



Formal Education Vs Health Literacy: An Insight Into Treatment Outcome Of The Randomized Control Trial Of MDR-TB Patients In Pakistan

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ARTICLE INFO

Article history:

Submitted 29.07.2020

Accepted 29.04.2021

Published

Volume No.8

Issue No.I

ISSN (Online) 2414-8512

ISSN (Print) 2311-293X

DOI:

Keywords: Education, Health literacy, Treatment arms, financial incentives, Cure.

ABSTRACT

This study analyzes the association of education and health policy initiatives i.e. selection of treatment arms of ambulatory vs. hospital care and financial incentives undertaken by the National Tuberculosis Program of Pakistan (NTP) with the outcome of cure of multi-drug resistance tuberculosis patients. The data of 370 patients enrolled in randomized control trial is collected from three Tuberculosis centers of Lahore, Karachi and Murree and the multi-variate logistic regression method is applied. The empirical findings show that education and selection of treatment arm do not have a significant association with the outcome of cure but financial incentives increase the chance of cure. The health literacy provided by NTP has played a more vital role in improving the treatment outcomes than formal education. Moreover, WHO (2011) recommendation of a shift towards ambulatory care is applicable for Pakistan and the financial incentives should continue as it reduces the treatment burden for patients.



Introduction

Education is considered as a vital component in developing the understanding of the importance of health as an “investment good” (Zweifel, Breyer & Kifmann, 2009). It helps the individuals to enhance their capabilities to their highest potential, improve their “doings” and provides remedy from the non-freedoms (Sen, 1988). Hence the wellbeing of the individuals improves as they achieve more “functioning”. The individuals value the societal life, “being” free of disease, education and good health, etc. which can lead towards the healthy and prosperous life-a social drift phenomenon (Smith, Bambra & Hill, 2016). Education helps individuals to understand the value of life and expands the horizon of opportunities that would otherwise be a far cry. Hence education is considered an important component to improve the living standards and wellbeing of individuals.

The challenge arises to maintain the wellbeing in case of the advent of disease. The disease does not only affect the health of an individual but also create a potential loss of 20 to 30 percent of the household income. It creates financial and non-financial constraints and engulf the household into the “intergenerational poverty cycle” when the financial burden is high and the problem is intensified if the bread runner of a family is affected by diseases that create the “medical poverty trap” (Whitehead, Dahlgren, & Evans, 2001) and “poverty ratchet” (Chambers, 1983). The lack of income flow will lead to reduced investment in health and human capital development through education. There is a need to protect the vulnerable groups in the economy to reduce the negative spillover of disease and to improve the outcome of treatment. United Nations has formulated the sustainable development goals amongst which one

agenda is “Ensuring healthy lives and promoting the well-being at all ages”.

Amongst other diseases, a major challenge faced by health programs across the globe is multi-drug resistant tuberculosis (MDR-TB) as the first-line drugs have failed to cure the changing strain of TB and second-line drugs have a higher cost and less efficacy (WHO, 2017) Another challenge is the ‘person-to-person transmission’¹ which can spread the disease in the community. Amongst the high disease burden country, Pakistan is ranked 4th for MDR-TB in the world (WHO, 2020).

National Tuberculosis Program (NTP), Ministry of Health Pakistan, is trying to intervene in various dimensions to control MDR-TB. NTP has performed a randomized control trial (RCT) for treatment of MDR-TB patients at three health facilities in Lahore, Karachi and Murree from 2012-2017 where the clinical characteristics of the patients are the same. NTP has provided assistance by providing health literacy to the patients and their families related to the treatment protocols. Health literacy refers to the knowledge about the importance of health and ability to understand and implement the information about the maintenance of good health (Nutbeam, 1998; Fineman, 2005 & Liu, 2020).

Another intervention involves the selection of treatment arm i.e. hospital vs ambulatory care arm. The hospital care arm (HC) is a usual treatment arm involving two months of hospitalization then treatment is conducted in the community (Bassili et al., 2013) and ambulatory care arm (AC) means that treatment is conducted in community from the beginning with the collaboration of family and health workers which may be accompanied by two weeks of hospitalization initially (Jennifer et al., 2017). This intervention is based on the recommendation of World Health Organization (WHO, 2011) to ensure that the burden on hospitals can be minimized. This can be an important initiative in the case of Pakistan as one bed is available for 1580 patients (Economic Survey of Pakistan, 2018-19). Alongside that NTP has also provided financial initiatives to patients to ease the financial burden of disease and to reduce the impact of catastrophic health care expenditure i.e. expenditure on health care exceeding 40% of the effective income of the household (WHO, 2005 & 2015).

The literacy rate in Pakistan is 62.3% (Economic Survey of Pakistan, 2017-18) with a moderate increase in both urban and rural settings. But still, formal education is not a widespread phenomenon under the scarcity of resources (Khan & Majeed, 2018; Kazi, Aziz, & Quraishi, 2018). Hence, it is expected that the health literacy provided by health program in RCT may play an important role in improving the treatment outcome for patients i.e. increase in the number of cured patients. Cured means “a patient whose sputum smear or culture is positive at the beginning of the treatment but who is smear- or culture-negative in the last month of treatment and on at least one previous occasion” (WHO, 2010).

Objective of the Study

The objective of this study is to analyze the association of education with the treatment outcome of cure of MDR-TB patients. Alongside that relation of policy interventions, i.e. ambulatory vs hospital care arm and financial incentives with the outcome of cure are analyzed. Then the association of income group with the outcome of treatment is also considered under the setting where health literacy is provided to all patients irrespective of the level of formal education. Lastly, the association of medical expenditure with cure rates is also explored.

Hypotheses

The following null hypotheses would be tested:

H1: There is no significant association of education and outcome of cure.

¹https://www.who.int/trade/distance_learning/gpgh/gpgh3/en/index6.html

²<https://www.who.int/features/qa/79/en>

H2: There is no significant association of selection of treatment arm and outcome of cure.

H3: There is no significant association of financial incentives and outcome of cure.

Review of literature

The existing research identifies that health care alone is not a vital factor in determining the health status. Therefore, the researchers and policymakers incorporate the impact of socio-economic determinants on the health status of individuals for example how the lower level of income may lead to lower health status (Black Report, 1982; Collins, Hayes, & Oliver, 2009; Majeed & Khan, 2019). Moreover, the term PROGRESS explains the place of residence, race, occupation, gender, education, socio-economic status, and social capital that shows the mutual dependency of medical and non-medical factors in determining the final health outcome (Oliver et al., 2008).

The impact of the formal education on the health outcomes examined in the literature shows that the overall impact of education varies across studies, for example, the education level of patients in Mexico varies from primary to post-doctorate level thereby not a significant risk factor as indicated by Morris et al. (2013). Whereas, Balabanova et al. (2011) find that education has a positive impact on health in Lithuania as the educated person will have better awareness regarding preventive and curative measures.

Ahmad et al. (2012) find that male gender, age of 15-25 years, Sindhi ethnicity, and low education attainments are associated with greater risk of MDR-TB in Karachi, Pakistan. The male gender is medically more prone to TB and often shows inconsistencies in taking medication. There is a need to educate and counsel people about the importance of continuation of treatment and curability of disease to avoid the stigma attached to MDR-TB in Pakistan (Akhtar et al., 2016 & Ali et al., 2018).

The burden of disease is more for younger population engulfing the majority of the economically active population in different countries e.g. 79.4% patients belong to the age group of 15-55 in Southern Ethiopia and more than 40% in Pakistan. Alongside that poverty, illiteracy, lack of facilities in health care centers, gender discrimination, high cost of treatment and unavailability of the health workers lead to more chances of MDR-TB (Gebrezgabiher et al., 2016; Olupot-Olupo et al., 2017; Ali et al., 2018).

According to Penaloza et al. (2019), another important factor is health literacy which has the potential to improve the treatment outcome of the existing patients and increases the chance of detection of passive cases among the people who came in close proximity of the TB patients that will reduce the spread of disease in the community. Meressa et al. (2015) find that Ethiopia has the greatest success rate in MDR-TB treatment in Africa while analyzing clinical data of 612 patients. The family members are given basic training to ensure that patient adherence to treatment along with monthly visits of community health workers. Food basket is given to patients every month with the inclusion of travel allowance for patients with less purchasing power. Success rate came out to be 78.6% showing that health literacy has played an important role in improving the treatment outcomes.

The behavior and attitude of the patients towards the disease and treatment also varies. The patients often believe that they do not have TB and are just concerned about the remedy of bad health symptoms as indicated for the studies for Bali, Indonesia, and Punjab, Pakistan (Watkins and Plant, 2004 & Akhtar et al., 2016). On the other hand, there are patients with the most severe symptoms who show most adherence to avoid further hardships (Menegoni, 1996). For example, patients in China continued their treatment despite being declared cured by the health practitioner to completely remove the root cause of disease showing health literacy is an important factor to eradicate the disease (Fong, 2004). Behavioral patterns like smoking and alcohol are also the risk factors for TB.

Under different types of constraints, the selection of the treatment strategy is an important perspective to eradicate the disease. "The choice between hospitalization and ambulatory treatment depends on several factors in addition to the severity of the disease. Such factors include the availability of hospital beds with adequate infection control measures, the availability of trained personnel to administer treatment and manage adverse drug reactions; a social support network to facilitate adherence to ambulatory; and the presence of other clinical or social conditions for in-patients" according to WHO (2009).

Institute of medicine US (2012) reports that most patients do not get the hospital beds timely and patients should not be kept in concentration in small hospital wards to avoid further contamination and spread of disease. So AC can play an important role in reduction of burden in hospitals in case of scarcity of resources (Shin et al., 2004). Another challenge is poverty that leads to less investment in health owing to the burden of direct and indirect expenditures in the treatment procedures which may engulf 10 to 100 percent of family income and creates negative externalities for the country (Grantham-McGregor et al., 2007, Wagstaff, 2007 & Mauch et al. (2012). The issue of the out of pocket expenditure is also a big hurdle in the treatment of MDR-TB in Pakistan therefore there is a need of provision of financial incentives to the patients (Razzaq, Naeem, & Fatmi, 2020).

The Universal Health Coverage (WHO, 2005) and End TB strategy (WHO, 2015) focus on the mass scale provision of the affordable and effective health services to eradicate TB hence it is important to focus on the multi-dimensional spectrum of health care to achieve this target.

The current study fills the literature gap by providing an insight about the relative importance of formal education vs health literacy and impact of policy initiatives of NTP on the outcome of cure MDR-TB patients in Pakistan by drawing important health policy conclusions.

Model

Education is an important social construct that may enhance the understanding of the importance of treatment and cure. As per WHO (2011), the use of AC can be a potential source to reduce the burden for patients and hospitals. The financial burden can create hindrance in acquiring the treatment facilities which may be eased out by the provision of the incentives by the health program. Hence, the association of financial incentive given by NTP needs to be analyzed along with the impact of income group. Though NTP has provided free medication to the patients in RCT but sometimes patients had to bear the medical expenditure if they were not able to access the medicines provided by NTP that may have an association with the treatment outcome. The study will analyze the impact of these variables on the outcome of cure of MDR-TB patients as shown in Equation 1.

Outcome of Cure

$$= \gamma_0 + \gamma_1 \text{Education} + \gamma_2 \text{Treatment Arm} + \gamma_3 \text{Financial Incentives} + \gamma_4 \text{Income Group} + \gamma_5 \text{Medical expenditure} + \varepsilon \quad 1$$

Variable construction

The dependent variable of outcome of “cure” is taken as the categorical variable with the value of 1 when the outcome of cure is declared by NTP and 0 otherwise. The standard definitions of WHO (2010) is applied in this analysis. The variable of ‘education’ has three categories namely illiterate (I)=0, secondary school education (S)=1 and any higher education (H)=2. The treatment arm of HC is referred to as 1 and AC is referred to as 0. The provision of financial incentive of the I\$ 136 (international dollar) is initiated by NTP on each follow-up visit of the patients but some patients did not receive it continuously. Hence, the financial incentive variable is categorized as 1 when incentives are given for more than 80% of the follow-up visits and 0 for less than 80% of the visits.

The variable of income group is constructed by using the benchmark of the poverty line of I\$ 187.16 per capita per month (3294 PKR) as given in the Household Integrated Economic Survey of Pakistan (2015). The family income per capita per month is obtained by the conversion of the annual income of the household into the monthly income divided by the household size. The nominal variable of income group is defined as poor=1 if family income is less than defined boundary and 0 if income is more. Medical expenditure caters the average expenditure on hospitalization, treatment of side effects, and precautionary measures. International dollar (I\$) is used to represent the financial incentives and medical expenditure by employing one I\$ equal to the worth of 17.60 Pakistan Rupee as per the measure proposed by WHO (Augustovski et al., 2018).

Econometric Methodology

Multivariate logistic regression is applied to analyze the Equation 1 where the log of odd ratios is used in the logit function that shows the probability of an outcome of cure (cure=1) and the probability of occurrence of any other outcome as (1-p) as shown in Equation 2

$$\text{Logit}(p) = \ln\left(\frac{p}{1-p}\right) = \frac{\ln\left(\frac{1}{1+e^{-(\alpha_0+X'\alpha)}}\right)}{\frac{1}{1+e^{-(\alpha_0+X'\alpha)}}} = \ln e^{-(\alpha_0+X'\alpha)} + \alpha_0 + X'\alpha \quad (2)$$

Above equation can be written as logistic regression model as:

$$\ln\left(\frac{p}{1-p}\right) = \alpha_0 + X'\alpha + \xi \quad (3)$$

$\frac{p}{1-p}$ is called odd ratios, $X'=[X_1, X_2, \dots, X_k]$ is explained as vector of kth explanatory variables as shown in Equation 1, α_0 and $\alpha'=[\alpha_1, \alpha_2, \dots, \alpha_k]$ are unknown parameters. The error term is denoted as ξ .

The hypotheses are tested by using the Wald test and level of joint significance of variables is tested by using log-likelihood ratio test (LR) and F-test. The goodness of fit of the model is tested by using Pearson chi-square goodness of fit statistics (Pearson, 1900).

Data

The data of 370 patients enrolled in the RCT is collected from three health facilities of TB Samli Sanatorium Hospital, Muree; Ojha Institute of Chest Diseases, Karachi and Gulab Devi hospital, Lahore. This cohort analysis (WHO, 2010) incorporates the time period of 2012-2017. The inclusion criteria involve patients above 12 years of age with a complete set of information availability.

The outcomes of the patients are shown in Table 1. Cured patients are 285 (77.03%) and died are 32 (8.65%). The patients who failed to recover are 11 (2.98%) and loss to follow-up occurred for 30 (8.11%). The treatment is still in process for 2 (1.35%) patients. One patient completed the treatment whereas evaluation is due for 6 (1.62%) patients.

Table 1: Outcomes of MDR-TB Patients

Outcomes	No. of patients n(%)	Females n(%)	Males n(%)
Cured	285(77.03)	125(43.86)	160(56.14)
Died	32(8.65)	17(53.13)	15(46.88)
Failed	11(2.98)	5(45.45)	6(54.55)
Loss to follow up	30(8.11)	7(23.33)	23(76.67)
still under treatment	5(1.35)	1(20.00)	4(60.00)
Completed	1(0.27)	0(0.00)	1(100)
not evaluated	6(1.62)	1(16.67)	5(83.33)

Percentages are shown in the parenthesis

Empirical Analysis and Discussion

The success rate of health program i.e. cured and completion is 77.3% in our sample. WHO (2015) has proposed the success rate range of 75-90% depicting that the NTP of Pakistan is able to achieve the desired range showing and overall measures taken by the health programs are reasonable.

Descriptive analysis

The descriptive statistics in Table 2 show that males are more in our sample than females i.e. 213 (57.57%: I= 24.4%, S=53.06% & H=22.54%) and 157 (42.43%: I=37.58%, S=38.85 & H=23.57%) as males are also more prone to TB biologically. The inconsistent behavior of males in taking medicines as compared to females may be an additional factor. However, the proportion of illiteracy i.e. no formal education is higher in females than males as more preference is given to male gender in the social settings prevailing in Pakistan (Idrees & Khan, 2020).

The age group of 25-45 has more number of patients i.e. 175 (47.30%:I= 30.28%, S=48.58 & H=21.14%) showing that the highest burden of disease is borne by a more economically active population thereby urging the government to focus on this segment of society to ensure less loss of income in the future. WHO (2002) reported that 75% of active TB cases usually belonged to the age group of 15-59 years with more incidence rate of males than females while in our sample it is much higher i.e. 94.3%.

Equal number of patients were enrolled in HC (I=31.35%, S=442.71% & H=25.94%) and AC (I=28.11%, S=52.43% & H=19.46%). Incentive are received for more time by major portion of the sample i.e. 309 (83.51%:I= 30.74%, S=46.28 & H=22.98%) as compared to the patients who received lesser incentives i.e. 61(16.49%:I= 26.23%, S=50.82 & H=22.95%).

Table 2: Descriptive Statistics of the Socio-economic characteristic of MDR-TB Patients

Patients characteristics	Total	Illiterate(I)	Secondary School Education(S)	Higher Education(H)
Gender				
Male	213 (57.57)	52 (24.4)	113 (53.06)	48 (22.54)
Female	157 (42.43)	59 (37.58)	61 (38.85)	37 (23.57)
Age				
≤24	132 (35.67)	30 (22.72)	66 (50)	36 (27.28)
25-45	175 (47.30)	53 (30.28)	85 (48.58)	37 (21.14)
≥46	63 (17.03)	28 (44.44)	23 (36.51)	12 (19.05)
Arm				
Hospital care	185 (50)	58 (31.35)	79 (42.71)	48 (25.94)
Ambulatory care	185 (50)	52 (28.11)	97 (52.43)	36 (19.46)
Incentive				
<80%	61 (16.49)	16 (26.23)	31 (50.82)	14 (22.95)
≥80%	309 (83.51)	95 (30.74)	143 (46.28)	71 (22.98)
Income group				
Poor	307	96	147	64

	(82.97)	(31.27)	(47.88)	(20.85)
Non-poor	63	15	27	21
	(17.03)	(23.81)	(42.86)	(33.33)

Percentages are shown in the parenthesis.

Patients belonging to the lower cohort of income constitute a major part of our sample. Poor are 307 (82.97%: I= 31.27%, S=47.88 & H=20.85%) and non-poor are 63 (17.03%: I= 23.81%, S=42.86 & H=33.33%). The socio-economic status has the potential to affect the health status according to the “social causation hypothesis”. Besides, there are more chances of person-to-person transmission if more people are living in close proximity. Mean direct expenditure on health i.e. expenditure on laboratory test, medicine, hospitalization, treatment of side effect, and protection cost is I\$ 222.25 and indirect expenditure on health care i.e. cost of transportation, relocation, rent, home visits, income loss of patient and accompanying fellow is I\$ 1386.39. The indirect expenditure has created more financial burden on households as compared to the direct expenditure.

Main Results

The empirical results show that patients with higher education have a lesser chance to experience the outcome of cure as indicated by the negative sign but the association is insignificant. This finding depicts that education alone is not sufficient to explain this trend. Complementary factors i.e. good medical counseling, family and community support, and other socio-economic factors, etc. are vital in determining the final health outcome. The health literacy provided by the health care experts is an important aspect that creates awareness among the people with lesser formal education and makes them adhere to treatment protocols. Our results differ from Ahmad et al. (2012) for Pakistan where lesser number of schooling years lead to adverse effects on health status.

Table 3: Results of the Logistic Regression Analysis

Variables	Coefficient	C.I	Wald test
Education	-0.009	-0.067-0.051	0.68
Arm	-0.013	-0.072-0.046	0.97
Incentive	0.137*	-0.006-0.267	0.02
Income group	-0.031	-0.141-0.078	0.59
Medical expenditure	-0.0001*	-0.0002 -0.000017	0.04
F-test	8.54	2 log likelihood	8.43
	(p= 0.0736)		(p=0.0770)
Pearson chi2 goodness of fit	P= 0.4046		

*=5% level of significance, C.I= 95% confidence interval

The chances of cure are less in HC than AC though the association is insignificant with the outcome of cure. This is an important finding showing that AC can be used as an important source of treatment provision. The timely start of the treatment in the home environment without having to wait for the hospital beds help the patients to be cured (WHO, 2009) and it also reduces the burden on hospitals. The guidance provided by the health experts related to intake of medication at home and follow-up protocols play an important role in improving outcomes in AC. This result also shows that health literacy has proved to be an important factor in determining the more chances of cure for patients.

Incentives has a positive association with the cure i.e. patients who received more incentives have more chance to cure as compared to the patients receiving fewer incentives. The incentives reduce the financial burden on the patients and households that increases the commitment to treatment. The poor income group has a lesser chance to cure but the association is insignificant. This shows that belonging to a particular income group does not affect the treatment outcome. The adherence to treatment while following the advice and health literacy provided by the medical experts is an important factor in achieving the better outcome of cure. It has helped the patients to understand that negligence in treatment can create havoc which led to better health outcomes in the RCT though a greater portion of the patients is poor.

Medical expenditure has a negative association with the outcome of cure but the magnitude is less. Medical expenditure creates a burden on the resources of the family and continuity in the treatment is often compromised if the expenditure is a greater proportion of total family income. NTP has helped in the provision of free medicines still some burden of expenditure is borne by the patients. If this expenditure is high, then negative health consequences can arise.

The hypothesis-testing validates that education and treatment arm do not have a significant association with the outcome of cure but financial incentives is significantly related to the better health outcome. The F test and log-likelihood test shows that the variables are jointly significant and the model carries a good fit as shown by the Pearson chi-square test statistics.

Conclusion

The purpose of this study is to analyze if formal education plays an important role in improving the treatment outcome of MDR-TB patients. Alongside that, the impact of the policy variables i.e. selection of the treatment arm and financial incentives on the outcome of cure is analyzed. The results suggest that education does have a significant association with the outcome of cure. This shows that health literacy is an important contributor to improve the cure rates where health expert advice and counseling about the treatment protocols can lead to the development of more understanding about the importance of adherence to treatment protocols. Another important result derived by the study is the applicability of the WHO (2011) proposition that treatment can be conducted in a conducive manner in ambulatory care as the percentage of the patients cured is more in AC. The income level is not a significant determinant of cure but the chances of cure reduce as more financial burden of medical expenditure is endured by the patients and households.

Some important policy conclusions can be drawn from the study. The health providers should focus on the provision of the health literacy to the patients and attendants. If the treatment supporters and family members can understand the importance of following treatment protocols, then better outcomes can be achieved. The NTP should focus on the provision of treatment of MDR-TB in ambulatory care to help the patients to start the treatment immediately in the community and to reduce the burden on the patients. However, the hospital should be having the services in case patients need more intensive care. The financial incentives should be ensured by the health program as they help to reduce the burden of the disease which will improve the success rate of the health program. Despite the important policy applications derived from the study, our study has a shortfall that more patients could not be included because of a shortage of data.

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