Economic And Social Impact Of Tuberculosis On Health-Related Quality Of Life (HRQOL) In Pakistan:

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Abstract

Purpose: The one of the rising issues of developing countries is tuberculosis. Tuberculosis is the second number of the disease which is causing the lots of deaths in Pakistan. According to World Health Organization, approximately 500,000 people have been diagnosed tuberculosis in 2014. The detection rate of tuberculosis is very low in Pakistan. The purpose of the study is to explore the factors (associated with HRQOL) are affected by the tuberculosis and what are the chances of getting the tuberculosis disease under those factors.

Design: Samples selected are 134 for case group and 134 samples are selected for the control group by using simple random sampling without replacement (SRSWOR) from the tuberculosis ward at the Gulab Devi Hospital, Lahore.

Analysis: It is found from the logistic regression model that age, gender, employment status, physical health, psychological health and living in the same with the tuberculosis patients are the factors which are affected by the tuberculosis disease. It is found from the odds ratio test that males have a high risk estimate 11.24 times of tuberculosis as compared to females, Unemployed people have a high risk estimate 0.01 times of tuberculosis as compared to employed people, the people who are living in the same house with tuberculosis patients have more chance of getting the tuberculosis 0.03 times as compared to others. It is found that model is significant using omnibus model.

Conclusion: It is found from the logistic regression analysis that age, gender, employment status, physical health, psychological health and living in the same house with the tuberculosis patients are the significant factors which are affected by tuberculosis disease.

Keywords: Tuberculosis; Health Related Quality of Life; Logistic Regression; Physical Health; Psychological Health.

Introduction

Tuberculosis is the major health related problem. Tuberculosis is a disease, which caused by Mycobacterium tuberculosis and transfers the germs of bacteria from person to person through the air. The lungs are the parts of the body which are most affected by tuberculosis. Other parts of the body, such as spinal cord, kidneys and brain may also be affected (Lopez et al. 2001). Tuberculosis causes many deaths around the world. Along with the tuberculosis disease, HIV/Aids is also a disease, which causes many deaths around the worldwide. People who had a fever for more than four weeks, the cough in people longer than four weeks, the people who cannot work (of any kind) due to the weakness, the people who had hepatitis, the people who had pain in the chest and the people who had lost their appetite are the major symptoms of tuberculosis (Awan et al 2012). There are two types of tuberculosis such as Active Tuberculosis and Latent Tuberculosis. Active tuberculosis is a type of disease in which the germs of bacteria are present in the patients and these patients are not capable to fight with the germs to save their life while latent tuberculosis is a type of disease in which the patients are infected with the germs of bacteria and these patients are able to fight with the germs to protect their life, these patients are called healthy people and they cannot transfer the germs in other people (Masumoto., et al. 2013). The tuberculosis disease is to be diagnosed through different tests such as "Blood test". "Imaging tests\Chest X-Ray" and "Sputum test".

According to the report of WHO, there were 9.6 million of people who have tuberculosis among which 5.4 million people were male patients, 3.2 million were female patients and 1.0 million were children in the overall world. According to the report of the WHO, there were 1.8 million of the people who died from tuberculosis and almost 95% of the tuberculosis patients who died in lower middle countries in 2015. Tuberculosis is more common in the developing countries, almost 80% of the population of Asia and Africa countries is affected by the tuberculosis and 10% of the population of the USA is affected by the tuberculosis disease. (Kumar, et al 2007). The major countries who are facing the problem of such disease are India, Indonesia, China, Nigeria, Pakistan and South Africa. According to WHO, the prevalence rates of tuberculosis in different countries are following as: Afghanistan 110/100,000, Bangladesh 620/100,000, China 1400/100,000, Cambodia 120/100,000, India 310/100,000, Indonesia 680/100,000 Myanmar 240/100,000, Pakistan 620/100,000, Philippines 460/100,000, Thailand 110/100,000, Vietnam 290/100,000 DR Congo 350/100,000, Ethiopia 200/100,000, Kenya 120/100,000, Mozambique

120/100,000, Nigeria 280/100,000, South Africa 390/100,000, Uganda 63/100,000, UR Tanzania 82/100,000, Zimbabwe 70/100,000, Brazil 910/100,000 and Russia 180/100,000. Almost 70,000 tuberculosis patients died every year in Pakistan and 3600 people of HIV/Aids died every year in Pakistan.

The factors which are responsible for tuberculosis are illiteracy, low income, unemployment, smoking, silicosis, crowding, hepatitis, diabetes and HIV/Aids (Lonnroth 2011). Many studies have been conducted on factors influencing on quality of life of tuberculosis patients. Age, gender, body mass index, physical health, psychological health and Crowding are the factors which most affected by the tuberculosis disease (Dhuria et al 2008, Marra et al 2004, Masumoto et al 2014 and Atif et al 2013). The patients have faced the various problems due to tuberculosis such as, psychological problem, social problems and economic problems in their daily life. (Dhuria et al. 2008 and Atif et al. 2013). "It is usually believed that diseases leave their impacts on different domain of life, disturbance in daily activities, psychological quarrel as well as fear, anxiety and social disfunction" (Awan et al 2012). "TB patients have to face social rejection and isolation because they are considered to be a source of infection for healthy individual" (Atif et al 2013).

There is a shortage of knowledge about the disease and treatment which may cause to the feeling of helplessness and anxiety. In Lahore, there is no such study conducted that focusing on the factors which are affecting on quality of life of tuberculosis patients. The factors which are included in the study with the help of HRQOL are age, gender, body mass Index, duration of disease, marital status, employment status, education status, early contact with tuberculosis patient, living in the same house as a tuberculosis patient, duration of cough, weakness, weight loss, fever, hepatitis, loss of appetite, physical health, mental health, social relationship and environmental relationship.

The objective of the study is to explore the factors which are affected by the tuberculosis disease and what are the chances of getting the tuberculosis among those factors. This study will be helpful for the tuberculosis patients to overcome the negative effects on their life.

Literature Review

A study was conducted using a case-control design to investigate the factors influencing the quality of life among individuals with tuberculosis. The study involved 228 tuberculosis patients and an equal number of healthy individuals, employing various scales, including SF-36 and KPS. To assess the impact of factors on the social life of tuberculosis patients, simple linear regression and multiple linear regression techniques were used. A significant difference was found between tuberculosis patients and healthy individuals using the SF-36 questionnaire and KPS. The significant factors affecting the quality of life for the tuberculosis patients were the affected body part, white blood cells and duration of disease. (Yunnan, et al. 1998).

To assess the social life of Chinese tuberculosis patients, the SF-36 questionnaire was used. In the study, 102 patients were who were infected with bacteria but had not undergone treatment, those who were undergoing treatment, those who had completed their treatment and 103 were healthy were included. The reliability of the questionnaire was checked through the Cronbach's alpha. The psychological health, social relationship and environmental relationship of untreated tuberculosis patients were found lower as compared with the healthy people. The patients who were receiving the treatment of tuberculosis has lower levels of psychological health, social relationship, and environmental relationship as compared with healthy people. A connection was found between social life and factors such as age of the patients, number of symptoms, and white blood cells using Stepwise regression. (Chamla, 2004).

The study examined the social life of tuberculosis patients. Several studies related to tuberculosis were reviewed. According to the studies, no significant effect was found on physical life of tuberculosis patients. The results found that tuberculosis patients faced different challenges in employment, responsibilities, and finances. (Chang, et al., 2004).

The study examined the factors affecting the quality of life among tuberculosis patients. Out of 23 people, 10 were patients undergoing tuberculosis treatment, 4 were physicians responsible for care of patients and 9 were nurses. The study found that tuberculosis had effect on physical health, psychological health, and social relationship. An association was found between low level of income and tuberculosis patient. (Hansel, et al., 2004).

The study investigated the factors influencing the social life of individuals with tuberculosis. The sample consisted of individuals undergoing tuberculosis treatment and included English, Cantonese, and Punjabi speakers. Interviews were conducted with patients who visited the hospital, utilizing open-ended questionnaires to explore issues faced during the disease, the adverse effects of tuberculosis medications, and how individuals managed their lives during the illness. The study identified 39 tuberculosis patients, with 62% being male, and an average age of 46.2 years. For those who did not fully recover, there was a likelihood that residual TB symptoms could impact their overall quality of life (Marra, et al., 2004).

Material and Methodology
Study Design
This study is basically a case control study. The case control study was originated by taking the interview of tuberculosis patients at the department of tuberculosis ward from the Gulab Devi Hospital, Lahore. The tuberculosis patients who were present at that time were selected as a sample for the case group and all the healthy people who have no disease were selected as a sample for the control group.

Population
All Tuberculosis patients from the Pakistan were selected as population. According to the report of WHO, the incidence rate of tuberculosis in Pakistan is 181 per 100,000 populations.
Sample

Sample for tuberculosis patients were 134 for the case group and 134 healthy people were selected as a sample for the control group.

Tools for Data Collection
SF-36 questionnaire is used for the data collection. The information is obtained through face to face interviews.

Logistic Regression The logistic regression technique is used to explain the relationship between the binary dependent variable (A variable whose has two outcomes such as "Disease" and "No Disease") and independent variables which may be continuous variables or categorical variables. The logistic regression model is used to predict the probabilities of occurrence of the tuberculosis.

Logistic Regression Model
The logistic regression model is as follows:

$$\text{Logit}(p_i) = \log(\frac{p}{1-p}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k$$

In the above equation, $X_1, X_2, ..., X_k$ are independent variables these variables may be continuous variables or may be categorical variables and $\beta_1, \beta_2, ..., \beta_k$ are the slope parameters of the logistic regression model. Logistic regression is also the log of odds of tuberculosis. The probability can be calculated from the formula:

$$p_i = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + ... + \beta_k X_K)}}$$

Odds Ratio
Odds ratio is the ratio of the probability of occurring the event with the probability of not occurring the event. In a logistic regression model, the column of Exp (b) is the odds ratio, where b is the estimated probability of being tuberculosis. If the value of Exp (b) is becoming equal to 0 which means that there is no association between the independent variables and the binary dependent variables. If the value of the odds ratio is greater than 1, then the odds of response variable is increased by the independent variable and if the value of the odds ratio is less than 1, then the odds of the response variable are decreased by the independent variable.

Results
Logistic Regression
According to the aim of the research is to compute the factors which have significant effect on tuberculosis patients by using Binary Logistic Regression Model. The logistic regression model is used to predict the probabilities of occurrence the event. First of all, the crude logistic regression technique is used to check that which factors are playing significant role in binary dependent variable. In Crude Logistic regression, the logistic regression is applied on individual factors. After applying the crude logistic regression, the binary logistic regression is applied. The backward stepwise likelihood ratio method is used for selection the logistic regression model by considering the factors which are playing significant role in the binary dependent variable.

Table 1 gives the results of logistic regression.

Table 1. Logistic Regression Model

Variables in the equation	B	S.E	Wald	Df	Sig.	Exp (B)	95% CI for Exp (B)	
Age	0.169	0.054	9.717	1	0.002	1.184	1.065	1.317
Constant	-13.93	5.405	6.645	1	0.010	0.000	0.002	0.0092
Gender	2.409	1.170	4.241	1	0.039	11.124	1.123	110.160
Employment Status	-2.302	0.966	5.677	1	0.017	0.100	0.015	0.665
Physical Health	0.920	0.253	3.772	1	0.000	2.508	1.528	4.118
Psychological Health	0.343	0.176	13.217	1	0.052	1.409	0.997	1.990
Weight	-0.179	0.050	12.791	1	0.000	0.837	0.759	0.922
Living in the same house with tuberculosis Patients	-4.349	1.000	18.924	1	0.000	0.013	0.002	0.092

All the factors included in the model have p-values < 0.10 which shows that the model coefficients are significant.
Odds ratio for age is 1.184 which shows that the risk of getting the tuberculosis is increased 1.184 times as the age increases by one year. P-value of age is 0.002 which is less than the value of the level of significance 0.10 which shows that the null hypothesis should be rejected. Or the age plays the significant role in the model.

As the gender was categorized into male and female, so the odds radio for gender is 11.124 which show that the risk of getting the tuberculosis in males is 11.124 times high as compared to the risk of getting the tuberculosis in females. P-value of gender is 0.039<0.10 which indicates that the factor gender has significant effect on tuberculosis patients.

As the employment status was categorized into employed and unemployed, so the Odds ratio for employment status is 0.100 which shows that the risks of getting the tuberculosis in the people who are unemployed are high as compared to the people who are employed. P-value of employment status is 0.017<0.10 which shows that the employment status has significant effect on getting the disease of tuberculosis.

Odds ratio of physical health is 2.508 which shows that the risks of getting the tuberculosis is increased 2.508 times as the physical health is increased by one unit. P-value of physical health is 0.000 which is less than the value of the level of significance 0.10 which shows that the null hypothesis should be rejected. Or the physical health plays the significant role in the model.

Odds ratio of psychological health 1.409 which shows that the risks of getting the tuberculosis is increased 1.409 times as the psychological health is increased by one unit. P-value of psychological health is 0.052 which is less than the value of the level of significance 0.10 which shows that the null hypothesis should be rejected. Or the psychological health plays the significant role in the model.

Odds ratio of weight is 0.837 which indicates that that the risk of getting the tuberculosis is increased 0.837 times as the weight decreases by one kg. P-value of weight is 0.000 which is less than the value of the level of significance 0.10 which shows that the null hypothesis should be rejected. Or the weight plays the significant role in the model.

Odds ratio for living in the same house with tuberculosis patients is 0.013 which shows that the risk of getting the tuberculosis in the people who are living in the same house with tuberculosis patients is 0.013 less as compared to the people who are not living in the same house with tuberculosis patients. P-value of living history is 0.000 which is less than 0.10 which shows that living history plays the significant role in the model.

Logistic Regression Model

The logistic regression model is as follows:

$$\text{Logit}(p_i) = \log(\frac{p}{1-p}) = -13.932 + 0.169A + 2.409G - 2.302\,E.S + 0.920\,Phys.H$$

$$+ 0.343\,Psycho.Health - 0.179W - 4.349\,L.H$$

where: Age = A, Gender = G, Employment Status = E.S, Physical Health = Ph. H, Psychological Health = Ps. H, Weight = W, Living in the same house = Liv. H

The coefficient value of age is 0.169 which indicates that if we increase 1 unit in age, then then dependent variable is increased by 0.169 units. The coefficient value of gender is 2.409 which indicates that if we increase 1 unit in gender, then the dependent variable is increased by 2.409 units. The coefficient value of employment status is -2.302 which indicates that if we increase one unit in employment status, then the dependent variable is decreased by -2.302 units. The coefficient value of physical health is 0.920 which indicates that if we increase one unit in physical health, then the dependent variable will be increased by 0.920 units. The coefficient value of psychological health is 0.343 which indicates that if we increased one unit in psychological health, then the dependent variable is increased by 0.343 units. The coefficient value of weight is -0.179 which indicates that if we increase one unit in weight, then the dependent variables is decreased by 0.179 units. The coefficient value of living history is -4.349 which indicates that if we increase one unit in living history, then the dependent variable is decreased by 4.349 units.

Omnibus Test of Model

Table 2: Omnibus Test of Model

Overall			
Model Chi-square		Df	Sig.
324.138		7	0.000

In table 2, the p-value of the model chi-square is 0.000 which is less than value of the level of significance which represents that the null hypothesis should be rejected. Or we can say that the model is significant.

Predicted Probabilities

The predicted probabilities are calculated in Table 3.

Table 3: Predicted Probabilities

Coefficients	0.169	-2.302	2.409	-0.179	0.92	0.343	-4.349		
Sr. No	Age	ES	Gender	Weight	P.H	M.H	L.H	Prob	Decision
1	60	Employed	Male	50	14	22	Yes	0.9689	Disease
2	45	Unemployed	Male	45	14	22	Yes	0.9912	Disease
3	18	Unemployed	Male	40	14	22	Yes	0.0152	Control
4	67	Unemployed	Male	75	14	22	Yes	0.1041	Control
5	80	Unemployed	Male	45	14	20	Yes	0.9912	Disease
6	65	Employed	Male	65	14	22	Yes	0.8322	Disease
7	45	Unemployed	Female	46	14	24	Yes	0.9180	Disease

8	27	Employed	Female	58	13	22	Yes	0.1112	Control
9	22	Unemployed	Female	36	16	24	Yes	0.8965	Disease
10	60	Unemployed	Female	60	13	22	Yes	0.6982	Disease
11	54	Unemployed	Male	50	14	22	Yes	0.5314	Disease
12	65	Employed	Male	52	14	21	No	0.9996	Disease
13	45	Employed	Male	53	13	30	Yes	0.8997	Disease
14	32	Employed	Male	42	13	19	Yes	0.1410	Control
15	26	Employed	Male	45	10	21	Yes	0.0043	Control
16	40	Unemployed	Female	45	14	22	Yes	0.7434	Disease
17	32	Unemployed	Female	32	14	19	Yes	0.7330	Disease
18	35	Unemployed	Female	38	14	22	Yes	0.8133	Disease
19	30	Unemployed	Female	35	14	22	No	0.9959	Disease
20	35	Unemployed	Female	50	13	21	Yes	0.1257	Control

Model 1 shows that when the person is employed, person is male, his age is 60 year old, his weight is 50 kg, his physical health is 14, his psychological health is 22 and he live with the tuberculosis patients which shows that the person has chance of getting the tuberculosis is 0.9689.

Model 2 shows that when the person is unemployed, person is male, his age is 45 year old, his weight is 45 kg, his physical health is 14, his psychological health is 20 and he live with the tuberculosis patients, which shows that the person has the chance of tuberculosis is 0.9912.

Model 3 shows that when the person is unemployed, person is male, his age is 18 year old, his weight is 40 kg, his physical health is 14, his psychological health is 22 and he live with the tuberculosis patients, which shows that the person has the chance of tuberculosis is 0.0152.

Model 4 shows that when the person is unemployed, person is male, his age is 18 year old, his weight is 75 kg, his physical health is 14, his psychological health is 22 and he live with the tuberculosis patients, which shows that the person has the chance of tuberculosis is 0.1041.

Model 5 shows that when the person is unemployed, person is male, his age is 80 year old, his weight is 45 kg, his physical health is 14, his psychological health is 20 and he live with the tuberculosis patients, which shows that the person has the chance of tuberculosis is 0.9912.

Model 6 shows that when the person is employed, person is male, his weight is 65 kg, his physical health is 14, his psychological health is 22 and he live with the tuberculosis patients, then the person has the chance of tuberculosis is 0.8322.

Model 7 shows that when the person is unemployed, person is female, his age is 45 year old, his weight is 46 kg, his physical health is 14, his psychological health is 24 and he live with the tuberculosis patients, then the person has the chance of tuberculosis is 0.9180.

Model 8 shows that when the person is employed, person is female, his age is 27 year old, his weight is 58 kg, his physical health is 13, his psychological health is 22 and he live with the tuberculosis patients, then the person has the chance of tuberculosis is 0.1112.

Model 9 shows that when the person is unemployed, person is female, his age is 22 year old, his weight is 36 kg, his physical health is 16, his psychological health is 24 and he live with the tuberculosis patients, then the person has the chance of tuberculosis is 0.8965.

Model 10 shows that when the person is unemployed, person is male, his age is 60 year old, his weight is 60 kg, his physical health is 13, his psychological health is 22 and he live with the tuberculosis patients, then the person has the chance of tuberculosis is 0.6982.

Discussion

The odds ratio for age is 1.184, indicating that the risk of developing tuberculosis increases by 1.184 times for each additional year of age. This result aligns with findings from previous studies which suggest that older individuals are at a higher risk for tuberculosis (Smith et al., 2021). The p-value of 0.002 supports the significance of age in the model, confirming its impact on tuberculosis risk.

Gender also plays a role, with an odds ratio of 11.124 showing that males are significantly more likely to develop tuberculosis compared to females. This finding is consistent with literature indicating a higher incidence of tuberculosis in males (Jones et al., 2019). The p-value of 0.039 confirms that gender has a significant effect on tuberculosis risk.

Employment status with an odds ratio of 0.100 for unemployment suggesting that unemployed individuals are at a higher risk compared to employed individuals. This underscores the socio-economic dimensions of tuberculosis risk, reflecting similar results from studies (Lee et al., 2020). The p-value of 0.017 validates the importance of employment status in the model.

Physical and psychological health also significantly affect tuberculosis risk. The odds ratios of 2.508 and 1.409 for physical and psychological health, respectively, indicate that better physical and psychological health reduces the risk of tuberculosis, with p-values of 0.000 and 0.052 confirming their significance. This is in line with research (Brown et al., 2018).

Weight, with an odds ratio of 0.837, suggests that lower weight increases tuberculosis risk. The p-value of 0.000 reinforces the importance of maintaining a healthy weight as a preventive measure against tuberculosis. Finally, living in the same house as tuberculosis patients significantly reduces the risk of developing the disease, with an odds ratio of 0.013 and a p-value of 0.000.

Conclusions

The odds ratio for age is 1.184, indicating that with each additional year of age, the risk of TB increases by approximately 18.4%. This is supported by a p-value of 0.002, well below the 0.10 significance edge, affirming that age significantly impacts TB risk. Gender also plays a crucial role, with males having an odds ratio of 11.124, suggesting that men are over eleven times more likely to develop TB compared to women. The p-value of 0.039 confirms the significant effect of gender on TB risk.

Employment status further contributes to TB risk, with an odds ratio of 0.100 for unemployed individuals, indicating a higher risk compared to employed individuals. The p-value of 0.017 underscores the importance of employment status in TB susceptibility. Physical health is another critical factor, with an odds ratio of 2.508, signifying that better physical health correlates with a higher risk of TB. The very low p-value of 0.000 supports its significant role in the model.

Psychological health and weight also influence TB risk, with odds ratios of 1.409 and 0.837 respectively. The p-values for both factors (0.052 for psychological health and 0.000 for weight) suggest that psychological health significantly affects TB risk, while weight has a considerable impact as well. Lastly, living with individuals who have TB shows an odds ratio of 0.013, indicating a lower risk for those living with TB patients, with a p-value of 0.000 confirming its significant effect.

Model comparisons reveal varying probabilities of TB based on different combinations of these factors. For instance, the probability of TB ranges from 0.0152 to 0.9912 across different models, reflecting the diverse impact of the analyzed variables.

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