Social Science Spectrum ISSN 2454-2806
Vol. 2, No. 1, March 2016, pp. 80-89

Controlling Tuberculosis: An Economic Perspective

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Abstract

The paper assesses the overall economic impact due to tuberculosis (TB) and the adequacy of current TB control strategy from a poverty reduction viewpoint in India. Data from large scale surveys carried out in Tamil Nadu were used to measure the burden of disease in terms of TB prevalence, economic costs to TB patient on diagnosis/treatment and its contribution to poverty alleviation. For a TB patient on an average 3-4 months of work time is lost, resulting in loss of potential earnings up to 20-30 per cent of annual household income. It is observed that economic status of two-thirds of the TB patients registered under TB control programme is low, none of the patients incurred any medical cost, more than 50 per cent did not incur travel costs and 88 per cent returned to work after completing treatment. These findings indicate that the TB control strategies engaged meaningfully help the families to escape the poverty trap.

Key words: Tuberculosis; poverty alleviation; India

I. Introduction

Illness and chronic disease create multiple burdens for patients, including the necessity to deal with pain, suffering, reduced quality of life, premature mortality, financial costs and familial emotional trauma. Ultimately, a society must bear the negative impact of the social consequences created by the combined effects of the disease on patients and their families (Thomas, 1983). It also has the potential to affect economic development in many ways. Improving health around the world today is an important social and development objective, which has obvious direct payoffs in terms of longer and better lives for millions. There is a growing consensus that improving health can have equally large indirect payoffs through accelerating economic growth (Bloom, 1998; Gallup, 2001; Bloom, 2005; Daron, 2007).

Tuberculosis (TB) is an infectious disease caused by the bacillus *Mycobacterium tuberculosis*. It typically affects the lungs (pulmonary TB) but can affect other sites as well (extra-pulmonary TB). The disease spreads through air when pulmonary TB infected persons expel bacteria by coughing. In general, a relatively small proportion of people infected with *Mycobacterium tuberculosis* will go on to develop TB disease. However, the probability of developing TB is much higher among people like those infected with the human immunodeficiency virus (HIV), malnourished, children, diabetics, etc. TB affects mostly adults in the economically productive age groups. Around two-thirds of cases are estimated to occur among people aged 15–59 years and TB is more common among men than women.

It was widely believed that there is a close association between poverty/low income and poor health outcomes (Michael, 2002; Spence, 1993). The concomitants of poverty are often poor nutrition, overcrowding, damp and inadequately heated housing, increased risk of infections and inability to maintain standards of hygiene (Davey, 1998). TB has historically been associated with high levels of poverty as it has traditionally been a disease of the poor. Globally, the highest burden of TB is found in poor countries, making it a disease of the poor. It is a serious public health

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The earlier version of the paper was presented in the Third Conference of the Indian Health Economics and Policy Association held at Gokhale Institute of Politics and Economics, Pune during 6-7 January, 2014. The author is grateful to the participants of the conference for their valuable comments. The author wishes to thank the anonymous referees of this journal for their comments on the earlier version of the paper.

challenge, not only because of its perennial toll of death and disease, but also because of its clear links with poverty (Schoeman, 1999; Bhatti, 1995; Muniyandi, 2007).

The economic impact of TB comes from the size of the problem and from the fact that in developing countries a majority of those affected are in the economically productive age group of the population. TB is a complex socio-economic problem that impedes human development and traps the poorest and most marginalized in a vicious circle of disease and poverty. Further, it has a severe impact on the impoverishment of the patients and their households.

The major factors which lead to impoverishment due to it are inability to work due to illness and cost for diagnosis and treatment. The costs are higher for poor patients and the impact of poverty will be felt by the generations to follow. Public health interventions in TB case detection and treatment could represent an effective part of an anti-poverty approach to development in developing countries. It has saved TB patients lives and financial loss to countries through curing TB patients and by their continued productivity. The theme for World Health Organization's annual World TB Day 2002 was "Stop TB, Fight Poverty". The theme stresses the urgency of tackling TB, a disease that disproportionately affects the poor. Stopping TB promotes economic development and reduces poverty. The theme supports DOTS expansion, the cornerstone of the recently launched Global Plan to Stop TB, and urges all stakeholders to accelerate action.

In India the Revised National Tuberculosis Control Programme (RNTCP), based on the DOTS (Directly Observed Treatment Short-Course) strategy, was introduced to address the increasing burden of TB. The RNTCP provides free diagnostic and treatment services to all the patients registered under it. Examining the prevalence of TB in different socio-economic strata, using standardized tools, will help to identify linkages between the disease and poverty, and also help to strengthen TB control measures.

II. Need of the study

Studies in both high income and low income countries (USA, United Kingdom, Germany, Norway, Vietnam, Mexico and Philippines) reveal significantly higher rates of TB in poor populations (Davies, 1999; Grange, 1999; Barnes, 1998; Tupasi, 2000). Recognition of the importance of poverty is increasingly reflected in international policy on health and development through: the Report of the Commission for Macroeconomics and Health; the Poverty Reduction Strategy Papers; Millennium Development Goals; and the Global Fund to fight AIDS, TB and Malaria. Under the 2002 World TB Day theme of "Stop TB, Fight Poverty", the ways in which poverty and TB are associated, and the mechanisms through which poverty increases the risk of infection and disease were considered. To control TB, India now has the second largest TB control programme (DOTS) in the world. It is the fastest expanding programme, and the largest in the world in terms of patients initiated on treatment, placing more than 100,000 patients on treatment every month.

Overall poverty in India has declined and the extent of poverty reduction is often debated. Poverty alleviation is expected to make better progress in the coming years than in the past. In addition to exclusive poverty reduction programmes, it is also expected from various other development programmes to contribute towards poverty alleviation. Empirical evidence on poverty reduction strategies will encourage policy makers to develop effective strategies for the overall development of the country. With this concern, this paper tries to provide evidence to overall economic impact due to TB and the adequacy of current TB control strategy from a poverty reduction viewpoint in India.

III. Methodology

Setting

India has a long and distinguished tradition of innovative investigations in the field of TB. Findings from these investigations have prompted radical changes in TB control practices in India and around the world. The National Institute for Research in Tuberculosis (NIRT) is a premier institute under Indian Council of Medical Research (ICMR). NIRT has been identified as a nodal centre for RNTCP training, and also in carrying out operational research on key aspects to strengthen India's RNTCP. It has undertaken a series of TB disease surveys in urban and rural areas of Tiruvallur district of Tamil Nadu since 1999 to monitor the epidemiological impact of TB on the community. This is a unique opportunity to compare TB prevalence with poverty (Gopi, 2003; Subramani, 2006). The purpose of these surveys was to measure the epidemiological impact of implementation of the Government of India's (GoI) DOTS-based TB control activities under the RNTCP. These TB disease surveys were undertaken in 64 randomly selected villages and three urban units. The methodology of the survey is explained elsewhere (Gopi, 2006). Briefly, in each survey, all persons in the selected villages/units were registered by door-to-door census, and all adults aged 15 years and above were questioned about chest symptoms and underwent a chest radiograph (70 mm photo-fluorogramposteroanterior view) at a nearby centre. Two sputum specimens were collected from those with an abnormal radiograph suggestive of TB and/or with chest symptoms. Those who were absent for examinations were revisited the same day or on subsequent days until at least 90 per cent had the required investigations performed. The sputum specimens were examined by fluorescence microscopy and cultured on Lowenstein-Jensen medium. A case of TB was defined as a person with a positive smear (more than three acid-fast bacilli) irrespective of culture results in this study. In addition to the epidemiological surveys, a series of operation research was also undertaken on the key aspects of RNTCP.

Data

The NIRT has undertaken a series of TB disease surveys in Tiruvallur District since 1999. Data for this study were derived from TB disease survey and socio-economic survey carried along with TB disease survey by NIRT, Chennai during 2004-2006. These cross sectional surveys were conducted at household level and elicited information on household identification, demographic and socio-economic status including the number of earning members, family income, assets possessed and standard of living particulars. Cost of treatment (direct, indirect and total) was also collected from TB patients registered for treatment under government health facilities. These surveys utilised trained field investigators to conduct interviews after obtaining informed consent from the head of the household or other responsible person who was able to answer the questions. During these studies, the respondents were informed about the purpose of the study and the confidentiality of the data collected. Further, treatment outcomes were also elicited from the RNTCP register.

All these data were entered twice independently in Data Star (MicroProDataStar version 1.40) to ensure accuracy. The households included for the economic survey were matched with that of the disease survey and the data was analysed using the SPSS (version 13.0) package. In univariate analysis, categorical variables were compared and the Chi-square test was used to test the difference in proportions. The level of statistical significance was defined as $p<0.05$.

Normally, the question regarding income of individuals or households in surveys is likely to attract substantial amounts of missing data and questionable quality of reported data. Since it is not easy to get income details directly from individuals or households, the same is captured through Standard of Living Index (SLI) in large scale surveys like National Family Health Survey (NFHS) in developing countries. SLI is a composite index consisting of more than twenty variables including household consumer durables and assets owned. The present study uses SLI as a proxy measure to capture economic status of the household by following the method used in NFHS-II.

SLI was calculated by adding the different scores used by NFHS-II for the following items: type of house, toilet facility, main fuel for cooking, source of drinking water, separate room for cooking, ownership of house, ownership of agricultural land, livestock ownership, ownership of durable goods such as motorcar, tractor, moped, scooter, motorcycle, telephone, refrigerator, colour

television set, bicycle, electric fan, radio set, transistor set, tape recorder, sewing machine, black & white TV set, water pump, bullock cart, thresher, mattress, bed, pressure cooker, mixer, grinder, chair, cot, table, clock and watch. Index scores ranged from 0-14 for a low SLI, 15-24 for a medium SLI and more than 25 for a high SLI.

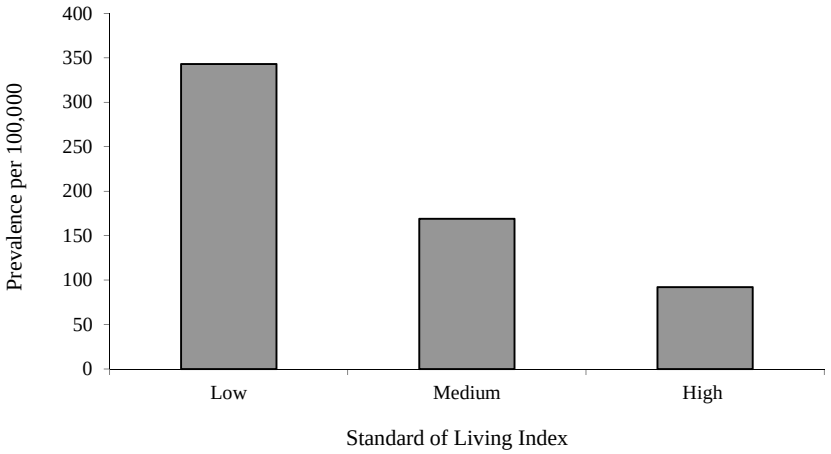
The burden of TB was calculated in terms of prevalence of smear positive cases, i.e., the number of cases existing in the community at a specific time divided by the number of persons in the population and is expressed per 100,000 population. The prevalence was adjusted for non-coverage for different examination like symptom/chest radiograph examinations and sputum collection. The direct cost was estimated by aggregating the medical expenditures such as consultation fees, money spent on investigations and drugs. Money spent on travel, lodging, special food and expenditure incurred for persons accompanying the patient were classified as non-medical expenditure. Indirect costs were classified as loss of wages due to illness, decreased earning ability due to illness, or long term disability that necessitated change in type of work. Total cost included the expenditure incurred on pre-treatment and during treatment under direct and indirect costs.

IV. Results

A total of 35,108 households consisting of 104,690 individuals aged 15 years and above were registered for the disease survey. Of these, 32,780 (93 per cent) households consisting of 99,070 (95 per cent) individuals were covered in the economic survey. Both these surveys were conducted simultaneously in 2004-2006. Of the total individuals, 11,400 had chest symptoms/or radiographic abnormality and 9,895 had both. Coverage for sputum examination was 95 per cent.

Among the population surveyed, 22 per cent were with low SLI, 36 per cent with medium SLI and 42 per cent with high SLI. With respect to their housing, 30 per cent lived in *kaccha* houses. Overall 71 per cent were landless and 28 per cent were living below the poverty line. In terms of TB burden, overall prevalence of smear positive TB was 175 per 100,000. The prevalence of TB among people living in low, medium and high SLI was 343, 169 and 92 per 100,000 ($p<0.001$) respectively (Figure 1). Further, TB prevalence was significantly higher among people living below the poverty line compared with those above it (242 vs 149; $P<0.01$). TB prevalence in families with only one earning member was 194 when compared with prevalence of 179 and 98 in families with two or more earning members respectively ($p<0.08$). (Charts not shown here).

Figure 1: Standard of living index and prevalence of tuberculosis



All diagnosed TB cases through community survey were referred to RNTCP for further care and treatment management. The notification rate for new smear-positive TB patients was more than thrice higher among men than women. At every age, males had a substantially higher prevalence than females (Figure 2). Once TB patients registered for treatment under RNTCP, none of the

patients incurred any medical cost and 33 per cent did not incur non-medical costs during treatment such as travel and loss of income. Very few patients (2 per cent) spent more than Rs. 1,000 as non-medical costs during treatment (Figure 3).

Figure 2: Distributions of TB patients by age and sex

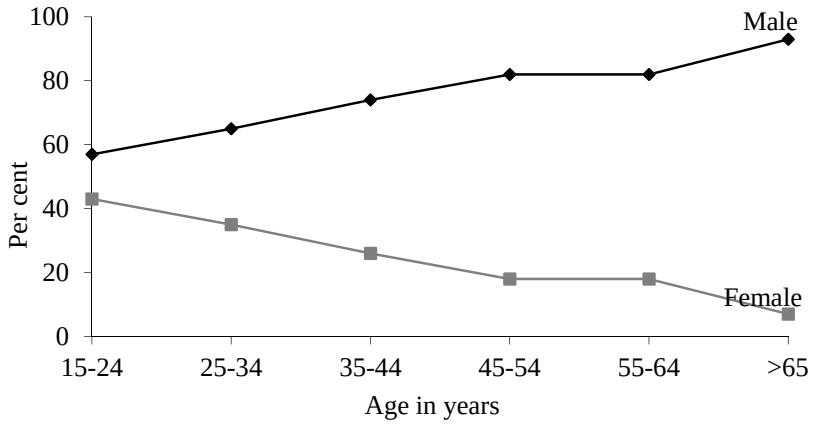


Figure 3: Direct non-medical cost during treatment

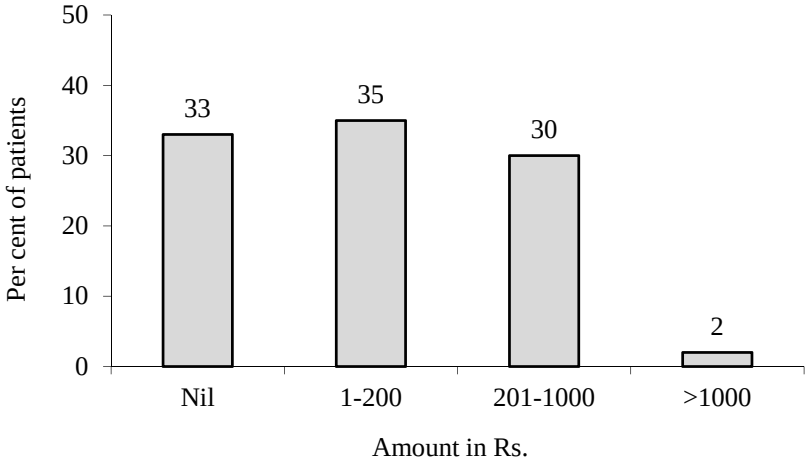


Table 1 compares the overall direct, indirect and total treatment costs in 2000 and 2005 in the same area. In the year 2000, the direct, indirect and total costs were converted to the year 2005 and they were Rs. 281, Rs. 1022 and Rs. 1257 respectively. Costs in 2005 were considerably reduced to patients with TB treated under RNTCP as compared with costs in the year 2000. Overall, there was 40 per cent costs reduction to the patients treated under DOT.

Table 1: Treatment costs (in Rs.) and percentage of total cost reduction from 2000 to 2005

Cost reduction in Rs	Direct	Indirect	Total
Actual cost in 2000	227	825	1014
Cost in 2000 converted to 2005	281	1022	1257
Actual cost in 2005	90	664	756
Cost reduction	191	358	501
Percentage of cost reduction	68	35	40

Among patients treated under government's free treatment programme, treatment success was observed at 69 per cent, 74 per cent and 78 per cent in low, medium and high SLI patients respectively. The patients who defaulted were 21 per cent, 18 per cent and 15 per cent respectively

among low, medium and high SLI groups respectively. Treatment default was recorded for 9 per cent, 6 per cent, and 7 per cent among low, medium and high SLI groups respectively (Figure 4). At the end of the treatment, 73 per cent, 84 per cent and 64 per cent patients returned to work in low, medium and high SLI groups respectively (Figure5).

Figure 4: Treatment outcome in different economic strata

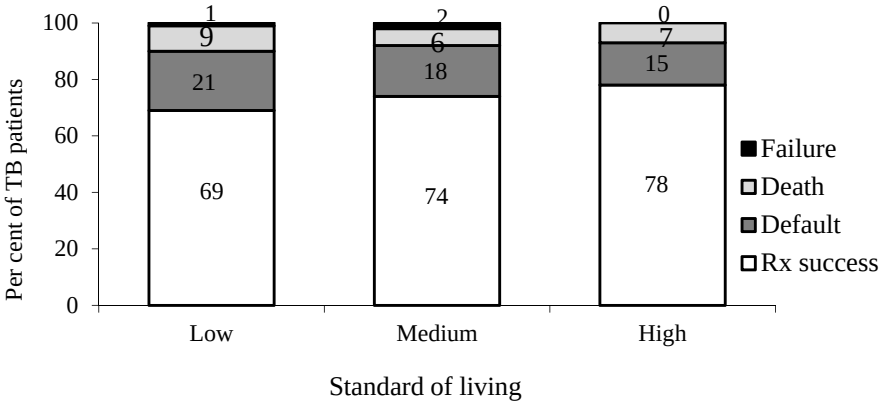
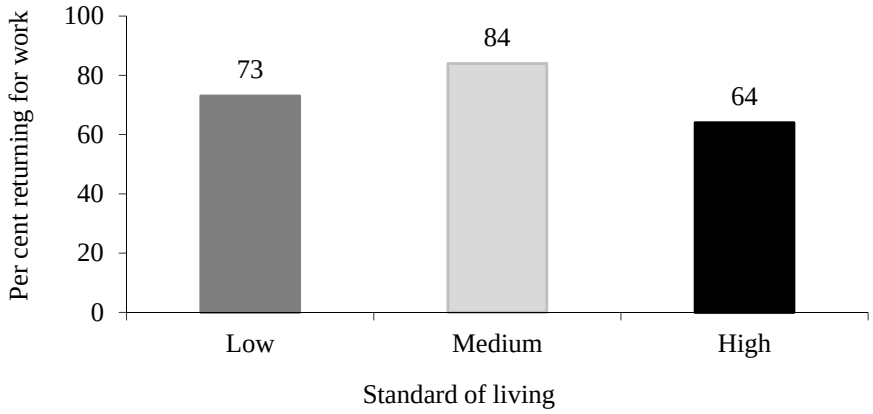


Figure 5: Work status of the TB patients after the treatment



V. Discussion

The main finding of the study is the significant association between SLI and prevalence of TB. In this study population, the proportions in different SLI categories being 22 per cent, 36 per cent, 42 per cent from low, medium and high SLI respectively. Those living below the poverty line (BPL) is 28 per cent based on the definition of income less than one dollar a day. The proportion of BPL was less when compared with the national estimates by the World Bank's 41.6 per cent living BPL based on $1.25 (PPP) a day, and 75.6 per cent BPL based on $2 a day. The current estimate of proportion BPL was similar (27.5 per cent) with that of Planning Commission of India's criteria of monthly per capita consumption expenditure below Rs. 356.35 for rural areas and Rs. 538.60 for urban areas. It was also reported that among the poor who live in rural areas (75 per cent), most of them are daily wage earners, self-employed householders and landless labourers. Although the Indian economy has grown steadily over the last two decades, its growth has been uneven when comparing different social groups, economic groups, geographic regions, and rural and urban areas.

In the socio-economic literature, several approaches have been used to describe wellbeing. Important among them are basic needs, economic growth, quality of life and welfare. Poverty as a public policy concern, whether at the global, national or community level, is now widely considered to be a multi-dimensional problem. Over the last few decades, new perspectives on poverty have challenged the focus on income and consumption as the defining condition of poor people. Studies

of the problems of poor people and communities, and of the obstacles and opportunities to improve their situation have led to an understanding of poverty as a complex set of deprivations. To take appropriate action to eliminate poverty necessitates better understanding of definition and measurement. We need an international poverty line that defines a threshold of income and regular reports on the extent of poverty in the country (absolute/extreme/overall poverty). Therefore, anti-poverty policies must be monitored and evaluated regularly. Coming to TB control and poverty reduction, these objectives require addressing the specific needs of vulnerable communities. In order to achieve this objective, such communities need to be identified using appropriate socio-economic, demographic and disease indicators. The present study addresses the need to use more appropriate socio-economic instruments to study the association between socio-economic factors and risk of developing TB. In this paper, SLI, a tool widely accepted by the World Bank and the GoI's National Family Health Surveys, was used to define the socio-economic status of population. The instrument is easy to use and is understood by both economists and health personnel. Similarly, we used standardized approaches to define a TB case. This study also utilized an ongoing community survey to link the socio-economic status to the prevalence of TB. Data gathered in such a study from the community survey would necessarily be influenced by the health seeking behaviour of the various socio-economic groups and also the strength of the case reporting system. In order to overcome this bias, we adopted a community approach to explore the association between socio-economic status and the prevalence of TB.

In the current study, the prevalence of TB was 3.7 times more among people having low SLI as compared with high SLI. Similar observations were reported from Stop TB Partnership Secretariat in which the poor were shown to be affected by TB 2.6 times more often than the non-poor (Stop TB Partnership, 2002). TB attack rates reported in Seattle, USA were the highest for whites in the low socio-economic residential areas. A study from New York city found that a 10 per cent increase in the proportion of people in a neighbourhood living below the US federal poverty line was associated with a 33 per cent increase in the incidence of TB (Barr, 2001; WHO, 2005). Similarly, the estimated prevalence of TB in Chiapas, a Mexican state with high poverty levels, is cited as being twice as high as the national average (Sanchez-Perez, 2001). In Manila, the prevalence of TB among the urban poor was found to be 1.5 times higher than non-poor (Tupasi, 2000). In the present study, when we used the type of housing as a proxy indicator we found that TB prevalence was 2.5 times more among people living in *kaccha* houses (poor housing) as compared with pucca houses, and 3.3 times higher among landless people (table not shown here). There has been a long debate as to the merits of describing poverty in absolute or relative terms. The World Bank defines poverty as not only lack of money but also lacking in material well-being, infrastructure, and access to services as well as wide spread social disintegration (World Bank, 1995). All these factors make poor people living under such circumstances more vulnerable to disease and illness.

The above findings indicate that strategies to eradicate poverty require not only economic growth and redistribution, but also direct intervention in many areas such as providing better health, expanding education, removing discrimination and securing social injustice – different types of deprivations in human lives are interrelated and reinforce one another. It is well known that poor health often defines the condition of a poor person but it is also an obstacle to other important aspects of a person's well-being like employment, income, health care and other basic amenities such as clean water and sanitation. These views are not new but what is relatively new is their emerging as a consensus among the policy makers, public and development specialists. This is reflected in the adoption of the Millennium Development Goals (MDGs), and as a conceptual shift in the treatment of poverty by the World Bank in their World Development Reports. The MDGs gave prominence to improvements in health in poor countries. The Global Fund was established in 2001 with initial commitments of finance with the explicit objective of providing financial backing for the health authorities in developing countries in their campaigns against these causes of mortality. Prevention of TB and reducing the disease burden has been strongly reflected in the Sustainable Development Goals (SDGs) of the global community (WHO, 2015). SDG III is targeting the end of TB epidemic by 2030. Also in 1996, the Human Development Report (HDR)

introduced the Human Poverty Index (HPI) (UNDP, 1997). It is a composite measure set in the capability and human development space, drawing on the several important perspectives that have enriched our understanding of poverty. In this framework, poverty is the deprivation side of human development, the denial of basic choices and opportunities to lead a long, healthy, creative and free life and to enjoy a decent standard of living.

Control of TB will be difficult to attain in a world burdened with poverty and inequalities as extensive as they are today (Hans, 2002; Singh, 2002). In an earlier study on 896 patients registered under RNTCP, we found 64 per cent of the notified patients were from low SLI, 32 per cent from medium SLI and 4 per cent from the high SLI groups (Muniyandi, 2007). Thus, among the RNTCP notified cases, the low and medium SLI groups were well represented as compared with the high SLI group. This is an evidence that the RNTCP is a pro-poor programme which is successfully catering to the majority of patients who need its services most. On the other hand, the present community based survey showed that around 15 per cent of TB patients detected were from high SLI while only one-fourth of the expected number from this group is registered in the programme. This gap may indicate the socio-economic segment's preference of the private sector for TB diagnosis and treatment. Several measures have been instituted by the RNTCP to bridge this divide. In order to reach the patients from all the segments of the population, RNTCP in addition to strengthening the government health facilities is promoting collaboration with the private health sector by encouraging the involvement of private hospitals and practitioners. Sensitization and training of members of the Indian Medical Association, Continuing Medical Education (CMEs) for medical colleges and the use of news letters are important advocacy tools being used by the programme. They need to be further strengthened rapidly if the programme is to reach all socio-economic segments and provide standardized quality TB diagnosis and treatment all over the country.

The RNTCP has been acknowledged to be a highly cost effective health intervention (Dholakia, 1997; Goodchild, 2011). Strategies such as DOTS, in the long run, will certainly contribute to poverty alleviation while they may not be the sole contributors to its decline or abolition. However, such changes cannot be identified unless they are measured and long term measurements require robust and reliable tools. This paper highlights the use of a tool that has been widely used to study the prevalence of the disease in well characterized socio-economic segments of the population. The programme should consider investing in similar studies since they also have other collateral benefits that can be used to measure cost-benefits that ultimately serve as useful advocacy tools.

Finally, the disease affects human capital accumulation such as accumulated kills???, knowledge and expertise of workers. Numerous studies in the past have effectively shown the relationship between human capital and economic development. The economic growth model offered by many economists in 1990s such as Romer, Lucas, Mankiw, Roma, Weil, Barro and others stressed the importance of human capital as a determinant of growth (Gregory, 1992). However, these growth models primarily used education as an index for human capital. Health status as a possible index for human capital has received less attention, though it has not been completely ignored. An insightful review of the recent literature on the nature of links between health and productivity (GDP) has been provided (Bloom, 2005; Arora, 2001; Bukenya, 2009). The findings of this paper also imply that a policy aimed at treating TB and reducing its incidence will promote poverty reduction.

Limitations

Data on both prevalence of TB and socio-economic status are from a rural area of south India. The prevalence of TB and the proportions of SLI segments in different parts of the country may vary and hence the findings may not be applicable for the entire country. In the current study we have used SLI as a measure to assess the socio-economic status of the households, and it is to be noted that SLI is a composite index of more than twenty variables.

VI. Conclusion

To conclude, we observed a significant inverse trend in the prevalence of TB in the different economic segments of the studied population, being higher among people living with low SLI as compared with medium and high SLI. More than half of the TB patients in the present survey were from low SLI, confirming that TB disproportionately affects the poor. Public health interventions in TB case detection and treatment could represent an effective part of an anti-poverty approach to development in developing countries. It has saved TB patients' lives and billions of dollars to countries through curing TB patients and by their continued productivity. In India and elsewhere, effective TB control facilitates break the cycle of poverty and disease. RNTCP has been acknowledged to be a cost effective health intervention in curing people and making them return early to work, which in turn benefits their families and in the broader perspective contributes to the overall economic and social development of their country that may also help in alleviation of poverty and to promote economic growth.

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