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EMPIRICAL ANLYSIS ON TUBERCULOSIS IN INDIA

Article Particulars

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Abstract

This paper made an attempt to find the growth rate of Tuberculosis and the amount spent by the government for controlling morbidity in total public health expenditure. The growth of communicable morbidity named Tuberculosis is negative over the period. The trend value of incidence, prevalence and mortality of Tuberculosis is negative and inversely related the time. The share of Expenditure on Tuberculosis Programme on Public Health Expenditure is zig zag over the period.

Key Words*: Tuberculosis, Incidence, Prevalence, Public Health Expenditure*

"Declare the past, diagnose the present, and foretell the future."

Hippocrates (the father of medicine)

Introduction

Worldwide, 9.6 million people are estimated to have fall-en ill with tuberculosis in 2014: 5.4 million men, 3.2 million women and 1.0 million children. Globally, 12% of the 9.6 million new tuberculosis cases in 2014 were HIV-positive. To reduce this burden, detection and treatment gaps must be addressed, funding gaps closed and new tools developed. In India there were gaps between state wise fund allocation released, utilization and expenditure form central and state government under tuberculosis controlling programmes and its relation with morbidity and health status. JMM report 2015 observed delayed data entry and incomplete records reported and validated outcomes and monitoring recommendations. There is no complete reporting of the

causes of death in India. Validation Studies of Verbal Autopsy (VA) have shown that they capture not more than 40-60 percent of true tuberculosis deaths, sub-national prevalence surveys have revealed wide heterogeneity in the prevalence of tuberculosis across different districts, particularly higher prevalence in rural compared to urban areas. Therefore, a single national level estimates is clearly not adequate to accurately describe the burden of tuberculosis and its controlling measures in India. Hence there is a need of various innovative networks of research and careful planning through implementation. It helps not only to an effective health system response to control tuberculosis in India, but also to help states to know their epidemic and guide states to develop effective planning and implementations. The researcher interested to study the past, present and future trend of tuberculosis programmes in India, and to predict the burden of tuberculosis for the year 2020 in India.

Floyd.K(2003) had also defined how economic studies can impact on TB control. First, a study can justify existing policy and practice. Second, a study can lead to, or contribute to, a change in existing policy and practice. Third a study can inform planning of services and related budget development. Fourth, a study can influence the amount of funding available for TB control. Fifth, a study can highlight important knowledge gaps and in doing so lead to new analysis. **Ray TK, Sharma N et al., (2005)** had examined the economic burden of tuberculosis in patients attending DOT (Directly Observed Treatment) centres in Delhi. This study explained that Tuberculosis inflicts a negative impact on global socioeconomic prosperity. **Muniyandi.M et al., (2006)** had examined the socio-economic dimensions of Tuberculosis control. Interview method was used, for TB patients enrolled under TB programme in South India and assessed the socio-economic status of patients (SLI- Standard of living index) and economic impact on patients, families both before and after RNTCP (Revised National Tuberculosis control Programme) and the impact of parental TB on children. In addition patient's perceptions of physical, mental, social well being during and after completion of treatment were also elicited. Majority of the patients registered under RNTCP were poor. Patients, provider costs and the impact on patient's including families on account of TB were enormous. About half of TB patients, despite completing treatment successfully had persistent respiratory ill health resulting in frequenting health facilities. This information is vital for programme planners indicating that the existing control programs have been ineffective. **Muniyandi.M and Rajeswari.R (2008)** had examined the socioeconomic inequalities of tuberculosis in India. The association between poverty and tuberculosis (TB) is well established and widespread. The objective is to study the socioeconomic inequalities of TB in India. Information related to socioeconomic inequalities of TB in India was reviewed, including study of varying prevalence and infection, regional disparities and demographic disparities of disease of TB with a view to establish a link between TB and poverty, in terms of income, standard of living, house type and social class. The burden of TB for India for the year

2000 was estimated to be 8.5 million and the annual risk of TB infection varied from 1 to 2%. The TB prevalence was significantly higher among people living below the poverty line compared with those above the poverty line (242 versus 149/100,000 population). Among the marginalized people, TB was 1.5 times more prevalent. **R.Venkatesh et al., (2014)** had made an attempt to assess the socio demographic profile of patient undergoing DOTS therapy. A cross sectional study was conducted to cover TB patients registered in all TB Unit of the Tiruvallur district over the period of 3 months. Total numbers of respondents were 210.The study found that there is a significance association with type of TB and sputum status and genders.

Significance of the Study

Tuberculosis is now emerging as a massive organizational and financial challenge to the RNTCP. It is not just a disease affects to a person but it is also one of the main reason to reduce the working ability of a person, and his earnings during the 6 months treatment or more than that sometimes and their contribution to the society. And finally every person contribution in a society is directly or indirectly linked to the future progress of the healthy and wealthy nation. So Tuberculosis is an economic burden to the people and as a communicable disease it spreads in a society with a chain sequence mostly to the poor people and men. There are lot of programmes implemented since 1962 to 2015, Millennium Development Target and National Strategic Plans (NSP 2012-2017).

Despite the significant progress of tuberculosis programme, tuberculosis still continues to be one of the major public health and economic problems in the country and necessary efforts are required to reduce tuberculosis transmission and accelerate reductions in tuberculosis incidence, burden and economic loss (Indirect and Direct cost) bear by the patient during the treatment. RNTCP during the 12th Five Year Plan (2012-2017) aims to achieve 'universal access' to qualify assured tuberculosis diagnosis and treatment. India is on the stage of last year of 12th FYP RNTCP goal and there are few research studies on economic burden of tuberculosis on the people in the society and performance of its programmes. Hence there is a need of some kind of economic research to examine the accesses, allocation and expenditure of tuberculosis programmes (NTCP and RNTCP) and predict its progress towards the goal through present, past and future evaluation of these tuberculosis ongoing controlling programmes.

Objectives

1. To find the trending status of Tuberculosis in India and to predict the incidence, prevalence and mortality for the year 2020 under Tuberculosis.
2. To examine the share of Expenditure of Tuberculosis Programme in Total Health Expenditure in India during 1997-98 to 2013-14.

Limitations

This research problem is totally depends upon the secondary source and not on the primary source. The information collected from various reports are presented, analyzed and interpreted.

Data Source and Period of the Study

The required data for analysis is collected from secondary data from the website www.indiastat.com and from the various published annual tuberculosis reports. The study is focusing the data of NTCP and RNTCP implementation in India. Hence the research issue considering the secondary data available in IndiaStat.Com and finalized the period is as 1997-98 to 2014-15.

Tools of Data Analysis

The researcher used the simple statistical tools for analysis. These tools are mainly trend or growth models, forecasting technique and regression used through using social science software's like MS-Excel, SPSS (Statistical package for Social Science). And also this analysis focused to find the status of tuberculosis programme in India and among its regions. The model used for studying the trend and forecast is as follows: Linear model:$Y = \beta_0+\beta_1X_t+U_{t,}$ Log linear model: $\text{Log } Y = \beta_0+\beta_1X_t+U_t$, Quadratic model: $\text{Log } Y = \beta_0+\beta_1X_t+\beta_2Xt^2+U_t$, Where Y= Incidence, Prevalence and Mortality ,X_t= Time period β_0 = Constant, β_1 and β_2 = Slope Coefficients U_t = Error term or Residuals

Data Analysis and Discussions

This section analysis the data related to the objectives chosen by the researcher. The discussion of this chapter is presented in a sequence one by one. The first objective is to find the trending status of tuberculosis in India and to predict the incidence, prevalence and mortality for the year 2020 and the second objective is to examine the share of Expenditure on Tuberculosis programme in Total Health Expenditure in India during 1997-98 to 2013-14, Here, an attempt is made by the researcher to evaluate the past, present and future trends of Tuberculosis in India.

- To find the trending status of Tuberculosis in India and to predict the incidence, prevalence and mortality for the year 2020.

Nevertheless, India achieved complete geographical coverage for diagnostic and treatment services for multi-drug resistant tuberculosis (MDR-TUBERCULOSIS) in 2014. In 2013, 248,000 cases of tuberculosis were tested for drug resistance and 35,400 were found to have MDR or rifampicin resistant tuberculosis. However, only 20,700 received treatment in that year – a diagnosis: treatment gap of 43%. Yet these cases, about a third of the estimated number, cost over 40% of the annual RNTCP budget. This is a financially unsustainable situation and emphasizes the crucial importance of prevention. NTI, Bangalore is conducting the nation's first national anti- tuberculosis drug resistance survey. The RNTCP developed and adopted unifying 'Standards for tuberculosis Care in India', applicable for public and private sector alike. Since tuberculosis became a notifiable disease in 2012, private providers nationwide have

notified nearly 230,000 tuberculosis patients. The RNTCP incorporated these innovative approaches and many others in its ambitious National Strategic Plan (NSP) 2012-2017 which aims to achieve Universal Access to quality tuberculosis diagnosis and treatment. So far, this NSP has guided activities and created accountability against results. The RNTCP has demonstrated unprecedented financial absorption capacity. While allocations have been lower than requested, whatever was allocated was spent. During the three years of the NSP the RNTCP has managed to disburse (spend and release to states) all of the Rs. 1,624 crores received. The health and economic benefits of the RNTCP have been enormous, with an estimated USD$350 billion in economic gain over 2006-2015 relative to the absence of RNTCP services. India reported 1.24 million new and relapsed cases in 2013, by far the largest burden of any country, and over 270,000 Indians died of tuberculosis in that year. Some estimates calculate deaths twice as high.

Table 1 Tuberculosis Situation in India during 1990 to 2013

Year	Incidence (Per lakh population)	Prevalence (Per lakh Population)	Mortality (Per lakh Population
1990	216	465	38
1995	216	465	38
2000	216	438	39
2005	209	365	36
2009	190	289	29
2010	185	269	27
2011	181	249	24
2012	176	230	22
2013	171	211	19

Source: Ministry of Statistics and programme Implementation, Govt. of India. (ON815)

To examine whether the growth has been accelerating or decelerating or constant, the regression models are used for the table -1 during the period 1990 to 2013. It involves mainly linear, log linear and quadratic growth models. The Variables are Incidence, Prevalence, and Mortality of per lakh population and Time.

Table 2 Linear Model estimation results

Sl.No	Variables	Linear Model				
		Constant	Coefficient	R^2	F	Sig.
1	Incidence (per lakh population)	228.38 (3.75)	-6.567 (0.66)	0.93	96.87	0.00
2	Prevalence (per lakh population	514.13 (19.70)	-36.58 (3.50)	0.94	109.16	0.00
3	Mortality (per lakh population)	43.80 (1.57)	-2.717 (0.27)	0.93	94.68	0.00

Source: Manipulated by researcher from secondary data.

Figures in the parentheses represent the receptive standard errors

The above table -2 explained the estimation of incidence, prevalence and mortality of tuberculosis in India (per lakh population) with the help of linear model. The R^2 value is calculated by the researcher is 93, 94 and 93 percent for incidence, prevalence and mortality respectively. It means that 93 to 94 the model is explained with the help of time. The calculated F value shows that it is highly significant for all

three variables in the table such as incidence prevalence and mortality. In this model the 228 per lakh population incidence is commonly occurs but with change in time it reduce to 65 per lakh population. Whereas 514 Persons per lakh population are constant in prevalence and variation in time the coefficient shows 365 persons per lakh population. The mortality also declining with the change in time is 43persons among per lakh population to persons among per lakh population based on linear model. The co-efficient are having negative sign which stands for a year passes is inversely related to the incidence, prevalence and mortality. It means that when a year pass/ over then 27 persons are saved from the death due to tuberculosis. The prevalence reduces as 365 persons per annum increases and incidence per lakh population reduces as 65 persons per lakh population. In general the cases suffering with tuberculosis will be reduces over the year.

Table 3 Log Linear Model estimation results

Sl.No	Variables	Quadratic Linear model					
		constant	coefficients		R^2	F	Sig.
1	Incidence (per lakh population)	226.52 (7.04)	-5.54 (3.23)	-0.10 (0.31)	0.93	42.28	0.00
2	Prevalence (per lakh population	548.64 (33.09)	-55.40 (15.19)	1.88 (1.48)	0.95	60.16	0.00
3	Mortality (per lakh population)	41.04 (2.63)	-1.21 (1.21)	-0.15 (0.11)	0.94	52.36	0.00

Source: Manipulated by researcher from the secondary data

Figures in the parentheses represent the respective standard errors.

The table -3 indicates the estimation results of incidence, prevalence and mortality of tuberculosis in India (per lakh population) with the help of log-linear model. The R^2 value manipulated by the researcher is 79, 87 and 75 percent for incidence, prevalence and mortality respectively. It reveals that 75 to 87 percent the model is varied with the help of time. The calculated F value is also significant for all three variables. In this model the incidence (per lakh population) exists constantly is 228 but there is variation in time reduces the number of incidence up to 23 per lakh population. The prevalence is also constantly occurs as 522 among per lakh population. But according to variation in time period it declines to 134 per lakh population. And mortality rate among per lakh population is constantly occurs but the changes in time makes reduction in mortality is 9 per lakh population based on the estimation log linear model.

Table 4 Quadratic Log Linear Model estimation results

Sl.No	Variables	Log Linear model				
		constant	coefficient	R^2	F	Sig.
1	Incidence (per lakh population)	228.38 (6.98)	- 23.08 (4.43)	0.79	27.11	0.01
2	Prevalence (per lakh population	522.73 (29.89)	-134.63 (18.97)	0.87	50.36	0.00
3	Mortality (per lakh population)	43.47 (3.15)	-9.31 (2.00)	0.75	21.62	0.002

Source: Manipulated by researcher from secondary data

Figures in the parentheses represent the respective standard errors.

The table-4 shows the estimating results of incidence, prevalence and mortality of tuberculosis in India (per lakh population) with the help of quadratic log linear model. The R^2 value is estimated by the researcher is 93, 95 and 94 percent for incidence prevalence and mortality respectively. It means that 93 to 95 the model is explained with the help of time. The calculated F value shows that it is highly significant for all three variables in the table. This linear model involves constant (β_0) and coefficients (β_1 and β_2). It shows that the constant incidence is 226 per lakh population with the declining coefficient 55 and 0.1 with the change in time. The variation in time affects the prevalence per lakh population exits 548 reduced 55 to 1.8 per lakh population. The mortality per lakh population is 41.04 decelerating to 1.2 and 0.1 with the variation in time based on the results in quadratic linear model. Hence this results are coincide with the findings of C. Dye et al., (2009) in his article "Trends in tuberculosis incidence and their determinants in 134 countries" explained the falling rates of incidence. And Muniyandi.M (2008) explains the tuberculosis prevalence among poor people. But the difference is that here researcher has manipulated the declining growth rate of incidence, prevalence and mortality by using regression analysis and also forecast this result for future analysis for the year 2020.

The foregoing analysis shows that there is consequent decline in incidence and the tuberculosis burden (prevalence and mortality) under the tuberculosis programmes in India during the year 1990 to 2013. It indicates the significant progress of tuberculosis controlling through programmes (NTCP, RNTCP and NSP) in India and continuation of this type of programme will reached the goal of millennium development goals. The negative signs shown in the results estimated by linear models also indicates positive trend of incidence and tuberculosis mortality among per lakh population. Hence the researcher has interested to forecast the incidence, prevalence and mortality for the year 2020 under the ongoing tuberculosis programmes and examines how far it is from the goal of tuberculosis controlling programmes. These forecasting results can be explained in the given table (5) with the help of regression models.

Table 5 Forecasting Results for the Year 2020

Sl.No	Variables	Linear forecast for the year 2020	Log linear forecast for the year 2020	Quadratic linear forecast for the year 2020
1	Incidence (per lakh population)	182.42	66.82	220.28
2	Prevalence (per lakh population	258.07	- 419.68	480.08
3	Mortality (per lakh population)	24.78	-21.7	38.78

Source: Manipulated by researcher from secondary data

Figures in the parentheses represent the respective standard errors.

The above table -5 forecasts the incidence, prevalence and mortality for the year 2020 in India (per lakh population) with the help of regression models like linear model, log linear model and quadratic linear model. The linear model explains that the incidence (per lakh population) is 182 for the year 2020 with the prevalence of 258 per

lakh population and mortality is 24 for the year 2020. The log linear forecast shows that the incidence is declining to 66 (per lakh population), prevalence is -419 and mortality is -21. This negative signs indicates a clear picture to understand the declining rate of prevalence and mortality for the year 2020. Finally the last but not least model quadratic linear forecast indicates 220 per lakh population incidence, 480 per lakh prevalence and 38 (per lakh population) mortality for the forecasting year 2020. Therefore these results shows the downward positive trends and accelerating growth of tuberculosis programmes in India through measuring with incidence, prevalence and mortality with respect to variable time.

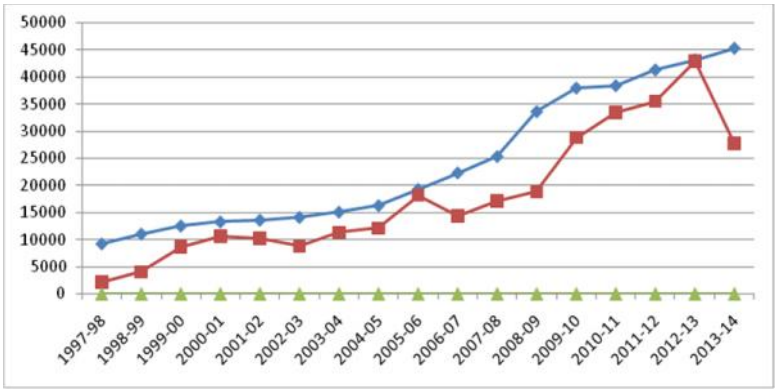
To examine the share of expenditure on Tuberculosis Programme in Total Health expenditure in India during 1997-98 to 2013-14.

Table 6 Public Health Expenditure and Share of Expenditure on Tuberculosis Programme in India during 1997-98 to 2013-2014

YEAR	Expenditure & Medical Public Health (in lakhs)	Index	TUBER CULOSIS Expenditure under NTCP &RNTCP	Index	Share of TUBERCULOSIS expenditure in health expenditure	% share of TUBERCULOSIS expenditure
1997-98	9167	100	2130	100	0.232	23.2%
1998-99	10993	119.91	4060.39	190.62	0.369	36.9%
1999-00	12474	113.47	8654.15	213.13	0.693	69.3%
2000-01	13231	106.06	10626	122.78	0.803	80.3%
2001-02	13548	102.39	10288.16	96.82	0.759	75.9%
2002-03	14066	103.82	8746.22	85.01	0.621	62.1%
2003-04	15038	106.91	11309.98	129.31	0.752	75.2%
2004-05	16238	107.97	12109.66	107.07	0.745	74.5%
2005-06	19264	118.63	18198.55	150.28	0.944	94.4%
2006-07	22297	115.74	14408.22	79.17	0.646	64.61%
2007-08	25310	113.51	17118.75	118.81	0.676	67.6%
2008-09	33614	132.80	18845.13	110.08	0.560	56.06%
2009-10	37964	112.94	28843.54	153.05	0.759	75.9%
2010-11	38400	101.14	33531.19	116.25	0.873	87.32%
2011-12	41338	107.65	35583.81	106.12	0.860	86.08%
2012-13	43221	104.55	42987.02	120.80	0.994	99.4%
2013-14	45317	104.84	27839	64.76	0.614	61.43%

Source: Reserve Bank of India & www.indiastat.com

The above table-6 indicates total public health expenditure in India during 1997-98 to 2013-14. In the year 1997-98 the total medical public health expenditure is 9167 lakhs and it rises to 45317 lakhs in 2013-14. The total health expenditure in India increases every year, therefore it shows the persistence growth rate in the trend of public expenditure for the given years in the above table. Further table -6 reveals the total Tuberculosis expenditure in India under, Tuberculosis controlling programmes (NTCP & RNTCP) during 1997-98 to 2013-14. In 1997-98 the total tuberculosis expenditure under NTCP & RNTCP is rupees 2130 lakhs, which is continuously an increase to rupees 27839 lakhs in the year 2013-14. Hence it indicates the trends of growing tuberculosis expenditure in India from 1997 to 2013.



The above table-6 shows the share of Tuberculosis expenditure in total health expenditure during 1997-98 to 2013-14. The total health expenditure in 1997-98 is rupees 9167 lakhs and the total tuberculosis expenditure is rupees 2130 lakhs.

Source: Manipulated by researcher

Figure 1 Share of Tuberculosis expenditure in Total Health expenditure in 1997-98 to 2013-14

It indicates the 23.2 percent share of tuberculosis expenditure in total health expenditure. And then the percentage share of tuberculosis expenditure shows zig-zag trend from 1997-98 to 2013-14. In 2013-14 the percentage share of tuberculosis expenditure is 61.43 percent, which is an increase from 1997-98. But in the year 2012-13 the share of tuberculosis expenditure is 99.4 percent which is very high compare to the share of tuberculosis expenditure in other consecutive years. Therefore these upward and downward trends of tuberculosis expenditure in India can be clearly understood through given line chart 1.

The incidence & economic burden of tuberculosis in India during 1990 has high compare to 2013. It shows declining rate of 65 per lakh population incidence and 365 per lakh population mortality. Therefore it shows the effectiveness of tuberculosis controlling programmes to meet the target of National Strategic Plan (2012-17) which aims to achieve Universal access to quality tuberculosis diagnosis and treatment.

Hence India is on the last year of NSP to achieve universal access to tuberculosis diagnosis and treatment. The researcher has forecast the results for the year 2020. This shows the negative rate of occurrence of prevalence and mortality such as -419 & -21 among per lakh population and incidence will be reducing to 66 per lakh population. Therefore this forecasting result shows the positive side of tuberculosis programmes, and its distance to the goal of such programmes.

Every year Government allocated lot of budget for health expenditure in India. Health expenditure in India increases from 9167 lakhs in 1997-98 to 45317 in 2013-14 with an index number increased from 100.00 in 1997-98 to 104.84 in 2013-14. On the other hand the total tuberculosis expenditure under NTCP and RNTCP programmes is also increases from 2130 lakhs in 1997-98 to 42,987.02 in 2012-13. But it reduces a high amount in a particular year 2013-14 is rupees 27839 lakhs. The index rate is 100 in 1997-98 decreased to 64.76 in 2013-14.

The share of tuberculosis expenditure in total health is 23.2 percent in 1997-98 increases to 61.43 percent in 2013-14. But particularly it is high in the year 2012-13

approximately 99 percent based on the calculation by the researcher from the secondary data. The figure-1 also clearly shows the decreasing tuberculosis expenditure rate out of the share of total health expenditure.

The trend for allocation and expenditure under tuberculosis controlling programmes in India shows that every year continuously expenditure is increasing in state to central. And the expenditure is one third of the total allocated fund. There is vast gap between allocation and expenditure in India from 1997-98 to 2014-15.

Conclusion and Suggestions

The estimates of Tuberculosis incidence, prevalence, mortality, government funding on total allocation and expenditure and forecast for the year 2020 are necessary, not only to a more effective health system response to control tuberculosis in India, but also help as to develop effective interventions and modern diagnostic tools. Yet every rupee invested in tuberculosis control has a one-hundred fold economic return on investment (JMM report 2015). There is a substantial increase in the programme efficiency, but it is very far from its goal. Hence there is a need of equity in public health programmes, public awareness about chest symptoms and the availability of free diagnostic service and sustained improvement of tuberculosis control measures to reach the goal of NSP (National Strategic Plan) Stop tuberculosis at universal access. Therefore the success of this kind of programmes is depends on the careful planning through implementation, stable funding and the use of innovative network of research and techniques.

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