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Association between Environmental Factors and Pulmonary Tuberculosis: A Case Control Study

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ABSTRACT

Background: Association between environmental factors and tuberculosis infection assists in understanding the risk for tuberculosis infection in the community and planning appropriate preventive actions based on this risk. The study conducted to evaluate association between environmental factors & pulmonary tuberculosis.

Materials & method: This was case control study carried out in tertiary care hospital & urban field practice area from July 2010 to November 2012. Total 150 cases, 150 hospital control & 150 community controls were included in the study according to predefined inclusion and exclusion criteria. The study participants were interviewed and examined according to the preformed and pretested proforma in the respective OPDs.

Results: On univariate analysis, H/O contact with case of tuberculosis H/O not having BCG scar, overcrowding, use of wood, coal and kerosene oil as cooking fuel and kutcha house were found to have significant association with pulmonary TB and odds ratio & p value for this were statistically significant (<0.05).

Conclusion: H/O contact with case of tuberculosis H/O not having BCG scar, overcrowding, use of wood, coal and kerosene oil as cooking fuel and kutcha house were found to have significant association with pulmonary TB.

Key words: Overcrowding, cooking fuel, kuchha house, tuberculosis

INTRODUCTION

Songpol Tornee (2005) in his study concluded that community tuberculosis staffs get assisted by understanding association between environmental factors and tuberculosis infection in planning appropriate preventive actions based on the risk for tuberculosis infection.[1]

Khaliq A (2015) in his study stated that there is increased susceptibility of getting TB infection associated with environmental & socioeconomic risk factors. Smoking, exposure to TB infected patient, co-infection of other diseases, crowding, poor ventilation, and increased family size were the important factors which play crucial role in increased tuberculosis infection. Illiteracy, poor health care facilities, low socio economic status are the extra factors responsible for increased risk of tuberculosis infection.[2]

Case control study is most useful and appropriate analytical approach to establish risk factors for particular disease. Henceforth this case control study was carried out to evaluate association between environmental factors and pulmonary tuberculosis.

The study was conducted to evaluate association between environmental factors and pulmonary tuberculosis.

MATERIALS & METHOD

This was case control study carried out in a tertiary care hospital & Urban Health Field Practice Area of tertiary care hospital during July 2010 to November 2012. Cases were new patients of smear positive pulmonary tuberculosis attending TB & Chest OPD. Hospital controls were patients attending Medicine OPD. Community controls were residents of Urban Health Field Practice Area.

A ≥ 15 years old patient with c/o cough for more than 2 weeks and found to be positive for tubercle bacilli on sputum smear examination was selected as cases[2].Aperson matched for age (± 5 years) and sex who were not having c/o cough for more than 2 weeks and were ≥ 15 years old was selected as control. Two controls were taken against every case, one hospital control from Medicine OPD and the other community control from the Urban Health Field Practice Area. One to one age & sex matching was done. Persons having H/O tuberculosis were excluded from the study.

On the basis of findings of pilot study, proportion of exposure (history of contact with case of tuberculosis) in cases was found to be 18% and in hospital controls it was 8%. [2]

Considering this taking p_1 (Proportion of exposure in the diseased population) as 0.18; p_2 (Proportion of exposure in the control population) as 0.06; q_1 equal to $1-p_1$; q_2 equal to $1-p_2$; α (level of significance) as 0.05; β (claiming that exposure is not associated with disease when in fact it is) as 0.01; Z_α equal to 1.96; and Z_β equal to 1.28 the calculated sample size using the following formula was 137.

$n = (Z_\alpha + Z_\beta)^2 \cdot (p_1q_1 + p_2q_2)/ (p_2 - p_1)^2 = 137$.

Approval from institutional ethics committee and Maharashtra University of Health Sciences (MUHS), Nashik was taken before commencing the study. After informed and written consent was sought, the study participants were interviewed and examined according to the preformed and pretested proforma in the respective OPDs.

The TB & Chest OPD was visited daily for cases. Visit was given to the Medicine OPD for matched controls. The community controls were taken within 7 days of the interview of the cases. The proforma included detailed information aboutenvironmental factors like overcrowding, type of house, type of fuel used for cooking & history tuberculosis contact etc.

Statistical analysis was done by percentages, odds ratio, 95% confidence intervals, and chi square test as a test of significance. P Value < 0.05 was taken as statistically significant. Software Epiinfo version 7.1 was used for statistical analysis.

RESULTS

Table 1 shows association of pulmonary tuberculosis with TB contact. 36 (24%) cases had history of TB contact in the family or neighbourhood (H/O TB contact). 13 (8.67%) hospital controls had history of TB contact in the family or neighbourhood. 15 (10%) community controls had history of TB contact in the family or neighbourhood.

On analysis of cases versus hospital controls, H/O TB contact was found to be associated with risk of pulmonary tuberculosis and this association was statistically significant (OR = 3.33, 95% CI 1.68 – 6.58, p = 0.0003).

On analysis of cases versus community controls, H/O TB contact was found to be associated with risk of pulmonary tuberculosis and this association was statistically significant (OR = 2.84, 95% CI 1.48 – 5.46,p = 0.0012).

As shown in table 1, 75 (50%) cases had no BCG scar. 43 (28.67%) hospital controls and 34 (22.67%) community controls had no BCG scar.

On analysis of cases versus hospital controls, absence of BCG scar was found to be associated with risk of pulmonary tuberculosis and this association was statistically significant (OR = 2.49, 95% CI 1.54 – 4.01,p = 0.0002).

On analysis of cases versus community controls, absence of BCG scar was found to be associated with risk of pulmonary tuberculosis and this association was statistically significant (OR = 3.41, 95% CI 2.07 – 5.62, p< 0.0001).

As shown in table 1, 121 (80.67%) cases were living in the overcrowded households. 102 (68%) hospital controls and 73 (48.67%) Community controls were living in overcrowded households.

On analysis of cases versus hospital controls, overcrowded households were found to be associated with risk of pulmonary tuberculosis and this association was statistically significant (OR = 1.96, 95% CI 1.15 – 3.34,p = 0.012).

On analysis of cases versus community controls, overcrowded households were found to be associated with risk of pulmonary tuberculosis and this association was highly statistically significant (OR = 4.4, 95% CI 2.63 – 7.38, p < 0.0001).

Study participants were divided into two categories, one using LPG and the other using wood, coal and kerosene oil[7]. 103 (68.67%) cases used wood, Kerosene oil & coal as a cooking fuel. 92 (61.33%) hospital controls and 32 (21.33%) community controls used wood, Kerosene oil & coal as a cooking fuel.

Table 1: Association of Pulmonary Tuberculosis with H/O TB Contact

Variables	Cases (n=150)(%)	Hospital controls (n=150)(%)	Community controls (n=150)(%)	Cases v/s hospital controls			Cases v/s community controls		
				OR	95% CI	P value	OR	95% CI	p value
History of TB contact									
Yes	36 (24)	13 (8.67)	15 (10)	3.33	1.68–6.58	0.0003	2.84	1.48–5.46	0.0012
No	114 (76)	137 (91.33)	135 (90)						
BCG scar									
No BCG scar	75 (50)	43 (28.67)	34 (22.67)	2.49	1.54–4.01	0.0002	3.41	2.07–5.62	<0.0001
BCG scar present	75 (50)	107 (71.33)	116 (77.33)						
Overcrowding (4)									
Yes	121(80.67)	102 (68)	73 (48.67)	1.96	1.15–3.34	0.012	4.4	2.63–7.38	<0.0001
No	29(19.33)	48 (32)	77 (51.33)						
Cooking fuel									
Wood, Kerosene oil & coal	103 (68.67)	92 (61.33)	32 (21.33)	1.38	0.86–2.23	0.1830	6.16	3.76–10.08	<0.0001
LPG	47 (31.33)	58 (38.67)	118 (78.67)						
Separate kitchen									
No separate kitchen	58 (38.67)	52 (34.67)	26 (17.33)	1.19	0.74–1.90	0.4722	3.01	1.76–5.14	0.0001
Has Separate kitchen	92 (61.33)	98 (65.33)	124 (82.67)						
Type of house									
Kutcha house	94 (62.67)	89 (59.33)	43 (28.67)	1.15	0.72–1.83	0.554	4.18	2.57–6.78	<0.001
Pukka house	56 (37.33)	61(40.67)	107 (71.33)						

On analysis of cases versus hospital controls, use of wood, coal and kerosene oil as cooking fuel was not found to be significantly associated with risk of pulmonary tuberculosis (OR =1.38 , 95% CI 0.86 – 2.23, p = 0.1830).

On analysis of cases versus community controls, use of wood, coal and kerosene oil as cooking fuel was found to be significantly associated with risk of pulmonary tuberculosis (OR = 6.16, 95% CI 3.76 – 10.08, p < 0.0001).

As shown in table 1, 58 (38.67%) cases had no separate kitchen in their houses. 52 (34.67%) hospital controls and 26 (17.33%) community controls had no separate kitchen in their houses.

On analysis of cases versus hospital controls, having no separate kitchen in the house was not found to be associated with risk of pulmonary tuberculosis (OR = 1.19, 95% CI 0.74 – 1.9, p = 0.4722).

On analysis of cases versus community controls, having no separate kitchen in the house was found to be associated with risk of pulmonary tuberculosis and this association was highly statistically significant (OR = 3.01, 95% CI 1.76 – 5.14, p <0 .0001).

As shown in table 1, 94 (62.67%) cases were living in the kutcha houses at the time of interview. 89 (59.33%) hospital controls owned kutcha houses and 43 (28.67%) Community controls were living in kutcha houses.

On analysis of cases versus hospital controls, living in a kutcha house was not found to be associated with risk of pulmonary tuberculosis (OR = 1.15, 95% CI 0.72 – 1.83, p = 0.554).

On analysis of cases versus community controls, living in a kutcha house was found to be associated with risk of pulmonary tuberculosis and this association was highly statistically significant (OR = 4.18, 95% CI 2.58 – 6.78, p < 0.001).

DISCUSSION

History of contact with case of tuberculosis: In the present study, on multivariable analysis, history of contact with case of tuberculosis in the family or neighbourhood was identified as a significant risk factor on analysis with both the control groups. 36 (24%) cases, 13 (8.67%) hospital controls and 15 (10%) community controls had history of TB contact in the family member or neighbourhood. On analysis of cases versus hospital controls, H/O TB contact was found to be associated with risk of pulmonary tuberculosis and this association was statistically significant on univariable analysis (OR = 3.33, 95% CI 1.68 – 6.58, p = 0.0003) as well as on multivariable analysis (adj OR = 4.55, 95% CI 2.17 – 9.52, p = 0). Also, On analysis of cases versus community controls, H/O TB contact was found to be associated with risk of pulmonary tuberculosis and this association was statistically significant on univariable analysis (OR = 2.84, 95% CI 1.48 – 5.46, p = 0.0012) as well as on multivariable analysis (adj OR = 3.68, 95% CI 1.65 - 8.21, p = 0.002). Different investigators have used different definitions of contact as far as duration since exposure is concerned.Kan X et al (2011)[6]askedthe history of tuberculosis in family member in past 5 years. In present study H/O contact in past 10 years was asked. In a study conductedby Kumar RA et al(1984)[7], prevalence of bacteriologically confirmed tuberculosis was found to be 1.1% in household and neighbourhood contacts. In case control study conducted by Hill PC et al (2006)[8], household

member was found to be significantly associated with risk of tuberculosis (adjusted OR = 7.55, 95% CI 3.43–16.6 adjusted p value <0.0001). Shetty N et al (2006)[9] found that history of contact was not a significant risk factor (OR = 1.24, 95% CI 0.73–2.10, P = 0.42). In a study conducted by Kan X et al (2011)[6] h/o household contacts in the past 5 years was found to be significantly associated with tuberculosis (OR = 27.23, 95% CI 8.19 – 90.58, p < 0.01).

BCG scar: Present study identified having no BCG scar as a significant risk factor for pulmonary tuberculosis on analysis with both the control groups.

75 (50%) cases, 43 (28.67%) hospital controls and 34 (22.67%) community controls had no BCG scar. On analysis of cases versus hospital controls, having no BCG scar was found to have significant association with risk of pulmonary tuberculosis (OR = 2.49, 95% CI 1.54 – 4.01, p = 0.0002) and remained significant after controlling the other factors (adj OR = 2.51, 95% CI 1.48 – 4.27, p = 0.001). On analysis of cases versus community controls, having no BCG scar was found to have significant association with risk of pulmonary tuberculosis (OR = 3.41, 95% CI 2.07 – 5.62, p< 0.0001) and remained significant after controlling the other factors (adj OR = 3.19, 95% CI 1.72 - 5.90, p = 0).

In a study conductedby Sepulveda RL et al (1992)[10], there were 13.2% non-immunized individuals among patients of tuberculosis and 12.2% among controls. But, this difference was not found to be statistically significant. As per findings of the study by Hill PC et al (2006)[8], absence of BCG scar was not significantly associated with risk of pulmonary TB (OR = 0.93, 95% CI 0.54–1.60, p = 0.78).

Overcrowding: On multivariable analysis, only on analysis with community controls, overcrowding was found to have significant association with risk of pulmonary TB.

121 (80.67%) cases, (68%) hospital controls and 73 (48.67%) community controls were living in overcrowded households at the time of interview. On analysis of cases versus hospital controls, statistically significant association was found between overcrowding and risk of pulmonary tuberculosis (OR = 1.96, 95% CI 1.15 – 3.34, p = 0.012). Also, on analysis of cases versus community controls, statistically significant association was found between overcrowding and risk of pulmonary tuberculosis (OR = 4.4, 95% CI 2.63 – 7.38, p < 0.0001). But on multivariable analysis, after adjustment for other factors, only community controls showed a significant association (adj OR = 2.27, 95%CI 1.18 - 4.37, p = 0.014).

Dong B et al (2001)[11]found that crowded living place was associated with risk of active tuberculosis (Adj OR = 1.14, 95% CI = 1.05 - 1.25). In a study conducted by Gupta D et al (2004)[12], on MLR analysis, overcrowding was found have statistically significant association with risk of pulmonary tuberculosis (OR increased by 3.66, 95%CI 2.9-4.61, with increasing number of persons per room, p<0.001). Shetty N et al (2006)[9] found it to be a non-significant factor (unadjusted OR = 0.79, 95% CI 0.53–1.19, p = 0.26). By Hill PC et al (2006)[8], household crowding was found to be significant risk factor for pulmonary tuberculosis (adjusted OR = 10.17, 95% CI 4.08–25.63, p value <0.0001).

Cooking fuels used: In the present study, on multivariable analysis, use of wood, coal and kerosene oil as cooking fuels were recognized as significant risk factor with community controls only.

103 (68.67%) cases, 92 (61.33%) hospital controls and 32 (21.33%) community controls used wood, coal and kerosene oil as a cooking fuel. On analysis of cases versus hospital controls, use of wood, coal and kerosene oil as a cooking fuel was not found to be significantly associated with risk of pulmonary tuberculosis (OR =1.38 , 95% CI 0.86 – 2.23,P = 0.1830). On analysis of cases versus community controls, use of wood, coal and kerosene oil as a cooking fuel was found to be significantly associated with risk of pulmonary tuberculosis on univariate (OR = 6.16, 95% CI 3.76 – 10.08, p < 0.0001) as well as on multivariable analysis after adjustment for other factors (adj OR = 5.29, 95%CI 2.89 – 9.68, p = 0).

Bruce N et al (2000)[12] found that persons living in households burning biomass had pulmonary tuberculosis more frequently than persons using cleaner fuels (OR = 2.58, 95%CI 1.98–3.37) after adjustment for socioeconomic factors. In a study done by Shetty N et al (2006)[9],use of biomass fuels was found to be significantly associated with risk of pulmonary tuberculosis (unadjusted OR = 1.80, 95% CI 1.10–2.90, p = 0.02). But after adjusting for other variables this association went non-significant (adjusted OR = 0.90, 95%CI 0.46–1.76, p = 0.75). Kaulagekar A et al (2007)[13]found that use of smoke causing cooking fuel was not a significant risk factor for tuberculosis (OR = 1.047, p = 0.511). Behera D et al (2009)[14]found that solid fuel used for cooking was not significantly associated with risk of tuberculosis (OR = 1.08, 95% CI 0.62-1.87, p = 0.78).

Separate kitchen: In the present study, no separate kitchen in the house was identified as a significant risk factor for PTB only on univariate analysis with community controls and it was also rendered insignificant on multivariate analysis.

58 (38.67%) cases, 52 (34.67%) hospital controls and 26 (17.33%) community controls had no separate kitchen in their houses.On analysis of cases versus hospital controls, having no separate kitchen in the house was not found to be associated with risk of pulmonary tuberculosis (OR = 1.19, 95% CI 0.74 – 1.9, p = 0.4722). On analysis of cases versus community controls, having no separate kitchen in the house was found to be associated with risk of pulmonary tuberculosis and this association was highly statistically significant (OR = 3.01, 95% CI 1.76 – 5.14, p<0 .0001). But on MLR analysis, it was found to be a non-significant risk factor.

Shetty N et al (2006)[9]association between no separate kitchen in the house and risk of tuberculosis was found to be statistically significant even after adjusting for other variables (adjusted OR = 3.26, 95% CI 1.25 - 8.46, p= 0.02).

Type of house: Living in kutcha house was identified as a significant risk factor only on analysis with community controls. 94 (62.67%) cases, 89 (59.33%) hospital controls and 43 (28.67%) community controls were living in a kutcha houses.On analysis of cases versus hospital controls, living in a kutcha house was not found to be associated with risk of pulmonary tuberculosis (OR = 1.15, 95% CI 0.72 – 1.83, p=0.554). On analysis of cases versus community controls, living in a kutcha house was found to be associated with risk of pulmonary tuberculosis and this association was highly statistically significant (OR = 4.18, 95% CI 2.58 – 6.78, p < 0.001) and remained significant in presence of other factors like smoking, H/ O of TB contact, use of biomass fuels, overcrowding and no BCG scar (adj OR = 2.76, 95% CI 1.5 - 5.00, p = 0.001).

Gupta D et al (2004)[12] concluded that deteriorating housing was significantly associated with risk of tuberculosis (p < 0.001). In a study conducted by Kaulagekar A et al (2007)[13] Kutcha house was found to be a significant risk factor for tuberculosis (OR = 1.264, p = 0.000). Muniyandi M et al (2007)[15] conducted a survey and found that prevalence of Tuberculosis was more in people living in Kutcha houses (p < 0.001). Behera D et al (2009)[14] found in a study that there was no association between type of house and tuberculosis (p = 0.101).

CONCLUSION

H/O contact with case of tuberculosis H/O not having BCG scar, overcrowding, use of wood, coal and kerosene oil as cooking fuel and kutcha house were found to have significant association with pulmonary TB.

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