Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(5C):1617-1623 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2016.v04i05.034

Original Research Article

Tuberculosis Status Among Cured or Treatment Completed Pediatric Tuberculosis Patients under Revised National Tuberculosis Control Programme in Delhi

Bhushan Kamble[1], Sanjeet Panesar[2], Saudan Singh[3], Jugal Kishore[4]
[1]Post graduate student,[2]Senior Resident, [3]Director Professor, [4]Professor & Head, Department of community medicine, VMMC and Safdarjung Hospital, New Delhi-110029

***Corresponding author**
Dr. Bhushan Kamble
Email: dr.bhushan@hotmail.com

Abstract: In Delhi, out of all new cases registered every year, about 14% cases occur in children.The RNTCP does not follow up patients for relapses, MDR-TB after treatment completion. The primary objective of this study was to assess the tuberculosis status of pediatric TB patients (<14 years) registered at DOTS center after two year of treatment completion. We conducted retrospective cohort study during January 2014 to October 2014. Out of 10 RNTCP zones of Delhi state, two zones namely south zone and south west zone were selected by convenient sampling method and all pediatric tuberculosis patients who were declared as cured or treatment completed at these two zones had been selected by complete enumeration method. We studied 462 study subjects regarding tuberculosis status after cure. Among 462 study subjects, majority were having extra-pulmonary tuberculosis 290 (62.7%) and only 172 (37.3%) were having pulmonary TB. We found that during the last 2 year, 22(4.8%) were having re-treatment other, 16(3.5%) developed Relapse and 3(0.6%) died due to TB. At current (time of interview), 11(2.4%) were re-treatment other, 8(1.7%) were having relapse and 3 (0.6%) were having MDR-TB. High proportion of recurrence was seen in pulmonary TB subjects, the difference was statistically significant (p- value0.001).
Keywords: Tuberculosis status, Pediatric TB patients, RNTCP, Delhi.

INTRODUCTION:

Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis [1]. It is estimated that one third of world's population is infected with Mycobacterium tuberculosis.Globally, out of 9 million cases, about 1 million cases (11%) occur in children (under 14 year of age) every year with more than 1, 00,000 deaths [2]. As per the RNTCP report, in Delhi, out of all new cases registered every year, about 14% cases occur in children. Infected children represent the pool from which a large proportion of future cases of adult TB will arise. In addition, childhood TB is a sentinel event, indicating ongoing transmission of TB within communities [3]. This "Orphan disease" exists in the shadow of adult TB and is significant child health problem, but is neglected.

Childhood TB patients under India's RNTCP are managed using diagnostic algorithms and DOTS with thrice-weekly regimens for 6-8 months and are declared either cured or treatment completed at end of treatment. Most cases of relapse follow completion of treatment closely and occur within 6-12 months. The RNTCP does not follow up patients for relapses and many patients who do suffer a relapse, default or fail treatment do not return to the programme [4].

There is, however, limited information on the basic demographic, clinical characteristics and programme defined treatment outcomes of these patients [5]. The current study was planned to assess tuberculosis status among cured or treatment completed pediatric tuberculosis patients.

MATERIALS AND METHODS:

Study Design:

A Retrospective Cohort Study

Study Period:

January 2014 to October 2014.

Study Area:

Delhi state is the capital of India. It is located 28^0 N Latitude and 77^0 E Longitudes. It has a population of 16 million (census 2011) with 10 RNTCP

zones, 26 chest clinics, 42 tuberculosis units, 196 Designated Microscopic Centers (DMC). DMCs are located in Municipal hospitals, Government hospitals and Medical colleges. This study was conducted in coverage area of four chest clinics of south and south west zones of Delhi. There are 2 chest clinics in each zone. South Delhi Zone has three tuberculosis units (TU) catering for 15 lakh population (1 TU at Malaviya Nagar chest clinic and 2 TU at Nehru Nagar chest clinic). South West Zone has three tuberculosis units (2 TU at LRS chest clinic and 1 at RTRM chest clinic) catering for 15 lakh population. Tuberculosis units are having DOTS Centres under them.

Study subjects:

A Retrospective Cohort of Pediatric Tuberculosis Patients who were declared as Cured or Treatment Completed 24 months prior to the date of starting of the data collection (From January 2012 To October 2012).

Study Methodology:

The permission for conducting the study was sought from State TB Officer (STO), Delhi state. TB register present at tuberculosis unit was used to collect details of study subjects. Study subjects were traced on given address. Apart from this, the parents or guardians of all the study subjects were also informed about the study and the consent for the same was taken. Parents or guardians of study subjects were interviewed about socio-demographic profile, past tuberculosis history, current tuberculosis status using a pre-structured, semi-open ended questionnaire. If patient had relapse, drug-resistant tuberculosis or extra-pulmonary tuberculosis during last 2year after declared as cured or treatment completed(during last 2year) or at the time of interview (At Current), detailed information regarding the same was enquired. Subjects having signs and symptoms suggestive of tuberculosis were examined and further evaluated.

Inclusion Criteria:

- Pediatric patient's declared as cured or treatment completed 24months prior to start of the data collection. (From Jan.2012 – Oct.2012).

Exclusion Criteria:

- Patients who can't be traced out even after 3 tracing attempts.
- Patients who have migrated.
- MDR-TB patients.

Sample Size:

Out of 10 RNTCP zones two zones namely South zone and South West zone are selected by convenient sampling method. All tuberculosis units in four chest clinics under south zone and south west zone (3 TU in each zone) have been taken for the study. By complete enumeration method all pediatric tuberculosis patients who were declared as cured or treatment completed, 24 months prior to the date of data collection of the study (Jan 2012- Oct 2012), registered at six tuberculosis units have been selected. We got 84 study subjects meeting the inclusion criteria from Malaviya nagar chest clinics, 180 study subjects from Nehru nagar chest clinics, 186study subjects from LRS chest clinic and 72 study subjects from RTRM chest clinic. Total 522 study subjects were selected from these four chest clinics.

We visited these 522 study subjects on their given address. We met 465 study subjects and 57 study subjects were not available on given address. Out of 465 study subjects, 3 study participant's parent not given consent. Thus, data was collected from 462 out of 522 study participants' parents/guardians.

Ethical Consideration:

Informed written consent was taken from parents or guardians of the study subjects and the personal information was kept strictly confidential. Study protocol was approved from Institution Ethics Committee of VMMC and Safdarjung hospital, New Delhi. Administrative approval was obtained from State TB Officer (STO) of Delhi state.

Data Analysis and Statistical Methods:

Data Entry was done on Microsoft Excel 2013 spread-sheet. IBM SPSS v20 statistical software was used for data analysis. Descriptive analysis was done (mean, proportion and percentages) for socio-demographic data. Categorical variables were compared using chi-square test and Fisher's exact test. $P<0.05$ was considered as statistically significant value.

RESULTS:

Socio-Demographic Data

The present study shows that majority of study subjects 276 (59.7%) were in the age group of 11 to 14 years, followed by the age group of 6 to 10 years. The study revealed that the mean age of the study subjects was 10 years (SD =3.5). A total of 462 study subjects were studied among which 281(60.8%) were females and 181 (39.2%) were males with male-female ratio of 0.6: 1. The present study revealed that 347 (75.1%) of study subjects were Hindus, 78(16.9%) were Muslims, 23(5%) were Sikhs and 14 (3%) were Christians. The majority of study subjects 405 (87.7%) lived in nuclear family and 57 (12.3%) study subjects lived in joint family. (Table 1.)

Socio-economic Status

The socio-economic status was measured using revised Kuppuswamy classification 2012. In this study majority of the study subjects 207(44.8%)

belonged to upper-lower class followed by lower-middle class 184(39.8%). Only 5(1.1%) study subjects belonged to upper class.

Table 1: Distribution of study subjects according to basic demographic profile (n=462)

Variable		No. (%)
Age group in years **(**at time of registration at DOTS center**)**	< 1	3 (0.6)
	1-5	53 (11.5)
	6-10	130 (28.1)
	11-14	276 (59.7)
Gender	Male	181 (39.2)
	Female	281 (60.8)
Religion	Hindu	347 (75.1)
	Muslim	78 (16.9)
	Sikh	23 (5.0)
	Christian	14 (3.0)
Type of family	Nuclear	405 (87.7)
	Joint	57 (12.3)

Disease classification

Among 462 study subjects at the time of registration, more than half were having extra pulmonary tuberculosis 290(62.7%) and only 172(37.3%) were having pulmonary TB.

Among 47 study subjects who developed TB during the last 2 year period, 22(46.8%) were having extra-pulmonary TB and 25 (53.2%) were having pulmonary TB.Sixteen (57.14%) out of 22 current study subjects were having pulmonary TB and 6 (42.85%) were having extra-pulmonary TB. (Table 2)

Table 2: Distribution of study subjects according to disease classification

Disease Classification	At the time of registration (n=462) No. (%)	During last 2 year (n=47) No. (%)	Current (n=22) No. (%)
Pulmonary	172 (37.3)	25 (53.2)	16 (57.1)
Extra-pulmonary	290 (62.7)	22 (46.8)	6 (42.9)
Total	185 (100)	47 (100)	22 (100)

Tuberculosis Status

We retrospectively studied 462 study subjects for their tuberculosis status after treatment completion, we found that during the last 2 year, majority of study subjects 414(89.6%) were not having symptoms suggestive of TB (Asymptomatic), 22(4.8%) were having re-treatment other, 16(3.5%) developed Relapse and 3(0.6%) died due to TB. (Table 3)

Table 3: Distribution of study subjects according to tuberculosis status during last 2 year (n=462)

Tuberculosis Status	No. (%)
Asymptomatic	414(89.6)
Relapse	16(3.5)
MDR-TB	7(1.5)
Re-treatment other	22(4.8)
Died	3(0.6)
Total	462(100)

At current (time of interview), 437 (94.6%) were asymptomatic, 11(2.4%) were re-treatment other, 8 (1.7%) were having relapse and 3 (0.6) were having MDR-TB. (Table 4)

Table 4: Distribution of study subjects according to current tuberculosis status (n=462)

Tuberculosis status	No. (%)
Asymptomatic	437 (94.6)
Relapse	8 (1.7)
MDR-TB	3 (0.6)
Re-treatment other	11(2.4)
Died	3(0.6)
Total	462(100)

Tuberculosis status with time duration

We studied the tuberculosis status of the study subjects who got recurrence during the follow period of 2 year after cure/treatment completion. Among 462 study subjects, 21(4.5%) got relapse, 26(5.6%) got re-treatment other, 7(1.5%) got the MDR-TB and 3 (0.6%) study subjects died due to TB during the period from treatment completion to time of interview. The cause of death was verified from records present with informants.

Out of 21 relapses, the majority 18 (85.7%) of relapse occurred in the first year and 12(57.1%) of total relapses were in the first 6 months of completion of treatment. Among 26 re-treatment other, more than half 14(53.8%) occurred in the first 6 months of treatment completion. All the MDR-TB occurred within first year, out of which 5(71.4%) occurred within the first 6 months of completion of treatment. (Table5)

Table 5: Distribution of study subjects according to tuberculosis status and period of treatment completion

Period after Cure/ Treatment Completion (In Months)	Relapse (n=21) No. (%)	Retreatment-other (n=26) No. (%)	MDR-TB (n=7) No. (%)
0-6	12 (57.1)	14 (53.8)	5 (71.4)
7-12	6 (28.6)	7 (26.9)	2 (28.6)
13-24	3 (14.3)	5 (19.2)	0 (0)
Total	21 (100)	26 (100)	7 (100)

Factors associated with Recurrence of TB

We analyzed the recurrence of TB during last 2 year with the gender of study subjects using chi-square test. However, the difference was not statistically significant (p- value 0.951). High proportion of recurrence was seen in pulmonary TB subjects than extra-pulmonary subjects, the difference was statistically significant (p- value0.001).

Recurrence rate was more in study subjects having history of contact (p- value < 0.05). Proportion of recurrence was higher in study participants who had missed dose during the treatment than who did not miss the doses. The difference was statistically significant (p-value <0.05). We found that studies subjects who had BCG scar were having less recurrence of TB than who did not have the BCG scar. This difference was statistically significant (p-value < 0.05). (Table 6)

Table 6: Distribution of study subjects according factor associated with recurrence of TB during last 2 year.

Sr. no.	Variable		Recurrence Yes	Recurrence No	Total	p-value
1	Gender	Male	19(10.5%)	162 (89.5%)	181 (100%)	0.951
		Female	29 (10.3%)	252(89.7%)	281 (100 %)	
2	Disease Classification	Pulmonary	28(16.3%)	144(83.7%)	172(100.0%)	0.001
		Extra-Pulmonary	20(6.9%)	270(93.1%)	290(100.0%)	
3	History of contact	Yes	32 (23.9%)	102(76.1%)	134 (100 %)	0.000
		No	16 (4.9 %)	312 (95.1 %)	328 (100)	
4	Missed Doses	Yes	31(25.6%)	90(74.4%)	121 (100 %)	0.000
		No	17(5.0%)	324 (95.0 %)	341 (100%)	
5	BCG Scar	Present	23 (6.6%)	325 (93.4%)	348 (100 %)	0.000
		Absent	25 (21.9%)	89 (78.1%)	114(100 %)	
6	Indoor Air Pollution	Present	29(10.9%)	237(89.1%)	266(100%)	0.67
		Absent	19(9.7%)	177(90.3%)	196(100%)	
7	Overcrowding	Present	46(11.2%)	364(88.8%)	410(100.0%)	0.101
		Absent	2(3.8%)	50(96.2%)	52(100.0%)	
8	Weight gain	Present	43(10.2%)	377(89.8%)	420(100.0%)	0.789#
		Absent	5(11.9%)	37(88.1%)	42(100.0%)	

#Fisher's exact test

DISCUSSION:

Socio-Demographic Data

In the present study total 462 study subjects were studied among which the majority of study subjects 276(59.7%) were in the age group of 11 to 14years, followed by the age group of 6 to 10 years130 (28.1%). Similar findings were seen from the study done in Delhi by Arora V K *et al.;* [6]. Where the majority number of patients were in the age group of 11-14 years 475(51.1%) and the study done in New

Delhi Sharma S *et al.;* [7] where the majority of patients were also in the age group of 11 to <15 years (55.1%). The study revealed that the mean age of the study subjects was 10 years (SD =3.5). However, in study done in Tamilnadu by Indumati C K *et al.;* [8] observed that mean age of their patients to be 7.6 and Shivanandan S *et al.;* [9] (2011) observed that the median age was 7.9 in study at Bangalore. These differences may be explained by the fact that these studies were hospital based.

In present study 462 study subjects were studied among which 281(60.8%) were females and 181 (39.2%) were males which was similar to study done in Ahmadabad by Thakor N *et al.;* [10] in pediatric TB patients which reported more females (60.0%) than males (40.0%). A cross sectional study by Satyanarayana S *et al.;* [11] on Characteristics and Programme-Defined Treatment Outcomes among Childhood in Delhi also reported more females 651 (61.0%). The present study revealed a male to female ratio of 0.6:1 which is similar to study done in Bangalore by Nelliyanil *et al.;* [12] which reported 0.6:1. According to the present study, among all the study subjects the proportion of Hindus was 347 (75.1%) which is lower than the census data, which reported that 80.5% of the population were Hindus[13]. so it does not imply that cases were more in Hindus but because the proportion of Hindus were more in the general population, more cases were reported among Hindus. Seventy eight (16.9%) study subjects were Muslims. The majority 405 (87.7%) of the study participants in this study lived in nuclear families. Nelliyanil *et al.;* [12] in their study on pediatric tuberculosis in Karnataka observed that 68.09% patients were from nuclear families. This difference may be explained by the fact that as most of the families in urban area are nuclear.

Socio-economic Status

In present study 221(48%) of the study subjects belonged to low socioeconomic status and 236(51.1%) belonged to middle class and 5(1.1%) belonged to high class. Nearly Similar finding seen in study by Sushmabhai S *et al.;* [14] in Kottayam district of Kerala slightly more than half (51.8%) belonged to low, 46.2% to middle and 2% to high socio-economic groups.

Disease classification

In the present study, among 462 study subjects at the time of registration, more than half were having extra-pulmonary tuberculosis 290 (62.7%) and only 172 (37.3%) were having pulmonary TB. A cross sectional study by Satyanarayana S *et al.;* [11] on Characteristics and Programme-Defined Treatment Outcomes among Childhood in Delhi also reported more extra-pulmonary cases 680(63.3%) than pulmonary 394(36.7%). Similar findings were seen in study done by Panigatti P *et al.;* [15] al in Hubble, Karnataka extra-pulmonary was common 58(62.4%) than pulmonary tuberculosis 35(37.6%).

However reverse finding was seen among 47 study subjects who developed TB during the last 2 year period, 22 (46.8%) were having extra-pulmonary TB and 25 (53.2%) were having pulmonary TB. Sixteen (57.14%) out of 22 current study participants were having pulmonary TB and 6 (42.85%) were having extra-pulmonary.This difference may be explained by the fact that more relapse occurs in pulmonary TB cases.

Tuberculosis Status

In the present retrospectively 462 study participants were studied for their tuberculosis status after treatment completion, It was found that during the last 2 year, majority of study subjects 414(89.6%) were not having symptoms suggestive of TB (Asymptomatic), 22(4.8) were having re-treatment other, 16(3.5%) developed Relapse 7(1.5%) developed MDR-TB and 3(0.6%) died due to TB. At current (time of interview), 437 (94.6%) were asymptomatic, 11(2.4%) were re-treatment other, 8 (1.7%) were having relapse and 3 (0.6) were having MDR-TB.

Mehra RK *et al.;* [16] done study in Delhi on adult TB patients which reported that out of 4905 (87.9%) successfully treated Cat I patients, 442 (9%) presented as relapses. Dave *et al.;* [17] in their study on adult tuberculosis patients in Ahmadabad, 71(10.8%) reported relapse of TB after 2 year of successful treatment completion. According to central TB division, proportion of MDR-TB in adult re-treatment cases is 15.3% [18]. In present study relapse rate and MDR-TB rate were low compared to other studies because our study was done in pediatric TB patients.

In the present study, out of 47 re-treatment cases, majority of relapses 18 (85.7%) occurred in first year of treatment completion and 12 (57.1%) out total relapses occurred in first 6months of treatment completion. Similar finding was seen in study done by Mehra *et al.;* [16] 68.5% of relapse occurred in the first year and 50% of total relapses were in the first 6 months of completion of treatment. Thomas *et al.;* [19] also found that 91.9% of the 62 relapses were within the first year and 77.4% were within the first 6 months. The period of observation in these two studies was 11 years and 1.5 years, respectively, so it is pertinent that the majority of relapses occur within the first year of successful completion of treatment.We also found that majority of Re-treatment others and MDR cases occurred in first year of treatment completion.

Factors associated with recurrence of TB

The study revealed that type of TB is associated with recurrence. High proportion of recurrence 28(57.3%) was seen in pulmonary TB subjects, the difference was statistically significant (p-value 0.001). The study subjects who were having history of contact with TB patients were having high recurrence32 (72.9%) than not having contact with TB patients (p-value <0.05). Proportion of recurrence was higher in study subjects who had missed dose 31(65.9%) during the treatment than who did not miss the doses. We found this association statistically significant (p- value <0.05).

The present study revealed that subjects who had BCG scar 23(48.9%) were having less recurrence of TB than who did not have the BCG scar. This difference was statistically significant (p-value < 0.05).As there is paucity of studies on recurrence among pediatric TB patients, we could not compare our finding with others and more research work is needed to establish these associations.

CONCLUSION:

The study concludes that Pediatric tuberculosis still continues to be a major problem in children of 11-14 years of age who are having history of contact with TB patients and belonging to lower-middle socioeconomic status. The high prevalence of cases in females in our study may be due to the fact that most of our study population belonged to unskilled workers class where the female child's nutrition and health may be neglected. Thus improving the socioeconomic conditions and proper treatment of adult TB who are the source of infection to children will go a long way in preventing pediatric TB and protect children who are the future of our country. Diagnosis of pediatric tuberculosis still continues to be a challenge. The duration of treatment for pediatric tuberculosis patients under RNTCP seems to be inadequate because most of relapses occurring with first year of treatment completion. Thus the timely follow up of successfully treatment completed pediatric tuberculosis patients is necessary to prevent development of MDR- TB and relapse among them. Awareness about tuberculosis is still inadequate among parents of TB patients.

Further research into long-term outcome of childhood tuberculosis is urgently needed. Advances in our understanding of tuberculosis in children would provide insights and opportunities to enhance efforts to control this disease.

RECOMMENDATIONS:

- All pediatric tuberculosis cases should be followed up for a minimum period of 1 year, as majority of recurrences occurs in first year of treatment completion.
- all children under 15 years of age living along with adult TB patients should be screened thoroughly and every 3 months up to the period of 1 year because children who have history of contact are more prone to develop tuberculosis disease and recurrence.
- Collaboration with NGOs has to be encouraged for outreach activities which would increase follow up of treatment completed patients and awareness regarding the recurrence of TB among local communities

REFERENCES

1. Central TB Division. Technical and operational guidelines for TB control. New Delhi: Ministry of Health and Family Welfare, Govt. of India; 2005 Dec 12.
2. Raviglione MC, O'Brien RJ; Tuberculosis. In: Fauci AS, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson JL *et al.;*(eds.) Harrison's principle of internal medicine. 17th Ed. New York: McGraw-Hill; 2008. p1006.
3. Walker K; The Story of Medicine", OUP, New York. 1955; 28-29.
4. Hershkovitz I, Donoghue HD, Minnikin DE, Besra G.S, Lee O.Y, Gernaey A.M*et al.;*Detection and molecular characterization of 9000-year-old Mycobacterium tuberculosis from a Neolithic settlement in the Eastern Mediterranean. PLoS ONE 2008; 3(10):e3426.
5. Chauhan L S; RNTCP: Past, present and future of TB control programme in India. J. Commun. Dis.2006; 38(3): 191-203.
6. Arora VK, Gupta R; Directly observed treatment for tuberculosis. Indian J pediatr 2003; 70(11):885-89.
7. Sharma S, Sarin R, Khalid UK, Singla N, Sharma PP, Behera D; The DOTS strategy for treatment of paediatric pulmonary tuberculosis in South Delhi, India.Int J Tuberc Lung Dis 2008;12:74-80.
8. Indumathi CK, Prasanna KK, Dinakar C, ShetA,Lewin S; Intermittent Short Course Therapy for Pediatric Tuberculosis. Indian Paediatr 2010; 47: 93 -96.
9. Sivanandan S, Walia M, Lodha R, Kabra S; Factors associated with treatment failure in childhood Tuberculosis. Indian Paediatr 2008; 45:769-71.
10. Thakor N, Prajapati D; Health and socio-demographic profile of paediatric tuberculosis patients on dots therapy in Ahmedabad city. Int J Med Sci Public Health. 2014; 3(9): 1123-1126.
11. Satyanarayana S, Shivashankar R, Vashist RP, Chauhan LS, Chadha SS, Dewan P.K *et al.;*Characteristics and Programme-Defined

Treatment Outcomes among Childhood Tuberculosis (TB) Patients under the National TB Programme in Delhi. PLoS ONE 2010; 5(10):e13338.

12. Nelliyanil M, Sharada MP, Joseph N, Basagoudar SS, Jayaram S,Patil D.C; A study of the socio-demographic profile and treatment outcome of paediatric tuberculosis patients in Bangalore Mahanagar Palike area. Indian J Tuberc 2012; 59(4): 207–13.
13. Religion, Census of India 2001.[cited 2015 Mar 10].Available from URL:http://censusindia.gov.in/Census_And_You/religion.aspx
14. SushamaBai S, Lekshmi Devi R; Clinical spectrum of tuberculosis in BCG vaccinated children Indian Pediatr 2002; 39:458-462.
15. Panigatti P, Ratageri VH, Shivanand I, Madhu P, Shepur N; Profile and Outcome of Childhood Tuberculosis Treated with DOTS—An Observational Study. Indian J Pediatr DOI 10.1007/s12098-013-1175-8
16. Mehra R.K, Dhingra V.K, Aggarwal Nishi, Vashist R.P; Study of relapse and failure cases of CAT I retreated with CAT II under RNTCP - An elevenyear follow-up. Indian J Tuberc, 2008; 55:188-191.
17. Dave P, Rade K, Modi B, Solanki R, Patel P, Shah A *et al.;*Assessment of Long-term Outcome among New Smear Positive Pulmonary TB Patients Treated with Intermittent Regimen under RNTCP – A Retrospective Cohort Study. Nat J Community Med 2013; 4(2):189-194.
18. Central TB Division; TB India 2013, RNTCP Annual Status Report. New Delhi: Ministry of Health and Family Welfare, Govt. of India; 2013 Mar 18.
19. Thomas A, Gopi PG, Santha T, Subramani R, Selva kumar N,Narayanan P.R; Predictors of relapse among pulmonary tuberculosis patients treated in a DOTS programme in South India. Int J Tuberc Lung Dis 2005; 9(5):556-61.