Research Article

A study on the smear conversion time and its associated factors in sputum positive Category I Tuberculosis DOTS cases in District Rohtak, Haryana

Har Ashish Jinda[l]*, Bhumika Bhatt[1], Jagbir Singh Malik[2]
[1]Junior Resident, [2]Senior Professor and Head, Department of Community Medicine, PGIMS Rohtak, India

*Corresponding author
Dr Har Ashish Jindal
Email: harry8723@gmail.com

Abstract: Tuberculosis still remains one of the major public health problems in the world. There is currently limited data available from developing countries like India on the time required for sputum smear conversion in patients who take uninterrupted DOTS. The present study was undertaken to determine the time to smear conversion in Category I DOTS patients receiving uninterrupted therapy and to determine factors that are associated with smear conversion. The NSP TB cases, which were to start their Category I treatment regimen at District Tuberculosis Centre, DOTS Centre, were recruited and an informed written consent was taken. After enrolment, various parameters were studied (recorded) on a predesigned, pre-tested, semi-structured schedule. After recording results of pre-treatment sputum specimen, recruited subjects were followed at weekly interval. Two sputum specimens were collected on each weekly follow-up. On weekly visit, the subjects were instructed to get the early morning sputum sample and a spot sputum sample was taken at the time of visit. Both the samples were examined thereafter. Weekly follow-up were continued for a maximum of 20 weeks of treatment or until the case becomes sputum smear negative, whichever was earlier. A total of 101 subjects were recruited in the study but 6 subjects could not be followed up for till their smear conversion. The median duration of smear conversion was found to be 4 weeks i.e. 28 days. Cavitatory and bilateral lesions on CXR, consumption of tobacco, pre-treatment bacterial load and BMI were independent factors associated with smear conversion.
Keywords: Tuberculosis, DOTS, sputum specimen

INTRODUCTION

Today, the world is undergoing a health transition but tuberculosis (TB), magnificently known as the "Koch's disease", still remains a major health problem, worldwide. Its control continues to elude the brightest minds and challenge the human and economic resources around the world. Millennium development goals (MDG) targets to eliminate TB as a public health problem by 2050 and to halt and reverse the prevalence and mortality by 50% in comparison to 1990 by 2015 [1].

In 2013, the annual incidence of TB in India was estimated to be 171 per lakh and prevalence was estimated to be 211 per lakh accounting to a total 1252 million including the new as well as relapse cases [1]. With a single open case infecting an 10-15 cases, it will rekindle its place with a great amount of burden on the Indian society in the near future [2]. In 2013, Haryana had 25,629 smear positive TB cases and cure rate of 85% while district Rohtak had 2,278 smear positive TB cases and cure rate of 86%.These are well above the objective of Revised National TB control program (RNTCP).According to District level Household survey

(DLHS) IV, Haryana and Rohtak had a prevalence of 1.3% and 1.4% respectively [3].

Based on the prevalence of disease in India of 2006, it was worked out to a total cost of Rs 13,000 crores a year for the country, even though the treatment and diagnosis were offered free of cost to patients. For a daily wage labourer the mean number of work-days lost was 83. Every year, more than 17 crores work-days are lost to the national economy on account of TB, amounting to Rs 700crores [4].

The sputum conversion rate (SCR) is the percentage of smear-positive pulmonary TB cases registered in a specified period that converted to smear negative status after the standard two months of the intensive phase of treatment. WHO recommends its use as a useful indicator in monitoring the TB program performance, and as a trigger for rigorous assessment in patients with still positive smear in follow up examinations? Even in well-functioning national TB programs 25% of initially smear-positive pulmonary TB patients may still be smear-positive at the end of the

intensive phase of treatment, despite good adherence and supervised medication [5].

Majority of data available on sputum conversion has been from developed countries [6-13]. There is currently limited data available from developing countries like India on the time required for sputum smear conversion in patients who take uninterrupted DOTS. The present study was undertaken to determine the time to smear conversion in Category I DOTS patients receiving uninterrupted therapy and to determine factors that are associated with smear conversion.

MATERIALS AND METHODS
Study Setting:
The study was conducted by Department of Community Medicine, PGIMS at the District Tuberculosis Centre (DTC), Rohtak (Haryana). It is located approximately 6 km from PGIMS, Rohtak and caters the population of the district. District Rohtak has a population of 10,61,204 with 42.0% living in the urban and 57.9 % living in the rural areas.[41]TB control services of the district are supervised by 2 Tuberculosis Units, one DTC itself and other being Sub Divisional Hospital (SDH), Meham. DTC is under the administrative control of District TB Officer (DTO) and is supported by their staff members. It also has diagnostic microscopic facilities and RNTCP trained Laboratory technicians for appropriate diagnosis of TB. AFB staining method used at DTC is Ziehl Neelson Staining. Apart from the DOTS centre functioning at DTC itself, it supervises five DOTS centres that provide services for TB control with the help of DOTS providers. The DOTS centre functioning at DTC itself was selected for the purpose of feasibility of the study.

Study subjects: The study subjects comprised of New Sputum Positive (NSP) TB patients in Category I as per RNTCP guidelines attending the DTC, DOTS Centre, Rohtak, who were ≥ 15 years of age and willing to take uninterrupted treatment.

Sample Size: The pre-diagnosed NSP TB cases were enrolled from DTC, DOTS Centre over a period of 7 months with a minimum of 100 study subjects.

Study design: The study was a prospective cohort.

Study Period: The study was conducted for a period of one year, from October 2013 to September 2014.The study subjects were enrolled for a period of 7 months and subjects enrolled were followed for a maximum period of next 5 months according to study criteria.

Exclusion criteria: Those who were not willing to give informed written consent, age < 15 years, smear negative cases and extra pulmonary cases were excluded from the study.

Data collection:
The NSP TB cases, which were to start their Category I treatment regimen at DTC, DOTS Centre, were recruited and an informed written consent was taken. After enrolment, various parameters were studied (recorded) on a predesigned, pre-tested, semi-structured schedule. After recording results of pre-treatment sputum specimen, recruited subjects were followed at weekly interval. Two sputum specimens were collected on each weekly follow-up.On weekly visit, the subjects were instructed to get the early morning sputum sample and a spot sputum sample was taken at the time of visit.Both the samples were examined thereafter. Weekly follow-up were continued for a maximum of 20 weeks of treatment or until the case becomes sputum smear negative, whichever was earlier. Confirmation of the slide was done by the investigator himself. Permission was granted by the State TB Officer for carrying out the study at DTC. The investigator underwent training for 5 days for sensitizing himself for the thesis work at District training centre under the guidance of District Tuberculosis Officer, Rohtak.. Ethical principles such as obtaining consent were adhered.

Data analysis: Data clean-up was performed to check for accuracy, consistencies and completeness. Data was analysed in percentages, proportions. Categorical variables were analysed by Pearson chi-square test and Odds Ratio (OR) was calculated. Stepwise multivariate regression analysis was used to find the factors independently influencing time for smear conversion and regression coefficient was used to interpret the findings.

Observations:
The mean age of the study participants was 36.19 ±15.88 years. The total number of males and females were in the ratio of 2.5:1. The study had71.3% males and 28.7% females with a mean age of 37.91 ±15.94 and 31.89 ± 15.17 years, respectively. More than half (55.4%) of the subjects were in the age group of 15-34 years. Of the total males, one fourth (25%) were in age group of 15-24 years and Of the total females, more than one third (37.9% and 34.5%) of the subjects were in age group of 25-34 years and 15-24 years, respectively.

A total of 101 subjects were recruited in the study but 6 subjects could not be followed up for till their smear conversion. The median duration of smear conversion was found to be 4 weeks i.e. 28 days. According to RNTCP, [42]

Smear Conversion Rate (SCR) = $\dfrac{\text{No. of patients with smear conversion}}{\text{No. of patients initiated on treatment}}$ x 100

At 4weeks from the start of the treatment 67.3 % of the study subjects had sputum conversion. At 8 weeks another 12 subjects were found to be sputum negative accounting to 79.2% of smear conversion and till 12 weeks' time, another 14 subjects had smear conversion leading to a sputum conversion rate of 93.1%. One case was a failure and had remained sputum positive till 20 weeks and was shifted to failure category.

Table 1: Association of smear conversion at different time interval with various socio-demographic factors

Socio demographic factors	Smear Conversion			Total	p value
	4 weeks	**8 weeks**	**12 weeks**		
Gender					
Female	15(22.1)	8(66.7)	3(21.4)	26(27.7)	χ^2=10.46, df=2
Male	53(77.9)	4(33.3)	11(78.6)	68(72.3)	p = 0.005
Age groups					
<40 years	38(55.9)	8(66.7)	9(64.3)	55(58.5)	χ^2=1.7, df=2
>40 years	30(44.1)	4(33.3)	5(35.7)	39(41.5)	p = 0.428
Education					
Literate	52(76.5)	8(66.7)	11(78.6)	71(75.5)	χ^2=.613, df=2
Illiterate	16(23.5)	4(33.3)	3(21.4)	23(24.4)	p = 0.736
Total family income per month (in Rs)					
<10000	41(60.3)	8(66.7)	9(64.3)	58(61.7)	χ^2=19.37, df=6
10000-50000	27(39.7)	4(33.3)	2(14.3)	33(35.1)	p = 0.004
50000-100000	0(0)	0(0)	2(14.3)	2(2.1)	
>100000	0(0)	0(0)	1(7.1)	1(1.1)	
Occupation					
Labourer	24(35.3)	4(33.3)	8(57.2)	36(38.3)	χ^2=17.96, df=12
Agriculture	5(7.4)	0(0)	3(21.5)	8(8.5)	p = 0.117
Student	13(19.1)	5(41.7)	0(0)	18(19.1)	
Housewife	7(10.2)	3(25)	1(7.1)	11(11.7)	
Private job	11(16.2)	0	1(7.1)	12(12.8)	
Govt. service	3(4.4)	0	0(0)	3(3.2)	
Others	5(7.4)	0	1(7.1)	6(6.4)	
Total	68(100)	12(100)	14(100)	94(100)	

(The values in parentheses indicate percentage)

Table 2: Association of socio economic status of the study subjects with smear conversion at different intervals

Socio economic status	Smear conversion			Total	p value
	4weeks	**8weeks**	**12 weeks**		
Upper	1(1.5)	0(0)	0(0)	1(1.1)	χ^2= 10.15, df = 8
Upper middle	5(7.4)	1(8.3)	0(0)	6(6.4)	p = 0.254
Lower middle	24(35.3)	4(33.3)	1(7.1)	29(30.8)	
Upper lower	37(54.3)	6(50)	13(92.9)	56(59.6)	
Lower	1(1.5)	1(8.4)	0(0)	2(2.1)	
Total	68(100)	12(100)	14(100)	94(100)	

(The values in parentheses indicate percentage)

Table 3: Association of consumption of tobacco and alcohol with smear conversion at different time intervals

Consumption of tobacco	Smear conversion			Total	p value
	4 weeks	**8 weeks**	**12 weeks**		
Yes	32(47.1)	4(33.3)	12(85.7)	48(51.1)	χ^2= 8.67, df = 2
No	36(52.9)	8(66.7)	2(14.3)	46(48.9)	p = 0.013
Consumption of alcohol					
Yes	30(44.1)	3(25)	6(42.9)	39(41.5)	χ^2= 1.54, df = 2
No	38(55.9)	9(75)	8(57.1)	55(58.5)	p = 0.461
Total	68(100)	12(100)	14(100)	94(100)	

(The values in parentheses indicate percentage)

Table 4: Association of BMI with smear conversion at different time intervals

BMI	Smear Conversion			Total	p value
	4 weeks	**8 weeks**	**12 weeks**		
<18.5	42(61.8)	11(91.7)	12(85.7)	65(68.1)	χ^2= 6.39, df = 2 p = 0.041
>18.5	26(35.3)	1(8.3)	2(14.3)	29(29.8)	
Total	68(100)	12(100)	14(100)	94(100)	

(The values in parentheses indicate percentage)

Table 5: Association of pre-treatment bacillary load with smear conversion at different time intervals

Pre-treatment bacillary load	Smear conversion			Total	p value
	4 weeks	**8 weeks**	**12 weeks**		
High bacillary load(3+)	30(44.1)	10(83.3)	9(64.3)	49(52.1)	χ^2= 7.26, df = 2 p = 0.027
Low bacillary load(1+,2+,scanty)	38(55.9)	2(16.7)	5(35.7)	45(47.9)	
Total	68(100)	12(100)	14(100)	94(100)	

(The values in parentheses indicate percentage)

Table 6: Association of findings at CXR and smear conversion at different time intervals

Findings at CXR	Smear Conversion			Total	p value
	4 weeks	**8 weeks**	**12 weeks**		
Normal	6(8.8)	1(8.3)	1(7.1)	8(8.5)	χ^2=13.49, df = 4 p = 0.009
Unilateral lesions	50(73.5)	8(66.7)	4(28.6)	62(66)	
Bilateral lesions	12(17.6)	3(25)	9(64.3)	24(25.5)	
Total	68(100)	12(100)	14(100)	94(100)	

(The values in parentheses indicate percentage)

Table 7: Association of cavitation in CXR with smear conversion at different time intervals

Findings at CXR	Smear Conversion			Total	p value
	4 weeks	**8 weeks**	**12 weeks**		
Normal	6(8.8)	1(8.3)	1(7.1)	8(8.5)	χ^2= 28.37, df = 4 p = 0.001
Cavitatory	6(8.8)	3(25)	10(71.4)	19(20.2)	
Non cavitatory	56(82.4)	8(66.7)	3(21.4)	67(71.3)	
Total	68(100)	12(100)	14(100)	94(100)	

(The values in parentheses indicate percentage)

Table 8:Step-wise multivariate regression on various factors with time taken for smear conversion in weeks

Factor	Unstandardized B coefficient	p value	Confidence limit 95% of B	
			Lower limit	Upper limit
Cavitatory lesion on CXR	2.503	0.001	1.568	3.439
Bilateral lesion on CXR	1.235	0.005	0.376	2.094
Consumption of tobacco	1.119	0.003	0.380	1.857
Pre-treatment bacterial load	1.380	0.047	0.21	2.739
BMI	-0.121	0.049	-0.242	-0.001

Constant = 4.150

The above table shows that presence of a cavitation on CXR, bilateral lesions, consumption of tobacco and an increased pre-treatment bacterial load leads to delay in the time taken for smear conversion with regression coefficients of 2.50 (95% CI 1.57-3.44), 1.23 (95% CI 0.38-2.09), 1.12 (95% CI 0.38-1.86) and 1.38 (95% CI-0.21-2.74) respectively and were found to be statistically significant (p <0.05). It was found that per unit increase in BMI leads to an early smear conversion with a regression coefficient of -0.121 (95 % Cl-0.242 to -0.001) and was statistically significant with a p value 0.047.

DISCUSSION

In the present study, the median duration for smear conversion was found to be 4 weeks i.e. 28 days. Domniguez *et al.;* had a similar finding with a mean smear conversion at 28.63 days.[10] Telzak *et al.;* found that the median time for smear conversion was 23 days [7]. Parikh *et al.;* and Long *et al.;* found that median time was 5 weeks and 43 days respectively [14, 6]. It might be due to different socio-demographic factors such as age, gender and tobacco smoking.

In the present study, it was found that at 4 weeks from the start of the treatment 67.3 % of the study subjects had smear conversion, at 8 weeks 79.2% had smear conversion and at the end 12 weeks' time, 93.1% had negative sputum smears. It was well above the current objective that is 90% cure rate among the new sputum positive TB. Bawri *et al.;* in Guwahati had comparable results with 71% patients becoming smear negative at the end of the first month, 84% patients become sputum smear negative at the end of 2nd month and 92%patient become sputum smear negative at the end of 3rd month [15]. Bouti *et al.;* in Morocco found that 77% patients became non-infectious after four weeks of standard treatment regimen and 94% at 8 weeks [16]. Baruwa *et al.;* also found sputum conversion of 68% of the subjects at the end of 1st month among 175 subjects [17]. Chaves Pachas *et al.;* found that at the end of the 12th weeks, the smear conversion rate was 93.3%, which is comparable to the present study [18]. Pajankar *et al.;* found a SCR of 78.5% at the end of two months of DOT for pulmonary tuberculosis similar to 82.4% SCR noted by Gopi *et al.;* and 75% by Rieder HL which are in accordance with the findings of the present study [13,19, 20]. Ruohonen *et al.;* also reported that sputum was negative in 82.8% of patients at the end of the 2nd month and 91.1% at the end of the 3rd month [21]. Thus there is variation in the response rates but the response is clearly evident by the end of 2nd month. The study conducted by Frieden showed that sputum conversion rates at the end of 2 months were 62.2% and 81.3% at the end of 3 months [22]. On the contrary, Parikh *et al.;* in Mumbai found that rate of sputum conversion at the end of one month of treatment was 34.8% while it was 44.7% between one and two months [14]. This might be due to different socio demographic and cultural factors and difference in adherence to the treatment in the study groups.

It was found in the present study that of the total who converted at end of 12 weeks, 78.6% of the subjects were males and 21.4% of the were females and among the subjects who converted at 4 weeks, 77.9% were males and 22.1% were females but on the contrary, among the subjects who converted at end of 8 weeks, two third (66.7%) of the subjects were females and one third (33.3%) were males. On step wise regression analysis it was non-significant. Babalik *et al.;* had a similar finding that male gender was not a significant predictor of late sputum conversion in their population [23]. On the contrary, Mota *et al.;* and Rekha *et al.;* found males as a significant factor for delay in smear conversion, though Balasubramanian et al found that males were more likely to default in taking regular medications for tuberculosis compared to female patients in India [24, 25, 26]. The element of chance cannot be ruled out.

In the present study, among the subjects with conversion at end of 4, 8 and 12 weeks, 55.9%, 66.7% and 64.3% of the subjects were below 40 years of age, respectively and 44.1%, 33.3% and 35.7% of the subjects were above 40 years. This association was found to be statistically non-significant. This result correlates with the study conducted by Bouti *et al.;* who found that age groups had no significant association with a delay in smear conversion [27]. On the contrary, Kuaban *et al.;* in Cameroon and Rekha *et al.;* in Chennai, also showed that age above or equal to 45 and 40 years was a predictor of non-conversion of sputum smears [28, 26] Arora *et al.;* in India observed that geriatric patients had lower smear conversion rate compared with younger patients [29]. Singla *et al.;* in New Delhi observed in a similar study that patients aged over 60 year had an almost six times greater risk of remaining sputum positive after two months [30]. Liu *et al.;* also reported that the elderly were the least likely to have documented sputum conversion after two months of treatment [31]. This difference might be due to supervised treatment in the elderly population ensuring adequate compliance resulting in insignificant association of age and smear conversion rate.

In the present study, majority of the subjects with smear conversion were engaged in manual labour. Nearly one third (35.3% and 33.3%) of the subjects who had their smear conversion at 4 weeks and 8 weeks respectively were labourers and 57. 1% of them with smear conversion at end of 12 weeks were engaged in manual labour. Nearly two third, 61.7% of the subjects who had smear conversion had an income of less than Rs 10,000 and among the subjects with smear conversion at 4 weeks, 8 weeks and 12 weeks, 60.3% 66.7% and 64.3% had the same while 39.7% and 33.3% and 14.3% had an income of an income ranging from Rs 10,000- 50,000. It was found to be statistically significant on bivariate analysis but was non-significant on regression analysis. Mota *et al.;* found that unemployment is a significant risk factor for delay in smear conversion [24]. This could be due to poor living conditions and poor nutritional status among the subjects with poor income.

In the present study, more than half of the subjects (59.6%) who had conversion were of upper lower SES. Among the subjects who converted by the end 4 weeks , 8 weeks and 12 weeks, 54.4%, 50% and 92.9% belonged to the upper lower SES respectively while 35.5%, 33.3% and 7.1% belonged to the lower middle SES. It was statistically non-significant. Not many studies have documented this association. However, low socio-economic status and particularly lack of money are important risk factors for smear conversion for a developing nation such as India.

In the present study, among the subjects with smear conversion at 4 weeks, nearly half (47.4%), at end of 8 weeks, one third (33.3%) and at end of 12 weeks, four fifth (85.7%) of the subjects had consumed tobacco. It was found to be statistically significant bivariate as well as on step wise multiple regression analysis. Parikh et al and Mota et al also found that tobacco consumption were associated with longer duration of conversion [14, 24]. Babalik *et al.;* found that smoking for more than 20 package/year were significantly associated with the likelihood of late sputum smear conversion (OR=4.11) [23]. Previous evidence has shown that active and passive smokers have an increased risk of contracting active TB compared to non-smokers, but there is still insufficient data on the association between smoking and outcome variables [32, 33].

Among the subjects, with smear conversion at 4 weeks 44.1%, at 8 weeks 10.3% and at 12 weeks 15.4% had a history of consumption of alcohol. It was statistically non-significant. The above results correlate with Mota *et al.;* and Rekha *et al.;* who speculated that this was due to the greater prevalence of alcohol consumption by subjects [24, 25].

In the present study, among the subjects with smear conversion at end of 4 weeks, 8 weeks, 12 weeks, 61.8%, 91.7% and 85.7% subjects were underweight respectively. More than one third (35.3%) of the subject who had conversion at 4 weeks had normal BMI. On step wise multivariate regression, it was found to be statistically significant. Jeremiah *et al.;* found sputum smear conversion rate to be 69.7% in patients with BMI <18.5kg/m2 and 84.7% in patients with BMI of 18.5kg/m2 or more at the end of the 2nd month of intensive phase. (OR = 2.17) [34]. Thus, Pulmonary TB patients who are undernourished are at a risk of sputum smear persistence at the end of 2nd month of treatment.

High bacillary load has been recognised to directly influence sputum conversion in few of the recent studies [35] there is a strong reason to suggest that patients with high initial bacillary load (sputum 3+) should be considered for a more aggressive treatment as compared to patients with lower bacillary load. This can be attempted by increasing the number of drugs and duration of chemotherapy, as is recommended in the treatment regimen (category II) for relapse or re-treatment patients under WHO guidelines. In the present study, the high a pre-treatment bacillary load (3+) was present in nearly half (49.5%) of the subjects while more than one fourth (29.7%) of the subjects had a bacillary load of 1+ and one tenth (11.9%) of the subjects had 2+ and rest (8.9%) had scanty. Nearly, two third (64.3%) of the subjects with high bacillary load had smear conversion at12 weeks and 83.3% had it at 8

weeks and 44.1% had it at 4 weeks while more than half (55.9%) with conversion at 4 weeks and 16.7% with conversion at 8 weeks and 35.7% with conversion at 12 weeks had low bacillary load. It was statistically significant. Multivariate regression analysis showed that an increase in the pre-treatment bacillary load as an independent factor effecting the smear conversion. In a refugee camp in Thailand under DOT, Rieder observed that sputum conversion at the end of two months of treatment among patients with initial weakly positive sputum to be 90.9 per cent. It was 77.9% and 61.7% among patients with initial moderately positive and strongly positive sputum smear results, respectively [20]. Similarly under national TB control programme under DOT, Lienhardt *et al.;* in Gambia reported sputum conversion at the end of two months in patients with initial sputum smear 1+, 2+, 3+ to be 96.2%, 85.8% and 81.8%, respectively [36]. Another study from Saudi Arabia reported numerous bacilli on pre-treatment sputum smear examination as an independent risk factor associated with persistent sputum smear positivity at the end of two months of treatment using DOT under national programme [37]. Tiwari *et al.;* found that after two months (end of the intensive phase), SCR was 57.9% among the high positive and 71.6% in the low positive cohort and after three months as well cumulative SCR was 85.2% in the high positive and 92.3% in the low positive cohort [38].

Cavitation is known risk factors for delayed sputum smear conversion [13,18, 20]. Cavities contain millions of bacilli, which favour the development of drug resistant mutants and this may contribute to the delayed or non-conversion in such patients. Similarly, patients with high smear grades are more likely to carry higher bacterial load. Singla *et al.;* found that at SCR among patients graded as sputum 3+ and rest of the patients (combined graded sputum 1+ and 2+) at the end of two months were 62.2% and 76.8% respectively (p<0.001), and at the end of three months were 81.3% and 89.5% respectively [30]. Low pre-treatment bacillary load was the predictor of high cure rate in other studies. Rajpal *et al.;* reveals that patients with 3+ sputum smear grading not only require extension of treatment in the intensive phase more often than those with scanty, 1+ or 2+ grading [39].

The present study found that cavitation was present in 71.4% of the subjects with conversion at 12 weeks, 25% of subjects with the conversion at 8 weeks and 8.8% of the subjects with the conversion at 4 weeks. About four fifth (82.4%) of the subjects with conversion at 4 weeks had non-cavitatory lesions on CXR. Unilateral abnormality was present in 73.5% of the subjects with conversion at 4 weeks, 66.7% of subjects who had the conversion at 8 weeks and 28.6% of the subjects had the conversion at 12 weeks. More than half (64.3%) of the subjects, with conversion

at end of 12 weeks had bilateral lesions on CXR. Stepwise regression analysis found that it had a significant detrimental effect on duration of smear conversion. Babalik *et al.;* also found that extended radiological findings (OR=2.3; 95% CI=1.21-4.37) were statistically significant predictors of late sputum smear conversion [23]. Abal *et al.;* found that smokers with far advanced radiographic abnormalities, were found to have a less chance of an early smear conversion [40].

CONCLUSION

In the end, it can be concluded that median duration for smear conversion was 4 weeks i.e. 28 days among NSP TB patients of Rohtak, Haryana (India). Cavitatory and bilateral lesions on CXR, consumption of tobacco, pre-treatment bacterial load and BMI were independent factors associated with smear conversion. TB still remains one of the important public health problems. It has a potentially devastating impact on health and economy of the individuals and nations, effecting the productive population of the nation. Therefore, it is the need of the hour to devise infection control measures and comprehensive strategy for management of TB cases who have delay in the smear conversion. It is also of paramount importance to institute prevention program for development of an effective vaccine for TB which will be an effective measure for combating the disease. It is further recommended to devise an effective chemotherapy regimen for a shorter duration to help reduce the burden of infectivity. The use of DST at earlier stage is highly recommended for effective management of resources.

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