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Original Article

Epidemiological pattern of tuberculosis in Babol City, northern Iran (2015-2021)

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Abstract

Background: Tuberculosis (TB) continues to persist being the most important cause of death and disability in developing countries. Prioritizing the analysis of the current situation is the most effective approach to managing and intervening in any health issue. Therefore, this study aimed to investigate the epidemiological patterns of TB in Babol City over seven years.

Methods: This study was performed from 2015 to 2021. For data collection, the information of all cases of TB patients registered in the system of the Tuberculosis Inventory of the health department of Babol Medical Sciences was examined.

Results: A total of 307 individuals diagnosed with TB were included in the study. More than 60 percent were under 50 years old and the highest number was observed in the 30-39 years old age group. Most of the patients were males (67.4%) and more than 90% were new cases of TB. 73.9% were pulmonary patients and 85.9% were smear-positive. The prevalence of tuberculosis (TB) had a notable decline, dropping from 7.05 per 100,000 individuals in 2015 to 5.26 per 100,000 individuals in 2021, which indicates a significant decreasing trend (P=0.012). Besides, there was a relationship between the type of disease (pulmonary/non-pulmonary) and age, gender, BMI, case of disease and history of TB-related hospitalization ($p<0.05$).

Conclusion: The trends and factors identified in this study can enhance public awareness, reduce risk factors, and support effective patient screening programs. Additionally, these findings can help health policymakers assess regional disease status and develop future strategies.

Keywords: Tuberculosis, Epidemiology, Iran.

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Tuberculosis (TB) is a global health challenge and one of the leading causes of mortality worldwide (1). TB, caused by the bacteria Mycobacterium tuberculosis, is one of the oldest diseases in human history. The condition mostly impacts the respiratory system, along with several other organs and tissues such as lymph nodes, pleural membranes, pericardium, kidney and bone (2). Nowadays, despite the socio-economic advancement of communities and the management of several infectious diseases, TB continues to persist being the most important cause of death and disability in developing countries (3). Based on the most recent statistics released by WHO, about 10.6 million individuals have been diagnosed with tuberculosis (TB) globally in 2021, which has increased by 4.5% compared to 10.1 million in 2020. The tuberculosis (TB) incidence rate, which measures the number of new cases per 100,000 individuals per year, is expected to have risen by 3.6% from 2020 to 2021. This follows a consistent drop of around 2% per year over the preceding two decades (4). According to the report from the Ministry of Health's Center for Infectious Diseases, the reported incidence of tuberculosis in the year 1402 was 8.4 per 100,000 individuals (5).

Among the provinces, Sistan and Baluchestan and Golestan recorded the highest incidence and prevalence rates in the country (6). Iran neighbors Afghanistan and Pakistan (which are among the 22 high risk TB Country List in the world), as well as Iraq (with its health crises of the last several years) and the newly independent countries in the north of Iran (with a high prevalence of multi-drug resistant tuberculosis) requires to pay more attention to this disease (7). The transmission of this pathogenic agent often occurs through individuals who are infected with the pulmonary variant and it can be diagnosed using a sputum sample test. The prevalence of tuberculosis is related to some epidemiological factors such as HIV/AIDS, low social and economic levels, overpopulation, and malnutrition (8). A study conducted in northern Iran identified aging, underlying medical conditions, and low cultural awareness as significant contributing factors to the risk of active tuberculosis and/or treatment outcomes (9). According to several studies, the main known risk factors of tuberculosis are age, gender, positive or negative smear, comorbidity, smoking, and family history of close contact with an infected person (10-12). Delays in the diagnosis and treatment of smear-positive pulmonary tuberculosis will lead to the spread of the disease in the community (13).

In the meantime, there are different categories of drug-resistant M.TB strains which have become the main threat to the TB control strategy in the last decade and cause high mortality despite treatment (14) and this threat continues to increase. The first step to control and intervene in any disease is to examine the disease process, check the control measures, review the plans, and analyze the current situation, all of which will cause timely interventions. TB incidence, recurrence, and mortality can be reduced by timely and effective intervention. Doctors will also be able to completely eradicate a disease using a clinical and epidemiological approach at the same time because in such acute cases, mere clinical treatment is insufficient. Therefore, this study aimed to examine the trend and epidemiological, clinical, and therapeutic patterns of tuberculosis and to investigate some of its aspects in Babol City between 2015 and 2021 to provide effective suggestions to improve the existing conditions by describing and analyzing the situation.

Methods

In this retrospective cross-sectional study, we used a complete count sampling method. The research population was extracted from the information of all cases of TB patients registered in the system of the Tuberculosis Inventory of the health department of Medical Sciences in a 7-year period, from 2015 to 2021 in Babol City. The sampling method in this study was a census approach, including all registered tuberculosis cases documented in the patient registry system. Situated in the northern region of Iran, Babol experiences a humid climate on the southern coast of the Caspian Sea. Approval for this study was obtained from the Research Ethics Committee under the code (IR.MUBABOL.HRI.REC.1401.092).

At first, a checklist was prepared of all the desired variables for review, including age, gender, educational level, occupation, residence area, year of diagnosis, history of addiction and prison, type of tuberculosis, history of contact with a TB patient, the result of treatment, etc. Then, data were extracted based on the information recorded in the tuberculosis information registration software at the Babol City Health Center. The tuberculosis software system of the health department is designed to register all cases of TB patients, both new and re-treated, based on patients' files. Our checklist was completed based on this system to collect patients' information. Also, the required demographic information was prepared from the Census Bureau’s data.

Descriptive statistics, including mean and standard deviation (SD), were employed for quantitative variables, while qualitative variables were presented using frequency and percentage. The chi-square test was utilized to assess statistically significant associations among qualitative variables, with Fisher's exact test applied in instances of expected frequency limitations. Moreover, the trend of the incidence of TB between the mentioned years was analyzed using the Cochran-Armitage-Trend Test. Statistical analyses were performed using SPSS Version 20 software, and graphs were generated using Excel 2013 software. A significance level of $p<0.05$ was deemed statistically significant.

Results

The results showed that among 307 patients identified during these years in Babol, most of the patients (60.3%, 185 cases) were in the age group of less than 50 years. The mean and SD of the age variable was 46.19±21.50 and the median age (interquartile range) was 43 years (30-63). Two-thirds of the patients were males (67.4%) and about 60% of the patients were urban residents. Only 4 (1.3%) patients were not Iranian national. In terms of BMI, the majority of (77.2%) patients, 237 were within the normal range. Table 1 presents the demographic characteristics of the research samples.

In terms of disease characteristics, 288 (93.8%) patients were newly registered cases, and about 6% were retreatment cases. About three-quarters (73.9%) of the patients were pulmonary and the rest were extrapulmonary. Among 227 pulmonary patients, 195 (85.9%) cases were smear-positive at the beginning of the treatment. A total of 34 patients, accounting for 11.1% of the sample, indicated a prior being imprisoned whereas almost 40% of the patients revealed a history of substance abuse. No cases of AIDS were reported among the investigated patients. 52 (16.9%) patients reported a history of being in contact with a TB patient (table 2).

Table 1. Demographic characteristics of identified tuberculosis patients in Babol City between 2015 and 2021

Variables		Frequency (percentage)
Age	< 50 years	185 (60.3)
	≥50 years	122 (39.7)
Gender	Male	207 (67.4)
	Female	100 (32.6)
Marital status	Single	127 (41.4)
	Married	180 (58.6)
Educational status	Illiterate	92(30.0)
	Elementary and secondary school	108 (35.2)
	High school	69 (22.5)
	University	38 (12.4)
Area of residence	City	183 (59.6)
	Village	124 (40.4)
Nationality	Iranian	303 (98.7)
	Non-Iranina	4 (1.3)
BMI (Body mass index)	Normal	237 (77.2)
	Overweight	49 (16.0)
	Obese	21 (6.8)

Table 2. Clinical characteristics and records of tuberculosis patients in Babol City between 2015 and 2021

Variables	Variable subgroup	Number (percentage)
Type of case	New treatment	288 (93.8)
	Retreatment	19 (6.2)
Type of disease	Pulmonary	227 (73.9)
	Extrapulmonary	80 (26.1)
Smear results of pulmonary tuberculosis cases (in 227 patients)	Positive smear	195 (85.9)
	Negative smear	32 (14.1)
Prison history	No	273 (88.9)
	Yes	34 (11.1)
AIDS (Acquired immunodeficiency syndrome)	No	282 (91.9)
	Yes	0 (0.0)
	Unknown	25 (8.1)

Variables	Variable subgroup	Number (percentage)
History of drug addiction (cigarettes, hookah, opium)	No	182 (59.3)
	Yes	125 (40.7)
History of contact with a TB patient	No	190 (61.9)
	Yes	52 (16.9)
	Unknown	65 (21.2)
The time of contact with a TB patient (Among 52 cases who had contact)	Less than two years ago	24 (46.2)
	2-5 years	7 (13.5)
	More than 5 years	21 (40.4)
Referral center (Center that diagnosed the TB)	Healthcare system (outpatient and inpatient units)	137 (44.6)
	Private clinic	114 (37.1)
	Self-representative	8 (2.6)
	Prison	25 (8.1)
	Other	23 (7.5)
History of hospitalization related to tuberculosis	No	141 (45.9)
	Yes	166 (54.1)

The mean duration from the beginning of TB symptoms to diagnosis was recorded as 90 days on average in Babol. Also, the median (interquartile range) of this index was 66 days (46-97), so this interval was less than 66 days (median) in half of the patients. However, the treatment started on the same day for at least half of the patients after the diagnosis. In terms of the results of treatment, the total number of 307 registered TB patients were categorized into 4 groups: 1) 261 (85.0%)cases were recovered and completed the course of treatment; 2) 25 (8.1%)cases were in the death group (7 patients died due to tuberculosis and 18 cases for other reasons); 3) 10 (3.3%) cases were in the wrong diagnosis group (7 cases due to atypical mycobacterium and 3 cases for other reasons); and 4) 11 (3.6%) cases were in the group of absent for treatment (4 cases moved and migrated, 2 non-compliance with treatment, 2 treatment failure and 3 other reasons) (table 3). Also, no case of multidrug resistance (MDR) was reported. The treatment outcomes regarding smear positivity over the course of treatment months revealed that 195 (85.9%) cases of pulmonary tuberculosis initially tested smear positive. This percentage decreased to 20.2% by the end of the second month of treatment and reached 0% by the completion of treatment.

The incidence of TB within 7 years was on average 8 per 100,000 individuals in the city. Examining the trend of the disease within 7 years showed that sometimes there were fluctuations during these years due to various reasons, but the overall trend was decreasing. In the starting year of the study (2015), the incidence rate of TB was 7.05, with a slight decreasing trend reached 5.26 per 100,000 individuals in the final year of the study (2021). The Cochran-Armitage-Trend Test results indicated a statistically significant decreasing trend (P.trend = 0.012) (figure 1).

A comparison of disease trends in Babol and the national level indicates an overall decline in tuberculosis incidence across the country. In all years except 2020, the incidence rate in Babol was lower than the national average. Nationally, the incidence rate decreased from 12.6 per 100,000 population in 2015 to 7.36 per 100,000 population in 2021 (figure 2). The incidence of the disease was not the same based on gender, and the disease in men was about twice as much as in women. The overall incidence of TB in men and women was 10.73 and 5.26 per 100,000 individuals, respectively. The disease had a slight decreasing trend in both genders, but this decreasing trend was noticeable and statistically significant only in men. In 2015, the incidence of TB in men was 8.33, which decreased to 6.27 per 100,000 individuals in 2021 (P.trend = 0.012). In women, this rate was 5.75, which reached to 4/23 per 100,000 individuals in 2021 (P.trend=0.416).

Table 3. Treatment outcomes in tuberculosis patients in Babol during the study years (2015–2021)

Variable	Subgroup of Variable	Number (percentage)	Reasons
Treatment Outcomes	Improved and completed treatment	261 (85.0)	-
	Deceased	25 (8.1)	7 due to tuberculosis, 18 unknown and other causes
	Lost to treatment	10 (3.3)	1 medical reasons, 2 patient non-compliance, 4 relocation/migration, 2 treatment failure, 1 other reasons
	Misdiagnosis	10 (3.3)	7 cases of atypical mycobacterium, 3 other cases
	Other	1 (0.3)	Based on the pediatric specialist's recommendation

Table 4. Examining the relationship between the type of disease (pulmonary/extrapulmonary) with demographic and clinical characteristics and records of TB patients in Babol City between 2015 and 2021- (number = 307)

Variables	Variable subgroup	Type of disease		P-value
		Pulmonary Number (percentage) 227 (73.9)	Extrapulmonary Number (percentage) 80 (26.1)	
Age	50>	125 (67.6)	60 (32.4)	0.002
	50 ≤	102 (83.6)	20 (16.4)	
Gender	Male	162 (78.3)	45 (21.7)	0.013
	Female	65 (65.0)	35 (35.0)	
Marital status	Single	88 (69.3)	39 (30.7)	0.119
	Married	139 (77.2)	41 (22.8)	
Educational status	Illiterate	69 (75.0)	23 (25.0)	0.126
	Elementary and secondary school	86 (79.6)	22 (20.4)	
	High school	49 (71.0)	20 (29.0)	
	University	23 (60.5)	15 (39.5)	
Area of residence	City	134 (73.2)	49 (26.8)	0.728
	Village	93 (75.0)	31 (25.0)	
BMI (Body mass index)	Normal	187 (78.9)	50 (21.1)	<0.001
	Abnormal	40 (57.1)	30 (42.9)	
Case of disease	New treatment	209 (72.6)	79 (27.4)	0.032
	Retreatment	18 (94.7)	1 (5.3)	
Prison history	No	197 (72.2)	76 (27.8)	0.060
	Yes	30 (88.2)	4 (11.8)	
History of drug addiction	No	129 (70.9)	53 (29.1)	0.140
	Yes	98 (78.4)	27 (21.6)	
History of contact with a TB patient	No	137 (72.1)	53 (27.9)	0.451
	Yes	42 (80.8)	10 (19.2)	
	Unknown	48 (73.8)	17 (26.2)	
History of hospitalization related to tuberculosis	No	116 (82.3)	25 (17.7)	0.002
	Yes	111 (66.9)	55 (33.1)	

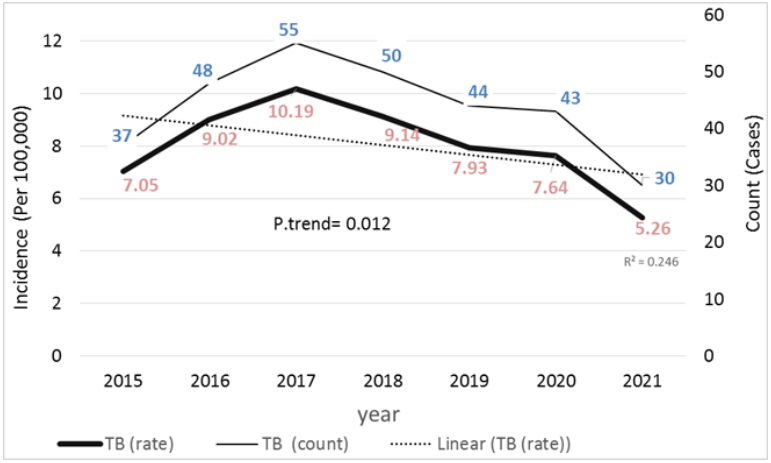

Figure 1. The trend, number, and incidence of TB per 100,000 individuals in Babol City between 2015 and 2021, TB: Tuberculosis

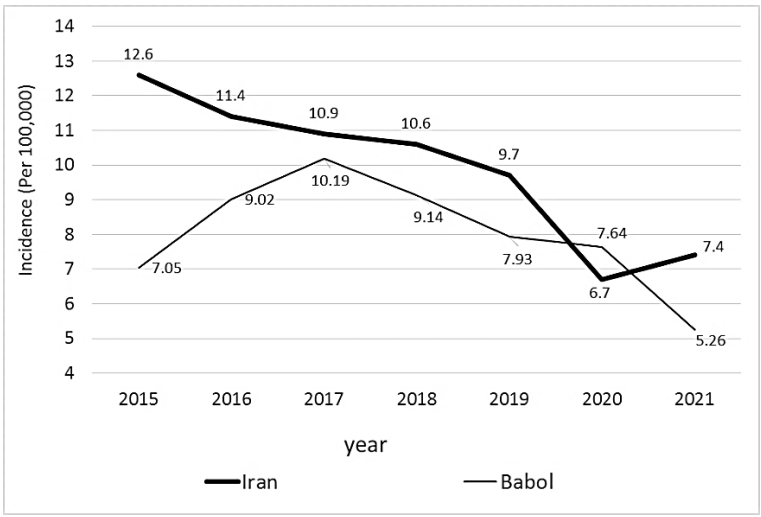

Figure 2. The trend of tuberculosis incidence in babol compared to the national level during the study period (2015-2021)

The incidence of the disease was not the same based on gender, and the disease in men was about twice as much as in women. The overall incidence of TB in men and women was 10.73 and 5.26 per 100,000 individuals, respectively. The disease had a slight decreasing trend in both genders, but this decreasing trend was noticeable and statistically significant only in men. In 2015, the incidence of TB in men was 8.33, which decreased to 6.27 per 100,000 individuals in 2021 (P.trend = 0.012). In women, this rate was 5.75, which reached 4/23 per 100,000 individuals in 2021 (P.trend=0.416). The incidence rate based on the place of residence showed that the overall incidence rate of TB in the residents of cities and villages was 8.35 and 7.80 per 100,000 individuals, respectively. In 2015, the incidence rate in urban areas was 7.67, which decreased to 5.75 per 100,000 in 2021 (P.trend=0.085). This rate was 5.72 in 2015 among the residents of the villages, which reached 5.28 per 100,000 individuals in 2021 with an almost constant decreasing trend. (P.trend=0.145).The results of the number and incidence of TB cases based on decades of aging are shown in figure 3. In general, the incidence of the disease increases with every decade of aging, and this trend was statistically significant (P trend < 0.001). Additionally, the lowest and highest incidence rates were observed in the age group below 10 years, with a rate of 1.58, and the age group above 80 years, with a rate of 39.94 per 100,000 individuals (within the same age group). Furthermore, the average age in 2015 was 45.32 years, which increased to 50.90 years by 2021 (figure 4). Table 4 displays the relationship between the type of disease (pulmonary/extrapulmonary) and patient characteristics.

The findings revealed a statistically significant association between the type of disease and variables such as age, gender, BMI, case of disease, and history of TB-related hospitalization ($p<0.05$). The pulmonary tuberculosis cases were observed in people 50 years and

older, as well as the extrapulmonary tuberculosis cases in people under 50 years. People with normal BMI were more likely to have pulmonary tuberculosis 187 (78.9%), while this was 40 (57.1%) in people with abnormal BMI. Re-treatment cases suffered from pulmonary tuberculosis type 18 (94.7%), while pulmonary tuberculosis was 209 (72.6%) in newly treated patients. Also, cases of non-pulmonary tuberculosis were higher in patients with a history of hospitalization related to tuberculosis 55(33.1%), while it was 25 (17.7%) in patients without a history of hospitalization.Upon examining the relationship between lung smear results (positive/negative smear) and patient characteristics, we identified a statistically significant association between smear results and variables including history of contact with a TB patient, history of TB-related hospitalization, place of residence, and marital status ($p > 0.05$). Specifically, individuals who had contact with a TB patient exhibited a higher percentage of positive smear results 39 (92.9%) compared to those without such history 111 (81.0%). Conversely, positive smear cases were less prevalent among individuals with a history of TB-related hospitalization (81.1% vs. 90.5%) (table 5).

Table 5. Examining the relationship between smear results (positive/negative smear) with demographic and clinical characteristics and records of TB patients in Babol City between 2015 and 2021- (number=227)

Variables	Variable subgroup	Pulmonary smear results		P-value
		Negative smear Number (percentage) 32 (14.1)	Positive smear Number (percentage) 195 (85.9)	
Age	50>	14 (11.2)	111 (88.8)	0.165
	50 ≤	18 (17.6)	84 (82.4)	
Gender	Male	22 (13.6)	140 (86.4)	0.724
	Female	10 (15.4)	55 (84.6)	
Marital status	Single	6 (6.8)	82 (93.2)	0.012
	Married	26 (18.7)	113 (81.3)	
Educational status	Illiterate	11 (15.9)	58 (84.1)	0. 811
	Elementary and secondary school	13 (15.1)	73 (84.9)	
	High school	6 (12.2)	43 (87.8)	
	University	2 (8.7)	21 (91.3)	
Area of residence	City	13 (9.7)	121 (90.3)	0.022
	Village	19 (20.4)	74 (79.6)	
BMI (Body mass index)	Normal	28 (15.0)	159 (85.0)	0.616
	Obese	4 (10.0)	36 (90.0)	
Case of disease	New treatment	28 (13.4)	181 (86.6)	0.294
	Retreatment	4 (22.2)	14 (77.8)	
Prison history	No	29 (14.7)	168 (85.3)	0.778
	Yes	3 (10.0)	27 (90.0)	
History of drug addiction	No	22 (17.1)	107 (82.9)	0.142
	Yes	10 (10.2)	88 (89.8)	
History of contact with a TB patient	No	26 (19.0)	111 (81.0)	0.035
	Yes	3 (7.1)	39 (92.9)	
	Unknown	3 (6.3)	45 (93.8)	
History of hospitalization related to tuberculosis	No	11 (9.5)	105 (90.5)	0.041
	Yes	21 (18.9)	90 (81.1)	

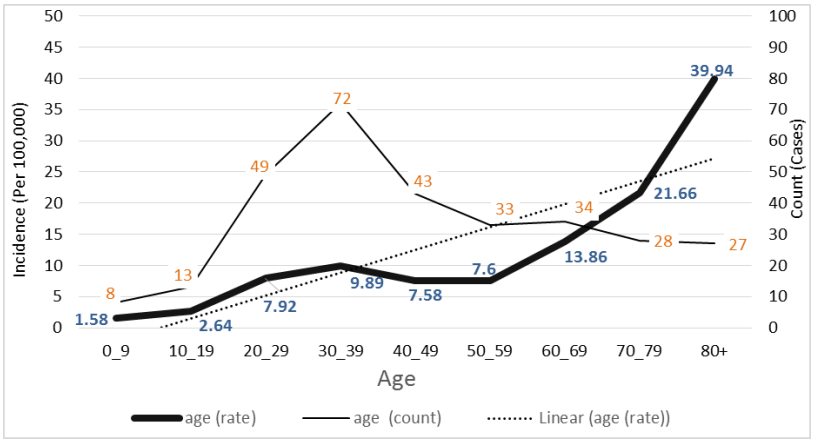

Figure 3. The trend, number and incidence of TB per 100,000 individuals in Babol City between 2015 and 2021 based on decades of ageing, TB: Tuberculosis.

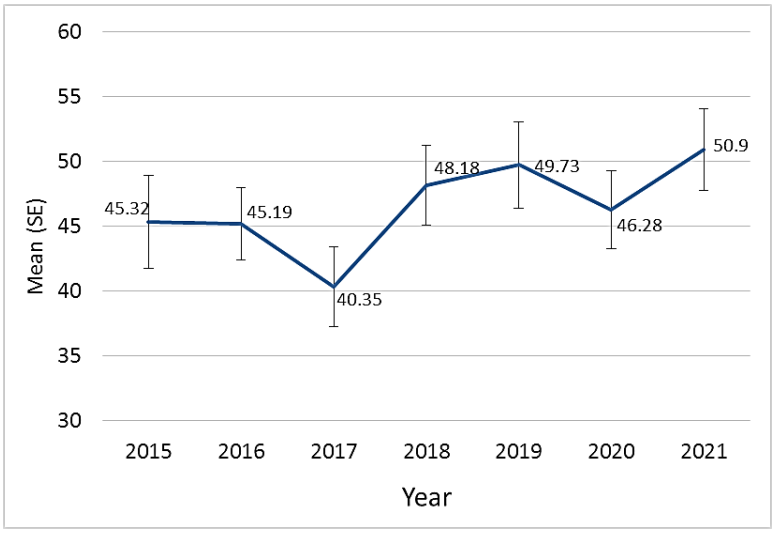

Figure 4. Average age of TB patients in Babol City between 2015 and 2021

Discussion

This retrospective study, spanning 7 years from 2015 to 2021, revealed a noteworthy declining trend in tuberculosis (TB) incidence rates. The TB incidence rate decreased from 7.05 per 100,000 individuals in 2015 to 5.26 per 100,000 individuals in 2021. Comparatively, recent surveys in Iran, as per World Bank Data (WBD), indicated a declining trend in TB incidence rates, with figures dropping from 23 per 100,000 individuals in 2000 to 12 per 100,000 individuals in 2021 (15). In the study of Arsang et al., which was conducted during 2001-2008 in Iran, they have reported a decreasing trend for the overall trend of tuberculosis. Based on their result, the incidence rate of TB was approximately 13 per 100,000 individuals in 2001, which reached nearly 10 per 100,000 individuals in 2008 (16). During the six-year study of Amani et al. from 2011 to 2016 in Ardabil, the incidence rate of TB reached from about 10 per 100,000 individuals in 2011 to less than 8 per 100,000 individuals in 2016, and this decreasing trend was also significant (17). In the study, there was a steady trend in the incidence of TB during the 5-year period of 2009-2013 in Babol (18). According to the study of Yazdani et al., the incidence of TB had a decreasing trend in the ten-year period of 1999-2008 in Mazandaran (the ten-year incidence rate of tuberculosis in Mazandaran was 10.69) (19). Although the downward trends of these studies were similar to the present study, they still have a much higher incidence than our study. This difference could be due to the difference in the years of study, being closer to the most infected areas in terms of tuberculosis, the higher rate of immigration in some provinces for non-Iranians, as well as the cultural, income, and health status of these areas.In the present study, TB was more common in men. In the study of Amani et al. in Ardabil, 429 (54%) of TB cases were males (17). In

another study in northern Iran, 62% were men. However, in the study conducted by Cherati et al. (20) in the period of 2007-2016 in Golestan province, the incidence rate of TB in women (49.62 per 100,000 individuals) was higher than in men (46.47 per 100,000 individuals), which was much higher than our study. Golestan province is one of the areas in Iran that accept immigrants, so it seems that controlling the immigrants for tuberculosis disease and developing coherent plans for follow-up and treatment of immigrants can play a key role in eradicating TB.

Globally, tuberculosis disease (TB) is more common among males than females (17, 21-23). This phenomenon may be due to the fact that men are more active in society and are more exposed to disease carriers and risk factors such as smoking and drug use. Also, the difference in the demographic characteristics of these studies can be related to the duration of the study, the higher percentage of extrapulmonary tuberculosis cases in certain communities, and the age pyramid of the research populations. In the present study, the average interval between the onset of TB symptoms and its diagnosis was 90 days with a median of 66 days. Also, the average interval between diagnosis and treatment was 1.40 days. In the study of BabaMahmoudi et al. in northern Iran, they reported an average interval of 47 days to visit a doctor after seeing the symptoms (22). In a study conducted in Golestan Province, the average delay in diagnosis and treatment was approximately 78 days, with 60.4% of pulmonary tuberculosis patients experiencing a delay of more than 34 days (24).

In another study in Saudi Arabia, this time was 60 days (25). The average interval between the onset of the first TB symptoms and the diagnosis in Babol City was longer than in both studies. One of the reasons for this difference can be due to the duration of studies. In the study by Ghaffari-Fam et al. (18) in the 5-year period of 2009-2013 in Babol, the average time from the onset of TB symptoms to its diagnosis was 56.5 days, which was less than the current study. The reason for the higher interval in this study can be due to the lower sensitivity of doctors and healthcare staff towards the diagnosis of tuberculosis, or because of important health crises in recent years such as COVID-19, or possible changes in the guidelines of the health system, which should be investigated in detail in future studies. In the present study, more than 70% of patients suffered from pulmonary tuberculosis, and only 26.1% of them had extrapulmonary tuberculosis. In the study of Amani et al. in Ardabil, 452 patients (56.7%) had pulmonary tuberculosis (17). This frequency is much less compared to our study for pulmonary tuberculosis, which can be due to the difference in risk factors. For example, in the study of Lin et al., it is mentioned that patients who do not smoke and are females, are more likely to suffer from extrapulmonary tuberculosis (26). Global extrapulmonary tuberculosis accounts for 13.37 to 53% of all TB cases (27).

The reason for this large difference in the range of extrapulmonary tuberculosis is its very different symptoms in patients, which causes misdiagnosis and sometimes not correctly diagnosing the disease. In the study of Ghaffari-Fam et al. (18) in the 5-year period from 2009 to 2013, 120 (80.0%)cases were smear-positive among patients with pulmonary tuberculosis, among which 47 (23.5%) cases had the history of contact with TB patients. During the 5-year study, only 3 (1.5%) patients were diagnosed with AIDS. Compared to the present study, the past statistics of Babol City showed that the frequency of positive smears and the history of contact with TB patients were almost similar, however, the status of AIDS has improved. This can be a strong point for health workers in this city in terms of minimal health conditions. It is suggested to conduct more prospective studies with a detailed follow-up plan, examination of the causes, and risk factors affecting TB infection due to the importance of the issue. It is essential to conduct comprehensive studies on drug-resistant tuberculosis and treatment challenges in northern Iran and the country as a whole. Investigations should also focus on the outcomes of treatment groups, particularly diagnostic errors, and examine the impact of socioeconomic conditions and public health infrastructure on tuberculosis. Such research can pave the way for effective strategies in managing, preventing, and controlling tuberculosis.

This study has certain limitations. First, the fact that the samples were selected from a single county in Iran may restrict the generalizability of the findings. Additionally, the absence of HIV infection test results for the early years of the study and the inability to evaluate all potential risk factors due to the retrospective nature of the study are notable constraints. Therefore, prospective cohort studies, particularly at the national level with a focus on current risk factors, are recommended to address these limitations and provide more precise results. Despite these limitations, the study also has significant strengths. It reports on the status of tuberculosis, including trends in disease incidence, over a 7-year period based on surveillance system data, offering valuable insights into the epidemiology of tuberculosis in the region. Generally, Babol City had a downward trend in the incidence of tuberculosis within the 7-year period of study from 2015 to 2021. The incidence rate of TB was lower than in other studies. This result can indicate a better health status, better screening, and overall better management of TB in the city. In terms of gender and place

of residence, we observed a decrease in all cases, and this downward trend was significant for men and for those living in the city. It seems that Babol City has been able to significantly decrease the constant trend of TB based on the previous 5 years, but we still need more investigations, higher awareness, and better diagnosis to reach the level of developed countries. In addition, paying attention to the risk factors identified in this study can help increase public awareness, eliminate risk factors, and plan appropriately for screening patients on the agenda of health managers and experts.

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