

Tuberculosis in Saudi Arabia: Prevalence between Saudis and Non-Saudis from 2013 to 2018 with a special concern about regions of the KSA

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Submitted: 13 Dec 2019; Accepted: 19 Dec 2019; Published: 30 Dec 2019

Abstract

The Kingdom of Saudi Arabia is one of the largest Arab countries with a moderate annual problem of tuberculosis that is either pulmonary or extra-pulmonary. TB is still one of the most significant health troubles in the KSA, affecting different nationalities (Saudis, non-Saudis), ages, provinces, and genders. The control of TB still faces some challenges in different provinces of the KSA.

Data were collected, arranged, analyzed and presented in tables and figures. In this retrospective study, we appraised TB surveillance data for the period between 2013 (1434H) and 2018 (1439H). Data were handled using Microsoft Excel and SPSS version 23. Data were checked for normality using Shapiro-Wilk normality test at 0.05 levels to determine whether they are parametric or nonparametric. Chi-squared, Kruskal Wallis, and analysis of variance tests were used to evaluate trends at a significance level of $p < 0.05$. Statistical analyses were performed using IBM-SPSS version 23 for Mac OS.

We appraised TB surveillance data for the period between 2013 (1434H) and 2018 (1439H). The data included the region of the country (province), age, sex, and nationality (Saudis, non-Saudis). The study evaluated the impact of TB on various nationalities (Saudis and non-Saudis), age groups (0-14, 15-34, 35-55, more than 55 years old), and genders (males and females). Non-Saudis had a higher incidence rate than Saudis in 2013-2018. The number of cases and incidence rates of TB recorded in males between 2013 to 2018 were about two to three times greater than estimates for females. The Makkah, Riyadh, and Jeddah regions attract enormous numbers of non-Saudi migrant workers, who account for ~60% of all TB cases in the KSA. Assessing the main TB risk factors contributing to high TB rates in non-Saudi workers is essential. Furthermore, periodical accurate studies, including evidence-based studies for optimum surveillance, avoidance, spread risk, inspection, control procedures and treatment of TB, should be conducted. These assessments would lead to evaluating the strengths and weaknesses of KSA-NTP's TB action plan.

Introduction

Tuberculosis (TB) is an infectious disease that is a major cause of health problems and one of the top ten causes of death worldwide [1]. Around ten million people worldwide get TB every year. TB is caused by the single infectious agent Mycobacterium tuberculosis. About 90% of TB cases each year occur in 30 high-TB-burden countries. Globally, 1.7 billion people are estimated to be infected with M. tuberculosis and may be at risk of developing TB [1]. Worldwide, TB treatment in recent years has improved at the regional level. The success of the TB treatment rate in 2016 was greatest in the Eastern Mediterranean region by about 65%, according to the World Health Organization. However, the success rates were lower in the South-East Asia region by about 52%. Internationally, an estimated 10 million, with a range from 9.0 to 11.1 million, people got TB in 2018, and this range has changed very little in recent years. The TB disease burden differs immensely among countries, from <5 to >500 new cases per 100000 population/year, with 130 as a global

average. The global mortality of HIV-negative TB patients averaged 1.2 million, which is about a 27% decrease from 1.7 million in the year 2000. However, in HIV-positive patients, an additional 251000 deaths were recorded, which is a 60% reduction from 620000 in 2000 [1]. Both sexes are affected by TB in all age groups, but the highest risk is to males aged above 15 years old (about 57% of all TB cases in 2018). Comparatively, females accounted for 32%, and children aged less than 15 accounted for 11% to all TB cases [1]. Regionally, the highest numbers of TB cases in the year 2018 were recorded in different WHO areas: 44% in South-east Asia, 24% in Africa, 18% in the Western Pacific region, 8% in the eastern Mediterranean, 3% in the Americas, and 3% in Europe. About eight countries out of 30 of WHO's high-TB-burden countries recorded more than 65% of the global TB estimates: 27% in India, 9% in China, 8% in Indonesia, 6% in the Philippines, 6% in Pakistan, 4% in Nigeria, 4% in Bangladesh, and 3% in South Africa [1]. The worldwide average rate of TB was about 142 cases/100,000

people in the year 2004. Consequently, it has decreased by around ~1% a year, amounting to about 137 cases/100,000 people in the year 2009 [2]. A global estimate of 9.4 million TB incident cases was recorded in 2009, mostly in Southern-east Asia, Africa, and the Western Pacific areas (35%, 30%, and 20%, respectively). The main aim of reducing TB worldwide, as stated by the Millennium Development Goals (MDGs), is to reverse its incidence by 2015. Further aims, including decreasing the prevalence and mortality rates of TB, have been outlined by top TB partnerships to reduce the worldwide incidence rates of TB to one case/one million people by 2050 [2]. Overall, 13,068 XDR-TB cases were recorded by about 81 countries, of which 88% are in the WHO European and South-east Asia regions [1]. The highest numbers of cases were recorded in Belarus, India, the Russian Federation, South Africa, and Ukraine [1]. The Kingdom of Saudi Arabia (KSA) hosts a large number of migrant labors and workers from several high TB countries, including Southeast Asian, Asian, African, and other Middle Eastern countries. The total population of KSA was 34,218,169 in 2018 (of which 10,736,293 were non-Saudis) and was 32,552,336 in 2017 (of which 12,143,974 were non-Saudis) [3].

The KSA is a large country in the Middle Eastern region and one of the main countries on the Arabian Peninsula. The KSA is divided into 13 provinces, the main ones with high populations being Riyadh, Al-Madinah, Makkah, Aseer, Al-Baha, Ha'il, Al-Jouf, Jizan, Najran, Qaseem, and Tabouk, over and above both the Northern and Eastern provinces. Each region/province has a Health Affairs Unit. The KSA has launched a National TB Control Program (NTP), the activities of which are incorporated into the general health-care services. KSA-NTP is guided and administered by the Preventive Medicine Unit, Ministry of Health. The main missions of this unit are strategic planning, examining, assessment, training, and coordinating with the national systems including the health system and others that would be involved in TB control activities [4, 5]. The TB health-care facilities are incorporated into general health-care units and chest hospitals (e.g., in Riyadh and Tai'f) that manage chest disease patients including TB, and these are referral hospitals for MDR-TB management over all of the KSA, in addition to two outpatient TB clinics in Jeddah and Al-Hassa [6]. Documentation of suspected TB cases is executed at health-care service levels. The diagnosis of TB and prescriptions are performed by specialists in national hospitals, but general practitioners perform follow-ups both in national hospitals and health-care centers. Health-care units submit monthly TB case reports that include relapsed and new patients in addition to treatment outcomes [4]. Various studies and reviews have been published about the TB problem in Saudi Arabia [4, 6-12]. However, recent and detailed data have not been published to date on TB, especially concerning the large migrant worker and labor force or its impact on TB incidence trends in the KSA among Saudi nationals. Understanding the epidemiological and clinical features of the TB problem and burden in the immigrant workforce is necessary for improved planning and implementation of TB services and prevention measures. This study includes a six-year retrospective evaluation of TB pulmonary and extra-pulmonary cases recorded in the Kingdom of Saudi Arabia from 2013 (1434H) to 2018 (1439H). It evaluates incidence rate trends by nationality, country of origin,

genders, and provinces.

Materials & Methods

Tuberculosis (TB), whether pulmonary or extra-pulmonary, is a notifiable disease in the Kingdom Saudi Arabia. Data were collected, arranged, analyzed, and presented in tables and figures. In this retrospective study, we appraised TB surveillance data for the period between the year 2013 (1434H) and 2018 (1439H). The data included the region of the country (province), age, sex, and nationality. The incidence of TB was estimated based on population count records from the Department of Statistics and Information, Ministry of Economy and Planning, KSA [3]. The Saudi population data were assessed intensively for different regions and provinces. The KSA was divided into five different geographical regions: (I) central: Riyadh, Al Qaseem, and Ha'il provinces, (II) western: Al-Madinah, Makkah, Jeddah, and Taif provinces, (III) eastern: Eastern province and Al-Ahsa'a, (IV) northern: Hafr Al Baten, Tabuk, Al-Jouf, Al Qurayyat, and Northern Border provinces, and (V) southern: Aseer, Al-Baha', Bisha', Najran, Jazan, and Al Qunfudah provinces. TB incidence trends were assessed for different nationalities (Saudis/non-Saudis) and for various ages. TB statistics were also assessed for the Saudi population according to different genders, provinces, and regions of the KSA. Data were handled using Microsoft Excel and SPSS version 23. Data were checked for normality using Shapiro-Wilk normality test at 0.05 levels to check whether the data are parametric or nonparametric. Chi-squared, Kruskal Wallis, and analysis of variance tests were used to evaluate trends at a significance level of $p < 0.05$. Statistical analyses were performed using IBM-SPSS version 23 for Mac OS. Denominators used to calculate the rates of period KSA were carried out on data from four censuses in 1419H (1998), 1421H (2000), 1428 H (2007), and 1437 (2016) [3]. Between these censuses, estimates for the population statistics were produced by the Central Department of Statistics & Information [3]. Population data were obtained from the Central Department of Statistics & Information, Ministry of Economy & Planning, and Saudi Arabia. The population data included the population by province, nationality (Saudis or non-Saudis), age, and sex for the period of the study (2013-2018). Data were used as denominators in the estimation of incidence rates.

Results

In this retrospective study, we appraised TB surveillance data for the period between 2013 (1434H) and 2018 (1439H). The data included the region of the country (province), age, sex, and nationality. In all, 18,928 TB cases were reported over the period from 2013 (1434H) to 2018 (1439H). The annual total cases in KSA were decreasing except for the years 2015 and 2018, but they remained nearly stable (Table 1; Figure 1). In all, 10,205 TB cases were non-Saudis, accounting for about 53.9%. However, 8,717 Saudi TB cases (46%) were reported from 2013 (1434H) to 2018 (1439H) (Tables 2-3; Figures 2-3). The TB annual incidence rate ranged between 0.29 and 18.67/100,000 population. Non-Saudis had a two to three times higher incidence. The disease trend from 2013 to 2018 decreased over the first six years of the study period, but increased in 2015 and 2018 (Table 1; Figure 1).

Table 1: The Result of Variable Measurement

Pulmonary/ Extrapulmonary		Year						Chi-square	
		2013	2014	2015	2016	2017	2018	X2	p-value
Pulmonary	Totlacase	2447	2336	2505	2166	2095	2543	395.8	>0.05
	Incidence rate	8.17	7.59	7.94	6.71	6.36	7.61	546	>0.05
Extrapulmonary	Totlacase	876	807	841	747	744	821	275.3	>0.05
	Incidence rate	2.93	2.62	2.66	2.31	2.26	2.46	522.4	>0.05
Total	Totlacase	3323	3143	3346	2913	2839	3364	501.1	>0.05
	Incidence rate	11.10	10.21	10.60	9.02	8.62	10.07	1026.1	>0.05

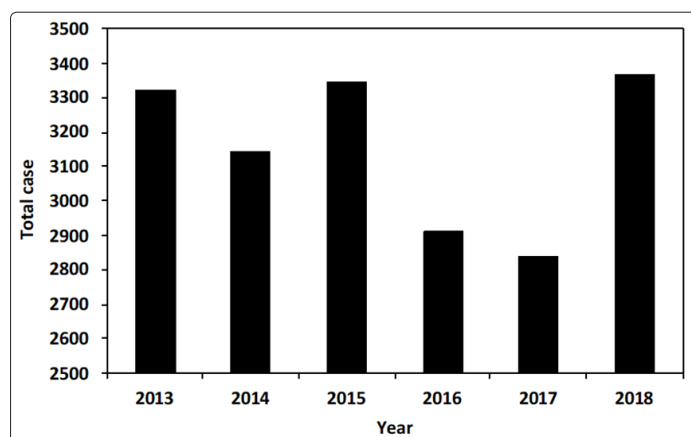


Figure 1: Annual change of total case of TB in KSA from 2013 to 2018

Table 2: Total case and incidence rate (/100000 population) of tuberculosis either Extrapulmonary or pulmonary in Saudi Arabia from 2013 to 2018 for Saudis and Non-Saudis

Year	Saudi			Non-Saudi			Total			Non-Saudi/ Total (%)
	No.	% Change	Rate	No.	% Change	Rate	No.	% Change	Rate	
2013	1488	--	4.97	1839	--	6.14	3323	--	11.10	55.34
2014	1506	1.21	4.89	1637	-10.98	5.32	3143	-5.42	10.21	52.08
2015	1515	0.60	4.80	1831	11.85	5.80	3346	6.46	10.60	54.72
2016	1383	-8.71	4.28	1530	-16.44	4.74	2913	-12.94	9.02	52.52
2017	1395	0.87	4.23	1444	-5.62	4.38	2839	-2.54	8.62	50.86
2018	1430	2.51	4.28	1924	33.24	5.76	3364	18.49	10.07	57.19
X2 p-value	378.5			404.6			501.1			1026.4
	>0.05			>0.05			>0.05			>0.05
Wilcoxon signed rank test										
Test statistic	-1.028									
Sign. (2-tailed)	>0.05									
t-test:	-3.02									
Sign. (2-tailed)	<0.05*									

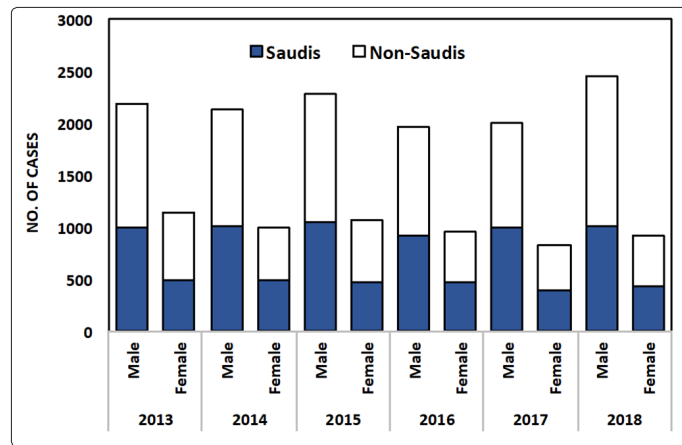


Figure 2: Annual changes of total cases per gender (male/female) for Saudis and Non-Saudis

Table 3: Annual changes of total cases per gender (male/female) for Saudis and Non-Saudis

Year	Gender	Saudis	Non-Saudis	Total	%
2013	Male	997	1186	2183	65.61
	Female	491	653	1144	34.39
2014	Male	1017	1124	2141	68.12
	Female	489	513	1002	31.88
2015	Male	1049	1227	2276	68.02
	Female	466	604	1070	31.98
2016	Male	920	1046	1966	67.49
	Female	463	484	947	32.51
2017	Male	993	1014	2007	70.69
	Female	402	430	832	29.31
2018	Male	1005	1435	2440	72.53
	Female	425	499	924	27.47

The incidence rate also decreased from 2013 to 2017 from 11.10 to 8.62/100000 and then increased slightly ($p>0.05$) in 2018. Pulmonary TB accounted for about 74.4% of the total TB cases, but extra-pulmonary TB amounted to about 25.5% (Table 4; Figures 4-7).

Table 4: Total case and incidence rate (/100000 population) of Tuberculosis either Extrapulmonary or pulmonary in Saudi Arabia from 2013 to 2018

Year	Pulmonary			Extra-pulmonary			Total		
	%			%			%		
	No.	Change	Rate	No.	Change	Rate	No.	Change	Rate
2013	2447	--	8.17	876	--	2.93	3323	--	11.10
2014	2336	-4.54	7.59	807	-7.88	2.62	3143	-5.42	10.21
2015	2502	7.23	7.94	841	4.21	2.66	3346	6.46	10.60
2016	2166	-13.53	6.71	747	-11.18	2.31	2913	-12.94	9.02
2017	2095	-3.28	6.36	744	-0.40	2.26	2839	-2.54	8.62
2018	2543	21.38	7.61	821	10.35	2.46	3364	18.49	10.07
X2	395.8		546	275.3		522.4	501.1		1026.1
p-value	>0.05		>0.05	>0.05		>0.05	>0.05		>0.05
Mann-Whitney:	3936.5;			p-value<0.0001***					

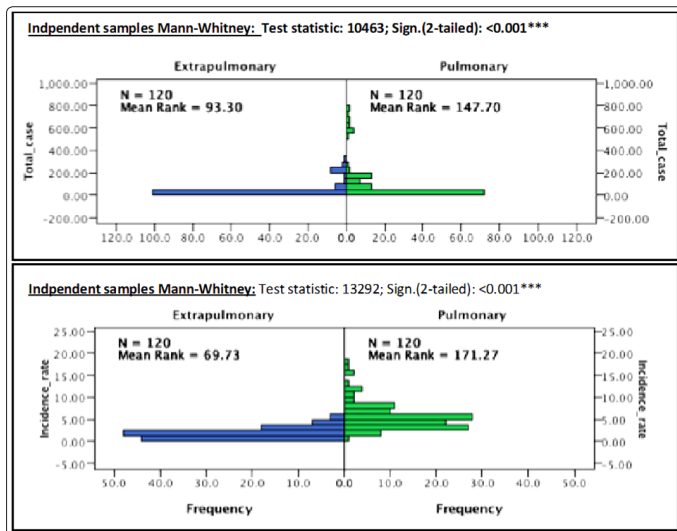


Figure 4: Total case number and incidence rate (/100000 population) of Tuberculosis either pulmonary or Extrapulmonary in Saudi Arabia from 2013 to 2018

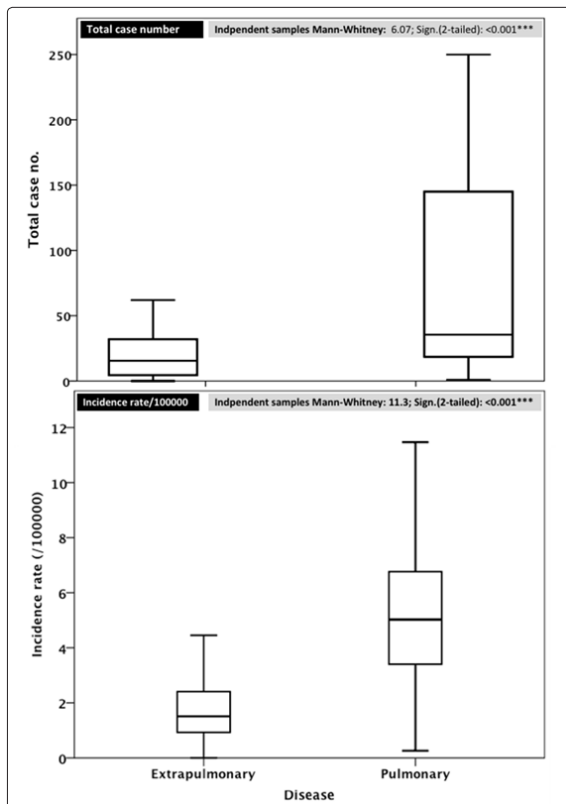


Figure 5: Boxplot for the total case number and incidence rate (/100000 population) of Tuberculosis either pulmonary or Extra pulmonary in Saudi Arabia from 2013 to 2018

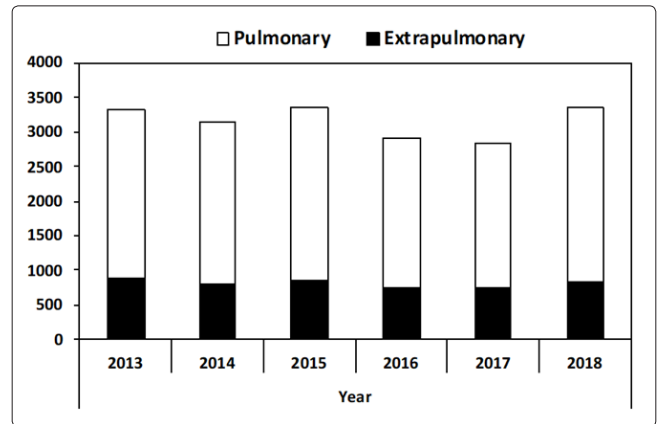


Figure 6: Total case of Tuberculosis either Extrapulmonary or pulmonary in Saudi Arabia from 2013 to 2018

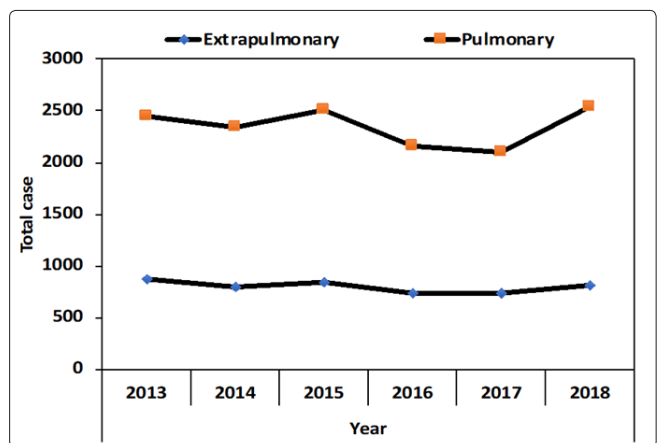


Figure 7: Yearly Change in total case of Tuberculosis either Extrapulmonary or pulmonary in Saudi Arabia from 2013 to 2018.

Pulmonary TB cases were significantly higher than extra-pulmonary TB ($p < 0.05$). The number of pulmonary TB cases general decreased yearly ($p > 0.05$), although it slightly increased in 2015 and 2018 ($p > 0.05$). The highest number of PTB cases recorded in 2015 was 2505, comprising about 74.8% of the total TB cases recorded that year. The incidence rate for pulmonary TB ranged from 6.36 (in 2017) to 8.17/100000 (in 2013). A general slight annual decrease ($p > 0.05$) in both PTB ($r = -0.05$; $p > 0.05$) and ETB ($r = -0.10$; $p > 0.05$) was revealed by Spearman's rank correlation. Generally, the number of cases and incidence rates increased with age. The lowest total TB cases in the age range of 0-14 years of about 104 cases in 2013 dropped to 93 cases in 2018 (Figure 8). The total TB cases strongly decreased with time (year) ($r = -0.43$; $p > 0.05$), i.e., a declining trend, but the age group from 35 to 55 showed a moderate increase with time ($r = 0.31$, $p > 0.05$) (Figure 8).

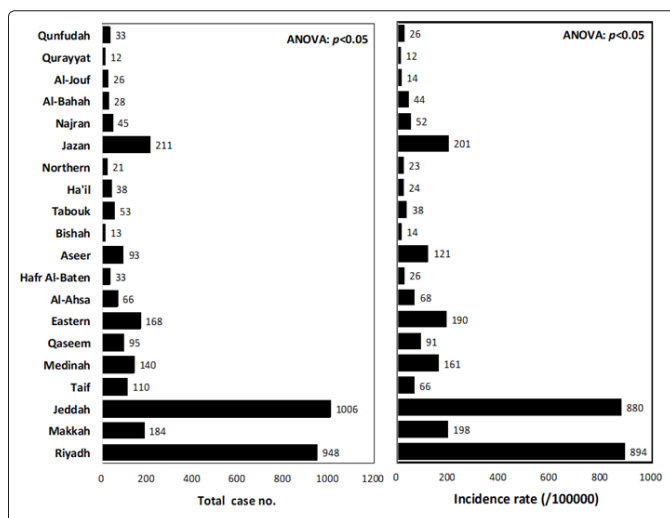


Figure 8: Average total number of Tuberculosis cases in KSA from 2013 to 2018 by region

The age group from 15 to 34 years showed the highest total number of TB cases. The total cases ranged from 1375 in 2017 to 1776 in 2013 (Figure 8). The age group 35-55 years showed total TB cases ranging from 524 in 2013 to 1333 cases in 2015. Both PTB and ETB showed nearly the same trend of total cases of TB and age groups. In all, 18,928 TB cases were reported during the period from 2013

to 2018. Non-Saudis were reported with 10205 TB cases (53.9%), but Saudis were reported with 8717 TB cases (46% of the total cases) (Table 3). The TB annual incidence rate ranged between 0.29 and 18.67/100,000 population. Non-Saudis had 1.2~1.5 times higher incidences than Saudis. The yearly percentage of reported non-Saudi cases ranged from a minimum of 50.9% (in 2017) to a maximum of 57.2% (in 2018) (Table 3). The incidence rate of Saudi cases ranged from 4.23-4.97/100000, with a non-significant yearly change ($p>0.05$), but the incidence rate for non-Saudis ranged from 4.38-6.14/100000 with a non-significant yearly change ($p>0.05$) (Table 3).

The percentage of TB cases in males/females for both Saudis and non-Saudis changed annually (Tables 2-3; Figures 2-3). The majority (68.7%) were males of either Saudi or non-Saudi extraction. This percentage changes annually, increasing from 65.6% in 2013 to 72.5% in 2018. The percentage of males increases annually among both Saudis and non-Saudis (Tables 2-3; Figures 2-3). The Jeddah, Riyadh, and Makkah regions reported over 60% of TB cases in the KSA (Table 5, Figure 9). These regions have the highest populations of the kingdom. Regional variations were observed. The Jeddah and Riyadh regions had the highest total number of cases among the studied provinces. Variations in incidence rates were also assessed, with Jeddah and Jazan showing the highest incidence rate/100000. Jeddah showed an incidence rate of 10.08/100000, and Jazan showed an incidence rate of 7.39/100000. The TB disease rates increase over the last six years in Makkah province (Table 5, Figure 9).

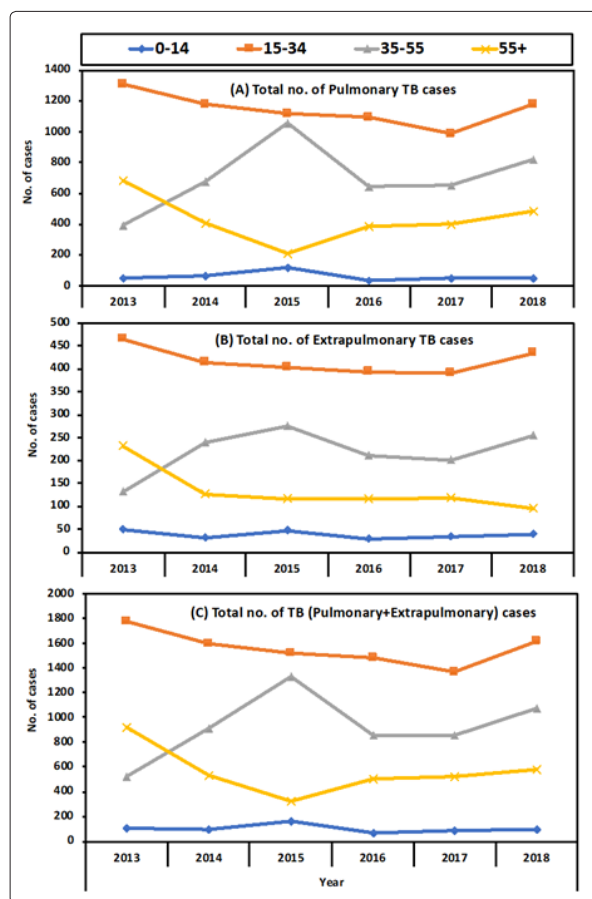


Figure 9: Average total number of Tuberculosis cases in KSA from 2013 to 2018 by region

Table 5: Total number and incidence rate of TB cases in Kingdom Saudi Arabia (2013-2018) calculated by province. Differences checked by Kruskal Wallis significance test at p<0.05

Province	2013		2014		2015		2016		2017		2018		Kruskal Wallis	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	X2	P
Riyadh	948	12.6	894	11.6	832	10.52	792	9.9	808	9.8	901	10.7	3.9	>0.05ns
Makkah	184	9.0	198	9.4	254	11.73	231	10.3	222	9.6	225	9.4	1.6	>0.05ns
Jeddah	1006	24.5	880	20.8	967	21.61	786	17.4	727	15.7	995	20.9	5.0	>0.05ns
Taif	110	9.0	66	5.2	56	4.35	53	4.2	56	4.3	62	4.7	3.2	>0.05ns
Medinah	140	7.1	161	8.0	198	9.60	134	6.4	129	6.0	153	7.0	3.3	>0.05ns
Qaseem	95	7.1	91	6.6	95	6.77	66	4.7	71	5.0	49	304	3.8	>0.05ns
Eastern	168	5.7	190	6.3	271	8.75	242	7.7	272	8.4	354	10.7	5.0	>0.05ns
Al-Ahsa	66	5.7	68	5.7	58	4.76	49	4.1	36	2.9	45	3.6	10.4	>0.05ns
Hafr Al-Baten	33	7.7	26	5.9	38	8.50	30	6.8	23	5.1	31	6.8	3.1	>0.05ns
Aseer	93	5.4	121	6.9	118	6.53	102	5.7	84	4.6	90	4.8	2.9	>0.05ns
Bishah	13	3.5	14	3.7	14	3.61	1	0.3	18	4.6	26	6.5	11.3	>0.05*
Tabouk	53	6.1	38	4.3	47	5.18	40	4.5	45	5.0	28	3.0	2.6	>0.05ns
Ha'il	38	5.8	24	3.6	26	3.79	32	4.7	13	1.9	19	2.6	4.1	>0.05ns
Northern	21	6.0	23	6.4	19	5.17	25	7.0	20	5.5	14	3.7	3.1	>0.05ns
Jazan	211	14.1	201	13.1	242	15.42	229	14.9	237	15.1	257	16.0	3.7	>0.05ns
Najran	45	8.1	52	9.2	54	9.29	39	6.8	27	4.6	47	7.9	5.2	>0.05ns
Al-Bahah	28	6.2	44	9.5	39	8.27	23	4.9	16	3.4	25	5.1	5.4	>0.05ns
Al-Jouf	26	8.1	14	4.3	24	7.12	8	2.4	9	2.7	6	1.7	6.3	>0.05ns
Qurayyat	12	7.4	12	7.3	8	4.72	8	4.8	6	3.5	15	8.7	1.4	>0.05ns
Qunfundah	33	11.1	26	8.5	16	5.14	23	7.6	20	6.4	22	6.9	5.0	>0.05ns

Discussion

This study revealed four significant findings: (1) TB, whether pulmonary or extra-pulmonary, is still a significant health challenge in the KSA that affects all nationalities (Saudis and non-Saudis), different age groups (0-14, 15-34, 35-55, more than 55 years old), and genders (males and females); (2) non-Saudis had nearly 1.2~1.5 times higher TB incidence rates compared to Saudis for the period 2013-2018; 3) non-Saudi cases were mainly workers originating from South-east Asia and African countries that are considered high TB endemic areas of the world, particularly Indonesia, India, Pakistan, Bangladesh, the Philippines, Ethiopia, Somalia, Chad, Nigeria, and other African countries. With respect to gender, the rate of TB reported in males (either Saudi/non-Saudi) was greater than in females (almost two to three times greater than in females); and (4) Makkah, Jeddah, and Riyadh provinces, which attract a large number of workers, account for more than 60% of TB cases in the KSA. Their incidence rates are also the highest among all KSA provinces.

This retrospective study gives an important and detailed statistical analysis of KSA TB surveillance data from 2013-2018. Previous reports have evaluated TB estimates in the KSA, the situation of TB cases among migrant laborers, and the impact of migration on TB incidence rates in the KSA. However, these reports covered data until the year 2012 [4, 6, 8]. To improve planning strategies for TB control and preventive measures, comprehensive epidemiological and clinical studies and statistics on TB are required concerning both nationals and non-Saudis.

The significant variations of TB incidence rates recorded at different geographical regions and provinces of the KSA can be explained by differences in rates between Saudis and non-Saudis and gender differences. They could be due to NTP diagnostic and health-care quality differences between these regions and the accessibility of health-care services and other social services [4]. For the Jeddah and Makkah areas, high incidence rates may be due to intensive people transportation and traffic who are mainly concentrated in a small area over the very short time period of Hajj [8]. Moreover, important TB risk factors are socioeconomic factors, poverty, poor living conditions, and income levels. Further studies evaluating common social determinants of TB could help explain some of the differences between TB rates between Saudis and non-Saudis and geographical areas and urbanization [4, 6, 8]. Malnutrition and life stresses may cause the latent M.tb infection (LTBI) to recur, but improved living conditions and higher income levels of migrants and the workforce together with the proper prevention, screening, and treatment strategies of LTBI could help control TB in the non-Saudi population [4, 13]. The illegal residence of some migrants in any country could lead to them living in very poor conditions with no access to health-care services, which could lead to difficulties in controlling TB. These reports could help improve various health-care services for undocumented migrants [14]. The KSA National Tuberculosis Control Program (NTP) was established in the early 1970s [13, 5]. Short course directly observed treatments (DOTs) were approved and carried out in some provinces in 1998 and was extended through the KSA by the year 2000 [4, 15]. Suitable funding for TB functional and effective services was applied. However, the TB incidence in KSA is not diminishing. This requires further

intensive evaluation of KSA-NTP to assess strategy, program, and operational issues [4].

The KSA vision 2030 targeted the optimization and utilization of developed health-care centers and hospitals with improved quality of therapeutic and prevention services. It also aims to promote preventive health care and declining rates of infectious diseases such as TB. This would increase cooperation and integration between social and health-care services [16, 17]. The establishment of a laboratory network to support the surveillance system and improve health-care education has resulted in an increased number of registered TB cases, but growth in population caused a nearly stable incidence rate during the study period. A rapid decline in TB incidence has been reported in countries that have established efficient TB control measures, such as China, Cuba, and Peru [18-20]. Non-Saudis showed a higher number of TB cases and rates compared to Saudis, which could be related to the high TB incidence rates in their countries [4, 13, 21-24]. Although many non-Saudis may have LTBI, they acquired active TB during their residence in the KSA due to poor living conditions, e.g., poor housing, malnutrition, and work stress [25]. The ratio could also indicate that TB infection by newly acquired M.tb is caused by the high TB incidence rates in major KSA cities since the total incidence rates of both Saudis and non-Saudis are nearly stable. Six-month interval assessments of migrant non-Saudis for active TB could improve early case recognition rates and early treatment and hence could diminish the TB spread rates.

There is a difficulty in explaining the reported gender differences between males and females in KSA in the period. The lower incidence rate and total case numbers for Saudi females suggest their limited contributions in KSA society and public life. Moreover, they reflect the stigma of a Saudi female being diagnosed with TB. In the meantime, non-Saudi females have higher incidences than Saudi females and lower incidences than non-Saudi males. These are related to the low socioeconomic levels of non-Saudi females. Furthermore, non-Saudi females mostly came to the kingdom from high TB risk countries. Saudi males were reported at higher TB rates than females (twice), representing the significance of the social/communal responsibility of both genders [21, 26]. Males are commonly more susceptible to TB than females because they have relatively wide-ranging social networks that increase their risk of TB infection [27, 21]. Moreover, smoking is more common in males and has a confirmed connection with TB [4, 28-30]. The Makkah, Jeddah, and Riyadh regions have the largest populations in the KSA and attract an enormous human workforce of both nationals and non-nationals that would trigger increased M.tb spread rates. Furthermore, the efficient medical and laboratory services with professional staff are aware of increased TB cases. Because the Makkah region is visited yearly by millions of hajis for the Hajj and Umrah festivals, this could attribute to high incidence rates of M.tb transmission to residents during such festivals [31-33]. Precise data on the real TB infection and transmission risk associated with mass gatherings are scarce [33]. Yearly, about 10 million hajis from 184 countries travel to the KSA to perform the Hajj and Umrah pilgrimages. Most pilgrims originate from high-TB-burden and MDR-TB endemic regions, of which many could have undiagnosed active TB, sub-clinical TB, and latent TB infections [33]. The Hajj pilgrimage is a unique opportunity for the 184 countries of origin and the KSA to perform high-quality research on TB under the responsibility of the Global Centre for Mass Gatherings Medicine.

More research is required to develop international strategies for managing and controlling TB [33, 34].

Conclusions

TB is still one of the most vital health troubles in the KSA, affecting different nationalities (Saudis, non-Saudis), ages, provinces, and genders. In this retrospective study, we appraised TB surveillance data for the period between 2013 (1434H) and 2018 (1439H). Our study assessed TB in the KSA, evaluating its impact on various nationalities (Saudis and non-Saudis), age groups (0-14, 15-34, 35-55, more than 55 years old), and genders (males and females). Non-Saudis had higher incidences than Saudis did in 2013-2018. The number of cases and incidence rates of TB recorded in males between 2013 to 2018 were significantly greater than in females by about two to three times. The Makkah, Riyadh, and Jeddah regions attract enormous numbers of non-Saudi labor migrant workers, who account for ~60% of all TB cases in the KSA. Assessment of the main TB risk factors in non-Saudi workers is essential. Furthermore, periodical accurate studies should include evidence-based studies for optimum surveillance, avoidance, spread risk, inspection, control procedures, and treatment of TB. These assessments would lead to evaluating the KSA-NTP for the strengths and weaknesses of the TB action plan to develop better strategies against TB.

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