ORIGINAL ARTICLE

Risk Factors Associated with Tuberculosis Infection Among Household Children Contacts of Sputum Smear Positive Tuberculosis Cases

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Citation

Article Cycle

Abstract

Background: India has highest burden of tuberculosis (TB) globally. The source of infection for children is usually an adult in their household with active TB. Only few studies have been carried out among household children contacts of active TB patients in India to assess the risk factors of infection among children. **Aim and Objective:** To study the risk factors of TB infection among household children contacts of sputum positive patients. **Material and Methods**: We conducted study on 200 household children contacts (1-15 years) of sputum positive patients registered at DOTS centers in Lucknow district, Uttar Pradesh. Stratified sampling was done. A semi structured questionnaire was administered to collect the information. Infection in children was assessed by TST (Mantoux test). **Results:** TST positivity in children of TST positivity was associated with female index case (p=0.027), lower socioeconomic status (p=0.011), overcrowding (0.008) and duration of symptoms before treatment (p<0.001). Among the factors of children, age >6 years, duration of stay with index case >10 hours/day and malnutrition were significantly associated. **Conclusion**: The study concludes that TB infection among children is significantly associated with various factors related to index case, susceptible host and environment, which can be intervened to prevent TB infection in children.

Keywords

Tuberculosis; Household contacts; Risk factors.

Introduction

Tuberculosis continues to dominate among infectious disease globally due to its high infectivity, ability to remain latent in the host for an indefinite period and reappear later as overt disease. India is the country with the highest burden of Tuberculosis globally. The World Health Organization (WHO) statistics for 2015 estimated incidence of 2.2 million cases of TB for India out of a global incidence of 9.6

million. (1) It is estimated that about 40% of the Indian population is infected with TB bacteria, the vast majority of whom have latent rather than active tuberculosis. (2) Children comprise 40% of the population but are currently under-diagnosed in India. (3) The World Health Organization (WHO) in 2015 estimated that 1 million children currently suffer from TB worldwide (<15 years).

In high burden TB settings, it has been noted that 15-20% of all TB cases are children. The source of infection for children is usually an adult in their household who has active TB. (4)

Severe malnutrition, younger age, illiteracy, low socioeconomic status along with house hold contact with sputum positive TB cases are important factors for tuberculosis infection. (5) Risk of tuberculosis infection increases even after the shorter period of exposure with infected person in the families, living in low-socioeconomic status and poor hygienic condition. (6)

Most of the house-hold contacts develop active tuberculosis within four months of contact with active index case. Therefore timely and pro-active screening of household contacts could be a very effective tool to break the chain transmission of tuberculosis and to achieve the goal of TB Free India. (7)

Aim & Objective

To study the risk factors of TB infection among household children contacts of sputum positive patients.

Material & Methods

A cross-sectional study was carried out in population comprising of household contacts of index TB patients in Lucknow district. An index TB case was defined as the new sputum smear positive case diagnosed by two consecutive sputum smear microcopy at DOTS center and have children < 15 years living in the same household for ≥ 2 months.

The initial TB diagnosis of the index case at DOTS center of Lucknow based on the sputum smear microscopy.

A household contact was defined as children <15 years of age living in the same house as of index case for ≥ 2 months. Study Area: DOTS Center of urban area of Lucknow. Study Duration: Feb 2016 to July 2016 Sample size calculation: We included 97 index cases from DOTS centers and 200 household contacts of index cases based on the following assumptions: an estimated prevalence of

tuberculosis infection in children is 25%, with a bound on error of 0.06. This sample size was also sufficient for identification of factors associated with TST positivity.

Sampling Technique: A stratified random sampling technique was used to select the sample from population from a total of 51 DOTS centers in Lucknow. Urban Lucknow was divided into trans-gomti and cis-gomti. Out of total 51 DOTS center two DOTS center were selected randomly from each strata. Index cases were selected from the TB notification register at DOTS center.

Data collection tools and measurements: The data was collected at DOTS center by using a predesigned and pretested semi-structured questionnaire, which consists of two parts. First part consists information about index cases and second part consists information about contacts related to anthropometric measurements, duration of stay with index case, medical history, immunization history and BCG scar assessment. For younger children history was taken by reliable informant/Mother.

Height was obtained by stadiometer (for children age over 2 years) and infantometer (for children less than 2 years) on the day of enrollment. Weight was obtained by pre-calibrated beam balance with minimum clothing and in standing position. Mid arm circumference was taken in the left upper arm at the mid-point between the olecranon process and acromion process in the age group of one to five years by using Shakir tape.

Tuberculin skin test performed by intradermal injection of 0.1 ml of PPD containing 5TU PPD-RT 23 with tween 80 by using tuberculin syringe and needle on the mid volar aspect of left arm. Reaction induration was read after 48-72 hours of injection in a good light by pen method and the transverse induration greater than 10 mm was defined as positive. Inclusion criteria- New sputum smear positive cases diagnosed by 2 consecutive sputum smear microscopy at DOTS center and Children less than 15 years and who have been staying with index case for more than 2 months in the same household. Exclusion Criteria: Consent not given by index case. The study was approved by institutional ethical committee.

Results

A total of 97 cases and 200 contacts were studied in this study. Socio-Demographic characteristics of Index Cases is tabulated in table-1.

According table1 out of total index cases (97) males accounted for (49.5%) belong to the age group 15-29 years. Majority of index cases were married and more than half (51.5%) index cases belonged to the lower socioeconomic group.

Table 2 showed a maximum number of index cases lived in overcrowded house (80.4%) and kitchen was attached with living room in houses of 69.1% cases. Cough and sputum production >2 week was present in 91.5% and 93.2% index cases respectively. 40.2% cases had +1 smear positivity followed by +2 (30.9%) (as per RNTCP guideline). More than half (53.6%) of the cases started ATT after 2 months of starting the symptom and there was treatment delay of more than seven days in 14.4% of cases.

Out of 200 children contacts 37.5% belonged to the age group less than 6 years with equal

percentage of males and females were. 31.5 % children contacts had father as their index cases. The average duration of stay more than 10 hours with index cases was observed in 19.5% of contacts and less than 1 hours in 36.5% of contacts. 68.5% of contacts were immunized with BCG. 41.5% contacts were suffering from mild malnutrition while 26% suffering from moderate malnutrition and 13.5% from severe malnutrition. (table 3)

TST result was positive (>10mm) in 48% of contacts and negative in 52% of contacts.

Univariate analysis was performed for potential risk factor. On univariate analysis low socioeconomic status, increase average duration of stay with index case, female index case, overcrowding, age of contact <6 years, and education, occupation, malnutrition were found to be significantly associated positively and education, occupation, smoking status, indoor air pollution, sputum production and cough production were negatively associated. The factors which were found to have significant association were included in multivariate analysis.

In the multivariate analysis (Table-4) showed that the tuberculosis infection were more in contacts of female index cases (OR- 0.027, CI- 1.32-99.22), lower socioeconomic group (OR- 8.235, CI 1.61-41.88), presence of overcrowding (OR-16.150, CI- 2.09-124.37), delay in treatment by index case for >2 month (OR-61.791, CI- 6.81-560.15), increase average duration of stay with index case (OR-

69.412, CI- 2.83-1697.25) and poor nutritional status (OR- 5.707, CI- 1.04-31.12).(Table 4)

Discussion

This cross-sectional study demonstrated 48% of household children contacts of smear-positive index TB cases were M. tuberculosis infected as assessed by TST. Comparable data on the prevalence of M. tuberculosis infection among household contacts of index cases have been reported from other countries. For example, prevalence of M. tuberculosis infection among contacts of TB patients of as high as 44% in Spain and 55% in Peru have been reported. (8-10) Also, in another study in an area with high TB incidence, 34% of children under the age of 5 years living in the same household as an index TB case were infected. Therefore, the results of the present study have similar findings with the findings of previous studies. This study showed that risk of TB infection higher in children who have female index cases. This finding was supported by the study done in Thailand by Tornee *et al*. (11) The results of present study state that lower socioeconomic group and overcrowding. is associated with high TB infection in children's which was supported by study done by Sami U.H in Pakistan (12) Patra in Delhi and Shah in Ahmedabad. This study showed that there is high risk of TB infection in contacts who lived for a longer duration (>2 month) with cases and similar results were also found in the study done by Tamhane in Mumbai. High risk of infection is also associated with increase average duration of stay (>10 hr/day) with cases which was supported by the study done by Lienhardt C *et al* (13) Jubulis *et al* (14).

It is a well-known fact which was supported by many studies and also from the present study that malnourished contacts has a significant higher risk of acquiring TB infection as compared to normal children.

There is no significant association found between TB infection and BCG scar which was supported by the study done by Lienhardt C *et al* (13) The present study also not showed any significant association with education level of index cases, it may be due to higher influence of environmental.

Conclusion

The study concludes that TB infection among children is significantly associated with various factors related to index case, susceptible host and

environment, which can be intervened to prevent TB infection in children.

Recommendation

Since the data was collected from DOTS centers so the information regarding environmental status of the index cases and contacts could not be verified by home visit.

Limitation of the study

Since the data was collected from DOTS centers so the information regarding environmental status of the index cases and contacts could not be verified by home visit

Relevance of the study

Since available data in India on determinants of TB infection among children is very limited and unreliable, more studies are needed to generate evidence for effective control of TB infection among children. Only few studies have been carried out among the household children contacts of active tuberculosis patients in India. Therefore, the present study is designed to investigate risk factors of tuberculosis infection among children contacts

Authors Contribution

All authors have contributed equally in the study.

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Tables

TABLE 1 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF INDEX CASES

	Male	Female	Total
Age			
15-29	15(31.2)	33(68.7)	48(49.5)
30-44	21(70)	9(30)	30(30.9)
45-60	13(92.8)	1(7.2)	14(14.4)
>60	3(60)	2(40)	5(5.2)
Total	52(53.6)	45(46.4)	97(100)
Religion			
Hindu	23(46.9)	26(53.1)	49(50.5)

Muslim	29(60.4)	19(39.6)	48(49.5)
Total	52(53.6)	45(46.4)	97(100)
Marital status			
Married	37(60.7)	24(39.3)	61(62.9)
Unmarried	15(41.7)	21(58.3)	36(37.1)
Total	52(53.6)	45(46.4)	97(100)
Socioeconomic status*			
Upper middle	9(45)	11(55)	2(20.6)
Lower middle	14(51.9)	13(48.1)	27(27.8)
Upper lower	29(59.1)	20(40.9)	49(50.5)
Lower lower	0(0)	1(100)	1(1)
Total	52(53.6)	45(46.4)	97(100)
*Socioeconomic status- Modified Kuppu Swami scale			

TABLE 2 DISTRIBUTION OF ENVIRONMENTAL & DISEASES RELATED FACTORS AMONG INDEX CASES

	n	%
Overcrowding		
Present	78	80.4
Absent	19	19.6
Kitchen		
Attached with living room	67	69.1
Separate from living room	30	30.9
Cough		
Yes	82	84.5
No	15	15.5
Duration of cough production		
<2 week	7	8.5
>2 week	75	91.5
Sputum production		
Yes	73	75.3
No	24	24.7
Duration of sputum production		
<2 week	5	6.8
>2week	68	93.2
Result of sputum Microscopy		
+1	39	40.2
+2	30	30.9
+3	28	28.9
Time gap between starting of symptom and ATT		
0-2 month	45	46.4
>2month	52	53.6
Time gap between diagnosis and starting of treatment at DOTS		
0-7 days	73	75.2
>7 days	14	14.4

TABLE 3 DISTRIBUTION OF IMPORTANT CHARACTERISTIC OF HOUSEHOLD CHILDREN CONTACTS

	N	%
Age		
Less than six years	75	37.5
More than six years	125	62.5
Sex		
Male	100	50
Female	100	50
Relationship of Index case with contact		
Father	63	31.5
Mother	29	14.5
Grandfather	17	8.5
Others*	91	45.5
Sleeping pattern of contact with index case		

Sleeping in different room	140	70.0
Sleeping in same room ,different bed	58	29.0
Sleeping in same bed	2	1.0
Average Duration of stay of contact with Index case per day		
<1 hour	73	36.5
1-5hours	45	22.5
6-10 hour	43	21.5
>10 hour	39	19.5
BCG scar		
Present	137	68.5
Absent	63	37.5
Nutritional status #		
Grade I (Normal)	38	19.0
Grade II (Mild Malnutrition)	83	41.5
Grade III (Moderate Malnutrition)	52	26.0
Grade IV (Severe malnutrition)	27	13.5
Total	200	100
#Nutritional status- IAP Classification		

TABLE 4 ASSOCIATION BETWEEN RISK FACTORS AND TUBERCULIN

Risk Factors	No. of Contacts TST Positive	No. of Contacts TST Negative	O.R.	95% C.I. of O.R.	
				Lower	Upper
Gender of Index					
Female	49	43	11.443	1.320	99.225
Male	47	61		Reference	
Age of index case (in years)					
15-29	50	46	1.647	0.015	184.579
30-44	30	34	0.701	0.007	67.397
45-60	12	15	5.585	0.132	236.384
>60	4	9		Reference	
Socioeconomic status					
Middle	41	61		Reference	
Lower	55	43	8.235	1.619	41.887
Overcrowding					
Present	87	77	16.150	2.097	124.370
Overcrowding	9	27		Reference	
Time gap between starting of symptom and ATT					
>2 Month	32	59	61.791	6.816	560.159
0-2 Month	64	45		Reference	
Age of contact					
>6 years	87	38	17.837	7.943	40.054
0-6 years	9	66		Reference	
Relation of index cases with contact					
Father	29	34	7.696	0.160	370.728
Mother	10	19	0.231	0.001	47.440
Grandfather	6	11		Reference	
Others	51	40	4.317	0.048	385.417
Average time duration of stay with index case per day					
<10 hour	74	87		Reference	
>10 hour	22	17	69.412	2.839	1697.25
BCG scar					
Yes	60	77		Reference	
No	36	27	0.686	0.148	3.189
Nutritional Status of contacts					
Grade I (Normal)	20	18		Reference	
Grade II (Mild)	56	27	5.707	1.046	31.124
Grade III (Moderate)	15	37	0.211	0.040	1.117
Grade IV (Severe)	5	22	0.181	0.014	2.316