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Original Article

The 10-year Trend of TB Rate in West Azerbaijan Province, Iran from 2001 to 2010

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Abstract

Background: The present study aimed to explore some risk factors affected the mean of the number of tuberculosis (TB) in West Azerbaijan Province, Iran between 2001 and 2010.

Methods: Our time series study analyzed the data of 2,560 TB patients as registered with TB Patients Care System in West Azerbaijan Province from early 2001 to 2010. A checklist was prepared for collecting the data and they were then analyzed in SPSS V.16 software.

Results: The percentage of male and percentage of female were close to each other (52.2% against 47.8%, respectively). A significant increasing trend of TB rate was found over the years of 2001and 2010 with a pick at 2008 ($P<0.001$). A Poisson log-linear analysis showed that the most important risk factor of the trend of rate was the level of education so that people with primary level or with illiterate level had a statistically significant TB rate of 5.21 (4.66-5.81), adjusted for years. The next risk factor was type of TB and place of residency, i.e., pulmonary TB cases had higher rate than External pulmonary TB cases (RR=1.67; (1.54-1.80). The last factor with the lowest risk was BCG with RR=1.29 (1.20-1.40) for people who received BCG compared to the people who had not received it.

Conclusion: Although the co morbidity of AIDS and TB was not a major problem, it is necessary that special attention be paid to the way of implementing the TB control program based on the demographic risk factors of the study population.

Keywords: Incidence, Tuberculosis, Epidemiology, Iran

Introduction

After the tuberculosis agent was discovered by Robert Koch in 1882, it was hoped that the disease would be controlled and eradicated. Unfortunately, more than a century has passed since the discovery and TB still claims lives across the world (1). World Health Organization (WHO) declared TB as urgency in 1993 and urged all nations to control the disease (2). In the 21st century, TB poses itself as a major medical concern for all countries. Furthermore, with advances in technology, particularly in the biological molecular field and genetic engineering, new horizons have opened in different research areas (3). TB is a necrotizing chronic or acute disease caused by various strains of *Mycobacterium*, namely, *M. bovis* and *M. Africanum*, and mostly due to *M. tuberculosis* (4). Tuberculosis attacks lungs and involves different body organs and tissues including lymph nodes, pleura, pericardium, kidney and bones (5). Every 4 seconds one person contract TB and every10 se-

conds one dies of the disease.-Given the current trend and by every decade, almost 300 million people get infected with the TB bacterium worldwide.

Despite the discovery of the causing agent, vaccine and highly effective medications, the disease still poses a major health challenge globally (6). If a person with pulmonary TB and sputum smear positive is not diagnosed and treated in time, he may infect 10 to 15 other people annually. Ten percent of these cases will have active TB. The best way through which one can prevent and control TB is timely diagnosis of smear positive pulmonary TB and effective treatment of the disease (7). TB is the deadliest infectious disease for adults in the world. So far, one third of the world's population has been infected with TB bacillus and 9 million people contract the disease annually. Currently, 20 million people suffer from TB worldwide. 75% of deaths happen among economically active groups (15-54) (8) .In 2009, 10,099 cases of TB were reported in Iran. Overall, 5,100 of the patients were sputum smear positive pulmonary TB. TB cases have been reported in all provinces of Iran, with most cases seen in Sistan and Balouchestan, Golestan, Khorasan Razawi, Khuzestan, Hormozgan, Qom, Kermanshah and Gilan provinces. 80% of the world tuberculosis cases have been reported in 22 countries including Pakistan and Afghanistan. Figures dating back to 40 years ago show that 140 out of 100 thousand people suffered from TB at the time in Iran. The figure has decreased to below 14 as of today. Drug-resistant tuberculosis has now become a major concern. The patient suffering from drug-resistant TB must be treated for 2 years instead of 6 months. Such a patient must be hospitalized, though it is not necessary, and the cost of his medication increased from 4,500,000 IRR to 300 million IRR. However, only 50% of the cases survive and the rest die of TB (9). The incidence of smear positive pulmonary TB has been declining in Iran and each year on average the incidence and the recurrence decreased by 4.1% and 3.6%, respectively. On average, TB mortality rate has decreased by 6.8% and TB case-detection rate has increased by 2.5% annually (10). The incidence of TB in Iran decreased by 10.1% annually during the first 11 years of assessment (1964-1973); it increased by 4.3% during the second period from 1977 to 1993; the incidence of TB decreased by 4.5% in the third period. During at least the last 10 years, the incidence of TB decreased by 4.5% (11).

The present study aimed to assess the 10-year trend of TB rate in West Azarbaijan Province from 2001 to 2010 and to explore some risk factors that affect the trend.

Materials and Methods

Study and sample

This was a time series study conducted on the data recorded in the TB care system within the healthcare system in West Azerbaijan Province from 2001 to 2010. The study counted the number of TB cases based on the data recorded by the health care system over the years between 2001 and 2010. On average, 256 cases of TB were recorded each year, which translates into 2,560 cases over a period of 10 years. To collect the necessary data, a checklist was developed through considering the nature of the study, and studying the recorded data.

Design of questionnaire

The questionnaire was design based on the demographic information of the patient files which had 17 simple questions. The questionnaire was given to an epidemiologist and an infectious diseases specialist to control the appropriateness of questions related to TB cases, and after approval, it was used for data collection. The outcome variable was the count of TB and demographic variables were sex, place of residency, pulmonary type, BCG status, employment, education level, age group, and job.

Data analysis

The researcher collected all the data of the patients from 2001 to 2010 using the checklist, after coordinating with relevant authorities and obtaining necessary permits from West Azerbaijan Uni-

versity of Medical Sciences. Then, all the data were entered into SPSSV.16 software program. There was not any missing value in the study. A Poisson log-linear regression analysis used to explore some factors that might affect the trend of TB rate. All the collected data were entered anonymously in the checklist and the researchers observed the individual's right for confidentiality with regard to the personal details. Results of relative risks were adjusted for demographic confounding, which were mentioned above to estimate the relative risk of TB more precisely.

Probably one of the sources of bias might be overlooking of some TB cases in the Western Azerbaijan province, although it was not considerable as the expertise of the province claimed it. There were not any missing values in the study. Sampling strategy was a time series and it was considered in the Poisson regression analysis by including year of study as a covariate. Adjusted and unadjusted results along with 95% CI for relative risks were presented in statistical tables. The results of the study were used and published after receiving the necessary permits.

Results

Distribution of demographic characteristics of the study population is shown in Table 1. In our TB study the percentage of male and percentage of female were close to each other (52.2% against 47.8%, respectively). The percentage of TB cases were living in the urban area of West Azerbaijan was 62.4%. Also, most of the TB cases were aged between 31 and 65 years old. In terms of education level the highest percentage of TB people (75%) fell in primary school or illiterate group. Interesting of the study population was that the frequency of Pulmonary TB was higher than the frequency of External Pulmonary TB (62.6% against 37.4%). The coverage of BCG vaccine in the TB population was not remarkable and estimated by 56.4% which is not an acceptable coverage. To understand the trend of TB rate over the years of 2001 and 2010 the percentages of TB cases were graphed and showed in Fig. 1.

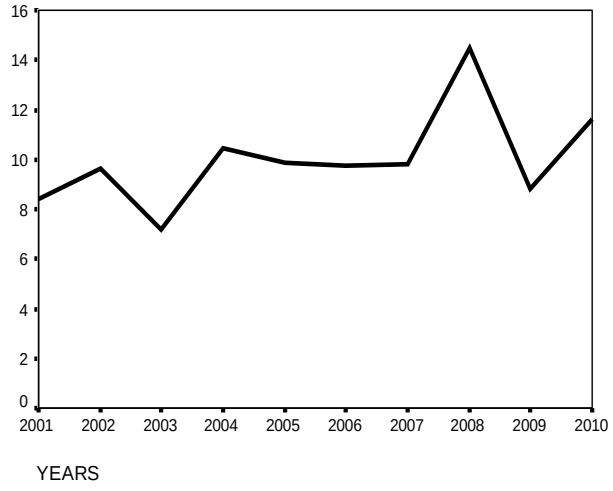

Fig. 1: Trend of TB by year in the West Azerbaijan, Iran

Figure 1 shows the overall increasing trend of TB rate over the ten years of our study. Fluctuations in the graph suggests that there was a reduction in TB rate for year 2003 then a slightly increase up to 2007. The important pick of the graph is on year 2008 in which the percentage of TB cases was increase dramatically to 14.5%. However, the trend came back to the same level of percentages belong to the years previous to the year of 2008. The fluctuation over the years was statistically significant (chi-square=89.08; df=9; $P < 0.001$). To study the effect size of each demographic variable on the mean of the number of TB cases over the followed up years, a Poisson log-linear analysis was used and its results were given in Table 2.

Table 2 shows the regression coefficients (B), standard errors of the coefficients, estimated risk ratio (RR), and 95% confidence interval for RR. All results were adjusted for the size of population of Azerbaijan province, as an offset variable, and years of the study.

The most important risk factor was the level of education so that people with primary level or with illiterate level had a statistically significant TB rate of 5.21 (4.66-5.81) times the same rate for people with diploma level or higher degrees adjusted for the years of study.

Table 1: Distribution of Demographic Variables of the TB Study Sample, the West Azerbaijan, Iran

Variable	Freq.	%	Variable	Freq.	%
Sex (n=2560)			TB type (n=2556)		
Male	1337	52.2	PulmonaryTB	1599	62.6
Female	1223	47.8	External pulmonary TB	957	37.4
Residency (n=2559)			BCG (n=2441)		
Urban	1597	62.4	Yes	1376	56.4
Rural	962	37.6	No	1065	43.6
Age(year) (n=2551)			Job (n=2560)		
<=30	553	21.7	Employee	471	18.4
31-65	1298	50.9	Housewife	1070	41.8
>65	700	27.4	Others	1019	39.8
Education (n=2560)					
Primary and Illiterate	1920	75.0			
High-school	272	10.6			
Diploma and higher	368	14.4			

Next risk factor was age and as Table 2 shows people who aged between 31 and 65 years had 1.85 (1.70-2.03) times rate of TB compare to the reference group, significantly. The next two risk factor were type of TB and place of residency, i.e., pulmonary TB cases had higher rate than external pulmonary TB cases (RR=1.67; (1.54-1.80)) and rate of TB in urban area was 1.66 (1.54-1.80) times more than the rate of rural area. In terms of gender, rate of TB in male cases was 1.09 (1.01-1.19) times the rate of TB in females and statistically significant.

Table 2: Single Variable Poisson Log-linear Analysis Results for TB Count Data

Variable	B*	SE	RR*	95% CI for RR
Male/Female	0.0891	0.0396	1.09	1.01 – 1.19
Urban/Rural	0.5069	0.0408	1.66	1.54 – 1.80
Pulmonary TB/ External pulmonary TB	0.5133	0.0409	1.67	1.54 – 1.80
BCG (Yes/No)	0.2562	0.0408	1.29	1.20 – 1.40
Age(year)				
<=30	-0.2357	0.0569	0.75	0.70 – 0.89
31-65	0.6175	0.0469	1.85	1.70 – 2.03
>65	---	---	1.00	
Job				
Employee	-0.7717	0.0557	0.46	0.41 – 0.52
Housewife	0.0488	0.0438	1.05	0.96 – 1.14
Others	---	---	1.00	
Education				
Primary & illiterate	1.65	0.0569	5.21	4.66 – 5.81
High school				
Diploma & higher	-0.30	0.0799	0.74	0.63 – 0.86
	---	---	1.00	

*- adjusted for years of 2001-2010 and size of the population as an offset variable

Finally, the last factor with the lowest risk was BCG with RR=1.29 (1.20-1.40) for people who received BCG compared to the people who had not received it. This is probably a significant result by chance and should be tested in a multiple analysis to see if BCG still has a significant effect as the above after adjustment for the other factors. As some risk factors may modify the size effects of the other factors we used a multiple Poisson log-linear analysis to estimate the adjusted effects of each factor on the rate of TB for the years of study, population offset, and for the other factors in the log-linear model. The results can be seen in Table 3. The interesting result of the multiple analysis was that although the BCG factor had a significant rate of RR=1.29 in the single variable analysis, it was not a protective significant factor in the multiple variable analysis, i.e. RR= 1.07 (0.98-1.16). It was in accordance with the coverage percentage of BCG which was very low in the TB population (56.4%) as mentioned in the descriptive results. All the remaining factors had significant effects on the trend of TB even after adjustment for year and population size. Among them education level and being housewife had higher RR, i.e. RR= 1.86 (1.63-2.10) and RR = 1.61 (1.39-1.86), respectively (Table 3). The remaining factors also had significant risk ratios ranged from RR=0.71 to RR=1.38.

To justify the log-linear results for the TB trend in the data of Azerbaijan province in Iran, the goodness-of-fit statistics of the log-linear model used in our study was checked and as likelihood ratio and Pearson statistics in Table 4 show the model was accepted in terms of assumptions of linearity, Poisson distribution for TB count data, and stability of variance (*P*= 1.000). It is important to note that in the log-linear model only main effects of the factors were included in the analysis, i.e., the model was not a saturated one.

Table 3: Multiple Poisson Log-linear Analysis Results for TB Study Sample, West Azerbaijan, Iran

Variables	B*	SE	RR*	95% CI for RR
Age(year)				
<=30	-0.3364	.0627	0.71	0.63 – 0.81
31-65	0.2174	.0499	1.24	1.23 – 1.38
>65	---	---	1.00	
Education				
Primary & illiterate	.6186	.0636	1.86	1.63 – 2.10
High school				
Diploma and higher	-.0278	.0832	.97	.83 – 1.15
	---	---	1.00	
BCG				
Yes/No	.0662	.0424	1.07	.98 – 1.16
Job				
Employee	-.2383	.0585	.79	0.70 – 0.89
Housewife	.4738	.0751	1.61	1.39 – 1.86
Others	---	---	1.00	
Residency				
Urban/Rural	.2001	.0434	1.22	1.12 – 1.34
Sex				
Male/Female	.2589	.0727	1.30	1.23 – 1.49
Type of TB				
pulmonary TB/ External pulmonary	.3241	.0423	1.38	1.27 – 1.51

*- adjusted for year, size of population as an offset variable, and all other variables in the model

Table 4: Goodness-of-fit statistics for multiple Poisson log-linear analysis

	Chi-Square	DF	*P*-value
Likelihood Ratio	926.5176	4300	1.0000
Pearson	1031.4441	4300	1.0000

Discussion

A key factor in health planning in any society is to determine the incidence trend of diseases. Knowing the pattern of changes in the incidence of diseases in a country can be of high significance for countrywide planning strategies. Public health organizations believe that assessing or monitoring the incidence trend of diseases, mortality rate and social, behavioral and health risk factors may contribute to unfavorable health incidents. Studying the trend of changes in prevalence or incidence rates provides valuable information for needs assessment, design and revision of programs and development indices in a country. Assessing the data over a period can also help predict the frequency of future incidents. Tuberculosis is one of the most serious challenges facing the global healthcare system today. The present study investigated the TB incidence in 10 years and its incidence in West Azerbaijan Province in 5 years.

The findings of this survey suggest that only 3.8% of the patients were HIV positive. AIDS has been the most common factor in spreading TB as it weakens the body's immune system. Some 200,000 HIV positive people have died of TB. In Africa, a rise by two to three times in HIV cases was documented for the incidence of TB in the 1990s (12). The comorbidity of HIV and mycobacterium tuberculosis increased the risk of active TB by 5 to 10% annually (20 to 37 times the number of non-HIV positive people). The figure is 5 to 10% for non-HIV positive people in their lifetimes (2). In countries where the prevalence of HIV is more than 1%, the rate of TB is higher among women than among men (13). The effects of AIDS virus on TB are as follows: low rate of treatment, high morbidity, recurrence and non-adherence to treatment due to side-effects of drugs, death during the treatment, and rise in the possibility of transmission of drug-resistant species (11). The present research showed that the total number of recorded TB cases within 10 years (2001-2010) was 2,560. Most cases occurred in 2008 when 370 people contracted the disease while the least number of cases was reported in 2005 when 184 people contracted it. The number of recorded cases in the first year (2001) was 215 people while it increased to 298 in the last year, that is, 2010. An assessment of the incidence rates showed that it was 8.70% per 100,000 people in 2006. This comes as the rate reached 9.91% in 100,000 in 2010 with a rising trend in the incidence of the disease. Farhoud et al. studied the trend and epidemiological features of TB in West Azerbaijan Province. They assessed 1,323 cases recorded in the TB healthcare system of the province between 2004 and 2009. In the period, a decreasing trend was seen in the incidence of TB in West Azerbaijan Province. The rate of smear positive during the period was within the acceptable range of Iran's program to control TB. However, the incidence of extrapulmonary TB was higher than the acceptable index (14). Manzouri et al. showed in Isfahan that the rate of case-detection was 90% and 77%, the rate of successful treatment was 80% and 58% and the incidence rate of smear positive pulmonary TB was 2.28% and 1.11%, respectively for 2005 and 2006. This shows that treatment was far from acceptable level (15). The reason why they went for a 5-year period was that they had no access to accurate population data over a period of 10 years. This is a main drawback to the program and a weakness of the healthcare system in that statistics are not stored and sorted out properly, which by itself led to a disruption in appropriate application of the statistical methods and better reasoning. However, the nature of this study has made it difficult to accurately determine the cause of the changes in the trend of the disease.

Assessing TB in terms of gender, there was 1,337 men (52.2%) and 1,223 women (47.8%). Thus, most of the recorded TB patients were men. However, a study on the trend of smear positive pulmonary TB between 2001 and 2008 showed the West Azerbaijan Province was witnessing a decreasing trend of TB incidence (10). The rate was 9.11 per 100,000 people among men in 2005 and 8.27 per 100,000 people among women in 2010. The rate also increased from 8.27 per 100,000 among women in 2006 to 10.73 per 100,000 in 2010. The increase is worthy of attention. In comparison, the results of our study show that despite the low percentage of female TB cases, the high number of women contracting the disease in 2006 compared to men shows how vulnerable they are to tuberculosis. It seems that the number of female cases of TB is obviously rising in comparison to men. The findings of our study also showed that the mean age of the recorded patients was 49.69±20.68. It was 48.22±20.89 among women and 51±20.41 years for men. That was statistically meaningful (P=0.001) despite the difference. Overall, the mean age of men was higher and most reported cases were higher than 60 years old. Given the rise in the age of TB patients in Iran, it seems that one of the features of tuberculosis in developing countries is evident among the population under study. The mean age of rural patients was 48.22±21.02 and urban patients 50.25±20.46. The discrepancy was not meaningful statistically (p=0.07). A study conducted in the US between 1994 and 2007 showed that of 18,965 reported cases, 31% were adolescents under 18. The research found that more than 40% of decrease came about among adolescents (16). TB is mainly found in industrial nations among the elderly and it is often caused by the recurrence of old infections. That is due to the weakness of the immunity system, as a result of age. In those countries, 80% of the patients are aged 50 or older (7).

Although most cases were recorded in urban areas (see the results of a study in Damghan) (17), the incidence rate among urban people decreased from 9.97 in 100 thousand in 2006 to 8.99 in 100 thousand in 2010. The rate increased among rural people from 6.79 in 100 thousand in 2006 to 11.33 in 100 thousand in 2010. However, a study showed a higher recovery success rate in the treatment for positive smear lung TB among rural patients as compared to urban patients in the province (14). A comparison of results showed that the incidence rate of the disease was higher among rural people. This is important considering the decreasing trend of the disease among urban people. More needs to be done to complete the study on the changes. Different studies show that the incidence rate of TB among urban people is more than rural people (1). Most TB patients in Oroumieh were aged between 31 and 40 years old. 73% lived in urban areas and 27% in rural areas (18). In a study showed, the results of Puissan Regression aimed at determining the concurrent effects of such factors as gender, age and place of living were significant only for age and place of living. The incidence rate was higher among the 65+ age group (19). Given the fact that TB is a disease of poverty, economic shortages and lack of knowledge, the decreasing trend of the disease is indicative of a rise in people's awareness about TB and an increase in income and living standards of people. The rise in the arte also stems from social and political changes in the country and in neighboring nations (20).

Limitations

It was impossible for us to conduct 10-year calculations that would involve all necessary variables. This was due to lack of access to separate population statistics, which was a major restriction faced by our study. Another drawback was that the data recorded with the healthcare deputy office were possibly incomplete. There were offices in Iranian cities where TB cases were recorded. Under such circumstances we also received information from related towns. The study was secondary in nature and retrospective. Hence, any deficiencies or changes in the system can change the results and cause problems over which the researchers have no control. Conside-ring the results of the present

study, we can improve the status quo by taking the following measures:

Recommendation for further studies

- Most TB patients are poor and may be addicts; there is no way to get them to follow the right medical regimen. For the reason, we need to make appropriate measures to help them earn a living so that they can afford the expenses of DOTS treatment.
- We must prevent test treatments practiced in some parts of Iran and authorities must deal with violators appropriately.
- TB continuous medical education course should be mandatory for general physicians and specialists.
- Decisions should be made and directives should be issued as to listing some diseases as a threat to public health and making the treatment of patients particularly TB patients mandatory so that they cannot escape treatment.

Conclusion

Proper knowledge of epidemiological differences and critical parts of towns; case-detection interventions among vulnerable people, particularly more susceptible age groups; studying the implementation of TB case-detection programs at healthcare centers; standardizing sputum microbiology labs and using them optimally; properly communicating with private healthcare centers; strengthening infrastructures; educating the population; empowering the personnel involved in controlling the disease, and following up on people in contact with the patients are all a necessity. We need to take more effective and comprehensive measures to achieve the goals of the millennium, that is, identifying at least 70% of expected positive smear TB cases, reducing the incidence and mortality rate among TB patients to 50% by 2015 as compared to 1990 and finally eradicating the disease by 2050 (decreasing the number of TB cases to less than 1 person in a million).

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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