Original Article

Influence of knowledge about their disease in TB patients on their motivation to assist in contact investigation

R M U K Rathnayake[1], R M J B Rathnayake[2], T L Rathnayake[3]

[1]Chest Clinic, Matara, [2]Lady Ridgeway Hospital for Children, Colombo, [3]District General Hospital, Matara

Abstract

Introduction
Contact investigation involves the systematic evaluation of the contacts of known TB patients to identify active disease or latent TB infection (LTBI). Poor knowledge and negative thoughts about the disease adversely affect contact investigation.

Objective
To determine the association between knowledge about disease transmission, treatment and prevention and the presence of a negative attitude to the disease and successful completion of contact investigation among sputum positive tuberculosis patients attending a clinic.

Methods
This was a descriptive, cross-sectional study carried out at the Chest Clinic, Matara. A self-administered questionnaire was used to collect data. A negative attitude to the disease was defined as self-distancing, reluctance to divulge presence of the disease to people other than family members and mental setback and hurt due to the attitudes of others. Knowledge response variables were compared between people who cooperated with contact investigations and those who did not cooperate.

Results
Data of 133 patients were analyzed in this study. The male to female ratio was 5:4. Age ranged from 12 years to 89 years (mean=47, SD±17). Contact investigations were completed in 24% of the patients. The level of knowledge on disease transmission, treatment and prevention among patients was good. Successful completion of contact investigation was significantly associated with knowledge of the availability of prophylaxis for close contacts below 5 years of age (x^2=68, p=0.0001), knowledge of the necessity of close contact investigation (x^2 =8.83, p=0.002) and keeping a distance when talking to others (x^2=4.41, p= 0.03).

Conclusion
Completion of contact investigation was inadequate in this study sample even though average knowledge on disease transmission, treatment, and prevention was good. Health education of patients on the beneficial effects of contact investigation will help to improve successful completion.

Introduction

According to the World Health Organization (WHO), tuberculosis (TB) is a leading health issue worldwide with 10 million patients recorded in 2019. Low- and middle-income countries are mostly affected. Deaths due to TB were around 1.4 million with multi drug resistant TB aggravating the problem. Out of the total global incidence, 39% occurs in the Southeast Asian region. It is estimated that about 3.4 million new cases occur annually in this region, especially in India, Bangladesh, Indonesia, Myanmar and Thailand. Many social factors influence the spread of TB such as poor quality of life, poor housing, overcrowding, under nutrition, smoking, alcohol abuse, low level of education and lack of knowledge about transmission of the disease. According to the WHO, identified high risk groups include children below 5 years and people with human immunodeficiency virus (HIV) infection or those at a risk of developing HIV infection. Ten percent of TB patients are children. Among HIV patients, TB is a salient cause of death. According to studies conducted in India, diabetes has become an independent risk factor for TB [1].

The control of TB will be an important contributing factor to social and economic development. A resolution was made by the 67th World Health Assembly to target a world free of TB by the year 2035. This resolution, named as the "End TB Strategy", aims to reduce TB deaths by 95%, to reduce the TB incidence rate by 90% and to minimize the appalling expenditure experienced by patients and their families to zero. This strategy is being implemented globally and it is expected to achieve certain interim milestones by 2020, 2025 and 2030 [2]. To achieve these goals, it is crucial to detect patients with active TB or latent infection by an orderly assessment of contacts in view of preventing further spread.

It has been postulated that one patient could transmit the disease to ten others during the infectious period. Hence active contact investigation plays a major role to stop spread. Contact investigation also identifies people with latent TB infection (LTBI) who could be given prophylaxis to prevent transmission. The WHO has developed international standards for contact investigation [3].

In the Southeast Asian region, Sri Lanka stands as a low prevalence country [4]. The WHO estimate of incidence of TB in Sri Lanka was 65 (57-73) per 100,000 population [5]. Accordingly, an estimated 13,000 people contracted TB in Sri Lanka in 2015. This estimates guide the case detection and preventive activities. However, the case detection rate for that year was only 45.9%. According to the annual statistics for 2016, a total of 8886 cases of all forms of TB were notified to the National Programme for Tuberculosis and Chest Diseases (NPTCCD) [6]. Almost 60% of them were smear positive for pulmonary TB. The incidence rate for TB was 40 per 100,000 population in Sri Lanka in 2018. Matara District had 216 cases in the year 2018. Out of them 48% were smear positive [7].

In this background, it is valuable to assess knowledge about the disease among TB patients and to evaluate their motivation to assist in the contact investigation conducted by the public health team. This information may help to design strategies to influence the

success of contact investigation and strengthen preventive activities in the Matara District.

Objectives

To assess the influence of knowledge on transmission, treatment and prevention of TB and attitude towards the disease on patient motivation to assist contact investigation by the public health team, among sputum positive tuberculosis patients

Methods

A descriptive cross-sectional study was conducted at the Chest Clinic, Matara for one year from 2019.02.15. Patients were educated on disease transmission, treatment and prevention by the public health staff at the first visit. Patients with pulmonary TB who were smear positive were recruited for the study four months after the diagnosis. Patients with pulmonary TB who were smear negative and patients with extra-pulmonary tuberculosis (EPTB) were excluded. A systematic convenient sampling method was applied. Patients who fulfilled the inclusion criteria were recruited until the required sample size was reached. Sample size was calculated according to the recommended formula for prevalence studies, aiming a precision of 0.05 and standard deviation at a 95% confidence of 1.96 [8]. The sample size required for this study was 138.

Data was collected using a pre-tested, self-administered questionnaire which was given to the patient at their 4th visit to the clinic. The questionnaire comprised of close ended questions in four categories, in addition to demographic data. Knowledge about the disease transmission, treatment and prevention and the patient's attitude towards the disease were the four categories assessed. Education level of the participants was classified according to the International Standard Classification of Education (ISED) (2011). Employment of the participants was categorized according to the International Standard Classification of Occupations (ISCO). Definitions for 'index case', 'contact', 'exposure', 'close contact' and 'contact investigation' were obtained from the WHO guideline [9]. "Index case" (index patient) is the initially identified case of new or recurrent TB in a person of any age in a specific household and other comparable setting in which others may have been exposed. "Contact" means any person who has been exposed to an index case. Exposure can be defined as a state of contact or proximity to a chemical, pathogen, radioisotope or other substance by ingesting, breathing or direct contact. Exposure may be intense or casual, easily identified or obscure. Close exposure, such as sharing a living or working space, is generally easily identified and quantified, whereas casual exposure, such as on public transport or in social situations, may be unidentifiable. "Close contact" can be defined as a person who is not in the household but shared an enclosed space, such as a social gathering place, workplace or facility for extended periods during the day with the index case during the 3 months before commencement of the current treatment episode.

"Contact investigation" means a systematic process intended to identify previously undiagnosed cases of TB among the contacts of an index case. In this study "completion

of contact investigation" means investigating all the members sharing the home of the index case. Investigations include evaluation of the history, three sputum tests (especially in adults), Mantoux test and chest radiography. An interferon gamma release assay was not considered.

Patients whose contact investigations were complete were categorized as "assisted in contact investigation" and those whose contact investigations were incomplete were considered as "not assisted in contact investigation" in this study. All independent variables were compared between patients who assisted in contact investigations in practice and patients who did not assist. Associations that were analyzed included factors like gender, age, income, education and knowledge. Responses for the questions on knowledge, baseline information and attitude towards the disease were cross tabulated between those who assisted in the contact investigation and those who did not assist in the contact investigation to determine the chi-square value. This enabled us to identify factors adversely affecting contact investigations and factors promoting contact investigation at the clinic. The ethics committee of the National Institute of Health Sciences approved the study proposal.

Results

Data of 133 patients were analyzed in this study. Age ranged from 12 years to 89 years with a mean value of 47 years and standard deviation of ±17. Majority 67.7% (n=90) were above 41 years of age. Educational status indicated that a greater proportion 83% (n=110) had lower secondary (up to Grade 11) and below education while 17% (n=23) had upper secondary (Grade 12-13) and above education. Majority 52% were employed. Out of this 57% were occupied in unskilled jobs, one third had trained jobs and the remaining 10% had higher employment. There were 32(24%) patients who assisted in contact investigation and none of the contacts were positive for pulmonary TB. Demographic information is shown in Table 1.

Table 1: Baseline characteristics of the patients

	Patient assistance for contact tracing		Total
	Yes N (%)	No N (%)	N(%)
Gender			
Male	17 (12.78)	57 (42,85)	74 (55.63)
Female	15 (11.27)	44 (33.08)	59 (44.36)
Age groups			
1- 20 years	3 (1.50)	6 (4.51)	9 (6.76)
21-30 years	8 (6.01)	12 (9.02)	20 (15.03)
31-40 years	4 (3)	10 (7.52)	14 (10.52)
41-50 years	8 (6.01)	23 (17.29)	31 (23.30)
51-60 years	4 (3)	20 (15)	24 (18.04)
61-70 years	3 (2.25)	19(14.28)	22 (16.54)
≥ 71 years	2 (1.5)	11(8.27)	13 (9.77)

Education			
Pre-primary	2 (1.5)	3 (2.25)	5(3.75)
Primary (< Grade 5)	10 (7.51)	44 (33.08)	54(40.60)
Lower secondary (Grade 6-11)	17 (12.78)	34 (25.56)	51(38.34)
Upper secondary (Grade 12-13)	3 (2.25)	18 (13.53)	21(15.78)
Post-secondary (University)	0	1(0.75)	1(0.75)
Second stage tertiary (Postgraduate)	0	1 (0.75)	1(0.75)
Marital status			
Married	25 (18.79)	79 (59.39)	104 (78)
Unmarried	7 (5.26)	22 (16.54)	29 (22)
Distance from living area to chest clinic			
0- 20 km.	16 (12)	57 (43)	73 (55)
≥21 .m	16 (12)	44 (33)	60 (45)
Unemployed	18 (13)	46 (35)	64 (48.12)
Employed group			
Elementary workers	3 (4.34)	12 (17.39)	15 (21.73)
Semi-skilled in agriculture/fisheries/forest	2 (2.89)	11 (15.94)	13 (18.84)
Sales and service providers	3 (4.34)	8 (11.59)	11 (15.94)
Machine operators	3 (4.34)	4 (5.79)	7 (10.14)
Armed force	3 (4.34)	3 (4.34)	6 (8.69)
Craft workers	0	5 (7.24)	5 (7.24)
Technicians	0	5 (7.24)	5 (7.24)
Professionals	0	4 (5.79)	4 (5.79)
Managers	0	2 (2.89)	2 (2.89)
Clerical	0	1 (1.44)	1 (1.44)

Knowledge about the disease was assessed with questions on disease transmission, treatment and prevention. Results of the responses are indicated by numbers and percentages and statistical significance is indicated by the p-value.

Table 2: Knowledge on disease transmission, treatment and prevention

	Responses	Patient assistance in contact tracing Number (%)		Total N(%)	χ^2 P-value
		Yes	No		
Knowledge on transmission					
Do you know that poor ventilation and poor exposure to sunlight could facilitate transmission of TB at home? N =133	Yes	29 (21.8)	87 (65.41)	116 (87.21)	3, 0.222
	No	3 (2.25)	14 (10.52)	17 (12.78)	
	Yes	28 (21.05)	83(62.40)	111 (83.45)	0.7, 0.697

Do you think that TB could transmit to close contact from the TB patients? N=133	No	4 (3.0)	18 (13.52)	22 (16.54)	
Do you think that TB germs enter into the lung through air? N=132	Yes	26 (19.6)	75 (56.81)	101 (76.51)	1.5, 0.471
	No	6 (4.54)	25 (18.93)	31(23.48)	
Do you know that overcrowding of your home or place of residence could help transmission of TB? N=133	Yes	24 (18.04)	68 (51.12)	92 (69.17)	3, 0.222
	No	8 (6.01)	33 (24.81)	41(30.82)	
Do you think that diabetes mellitus or a state of immune suppression could increase the chance of contracting the disease? N=133	Yes	19 (14.2)	64 (48.12)	83(62.40)	0.7, 0.918
	No	13 (9.77)	37 (27.81)	50(37.59)	
Do you think that TB could be contracted when there is poor nutrition? N=132	Yes	16 (12.12)	61 (46.21)	77(58.33)	0.7 0.386
	No	15 (11.3)	40 (30.3)	55(41.66)	
Do you know that TB could affect other organs other than the lung? N=133	Yes	12 (9.02)	25 (18.79)	37(27.81)	2.5 0.279
	No	20 (15.03)	76 (57.14)	96(72.18)	
Knowledge on treatment					
Do you know the benefits of obtaining medicine from a responsible person in your area during the first two months? N=131	Yes	27 (20.61)	89 (67.93)	116(88.54)	0.08 0.77
	No	4 (3.05)	11 (8.39)	15(11.45)	
Do you think that the disease cannot be cured even after treatment? N=132	Yes	6 (4.54)	20 (15.15)	26(19.69)	0.02 0.87
	No	26(19.69)	80 (60.6)	106(80.30)	
Do you know that there is a preventive treatment for children below 5 years who are close contacts? N=129	Yes	23 (17.82)	4 (3.1)	27(20.93)	68 0.0001*
	No	9 (6.97)	93 (72.09)	102(79.06)	
Knowledge on prevention					
Are you satisfied with the facilities available for investigations at the chest clinic? N=132	Yes	31 (23.48)	93 (70.45)	124(93.93)	6.3 0.424
	No	1 (0.75)	7 (5.30)	8(6.06)	
Are you satisfied with the maintenance of confidentiality by the doctors, health workers and the PHI? N=131	Yes	31 (23.66)	92 (70.22)	123(93.89)	0.6 0.418
	No	1 (0.76)	7 (5.34)	8(6.10)	
Do you think that it is appropriate to visit your home by health workers to investigate people whom you are in contact with? N=131	Yes	26 (19.84)	81 (61.83)	107(81.67)	0.005 0.94
	No	6 (4.58)	18 (13.74)	24(18.32)	

Do you think that it is appropriate to postpone investigations of close contacts as they do not have symptoms? N=132	Yes	26 (19.69)	74 (56.06)	100(75.75)	0.008 0.92
	No	5 (3.78)	15 (11.36)	20(15.15)	
Do you think that it is not necessary to investigate your close contacts for TB? N=132	Yes	15 (11.36)	75 (56.81)	90(68.18)	8.83, 0.002*
	No	17 (12.87)	25 (18.93)	42(31.81)	

Table 3: Attitude of the patients towards the disease

Attitude towards the disease	Response	Patient assistance for contact tracing		Total (%)	$\chi^{2,}$ P-value
		Yes N(%)	No N(%)		
1. Do you keep a distance when talking to the others? N=130	Yes	22(16.92)	82(63.07)	104 (80)	4.41 0.03*
	No	9(6,92)	12(9.23)	26 (20)	
2. Do you like to tell about the disease to people other than the family members? N=130	Yes	24(18.46)	75(57.69)	99 (76.15)	0.035 0.849
	No	7(5.38)	24(18.46)	31 (23.84)	
3. Have you had mental set back due to the illness? N=131	Yes	22(16.79)	60(45.8)	82 (62.59)	1.21 0.27
	No	9(6.81)	40(30.5)	49 (37.40)	
4. Were you hurt due to the attitude of the people towards you after the illness? N=132	Yes	17(12.87)	38(28.7)	55 (41.67)	2.28 0.13
	No	15(11.36)	62(47.32)	77 (58.33)	
5. Do you have a fear that somebody known to you may see you attending the clinic? N=131	Yes	13(9.92)	39(29.7)	52 (39.39)	0.08 0.77
	No	18(13.74)	61(46.56)	79 (60.30)	
6. Do you think that you have become a burden to your family because of the illness? N=133	Yes	13(9.77)	31(23.3)	44 (33.08)	1.08 0.29
	No	19(14.28)	70(52.63)	89 (66.91)	
7. Do you believe that contracting the disease was an obstacle to the future achievements of the family? n=131	Yes	11(8.39)	31(23.6)	42 (32.06)	0.10 0.74
	No	21(16.03)	68(51.9)	89 (67.93)	
8. Do you feel that you have been isolated from the family and the society due to the illness? N=131	Yes	13(9.92)	25(19.08)	38 (29.01)	3.29 0.06
	No	18(13.74)	75(57.2)	93 (70.99)	
9. Are you keeping away from sexual life due to the illness? N=97	Yes	10(10.3)	20(20.6)	30 (30.93)	1.72 0.18
	No	14(14.43)	53(54.63)	67 (69.07)	
10. Are you reluctant to tell your family that you are suffering from TB? N=125	Yes	10(8)	18(14.4)	28 (22.40)	2.71 0.09
	No	20(16)	77(61.6)	97 (77.60)	

An analysis was done to establish any relationship between the "assisted in contact investigation" and "not assisted in contact investigation" groups with several outcome variables. The level of education [below lower secondary (99, 74.4%) and upper secondary (17, 12.8%)] did not show a statistically significant difference between the two groups (chi-square 0.45 p-value=0.498). Similarly, age below 40 years (43,32.3%) and above 41 years (90,67.7%) did not show any significant relationship with assistance (chi-square statistic 4.07, p-value=0435). Finally, skilled employees (30, 43%) and unskilled employees (39,57 %) did not differ in relation to contact investigation (chi-square 0.002, p-value=0.958).

Discussion

This study sample comprised TB patients with a male to female ratio of 5:4 and a wide age range. Education level included 44% with education below Grade 5, lower secondary education level among 38% and upper secondary and above in approximately 18%. The majority (78%) were married. Approximately half the sample lived within 20 kilometers of the clinic and the rest lived in distant places. Therefore, some people may have experienced difficulties in attending the clinic for the contact investigation. There were approximately equal numbers of employed and unemployed persons. Among the employed, 40% were elementary workers and semi-skilled workers. Contact investigation was completed in only 24% of patients in this study group. Although knowledge on disease transmission, treatment and prevention was satisfactory, it seems not to have influenced the patient's motivation to assist contact investigation. There were many reasons for this shortfall; about 67% of patients thought that it was not necessary to investigate close contacts and 75% thought that close contact investigation could be postponed as they do not have symptoms. Negative attitudes towards the disease may have contributed to the low interest in contact investigation. However, educational levels, age and employment status did not show any significant association with the willingness of patients to assist in contact investigation.

Knowledge on the effect of ventilation and exposure to natural light on disease transmission was adequate among patients. It is recommended by the Sri Lanka health authority for urban areas to have one seventh of the floor area of a room as windows and doors in a dwelling [10]. A study conducted on a small outbreak of TB in an office building in China has highlighted the importance of ventilation. The study had shown that workers in the office where two active pulmonary TB patients were found were more affected than workers in the manufacturing section. Furthermore, genome sequencing confirmed spread from the identified patients indicating intra office transmission [11].

Majority had good knowledge on the transmission of TB from the index case to close contacts. However, this knowledge did not seem to motivate patients to assist contact investigation. Aggressive contact investigation was found to be effective in early detection and prevention of TB in a retrospective cohort study conducted in Korea in 2020. This retrospective cohort study included 116,742 contacts identified during the investigation of 2,609 TB cases diagnosed from January to December 2015.During the mean

observation period of 2.9 years, 499 of 116,742 contacts (0.4%) developed new active TB. From these contacts, 404 (81.0%) developed TB within 2 years after exposure. The 2-year Kaplan-Meier cumulative risk for TB was the highest in contacts aged ≥65 years [1%; 95% confidence interval (CI), 0.8–1.3]. Contacts with LTBI who completed chemoprophylaxis exhibited a lower risk of active TB development than those without chemoprophylaxis. Contacts above the age of 65 years showed the highest 2-year Kaplan-Meier cumulative risk for TB. Furthermore, this study showed that there was a lower risk of developing active TB in contacts with LTBI who had completed chemoprophylaxis [12]. Contact investigation was able to detect active tuberculosis cases among 6% of contacts in Thailand [13]. In a US study, eligible contacts were selected and the tuberculin skin test (TST) was done. Out of them 36% became TST positive. Most were household contacts or contacts of highly smear positive patients or contacts of TB patients with a cavity [14].

Knowledge on overcrowding and high rate of transmission of TB was adequate among the patients in our study. Incidence of TB in New Zealand was associated with household crowding [15]. A study conducted in Uganda reported overcrowding of homes as a risk factor among 57.3% of close contacts [16]. A Brazilian study recognized a positive relationship between overcrowding at home and the incidence of TB. When prison inmates are considered, the risk of TB is higher as their living conditions are poor with overcrowding and inadequate health care facilities [17]. A study conducted in Naples, Italy revealed an association between population density and increased incidence of TB [18]. Studies conducted in West Africa showed an increased incidence of TB with overcrowding. Households with 6 to 10 adults or more had an increased risk of TB compared to households with less than 5 people [19].

This study revealed that only one third of the patients knew about the higher risk of tuberculosis in people with diabetes mellitus (DM), poor immune status or poor nutritional status. A study in Kerala, India also revealed that both urban and rural people had poor knowledge on the proneness to tuberculosis in diabetes [20]. This is an important fact to incorporate in health education as the prevalence of diabetes is increasing. Out of an estimated world population with diabetes mellitus of 415 million, about 80% live in low- and middle-income countries. Moreover, the prevalence of diabetes is predicted to rise in regions where a high incidence of TB is reported. Diabetes increases the risk of occurrence of TB by three-fold according to a systematic review of 13 observational studies [21]. A study from China revealed diabetes as a risk factor for developing TB among contacts within a period of 5 years after diagnosing the index case [22].
Knowledge that TB can affect other organs was poor among the patients. This fact needs to be highlighted in health education as EPTB worldwide is about 13.37–53% of TB [23].

Majority of the patients had good knowledge about the importance of obtaining treatment from a responsible person in their village. An Indian study has shown that 29% of patients had satisfactory knowledge about the directly observed treatment-short course (DOTS) method [24] while 36% of the patients in a study conducted in Sudan had

adequate knowledge about tuberculosis and its treatment [25]. Majority of patients believed that treatment could cure the disease in this study.

Knowledge on chemoprophylaxis for children under 5 years of age was poor. However, there was a statistically significant association between assisting contact investigation and adequate knowledge about the availability of prophylaxis. This shows that in-depth knowledge regarding beneficial effects of contact investigation could be a motivational factor to improve the health seeking behavior of patients. In this context, health education has a big role to play. A recently conducted Indian study has revealed that only eight percent had heard about TB prophylaxis [26]. A systematic review including studies of 34 countries regarding development of the disease in close contact below 5 years revealed that children who were not receiving chemoprophylaxis after a positive result on contact investigation had significantly higher incidence of active TB than children with a negative result on contact investigation [27]. Majority of the patients in this study were satisfied with the facilities at the clinic and the maintenance of confidentiality. These two factors had been identified as important factors with regards to contact investigation in a study conducted in Milan [28].

Home visits for the purpose of investigation was accepted by most of the patients. But they wanted to postpone it when there were no symptoms in the contacts. This indicates reluctance or inadequate understanding of the importance of contact investigation. A study conducted in Uganda using home based mobile short messages services had not improved household TB contact investigation. It further suggests that important obstacles to achievement of contact investigation were inadequate knowledge about TB, stigma related to the disease, expenditure to visit clinics and disappointment about clinic services [29].

Negative attitudes like self-distancing, reluctance to divulge the disease to people other than family members, mental setback and hurt due to the attitudes of the others were prevalent in this study. Social stigmatization could lead to a negative attitude and inadequate assistance to contact investigation. Fear of being seen by others at the clinic, fear of being a burden to the family, fear of compromising the future achievements of the family, feeling of isolation and fear of sexual activities indicate the stigma experienced by one third of the patients. Some patients were even reluctant to divulge their disease status to family members. Contact investigation following a case of positive TB in a "call center" in Milan identified three more TB patients among the employees. That study identified that fear of losing the job affected contact investigation [28].

Conclusion

Assistance to the public health system for contact investigation was inadequate in this study sample even though average knowledge on disease transmission, treatment and prevention was adequate. In depth knowledge on the beneficial effects of tracing contacts may have promoted contact investigation while inadequate knowledge on latent

tuberculosis may have adversely affected it. Contact tracing in TB helps in the early detection of cases and those with latent TB infection. Health education should be improved and revised to educate the patient, family members and other close contacts to understand the benefits of contact investigation.

References

1. Khan M.K, Islam M.N, Ferdous J, Alam M.M. An Overview on Epidemiology of Tuberculosis. Mymensingh Med J. 2019;28(1):259-266.

2. Ikushi Onozaki, Mario Raviglione. Stopping tuberculosis in the 21st century: Goals and strategies. Respirology.2010;15,1,32-43. https://doi.org/10.1111/j.1440-1843.2009.01673.x

3. Gregory J. Fox, Simone E. Barry, Warwick J. Britton, Guy B. Marks. Contact investigation for tuberculosis: a systematic review and meta-analysis. Eur Respir J. 2013 Jan; 41(1): 140-156. https://doi.org/10.1183/09031936.00070812

4. Wijesinghe PR, Palihawadana P, De Alwis S, Samaraweera S. Annual risk of tuberculosis infection in Sri Lanka: a low prevalent country with high BCG vaccination coverage in the South East Asia region. WHO South East Asia J Public Health 2013;2:34- 40 https://doi.org/10.4103/2224-3151.115835

5. World Health Organization. (2015). Global tuberculosis report 2015, 20th ed. World Health Organization. https://apps.who.int/iris/handle/10665/191102

6. Annual report of National Programme for Tuberculosis Control and Chest Diseases Ministry of Health, Nutrition & Indigenous Medicine Sri Lanka.2018;13-20. http://www.nptccd.info/wp-content/uploads/2020/06/Annual-Report-2018-Mail.pdf

7. National Guidelines for Management of Tuberculosis in Children. 2018. National programme for tuberculosis and chest diseases Sri Lanka. http://www.nptccd.info/wp-content/uploads/2019/03/Natonal-Guidelines-for-Management-of-tuberculosis-in-children-2018.pdf

8. Pourhoseingholi MA, Vahedi M, Rahimzadeh M. Sample size calculation in medical studies. Gastroenterol Hepatol Bed Bench. 2013 Winter;6(1):14-7. PMID: 24834239; PMCID: PMC4017493. https://pubmed.ncbi.nlm.nih.gov/24834239

9. Recommendations for Investigating Contacts of Persons with Infectious Tuberculosis in Low- and Middle-Income Countries. Geneva: World Health Organization; 2012. PMID: 24404639.

10. Urban Development Authority, Ministry Of Urban Development, Housing and Construction, Building regulations (1999) "City of Colombo Development Plan 1999"

11. X J Guo, H E Takiff, J Wang, G Y Han, Y Z Fan, G H Wu, J P Ma, S Y Liu. An Office Building Outbreak: The Changing Epidemiology of Tuberculosis in Shenzhen, China Epidemiol Infect, 148, e59, 2020 Feb 24. https://doi.org/10.1017/S0950268820000552

12. Shin Young Park, Sunmi Han, Young-Man Kim, Jieun Kim, Sodam Lee, Jiyeon Yang, Un-Na Kim, Mi-Sun Park. Risk of Active Tuberculosis Development in Contacts

Exposed to Infectious Tuberculosis in Congregate Settings in Korea Sci Rep, 10 (1), 1306, 2020 Jan 28. https://doi.org/10.1038/s41598-020-57697-1

13. Imsanguan W, Bupachat S, Wanchaithanawong V, Luangjina S, Thawtheong S, Nedsuwan S, Pungrassami P, Mahasirimongkol S, Wiriyaprasobchok A, Kaewmamuang K, Kamolwat P, Ngamvithayapong-Yanai J. Contact tracing for tuberculosis, Thailand. Bull World Health Organ. 2020 Mar 1;98(3):212-218. https://doi.org/10.2471/BLT.19.239293

14. Suzanne M. Marks, Zachary Taylor, Noreenl. Qualls, Robin J. Shrestha-Kuwahara, Maureena. Wilce, Cristy H. Nguyen. Outcomes of Contact Investigations of Infectious Tuberculosis Patients.Am J Respir Crit Care Med. 2000 Dec; 162(6): 2033-2038. https://doi.org/10.1164/ajrccm.162.6.2004022

15. Michael BakerDillip DasKamalesh VenugopalKamalesh VenugopalPhilippa Howden-ChapmanPhilippa Howden-Chapman. Tuberculosis Associated With Household Crowding in a Developed Country. 2008.Journal of epidemiology and community health 62(8):715-21.
https://doi.org/10.1136/jech.2007.063610

16. Kirenga, B.J., Ssengooba, W., Muwonge, C. et al. Tuberculosis risk factors among tuberculosis patients in Kampala, Uganda: implications for tuberculosis control. BMC Public Health 15, 13 (2015). https://doi.org/10.1186/s12889-015-1376-3

17. Pelissari DM, Diaz-Quijano FA. Household crowding as a potential mediator of socioeconomic determinants of tuberculosis incidence in Brazil. PLoS One. 2017;12(4):e0176116. Published 2017 Apr 18.
https://doi.org/10.1371/journal.pone.0176116

18. Ponticiello A, Sturkenboom MC, Simonetti A, Ortolani R, Malerba M, Sanduzzi A. Deprivation, immigration and tuberculosis incidence in Naples, 1996–2000. Eur J Epidemiol. 2005;20:729–34. pmid:16151887
https://pubmed.ncbi.nlm.nih.gov/16151887

19. Lienhardt C, Fielding K, Sillah JS, Bah B, Gustafson P, Warndorff D et al. Investigation of the risk factors for tuberculosis: a case–control study in three countries in West Africa. Int J Epidemiol 2005; 34: 914–923. pmid:15914505
https://pubmed.ncbi.nlm.nih.gov/15914505

20. Princy Felicia J, Thirunaaukarasu D, Roseline F. William, Gladius Jennifer H. Perception of tuberculosis among diabetics attending health training centres of a medical college hospital, Kancheepuram district, Tamil Nadu. Int J Community Med Public Health. 2019 Dec;6(12):5296-5301.
https://doi.org/10.18203/2394-6040.ijcmph20195488

21. Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: a systematic review of 13 observational studies. PLoS Med. 2008 Jul 15;5(7):e152. doi: 10.1371/journal.pmed.0050152. PMID: 18630984; PMCID: PMC2459204.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2459204

22. Restrepo BI. Diabetes and Tuberculosis. Microbiol Spectr. 2016;4(6):10.1128/microbiolspec. TNMI7-0023-2016.
https://doi.org/10.1128/microbiolspec.TNMI7-0023-2016

23. Kang W, Yu J, Du J, Yang S, Chen H, Liu J, et al. (2020) The epidemiology of extrapulmonary tuberculosis in China: A large-scale multi-center observational study. PLoS ONE 15(8): e0237753. https://doi.org/10.1371/journal.pone.0237753

24. Das R , Baidya S. A study on knowledge of pulmonary tuberculosis and dots among pulmonary tuberculosis patients in West tripura district, india. SAARC Journal of Tuberculosis, Lung Diseases & HIV/AIDS,2015;XII(1) https://www.nepjol.info/index.php/SAARCTB/article/view/15935/12866

25. Mohamed A.I, Yousif M.A., Ottoa P., Bayoumi A. Knowledge of Tuberculosis: A Survey among Tuberculosis Patients in Omdurman, Sudan. Sudanese Journal of Public Health 2007;2:21-28.

26. DeLuca, A., Dhumal, G., Paradkar, M. et al. Addressing knowledge gaps and prevention for tuberculosis-infected Indian adults: a vital part of elimination. BMC Infect Dis 18, 202 (2018). https://doi.org/10.1186/s12879-018-3116-7

27. Martinez L, Cords O, Horsburgh CR, Andrews JR. The risk of tuberculosis in children after close exposure: a systematic review and individual-participant meta-analysis. Lancet. 2020 Mar 21;395(10228):973-984. https://doi.org/10.1016/S0140-6736(20)30166-5

28. Faccini M, Cantoni S, Ciconali G, Filipponi MT, Mainardi G, Marino AF, Senatore S, Codecasa LR, Ferrarese M, Gesu G, Mazzola E, Filia A. Tuberculosis-related stigma leading to an incomplete contact investigation in a low-incidence country. Epidemiol Infect. 2015 Oct;143(13):2841-8. https://doi.org/10.1017/S095026881400394X

29. Davis JL, Turimumahoro P, Meyer AJ, et al. Home-based tuberculosis contact investigation in Uganda: a household randomised trial. ERJ Open Res. 2019;5(3):00112-2019. Published 2019 Jul 29. https://doi.org/10.1183/23120541.00112-2019