 (0.776-2.608)
No	36 (55.4)	83 (63.8)	119 (61.0)	Ref

Table 3: Association between low birth weight, BCG vaccination and childhood tuberculosis

Variables	Case (%)	Control (%)	Total (%)	OR (95% CI)
Low birth weight				
Yes	9 (25.7)	29 (27.6)	38 (27.1)	0.90 (0.38-2.16)
No	26 (74.3)	76 (72.4)	102 (72.9)	
BCG vaccination				
No	17 (26.2)	14 (10.8)	31 (15.9)	2.93 (1.34-6.42)
Yes	48 (73.8)	116 (89.2)	164 (84.1)	

Table 4: Association between smoking status of family members and childhood tuberculosis

Variables	Case (%)	Control (%)	Total (%)	OR (95% CI)
Smoking status of any family member				
Yes	13 (20.0)	25 (19.2)	38 (19.5)	1.05 (0.49-2.21)
No	52 (80.0)	105 (80.8)	157 (80.5)	
Father smoking status				
Smoker	10 (15.4)	19 (14.6)	29 (14.9)	1.06 (0.46–2.44)
Non-smoker	55 (84.6)	111 (85.4)	166 (85.1)	
Indoor smoking (father)				
Present	5 (50.0)	13 (68.4)	18 (62.0)	0.46 (0.10 – 2.22)
Absent	5 (50.0)	6 (31.6)	11 (38.0)	

Table 5: Association between passive smoking and childhood tuberculosis (n=39)

Passive smoking	Case (%)	Control (%)	Total (%)
Yes	7(53.8)	19 (73.0)	26 (66.7)
No	6 (46.2)	7 (27.0)	13 (33.3)
Total	13 (100)	26 (100)	39 (100)

Fisher Exact two tailed p value=0.290, OR=0.43 (95% CI 0.08-2.12)

The association between housing conditions and childhood tuberculosis among cases and controls is as shown in table 2. There was no statistically significant association was found between type of house, ventilation, cross ventilation, overcrowding, indoor smoke exposure of children and childhood tuberculosis (table 2).

The association between low birth weight, BCG vaccination and childhood tuberculosis is as shown in table 3. Statistically, there was significant difference between BCG vaccination and childhood tuberculosis (p=0.007). Association between no BCG vaccination and childhood tuberculosis was positive (95% CI 1.34-6.42).

There was no statistically significant association found between smoking status of family members, father smoking status, indoor smoking by father and childhood tuberculosis 9Table 4).

As demonstrated in table 5, 53.8% cases and 73.0% controls were exposed to passive smoking. There was no statistically significant association was found between passive smoking and childhood tuberculosis (table 5).

DISCUSSION

In the present study out of 195, 39 (20%) children were found with history of smoker within family members. Out of 39 children, 53.8% cases and 73.0% controls were exposed to passive smoke. There was no statistically significant association was found between passive smoking and childhood tuberculosis (p=0.290). No significant mean difference was found between duration of passive smoking among those with childhood tuberculosis (87.57 ± 55.47) and those without childhood tuberculosis (58.58 ± 37.77) (p=0.139). The present study could not find statistically significant association between passive smoking and childhood tuberculosis (p value ≈ 1.000).

Ramchandran R, et al. found in case-control (1:2) study on determinants of childhood tuberculosis, at TVM district of Kerala, positive association between exposure to passive smoke and childhood tuberculosis in multivariate analysis [p<0.001, adjusted OR=6.285 (2.317-17.047)].[7] In another case-control (1:1) study at tertiary care hospital in North India on passive smoking, indoor air pollution and childhood tuberculosis; Patra S, et al. had similarly reported strong association between passive smoking (presence of smoker in household) and childhood tuberculosis in multivariate analysis [p=0.009, adjusted OR= 1.752 (1.154-2.662)]. [4] In the case-control study of Spain to determine association between passive smoking and childhood tuberculosis, Altet MN, et al. reported 89.2% childhood TB cases with history of passive smoking. [8] The study also found strong association between passive smoking and pulmonary tuberculosis [p<0.00005, adjusted OR=5.39 (2.44, 11.91)]. In a hospital-based case-control study in Thailand, Tipayamongkholgul M, et al. had reported passive smoking as risk factor for tuberculosis infection among children either without history of contact [OR=9.31, 95% CI 3.14 - 27.58; p=0.0001] or with history of contact [OR=6.42, 95% CI 2.13 - 19.39; p<0.001].[9] In the community survey at Cape Town, South Africa, den Boon, et al. (2006) had found significant association between passive smoking (presence of smoker in house) and tuberculosis infection among children lived in houses with tuberculosis patient (adjusted OR: 4.60; 95% CI: 1.29–16.45). [10] In the cross-sectional study in South Africa on M. tuberculosis infection in children, du Preez, et al. revealed association between environmental tobacco smoke exposure and M. tuberculosis infection in children (p<0.05). [11]

Singh M, et al had reported exposure to smoke as a risk factor for tuberculosis infection among children with history of adult pulmonary tuberculosis contact [p=0.003, OR=2.68 (1.52 to 4.71)].[12] Among children exposure to tobacco smoke has been found to be associated with increased risk of pulmonary tuberculosis. Contacts, 0-4 and 5-9 years old, showed a significantly higher risk of developing TB than those aged >10 years. There was a dose response relationship between risk of active pulmonary tuberculosis immediately following infection and cigarette smoked by household adults.[13] A case-control study in Thailand conducted by Ariyothai N, et al. also revealed association between passive smoking and pulmonary tuberculosis in adults in univariate analysis [OR= 2.89 (1.19-7.02)]. [14] The prospective study in China conducted by Leung C, et al. had reported passive exposure to second hand tobacco smoke in the household was independently associated with the development of both active TB [hazard ratio (HR) = 1.49(1.01-2.19)] and culture-confirmed TB [HR=1.70(1.04-2.80)] among adults on prospective follow-up after potentially confounding background variables were controlled.[15] Passive smoking accounted for 13.7% of active TB and for 18.5% of culture-positive TB.[15]

Exposure to biomass fuel combustion and passive smoke within the household had been shown to increase the risk of development of TB, though not to the same extent as smoking.[16-19] In the study on childhood TB profile and outcome under RNTCP at Bangalore (India), Nelliyanil M, at al. did not found association between indoor air pollution and type of tuberculosis (p>0.05).[20] Odds of having TB was 6.914 times higher among children exposed to fir-wood smoke compare to those who were not exposed (95% CI 2.529-18.905). Ramchandran R et al., in case-control (1:2) study on determinants of childhood tuberculosis at TVM district of Kerala, had reported 63.4% children were exposed to indoor fir-wood smoke and found an association between exposure to

indoor smoke and childhood tuberculosis in multivariate analysis (p<0.001).[7] In the present study out of 195, 39% children were found exposed to indoor smoke (indoor air pollution). The study showed 44.6% cases and 36.2% controls were exposed to indoor smoke. Though there was no statistically significant difference was found either between indoor air pollution (smoke exposure) and childhood tuberculosis (p=0.253).

CONCLUSION

Age of more than 10 year and nuclear family are socio-demographic factors which significantly associated with cases of childhood tuberculosis compare to non-tuberculous children. Absence of BCG immunization and past history of tuberculosis were found significantly associated with cases of childhood tuberculosis compare to non-tuberculous children. The present study could not found association between passive smoking and childhood tuberculosis.

Author contribution: **GP** contributed to the study conception and design, data collection, analysis and interpretation, and manuscript preparation. **SP** contributed to data analysis and interpretation, as well as manuscript preparation. **SA** and **NP** contributed to the study conception, data analysis and interpretation, and manuscript preparation.

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