



Evaluation of treatment outcomes for Tuberculosis patients during 10 years

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General Note

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ABSTRACT

Background and purpose: Tuberculosis is one of the most common infectious diseases in the world that can affect various organs including the lungs. Currently it is one of the major causes of death and disability, especially in developing countries. The aim of this study is to analyze the outcome of treatment for tuberculosis patients in Chaharmahal & Bakhtiari province during the years 2007-2017. **Materials and Methods:** This is a descriptive-analytic study of historical cohort. Data on type of treatment, outcome of treatment, demographic and epidemiological characteristics were collected by referring to patients' health records through Health Department. Data were analyzed by SPSS v.20 using chi-square, Kruskal-Wallis and logistic regression tests at the 0.05 level. **Results:** The number of patients was 342 who were studied during 11 years from 2007-2017. 51.2% were female and 48.8% were male. The mean age of the patients was 49.79 ± 21.66 years. 1.2% of patients were infected with HIV. The outcome of treatment for a total of 342 patients with tuberculosis, 304 (88.9%) were successfully treated and eventually recovered. Of the 38 patients who had unsuccessful treatment, 22 died during the course of treatment and 16 patients had treatment failure and absenteeism. The highest treatment failure, absenteeism, and death were seen in the age group 65 and older. There was a significant relationship between age ($p < 0.0001$), gender ($p = 0.01$), history of imprisonment ($p < 0.0001$) and type of disease ($p < 0.0001$) with treatment outcome. **Conclusion:** To achieve desirable outcome of treatment, comprehensive support, supply of drugs needed for TB control, need to improve DOTS strategy and planning for timely screening and identification of patients especially in high risk groups.

Keywords: Treatment Outcome, Tuberculosis, Epidemiology, Chaharmahal & Bakhtiari.

1. INTRODUCTION

Tuberculosis (TB) is one of the most common infectious diseases in the world (Houben and Dodd, 2016 and Organization, 2013). Fifty percent of immigrants are now infected with bacilli tuberculosis every second a new infection occurs globally. It is estimated that one in three people have TB bacilli infected and every 4 seconds someone sick with TB disease characterized by the trends over a decade, nearly 300 million people with TB become infected (World Health Organization, 2015). About 10% of these infections eventually lead to tuberculosis (Atif et al., 2014). Tuberculosis has always been associated with high mortality and morbidity rates throughout history. Tuberculosis after HIV (Human Immune Deficiency Virus) infection is the most important cause of death from infectious diseases (Endris et al., 2014). Tuberculosis can affect various organs of the body and will have a bad effect on all body tissues (Hatami et al., 2007). 85% of TB cases occur in the pulmonary and 15% in the extra pulmonary form (Azizi et al., 2004 and Dye et al., 2008 and Arsang et al., 2011). Statistics of the annual WHO 140 people per year in the Department of Health and Human Services reports that 14.4 percent of the 100,000 people in Iran are infected with TB (Nasehi and Mirhaghani, 2009 and Organization, 2011). It is estimated that one third of the world's population is infected with bacilli (Dye et al., 2008). The prevalence of tuberculosis in Iran is high and the provinces of Sistan and Baluchistan and Golestan are among the most polluted provinces (Hatami et al., 2008). Given its immediate priorities, it has become the most widely categorized household in the world, with the prevalence of tuberculosis reaching 50% by 2015 at 50% between 1990 and 2050. TB is reduced to one in a million (Dye et al., 2008). The prevalence of tuberculosis in Iran is high and the provinces of Sistan and Baluchistan and Golestan are among the most polluted provinces (Hatami et al., 2008). According to the priorities, the next step is to consolidate the fundamentals; Three points suggest that the prevalence of tuberculosis in the world by 2015 will reach 50% in 1990 and by 2050, the death toll will be significantly lower (Dye et al., 2008). Despite the fact that tuberculosis is a preventable disease, it is still among the top ten causes of death worldwide (Zumla et al., 2015). According to a recent WHO report in 2016, about 10 million people have Mycobacterium tuberculosis and 1.7 million have died (Organization, 2010). About 8 million people die from the disease each year. Tuberculosis is still one of the major health problems in developing countries including Iran (Sharifi-Mood et al., 2004). Early detection and complete the full course of treatment plays an important role in the control and prevention of disease and ultimately facilitate eradication of the disease (Ejeta et al., 2015 and Sunday et al., 2014). In addition, the lack of success in treating patients and health economic burden on individuals and society imposes (Sawadogo et al., 2015). A comprehensive analysis of patient management is very necessary to evaluate the effective implementation of DOTS: Directly Observed Treatment Short-Course (Woldeyohannes et al., 2015). In addition, understanding the factors associated with treatment failure is also important to improve and improve the DOTS treatment system (Kanade et al., 2010). Given the emergence of resistant TB, especially MDR, and the potential to spread these strains to other parts of the country and to increase treatment failure and mortality in patients with refractory tuberculosis, increasing the duration and cost of treatment (Dye et al., 1999) since Iran is an endemic area of tuberculosis. And given the rising prevalence of TB in the country and the lack of research into the effective treatment of my patients in Chaharmahal va Bakhtiari province, no information is available on

the surveillance and epidemiological indicators of this disease at the provincial level. Therefore, we decided to conduct a study aimed at determining the outcome of treatment of my patients in Chaharmahal va Bakhtiari province during the years 2007-2017.

2. MATERIALS AND METHODS

This study is a descriptive-analytic study of historical cohort studies that was performed on 342 patients with pulmonary and non-pulmonary tuberculosis in Chaharmahal va Bakhtiari province during 11 years in 2007-2017. Inclusion criteria included: All identified pulmonary and non-pulmonary tuberculosis patients in Chaharmahal va Bakhtiari province who were diagnosed and treated during the years 2007-2017. Exclusion criteria included patients who were mistakenly selected as tuberculosis patients, those who used prophylaxis as tuberculosis drugs, and patients whose treatment outcome was unclear. In this study, after applying the inclusion and exclusion criteria of patients who met the inclusion criteria, all 342 patients were included in the study and the necessary data were obtained and finally analyzed. The data of all patients identified as Excell file were extracted through the software of Shahrekord University of Medical Sciences. Demographic and epidemiological variables related to the disease include sex, age, urban and rural residence, occupation, nationality, education level, city name of residence, type of tuberculosis (pulmonary and non-pulmonary), type of treatment group, prisoner record, the year of diagnosis, case (new, relapse, etc.), treatment outcome, HIV infection and history of TB were collected. Outcome of treatment was evaluated according to the World Health Standards and Centers for Disease Control guidelines including: improved, completed treatment, died, treatment failure, absenteeism, transfused and unspecified (other). The data of patients with pulmonary and non-pulmonary tuberculosis were entered in SPSS software version 20 and finally were analyzed using chi-square, Kruskal-Wallis and logistic regression tests at the significant level of $\alpha = 0.05$.

Ethical committee approval number & details

The code of ethics of the article is SSUMS.1398.22982 by Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

3. RESULTS

A total of 342 patients with pulmonary and non-pulmonary tuberculosis were studied over a period of 11 years from 2007 to 2017. Of these, 48.8% were male and 51.2% were female. The mean age of patients was 49.79 ± 21.66 years. Maximum age 93 years and the minimum age was 1-year old. 53.2% lived in the city and 46.8% lived in the village. 99.1% of patients were Iranian and the rest were Afghan. 1.2% of patients were infected with HIV and 17.5% had history of contact with tuberculosis patients and less than 1% had Prisoner (Table 1). The outcome of treatment for a total of 342 patients with tuberculosis, 304 (88.9%) were successfully treated and eventually recovered. Of the 38 patients who had unsuccessful treatment, 22 died during the course of treatment and 16 patients had treatment failure and absenteeism (Table 2). 63.2% had pulmonary tuberculosis and 36.8% non-pulmonary tuberculosis. The most common site of non-pulmonary tuberculosis was lymphatic tuberculosis (32.5%) and the least involved member was neck, peritoneal curtain and other organs Involved in non-pulmonary tuberculosis is shown in Figure 1. The lowest age group with TB is 0-14 years and the highest age group with TB is 65 years and above. The highest treatment failure, absenteeism, and death were seen in the age group 65 and older. The highest overall improvement was seen in the younger group of 15-44 years old. There were no deaths, treatment failure and absence of treatment in the 0-14 and 15-24 age groups (Table 3). Chi-square test showed a significant relationship between age ($p < 0.0001$), gender ($p = 0.01$), history of imprisonment ($p < 0.0001$) and type of disease ($p < 0.0001$) with treatment outcome. Also, based on the results of Chi-square test, no significant relationship was found between residence ($p = 0.2$) and outcome of treatment. According to the results of Kruskal-Wallis nonparametric test, there was a statistically significant relationship between the ages of patients in different treatment outcome groups ($p = 0.000$). According to multivariate logistic regression analysis, age variable was effective on treatment outcome (death) and the relationship Significance was observed.

Table 1 demographic characteristic of patients with pulmonary and extra pulmonary TB

Variable	Variable-type	Gender	Frequency	percentage	
Gender	Male		167	48.8	
	Female		175	51.2	
Nationality	Iranian	Male	166	339	99.1
		Female	173		
	Afghan	Male	1	3	0.9
		Female	2		
Location	Village	Male	76	160	46.8

	City	Female	84	182	53.2
		Male	91		
		Female	91		
HIV infection	Yes	Male	2	4	1.2
		Female	2		
	No	Male	165	338	98.8
		Female	173		
History of Prison	Yes	Male	3	3	0.9
		Female	0		
	No	Male	164	339	99.1
		Female	175		
Group Therapy	Type 1	Male	153	320	93.6
		Female	167		
	Type 2	Male	14	22	6.4
		Female	8		
Type of disease	Pulmonary	Male	105	216	63.2
		Female	111		
	Non-pulmonary	Male	62	126	36.8
		Female	64		

Table 2 Treatment outcomes in pulmonary and non-pulmonary TB patients

Variable	Variable-type	Gender		Frequency percentage	
Recovery	Improved	Male	53	128 (37.4%)	304 (88.9%)
		Female	75		
	Complete the course of treatment	Male	89	176 (51.5%)	
		Female	87		
No recovery	Death	Male	13	22 (6.4%)	38 (11.1%)
		Female	9		
	Treatment failure	Male	6	7 (2%)	
		Female	1		
	Absence of treatment	Male	1	4 (1.2%)	
		Female	3		
		Male	5	5 (1.5%)	
		Female	0		

Table 3 Treatment outcome in different age groups

age category	Outcome of treatment											
	Improved		Complete the course of treatment		Death		Treatment failure		Absence of treatment		Others	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
0-14	1	0.8	12	6.8	0	0	0	0	0	0	0	0
15-24	12	9.4	14	8	0	0	0	0	0	0	0	0
25-34	20	15.6	35	19.9	0	0	1	14.3	0	0	3	60
35-44	25	19.5	20	11.4	1	4.5	2	28.6	1	25	1	20
45-54	16	12.5	29	16.5	1	4.5	1	14.3	1	25	0	0
55-64	16	12.5	23	13.1	3	13.6	1	14.3	0	0	1	20
≥65	38	29.7	43	24.4	17	77.3	2	28.6	2	50	0	0
Total	128	100	176	100	22	100	7	100	4	100	5	100

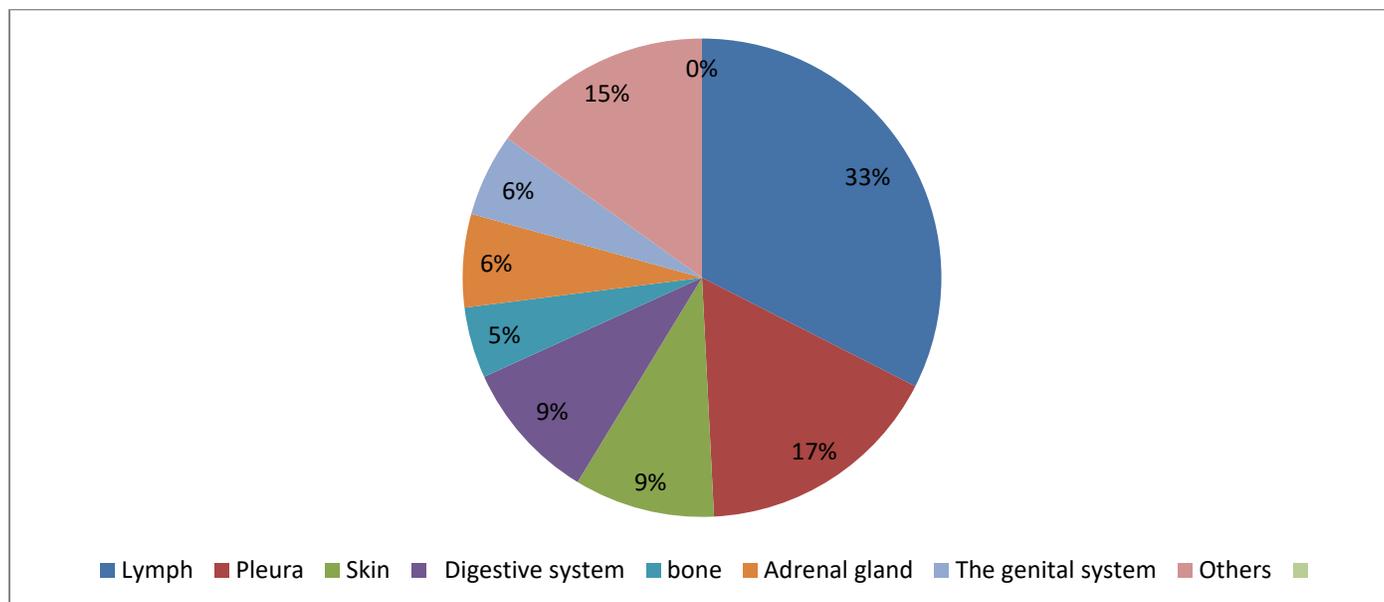


Figure 1 Types of extra-pulmonary TB

4. DISCUSSION

Tuberculosis is one of the most important health problems in the world right now that approximately 3 million people to the killing. Despite the fact that tuberculosis is a preventable disease, it is still among the top ten causes of global mortality (World Health Organization, 2018). In this study the prevalence rate of women (51.2%) and men (48.8%) is approximately equal to TB compared to the national report of the year 1396 (World Health Organization, 2013). This result is similar to the study by Sakineh Naroui et al., Which showed that the rate of infection was 50.3% in women and 49.7% in men. In our study, a significant relationship was found between gender and treatment outcome, which was consistent with the study by Sakineh Naroui et al. (Naroyi et al., 2016). Here was also a significant relationship between age and outcome of treatment. The highest level of remission was observed in the age group of 65 and over, which is similar to the study in Pakistan (Atif et al., 2018). In our study, in addition to the age group 65 and over, the age group 35-44 years had the highest number of treatment failures. Another age group with the least age group with the least improvement was 25-34 years old, which can be attributed to being economically active. Chaharmahal va Bakhtiari Province Due to the mountainous texture and lack of suitable employment opportunities, this high age group emigrates to neighboring provinces. This transfer can be one of the reasons for the lack of improvement in the process of complete treatment. Causes of failure to recover in the age group of 65 years and over, age, underlying disease, lack of knowledge about timely and correct use of TB drugs, and lack of care during treatment. In the study by Sakineh Narouei et al. (Naroyi et al., 2016) non-recovery in the age group of 21-40 years was also consistent with our study. The success rate of treatment in tuberculosis patients was reported at 85% in 2018, according to the World Health Organization. Also, in Somalia 81.8% (Ali et al., 2017) Nigeria (Ukwaja et al., 2013) and India 74%, Brazil 71% in 2018 (World Health Organization, 2017) and in the study of Atif et al. In Malaysia 67.2% and in the west Ethiopia reported 70.8% (Ejeta et al., 2015 and Atif et al., 2014). The success rate of treatment of this disease in Iran in 1986 was 85%. For Horizon 1404, the success rate of TB treatment was estimated to be over 90% (World Health Organization., 2013).

In our study, the success rate of tuberculosis treatment was 88.9%, which is higher than that of the world and the countries mentioned, and is far below our predicted prospects. Comparison of treatment success rate of this study with studies in Iran including Sakineh Naroui et al and Study in southeastern Iranshahr (treatment success rate 84.88%) (Naroyi et al., 2016) and Nasrollah Weissy et al study in Kurdistan (treatment success rate 87.6%) Was also higher (Wisey et al., 2015). Differences in the outcomes of TB treatment success in our world and in our country may be attributed to various factors including study design, study duration, sample size, population under study, quality of information provided in prevention and treatment centers, migration and patient death (Atif et al., 2018). In this study, there was a significant relationship between the outcome of treatment and the type of disease as in other studies, including the study by Sakineh Naroui et al. (Naroyi et al., 2016) and the study in southern Ethiopia by Gebrezgabiher (Gebrezgabiher et al., 2016). But in the study of Ejeta et al., There was no significant relationship between treatment outcome and type of disease (Ejeta et al., 2015).

In our study, there was a statistically significant relationship between HIV / AIDS and treatment outcome. Since the presence of a disease concomitant with tuberculosis can affect the success rate of treatment, therefore, one of the factors examined in this study was the coexistence of AIDS with tuberculosis (Lucenko et al., 2014). Also, the spread of immunodeficiency diseases such as human immunodeficiency virus (HIV) and AIDS worldwide and changing living conditions and overpopulation in developing countries are now addressing these diseases due to anti-tuberculosis drug resistance to human health problems has become (Control, 1998). As a result of our study regarding the existence of a significant relationship between treatment outcome and HIV disease has been aligned with the study of Sakineh Naroui et al. (Naroyi et al., 2016). In our study based on the results and studies conducted in Peru, South Ethiopia, Uzbekistan and Sakineh Naroui et al. Study, there was a significant relationship between treatment outcome and prison history of TB patients (Gebrezgabiher et al., 2016 and Gadoev et al., 2015 and Lackey et al., 2015). But in the study of Amin Saeedinia et al, no significant relationship was found between treatment outcome and patients' prison history (Saeedi et al., 2013). Imprisonment can be an effective factor in the treatment of TB patients and it is also a factor in the treatment of the patient, and this may be because inmates have various causes such as nutrition, drug addiction, being in the community and maybe Lower literacy and culture, and more likely to be related to a particular stratum of society or to specific social behaviors, are more likely to be an important factor in the development of resistant TB germs. Other factors that can accelerate and resonance the transmission of TB germs in prisons around the world include: prolonged contact, late diagnosis and treatment, overcrowding (Saeedi et al., 2013 and Mirhaghani and Nasehi, 2009). There was no significant relationship between outcome of treatment and place of residence in this study. The reason for the lack of a meaningful relationship can be the same as the way in which access to treatment services and risk factors are provided.

In a study in southern Ethiopia by Gebrezgabiher et al. (Gebrezgabiher et al., 2016), there was a significant relationship between treatment outcome and patients' place of residence. But the results of the study by Sakineh Naroui et al. (Naroyi et al., 2016) were not consistent with our study.

Limitations

With the possibility of investigating the effective factors in the development of tuberculosis and causing drug resistance. Another limitation of this study was the recording of patient information electronically, which in some cases was incomplete information that required more accurate recording of TB patients. Other limitations of our study were lack of information on major adverse drug reactions Anti-tuberculosis and unavailability of factors affecting successful follow-up and disease-related mortality and lack of body mass index and nutrition of patients can be named.

5. CONCLUSION

Given that the success rate of TB treatment in our study was 88.9%, this success rate was higher than the expected target rate in the world and Iran (success rate of 85%). Treatment requires all-round support, resources, and medication needed to achieve the goals set for TB control, disease detection, strengthening the laboratory network, DOTS, and planning for timely patient identification especially in high-risk groups.

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Conflicts of Interest: The authors declare no conflict of interest.

Abbreviation

TB:	Tuberculosis
HIV:	Human Immune Deficiency Virus
DOTS:	Directly Observed Treatment Short-Course
WHO:	World Health Organization
MDR:	Multiple Drug Resistance
SPSS:	Statistical package for social science
AIDS:	Acquired Immune Deficiency Syndrome

REFERENCE

1. Ali MK, Karanja S, Karama M. Factors associated with tuberculosis treatment outcomes among tuberculosis patients attending tuberculosis treatment centres in 2016-2017 in Mogadishu, Somalia. *Pan African Medical Journal* 2017;28:197.
2. Arsang S, Kazemnejad A, Amani F. Epidemiology of tuberculosis in Iran (2001-08). *Journal of Gorgan University of Medical Sciences* 2011;13:78-86.
3. Atif M, Anwar Z, Fatima RK, Malik I, Asghar S, Scahill S. Analysis of tuberculosis treatment outcomes among pulmonary tuberculosis patients in Bahawalpur, Pakistan. *BMC research notes* 2018;11:370.
4. Atif M, Sulaiman SAS, Shafie AA, Ali I, Asif M. Treatment outcome of new smear positive pulmonary tuberculosis patients in Penang, Malaysia. *BMC infectious diseases* 2014;14:399.
5. Azizi F, Hatami H, Janghorbani M. Epidemiology and control of common diseases in Iran. Tehran. Khosravi Publisher 2004.
6. Control CfD, Prevention. Tuberculosis (TB). 2012 [updated May, 2015; cited September, 2015].
7. Control CfD, Prevention. Tuberculosis morbidity--United States, 1997. *MMWR Morbidity and mortality weekly report* 1998;47:253.
8. Dye C, Floyd K, Uplekar M. Global tuberculosis control: surveillance planning financing. WHO report 2008. 2008;393:294.
9. Dye C, Scheele S, Dolin P, Pathania V, Raviglione MC. Global burden of tuberculosis: estimated incidence, prevalence, and mortality by country. *Jama* 1999;282:677-86.
10. Ejeta E, Chala M, Arega G, Ayalsew K, Tesfaye L, Birhanu T, et al. Outcome of Tuberculosis patients under directly observed short course treatment in western Ethiopia. *The Journal of Infection in Developing Countries* 2015;9:752-9.
11. Endris M, Moges F, Belyhun Y, Woldehana E, Esmael A, Unakal C. Treatment outcome of tuberculosis patients at Enfraz Health Center, Northwest Ethiopia: a five-year retrospective study. *Tuberculosis research and treatment* 2014; 2014:726193.
12. Gadoev J, Asadov D, Tillashaykhov M, Tayler-Smith K, Isaakidis P, Dadu A, et al. Factors associated with unfavorable treatment outcomes in new and previously treated TB patients in Uzbekistan: a five year countrywide study. *PLoS one* 2015;10:0128907.
13. Gebrezgabihier G, Romha G, Ejeta E, Asebe G, Zemene E, Ameni G. Treatment outcome of tuberculosis patients under directly observed treatment short course and factors affecting outcome in southern Ethiopia: a five-year retrospective study. *PLoS one* 2016;11:0150560.
14. Hatami H, Razavi S, Eftekhar H, Majlesi F, Sayed Nozadi M, Parizadeh S. Text of public health. Tehran, Iran: Arjmand Publications 2007.
15. Hatami H, Razavi S, Eftekhar-Ardabili H. Text book of public health. Volume 1, Tehran. Arjmand Press 2008.
16. Houben RM, Dodd PJ. The global burden of latent tuberculosis infection: a re-estimation using mathematical modelling. *PLoS medicine* 2016;13:1002152.
17. Kanade S, Nataraj G, Anita R, Mehta P. Correlation between smear positivity grade at two months with culture positivity and final outcome in patients receiving antituberculosis treatment. *Bombay Hospital Journal* 2010;52:183-8.
18. Kh R. Text book of public health. Tehran. Semat Press 2010.
19. Lackey B, Seas C, Van der Stuyft P, Otero L. Patient characteristics associated with tuberculosis treatment default: A cohort study in a high-incidence area of Lima, Peru. *PLoS one* 2015;10:0128541.
20. Lucenko I, Riekstina V, Perevoscikovs J, Mozgis D, Khogali M, Gadoev J, et al. Treatment outcomes among drug-susceptible tuberculosis patients in Latvia, 2006–2010. *Public health action* 2014;4:54-8.
21. Mirhaghani L, Nasehi M. National Tuberculosis Control Guideline. Tehran: Andishmand 2009.
22. Naroyi S, Sufi Kh, Dadgar J, Parvin Ab. Investigating the Outcome of Treatment of Tuberculosis Patients and Related Factors in Southeast Iran - Iranshahr during 2005 to 2014. *Journal of Preventive Medicine* 2016;3:1-7.
23. Nasehi M, Mirhaghani L. National tuberculosis control guide. Tehran: Andishmand Publisher 2009.
24. Organization WH. Global tuberculosis report 2013: World Health Organization; 2013.
25. Organization WH. Global tuberculosis report 2018: World Health Organization 2018.
26. Organization WH. Strengthening health sector response to HIV/AIDS and sexually transmitted infections in the Eastern Mediterranean Region 2006–2010. WHO 2006 [updated June, 2006; cited May, 2015].
27. Organization WH. The sixteenth global report on tuberculosis. Tuberculosis: Executive summary WHO Rep 2011;2011:1-2.
28. Organization WH. World Health Organization tuberculosis fact sheet no. 104. World Health Organization, Geneva, Switzerland <http://www.who.int/mediacentre/factsheets/fs104/en>. 2010.
29. Saeedi Nia A, Taromian S, Kayhaniyan F. Evaluation of the outcome of treating patients with tuberculosis in the city of Rasht. *Journal of Gilan University of Medical Sciences* 2013;23:7-13.

30. Sawadogo B, Tint KS, Tshimanga M, Kuonza L, Ouedraogo L. Risk factors for tuberculosis treatment failure among pulmonary tuberculosis patients in four health regions of Burkina Faso, 2009: case control study. *Pan African medical journal* 2015;21.
31. Sharifi-Mood B, Alavi-Naini R, Metanat M, editors. Relapse rate and Failure rate in hospitalized smear positive Pulmonary TB. 2nd National Congress of Epidemiology 2004.
32. Sunday O, Oladimeji O, Ebenezer F, Akintunde B, Abiola T-O, Saliu A, et al. Treatment outcome of tuberculosis patients registered at DOTS Centre in Ogbomoso, southwestern Nigeria: a 4-year retrospective study. *Tuberculosis research and treatment* 2014;2014.
33. The incidence of tuberculosis in Iran. 1990-2017.
34. Ukwaja K, Ifebunandu N, Osakwe P, Alobu I. Tuberculosis treatment outcome and its determinants in a tertiary care setting in south-eastern Nigeria. *The Nigerian postgraduate medical journal* 2013;20:125-9.
35. Wisey N KM, Azadi N, Rahmani KH. The incidence and success rate in the treatment of tuberculosis in Kurdistan in 2000-2012. *Journal of Kurdistan University of Medical Sciences* 2015;20:1-9.
36. Woldeyohannes D, Sisay S, Mengistu B, Kassa H. Directly observed treatment short-course (DOTS) for treatment of new tuberculosis cases in Somali Regional State, Eastern Ethiopia: ten years retrospective study. *BMC research notes* 2015;8:357.
37. World Health Organization. *Global tuberculosis report 2016* 2017.
38. Zumla A, George A, Sharma V, Herbert RHN, Oxley A, Oliver M. The WHO 2014 global tuberculosis report-further to go. *The Lancet Global Health* 2015;3:10-2.