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Effects of Poor Protein Intake and In-House Overcrowding On Childhood Tuberculosis in a Low-Income Bangladeshi Rural Community: A Case-Control Study

Taifur Rahman[1,2], Iqbal Kaiser[1], Sabrina Saba[1], Samira Irfan[1], Anzuman Akter[2], Ahmed Hossain[1]*

Abstract

Despite a well-functioning tuberculosis (TB) control program in Bangladesh, tuberculosis (TB) contributes to an unacceptably high rate of morbidity and mortality among children. We identify the risk factors of childhood TB in a tea garden based area of Bangladesh. A case control study with 216 cases and 216 controls was conducted at seven sub-districts of Moulvibazar district in Bangladesh during the period of March 2016 to September 2016. Socio demographic and clinical data were obtained from each participant *via* face-to-face interview using a standard semi-structured questionnaire. Data was collected from the patient's relative who came to the DOT'S center along with the children. Crude and multivariate logistic regression analyses were used to analyze the data. The multivariate logistic regression analysis indicated that over-crowding (>4 persons per bedroom) in the house (OR = 2.64, 95% CI = 1.66-4.25), positive history of TB in the family (OR = 1.87, CI = 1.19-2.95) and poor protein intake (OR = 1.72, CI = 1.07-2.77) are the significant risk factors for childhood TB. Besides, poor monthly income (<10000 taka) (OR = 0.58, CI = 0.30-1.10) and younger child (<10 years of age) are found nearly significant for childhood TB. To conclude, improvement in the living standard of children will help in reducing childhood TB in the community. The identified risk factors for the childhood tuberculosis reflect a complex interaction among socio-demographic conditions. The control program for the childhood TB would benefit from a collaboration of broad public health activities in improving the socio-demographic factors in the rural community.

Keywords

Childhood tuberculosis; Case-control study; Crowding; Multivariate analysis; Bangladesh

Introduction

Despite a well-functioning tuberculosis (TB) control program in Bangladesh, tuberculosis (TB) contributes to an alarmingly high rate of morbidity and mortality among children. According to WHO (2016) report, approximately one million (11%) are children from the 9.2 million new tuberculosis cases worldwide [1]. It is estimated that with accurate diagnosis and good reporting systems, children less than 15 years of age are likely to contribute to 4-22% of the disease burden in 22 high-risk countries [2]. With excellent TB control and active provision of preventive therapy to child contacts, the burden of childhood TB can be reduced to below 5%, which is the case in many developed countries. Because children acquire TB from the infectious adult cases, the incidence of pediatric TB provides an accurate measure of ongoing transmission within communities, a key indicator of epidemic control [3-6].

In Bangladesh, childhood TB is a highly neglected public health phenomenon. Bangladesh ranks seventh among the world's 30 high TB burden countries. The incidence and prevalence of all forms of TB for all age groups was 224/100,000 and 402/100,000 population in 2013, respectively [2,7]. In 2015, among all 199,001 TB cases, a total of 7984 (4.01%) TB cases were children [7]. In fact, the actual burden of TB in children is likely higher, especially given the challenge in diagnosing childhood TB.

In developing countries, the number of childhood TB cases are heavily found in low-income rural compared to the urban areas. Studies showed that the TB proliferation risk is reduced when availability of a separate kitchen, house type, indoor crowding, age, gender, urban or rural residence are adjusted [8-12]. A household TB case is most commonly implicated for infection among young children. Older children are increasingly likely to be infected from outside the household. Poor nutrition is also a predominant risk factor for contracting TB and mortality [13-16]. Malnutrition increases the host's susceptibility to infection especially in case of children. Both, protein-energy malnutrition and nutrient deficiencies increase the risk of tuberculosis.

Knowing the underlying risk factors of childhood TB in rural areas could be helpful in terms of devising preventive measures against childhood TB in order to reduce the morbidity and the mortality associated with TB. In Bangladesh, childhood tuberculosis is a relatively neglected problem and factors responsible for its aggravation have not been studied adequately. This study will be conduct to determine the socio-demographic features in a low-income rural community that may be in taking preventive measures against tuberculosis to reduce morbidity and mortality related to this disease.

In Bangladesh, there is yet to be a formal study conducted about the effect of the in-house crowding on the susceptibility to childhood TB. Our main interest of the study is to gain a understanding of the risk factors of childhood TB and how crowding affects on it.

Methods

Study design, site and population

We conducted a case-control study in seven sub-districts of Moulovibazar, Bangladesh. Cases were the children who diagnosed as TB patients by the laboratory test of sputum-positive. Children who visited the DOTS centers but were sputum-negative during the same time period were taken as controls. The children from the tea-garden workers were chosen because they live in tight-knit communities in smaller houses and belong to the low-income family

***Corresponding author:** Ahmed Hossain, Department of Public Health, North South University, Dhaka, Bangladesh, Tel: 880-172-937-8236; E-mail: ahmed.hossain@utoronto.ca

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group. The maximum family income was found around 20000 taka (or approximately $250 U.S.) per month. The highest education of the participants father is relatively low with few of them went secondary schools but didn't complete it. They originate from lower socio-economic backgrounds therefore they live in smaller and more crowded residences.

The data was collected via face-to-face in-depth interviews from the adult relatives of children that followed a semi-structured questionnaire. The questionnaire comprised comprehensive questions about study participants' socio-demographic characteristics, lifestyle-related factors and clinical factors.

Ethical approval

Ethical approval for the study protocol was obtained from the North South University Ethics Review Committee, while a written consent was obtained from each study participant.

Statistical analysis

We analyzed the data using the software R. Descriptive statistics were calculated for all of the categorical variables (presented as frequencies and percentages). We fitted a multivariate logistic regression model with the case-controls. The results are reported by the adjusted odds ratios (ORs) and corresponding p-values are also presented in a (Table 1). p-values less than 0.05 were considered statistically significant.

Results

The data were comprised of 216 cases and 216 controls. Table 1 shows the participants characteristics corresponding to the TB status. Among these covariates, age, sex, crowding (4+), family history of TB during the last 6 months and protein intake per week were found significantly associated with the TB status according to the values of unadjusted odds ratios. It appears that the 56% of the male children were found from TB cases whereas 46% of the female children were found from TB cases. Besides, increasing age of the child was found associated with increasing odds of infection of TB (57% of the cases are from above 10 years of age while 44% of the cases are from less than or equal to 10 years of age). The variable crowding reflects that 64% of the cases are from the participants who lived in a over-crowed room (>4 persons per room) whereas 44% of the cases are from the participants who lived in a less crowded room (<=4 persons per room).

According to the adjusted multivariate analysis, crowding (>4 persons per bedroom) in the house (OR = 2.64, 95% CI = 1.66-4.25),

Table 1: Patient's characteristic and unadjusted odds ratio of each covariates and case control.

Factors	Categories	Case (row %)	Control	OR (CI)	P-Value
Age	2-6	38 (44%)	49	0.59 (0.36-0.97)	**0.040**
	7-10	55 (43%)	73	0.57 (0.37-0.89)	**0.014**
	11-14	123 (57%)	94	Ref	
Sex	Female	100 (45%)	123	Ref	
	Male	116 (56%)	93	1.53 (1.05-2.25)	**0.027**
Family income	<10000	190 (51%)	182	Ref	
	>=10000	26 (43%)	34	0.73 (0.42-1.26)	0.267
Crowding*	<=4	138 (44%)	173	Ref	
	> 4	78 (64%)	43	2.27 (1.48-3.53)	**<0.001**
Mother education	11+	13 (54%)	11	1.19 (0.51-2.78)	0.683
	1-10 Years	43 (50%)	44	0.98 (0.61-1.58)	0.945
	No schooling	160 (50%)	161	Ref	
Father education	11+	22 (61%)	14	1.61 (0.80-3.34)	0.185
	1-10 Years	46 (48%)	50	0.94 (0.59-1.50)	0.809
	No schooling	148 (49%)	152	Ref	
Mother occupation	House wife	152 (48%)	166	Ref	
	Working	64 (56%)	50	1.39 (0.91-2.15)	0.127
Father Occupation	Day labor	145 (51%)	137	Ref	
	Garden worker	71 (47%)	79	0.85 (0.57-1.26)	0.419
Distance from DOTS center	<=5 km	77 (49%)	79	Ref	
	5+ km	139 (50%)	137	1.04 (0.70-1.54)	0.841
Family History of TB (last 6 months)	No	139 (45%)	169	Ref	
	Yes	77 (62%)	47	1.99(1.30-3.06)	**0.001**
Protein Intake	<=2 per week	169 (53%)	149	1.62 (1.05-2.50)	**0.029**
	>2 per week	47 (41%)	67	Ref	
Neighbor TB	No	118 (49%)	123	Ref	
	Yes	98 (51%)	93	1.09 (0.75-1.61)	0.628
BCG was given	No	19 (58%)	14	Ref	
	Yes	197 (49%)	202	0.72 (0.34-1.46)	0.367

Ref is reference.

OR is the crude odds ratio.

* Family members to room ratio

Table 2: Adjusted relationship between covariates and case control that is analysed using multivariate logistic regression model.

Factors	Reference	Estimate	OR	LCL	UCL	P-Value
Age (2-6)	11-14	-0.47	0.62	0.36	1.06	0.084
Age(7-10)	11-14	-0.61	0.54	0.34	0.87	**0.011**
Gender (Male)	Female	0.37	1.45	0.96	2.19	0.078
Family income- 10000+	<10000	-0.53	0.58	0.30	1.10	0.098
Crowding 4+	<=4	0.97	2.64	1.66	4.25	<0.001
Mother Education 11+	No Schooling	0.04	1.04	0.34	3.17	0.946
Mother Education-1-10	No Schooling	0.07	1.07	0.59	1.94	0.824
Father Education 11+	No Schooling	0.61	1.83	0.74	4.69	0.193
Father Education 1-10	No Schooling	0.04	1.04	0.60	1.79	0.891
Mother occupation-working	Housewife	0.42	1.51	0.89	2.60	0.125
Father occupation-Garden worker	Day Labor	-0.26	0.77	0.47	1.25	0.298
Distance from DOTS center 5+ KM	<=5	-0.11	0.89	0.57	1.39	0.620
Family History TB-Yes	No	0.63	1.87	1.19	2.95	**0.006**
Neighborhood TB- Y	No	0.10	1.10	0.73	1.67	0.639
Protein Intake per week (<=2)	>2	0.54	1.72	1.07	2.77	0.025

positive history of TB in the family (OR = 1.87, CI = 1.19-2.95) and poor protein intake (OR = 1.72, CI = 1.07-2.77) are found positively associated with childhood TB. The results indicate that the children who live in a over-crowded room (>4 persons in a room) are 2.64 times more likely to be in the TB case group compared to the children who live in a less crowded room (<=4 persons in a room). Besides, poor monthly income (<10000 taka) (OR = 0.58, CI = 0.30-1.10) and younger child (< 10 years of age) are found nearly significant for childhood TB. Father's educational status, mother's educational status, as well as occupational status did not have a significant association. The propensity to contract childhood TB is almost 2 times higher in families that have previous positive family TB history. The association between contracting TB and family history is highly significant (p=0.001) (Table 2).

In the multivariate model, Crowding 4+ (Ref: <4): OR (95% CI)=2.64 (1.66-4.25); p<0.001. The odds of being infected with childhood TB was more likely (2.64 times higher) among those participants having crowding of 4 and more compared, with the children who lived in relatively less crowded residences.

Discussions

This study shows a highly significant association between childhood tuberculosis and crowding. National statistics of Bangladesh showed male to female ratio is 2:1 among TB patients below 14 years of age. In this study, we saw male child aged between 7-10 years are likely to develop tuberculosis (TB) 1.5 times more than girls of the same age.

Socioeconomic conditions have traditionally been cited as risk factors for developing TB. Several studies have shown a correlation between the rate of infection in households, crowding, and poverty (US), between TB case notification rate, income, and socioeconomic characteristics (Canada), and between prevalence of infection, social, and economic environment (Panama). The case notification rate of childhood TB has been reported to be related to crowding (US), income (US), rate of unemployment (US), infant mortality (US), and social deprivation (UK). That all three factors studied by us (crowding, economic status, and parental education) were significantly correlated with the case notification rate of TB in children was thus expected. The correlation between maternal literacy and childhood morbidity and mortality is well known [17-20].

This study showed household contact as an important risk factor for tuberculosis which is consistent with the findings of some previous studies in West Africa and Lao People's Democratic Republic where family history of TB was two to three times more frequent among childhood TB cases compared to the controls. We saw its alomost 2 times higher in families that have previous positive family TB history. The association is highly significant [21-22]. The findings suggest that there are highly positive association (P<0.001) between crowing 4 and more with childhood TB.

Increased size of the household was found to be important and overcrowding has been documented as a risk factor for TB in several studies in a variety of settings. Measurement of the bedroom area may not reflect the actual usable bedroom space because in a rural setting, it is always occupied by some furniture, utensils, stored crops, agricultural tools, bundles of firewood, jute-straw, and sometimes pet animals. The number of windows reflects a vague expression of ventilation status (there are many variables regarding window(s), such as: size of the window, position or placement, how often it is kept open, window material – glass, wood or metal, etc.). Children living in households with a separate kitchen were less likely to have active TB as was also found in India [23].

One of the major limitations of this study was that, due to the small sample size, it is difficult to adequately represent the scenario about the underlying risk factors of childhood TB. Moreover, since this study was also conducted in one catchment area, it may not have been entirely representative of the Bangladeshi childhood TB-positive population.

Conclusion

To conclude, improvement in the living standard of children (housing condition etc.) will help in reducing childhood TB in the community. The tuberculosis prevention programme in Bangladesh

mostly focuses on detecting and treating index cases. Contact tracing and contact screening should also be incorporated as part of the National TB Control Programme for early diagnosis and treatment. Poverty, lack of education, poor housing, urban environments and overcrowding are all associated with increased transmission.

References

1. World Health Organization (2016) National Guidelines for the Management of Tuberculosis in Children, Bangladesh.
2. Karim MR, Rahman MA, Mamun SA, Alam MA, Akhter S (2012) Risk factors of childhood tuberculosis: a case control study from rural Bangladesh. WHO South East Asia J Public Health 1: 76-84.
3. Van Rie A, Beyers N, Gie RP, Kunneke M, Zietsman L, et al. (1999) Childhood tuberculosis in an urban population in South Africa: burden and risk factor. Arch Dis Child 80: 433-437.
4. Nelson LJ, Wells CD (2004) Global epidemiology of childhood tuberculosis [Childhood TB]. Int J Tuberc Lung Dis 8: 636-647.
5. Lönnroth K, Jaramillo E, Williams BG, Dye C, Raviglione M (2009) Drivers of tuberculosis epidemics: the role of risk factors and social determinants. Soc Sci Med 68: 2240-2246.
6. Dodd PJ, Gardiner E, Coghlan R, Seddon JA (2004) Burden of childhood tuberculosis in 22 high-burden countries: a mathematical modelling study. lancet glob health 2: e453-459.
7. Talukder K, Salim MA, Jerin I, Sharmin F, Talukder M, et al. (2012) Intervention to increase detection of childhood tuberculosis in Bangladesh. Int J Tuberc Lung Dis 16: 70-75.
8. Singh M, Mynak ML, Kumar L, Mathew JL, Jindal SK (2005) Prevalence and risk factors for transmission of infection among children in household contact with adults having pulmonary tuberculosis. Arch Dis Child 90: 624-628.
9. Lienhardt C, Fielding K, Sillah JS, Bah B, Gustafson P, et al. (2005) Investigation of the risk factors for tuberculosis: a case–control study in three countries in West Africa. Int J Epidemiol 34: 914-923.
10. Marais BJ, Obihara CC, Warren RM, Schaaf HS, Gie RP, et al. (2005) The burden of childhood tuberculosis: a public health perspective. Int J Tuberc Lung Dis 9: 1305-1313.
11. Donald PR (2002) Childhood tuberculosis: out of control?. Current opinion in pulmonary medicine 8: 178-182.
12. Marais BJ, Graham SM, Cotton MF, Beyers N (2007) Diagnostic and management challenges for childhood tuberculosis in the era of HIV. J Infect Dis 196: S76-85.
13. Marais BJ, Pai M (2007) New approaches and emerging technologies in the diagnosis of childhood tuberculosis. Paediatr Respir Rev 8: 124-133.
14. Marais BJ, Gie RP, Schaaf HS, Beyers N, Donald PR, et al. (2006) Childhood pulmonary tuberculosis: old wisdom and new challenges. Am J respiratory critical care med 173: 1078-1090.
15. Marais BJ, Schaaf HS (2010) Childhood tuberculosis: an emerging and previously neglected problem. Infect Dis Clin North Am 24: 727-749.
16. Newton SM, Brent AJ, Anderson S, Whittaker E, Kampmann B (2008) Paediatric tuberculosis. Lancet infect Dis 8: 498-510.
17. Reddy K, Moore D, Gilman R (2009) Tuberculosis in Childhood and Pregnancy. In Maternal Child Health 1: 245-269.
18. Hesseling A, Schaaf H, Gie R, Starke J, Beyers N (2002) A critical review of diagnostic approaches used in the diagnosis of childhood tuberculosis. Int J Tuberc Lung Dis 6: 1038-1045.
19. Marais BJ, Gie RP, Schaaf HS, Hesseling AC, Obihara CC, et al. (2004) The clinical epidemiology of childhood pulmonary tuberculosis: a critical review of literature from the pre-chemotherapy era. Int J Tub Lung Dis 8: 278-285.
20. Abubakar I, Laundy M, French CE, Shingadia D (2008) Epidemiology and treatment outcome of childhood Tuberculosis in England and Wales: 1999 to 2006. Arch Dis Child 93: 1017-1021.
21. Berman S, Kibel MA, Fourie PB, Strebel PM (1992) Childhood tuberculosis and tuberculous meningitis: high incidence rates in the Western Cape of South Africa. Tuber Lung Dis 73: 349-355.
22. Nguyen TH, Odermatt P, Slesak G, Barennes H (2009) Risk of latent tuberculosis infection in children living in households with tuberculosis patients: a cross sectional survey in remote northern Lao People's Democratic Republic. BMC Infect Dis 9: 96.
23. Kochi A (1991) The global tuberculosis situation and the new control strategy of the World Health Organization. Tubercle 72: 1-6.

Author Affiliations

Top

[1]*Department of Public Health, North South University, Dhaka, Bangladesh*

[2]*Health Management BD foundation, Dhaka, Bangladesh*