

Trends in incidences of newly notified tuberculosis in Jeju Province, Korea, 2017–2021

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Abstract In 2021, the incidence of newly notified tuberculosis in Jeju Province decreased by 23.0% compared to that in the previous year. This was the largest decline among the 18 municipalities studied. This study aimed to examine trends in the incidence of tuberculosis among different age and sex groups in Jeju Province between 2017 and 2021. This study observed the number of new cases in the annual report from 2017 to 2021, published by the Jeju Center for Infectious Diseases Control and Prevention. The average annual percentage change (AAPC; %) was calculated to determine the trend in crude incidence rates over the past 5 years by sex and age. While a P -value of <0.1 was considered marginally significant, a P -value of <0.05 was considered statistically significant. The AAPC of all age groups in Jeju Province had negative values. In men, there was a statistically significant decrease in ages 30-34, 40-44, 45-49, and 50-54 years and a marginally significant decrease in ages 35-59, 55-59, 60-64, 65-69, 75-79, and ≥ 80 years. In women, a statistically significant decrease was observed among patients aged 30-34, 35-39, and ≥ 80 years, and a marginally significant decrease was observed among patients aged 45-49, 50-54, 60-64, 65-69, and 75-79 years. A statistically significant decrease in tuberculosis was observed among patients in their 30s and 40s, and elderly patients aged ≥ 80 years comprised the group vulnerable to tuberculosis. Based on these findings, tuberculosis prevention and screening programs conducted in Jeju Province were effective.

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INTRODUCTION

Among the 38 member countries of the Organization for Economic Cooperation and Development, Korea has the highest incidence of tuberculosis.¹ However, the incidence of tuberculosis in Korea has decreased by 7.4% per year, on average, since peaking in 2011. Over the past 10 years, a 53.6% decline in incidence has been observed.² In 2021,

the incidence of tuberculosis in Jeju Province decreased by 23.0% compared to the previous year. It was the greatest decline observed among the 18 municipalities nationwide.²

Although the incidence of tuberculosis has decreased nationwide, the proportion of elderly patients has steadily increased to 51.3% by 2021.² Additionally, males are 1.4 times more likely to be involved than females in a new tuberculosis case.² Therefore, it is necessary to examine

the trends in tuberculosis incidence according to age and sex to improve the effectiveness of the tuberculosis control programs in the province.

This study aimed to evaluate recent trends in the incidence of tuberculosis by age and sex in Jeju Province between 2017 and 2021.

METHODS

The Jeju Center for Infectious Diseases Control and Prevention (<http://jeci.kr>) has constructed a database containing tuberculosis incidents in Jeju Province since July 1, 2016. The “Yearbook of Jeju Special Self-Governing Province Tuberculosis Patient Notified” has been in

Table 1. Crude incident rates of newly notified tuberculosis in Jeju Province, Korea, 2017-2021

Sex	Age (years)	2017	2018	2019	2020	2021
Men	0-4	0.00	0.00	0.00	7.45	0.00
	5-9	0.00	0.00	5.55	0.00	0.00
	10-14	0.00	0.00	16.68	0.00	0.00
	15-19	37.27	24.05	19.92	10.46	0.00
	20-24	47.92	17.44	35.49	45.27	18.60
	25-29	38.72	61.69	58.43	28.15	0.00
	30-34	51.90	48.47	27.73	16.85	11.08
	35-39	44.31	46.74	27.47	24.66	26.14
	40-44	79.31	81.13	53.06	26.63	33.70
	45-49	71.01	72.30	65.80	41.33	39.59
	50-54	108.80	98.61	58.01	72.94	51.65
	55-59	111.01	83.43	103.66	69.87	76.43
	60-64	88.11	130.12	115.13	82.62	41.40
	65-69	156.26	61.61	111.90	88.39	49.14
	70-74	87.44	147.47	88.32	155.17	59.16
75-79	155.54	222.24	168.10	187.28	114.01	
≥80	362.47	357.17	255.79	135.58	124.62	
Women	0-4	0.00	0.00	0.00	0.00	0.00
	5-9	0.00	0.00	0.00	0.00	5.86
	10-14	6.18	0.00	0.00	0.00	0.00
	15-19	5.11	15.89	10.97	0.00	6.14
	20-24	44.23	19.57	24.97	0.00	21.07
	25-29	60.61	22.72	32.38	20.87	20.52
	30-34	64.62	56.05	40.29	35.04	28.62
	35-39	50.11	48.16	20.10	25.06	13.11
	40-44	39.30	20.07	40.60	27.92	26.98
	45-49	39.08	51.79	27.39	24.22	10.72
	50-54	32.40	27.50	22.83	11.00	17.54
	55-59	45.91	40.14	35.34	50.97	23.57
	60-64	60.15	45.43	32.70	35.30	8.42
	65-69	51.22	71.97	48.77	32.22	35.21
	70-74	50.26	89.09	31.38	53.32	74.82
75-79	116.76	96.98	105.77	88.57	62.03	
≥80	183.50	192.21	171.99	142.79	136.47	

publication for 5 years, from 2017 to 2021. This study analyzed the number of newly notified cases published in the annual report from 2017 to 2021.

The crude incidence rates were calculated according to the research purpose of evaluating incidence trends in the same area as Jeju Province. The mid-year population of the resident registration age, provided by the National Statistical Portal, was used to calculate the crude incidence rate by year, age, and sex (<https://kosis.kr>). The crude incidence rates over five years were calculated for 17 age groups (0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, ≥80), sex (men and women), and two cities (Jeju-si and Seogwipo-si). The average annual percentage change (AAPC; %) was calculated to evaluate the incidence rates over the past 5 years by sex and age. Permutation tests were conducted using Joinpoint regression, provided by Joinpoint Statistical Program version 4.9.0.1 (<https://surveillance.cancer.gov/joinpoint>; National Cancer Institute, Bethesda, Rockville, US), were conducted.³ Statistical significance set at $P < 0.1$ was considered marginally significant, and a P -value of < 0.05 was considered statistically significant. A P -value of < 0.05 was obtained with 95% confidence intervals (CIs). This study was exempted from the Jeju National University Institutional Review Board (JJNU-IRB-2022-048).

RESULTS

Table 1 summarizes the 5-year tuberculosis incidence rates for 2017-2021 according to sex and age group in Jeju Province. Its incidence increased with age in both men and women (Fig. 1). There was a higher incidence among men than women among patients aged 35-79 years. In most age groups, the incidence tended to decrease over time.

Due to the nature of Joinpoint regression, it was impossible to calculate the AAPC if there were no new tuberculosis cases within 5 years. Therefore, AAPC values were calculated for both men and women aged > 30 years (Table 2). AAPC was negative for all age groups in Jeju Province. A statistically significant decrease in tuberculosis incidence was observed in men in age groups 30-34, 40-44, 45-49, 50-54 years, and a marginally significant decrease in age groups 35-59, 55-59, 60-64, 65-69, 75-79, ≥ 80 years. The largest negative value was obtained from patients in the age group 30-34 years, followed by those in the age groups 40-44, 50-54, and 45-49 years, with a significance level of 0.05. A statistically significant decrease in tuberculosis incidence was also observed among women in the age groups 30-34, 35-39, and ≥ 80 years. A marginally significant decrease was observed among women in age groups 45-49, 50-54, 60-64, 65-69, 75-79 years. The 35-39, and 30-34 years age groups exhibited the largest negative AAPC% values.

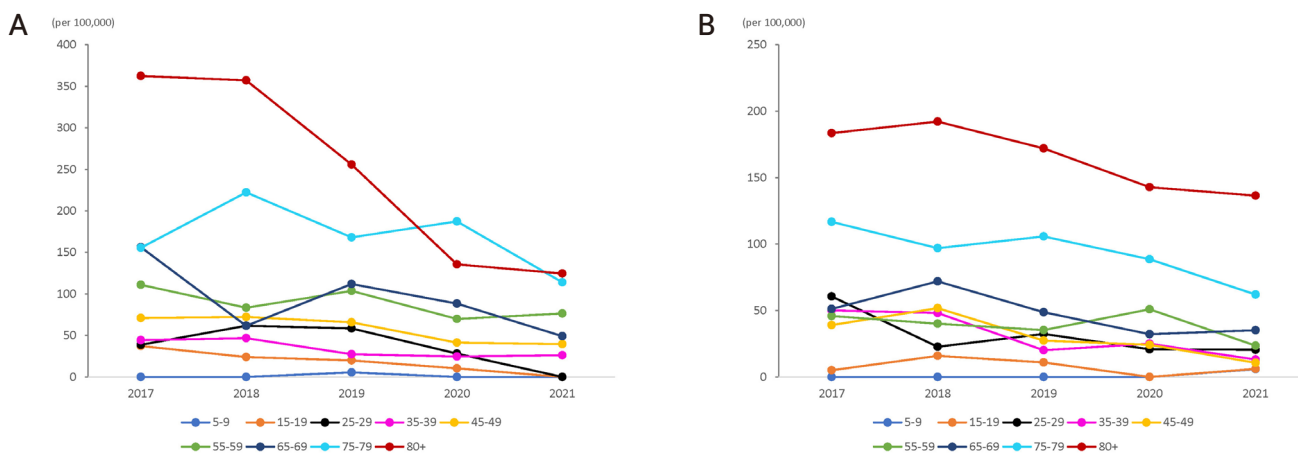


Figure 1. Crude incident rates of newly notified tuberculosis in men (A) and women (B), Jeju Province, 2017-2021.

The AAPC values for the two cities were calculated (Table 3). In both cities, the incidence significantly decreased in males aged ≥ 80 years. Only the incidence rate of women aged ≥ 80 years in Jeju-si exhibited a statistically significant decrease in the incidence of tuberculosis. The incidence of tuberculosis in Jeju-si decreased significantly among men aged 40-44 years and marginally significantly among those in the age groups 30-34, 45-49, 50-54, 55-59, 65-69, and ≥ 80 years. In addition to women, the incidence of tuberculosis decreased significantly among those in the age groups 30-34, 60-64, and ≥ 80 years and marginally significantly in the age group 35-39. In Seogwipo-si, the incidence of tuberculosis significantly decreased among males aged ≥ 80 years and marginally decreased among those aged 30-34 years.

Table 2. Average annual percentage change (AAPC; %) in crude incident rates of newly notified tuberculosis in Jeju Province, Korea, 2017-2021

Sex	Age (years)	AAPC (%) [*]	95% confidence interval
Men	30-34	-32.0 [†]	-44.7 to -16.3
	35-39	-16.1 [*]	-30.2 to 0.7
	40-44	-23.5 [†]	-39.7 to -2.9
	45-49	-15.1 [†]	-27.3 to -0.8
	50-54	-16.4 [†]	-29.3 to -1.2
	55-59	-8.9 [*]	-22.0 to 6.5
	60-64	-15.7 [*]	-43.0 to 24.6
	65-69	-19.2 [*]	-42.8 to 14.2
	70-74	-3.0	-40.6 to 58.4
	75-79	-7.2 [*]	-28.5 to 20.5
≥ 80	-25.9 [*]	-39.0 to -9.9	
Women	30-34	-19.0 [†]	-23.2 to -14.6
	35-39	-27.3 [†]	-45.0 to -4.0
	40-44	-6.2	-30.3 to 26.2
	45-49	-24.8 [*]	-48.5 to 9.8
	50-54	-17.9 [*]	-34.5 to 3.0
	55-59	-6.7	-30.7 to 25.7
	60-64	-25.3 [*]	-47.6 to 6.3
	65-69	-14.8 [*]	-34.5 to 10.8
	70-74	1.4	-32.6 to 52.7
	75-79	-11.7 [*]	-22.6 to 0.8
≥ 80	-8.5 [†]	-14.8 to -1.8	

^{*}P-value <0.1, [†]P-value <0.05.

DISCUSSION

To summarize, the incidence of tuberculosis in Jeju Province over the past 5 years has significantly decreased in both males and females. In particular, the incidence significantly declined among patients in the age groups 30-49 and ≥ 80 years. The finding that men have a higher incidence than women in Jeju Province is a corresponding result, as men were 1.4 higher than women nationwide.²

The coronavirus disease 2019 (COVID-19) pandemic occurred during the observation period of this study from 2017 to 2021. The World Health Organization has reported that the COVID-19 pandemic has negatively impacted the management of tuberculosis. The target reduction in the

Table 3. Average annual percentage change (AAPC; %) in crude incident rates of newly notified tuberculosis in Jeju-si and Seogwipo-si, Jeju Province, Korea, 2017-2021

Sex	Age (years)	AAPC (%)	
		Jeju-si	Seogwipo-si
Men	30-34	-34.3 [*]	-28.3 [*]
	35-39	-19.3	-
	40-44	-23.6 [†]	-23.3
	45-49	-21.0 [*]	-0.7
	50-54	-15.8 [*]	-16.9
	55-59	-11.8 [*]	-2.4
	60-64	-18.1	-10.7
	65-69	-22.0 [*]	-11.4
	70-74	-6.6	1.3
	75-79	-3.3	-12.8
≥ 80	-20.0 [*]	-38.8 [†]	
Women	30-34	-11.7 [†]	-
	35-39	-23.1 [*]	-
	40-44	1.5	-
	45-49	-19.6	-
	50-54	-20.6	-16.1
	55-59	-0.6	-11.1
	60-64	-32.4 [†]	-
	65-69	-10.7	-19.3
	70-74	-10.2	-
	75-79	-12.5	-8.6
≥ 80	-12.8 [†]	-1.5	

^{*}P-value <0.1, [†]P-value <0.05.

incidence of tuberculosis in 2015-2022 was 20%, but only a reduction of 11% was achieved.⁴ This was due to insufficient healthcare resources for the management of tuberculosis, exacerbated by the COVID-19 pandemic. However, the incidence of tuberculosis in Korea decreased during the same period.²

Zimmer et al.⁵ reported that the number of notified tuberculosis cases worldwide in May 2020 was 21% lower than 2019. Kwak et al.⁶ also reported that the number of domestic tuberculosis cases reported in the first half of 2020 decreased by 24%. This implied that the COVID-19 outbreak temporarily lowered the notification rate. Thus, the notification rate is expected to decrease from 2020 to 2021 during the COVID-19 pandemic. The sharp drop in the notification rate has three implications.

First, the spread of tuberculosis cannot be reduced by preventive measures against COVID-19, including wearing a mask, practicing handwashing, and implementing social distancing.⁶ It is difficult to determine the effect of the COVID-19 pandemic on the decrease in the incidence of tuberculosis in Jeju Province, where the incidence of tuberculosis decreased the most in 2021.² Meanwhile, the incidence of tuberculosis in Korea has decreased, with an average annual decline of 7.4% since 2011.

Second, notification of tuberculosis cases was delayed during the first pandemic.^{7,8} However, the delay lasted 6 days, which did not significantly affect annual fluctuations. Moreover, the length of the delay in Sejong City was 8 days at most, while that of Jeju province was 1.5 days. Thus, the decreased incidence of tuberculosis in Jeju Province was not entirely caused by the COVID-19 pandemic.

Lastly, Kim et al.⁹ reported that the notified number of elderly people with tuberculosis decreased while the number of tuberculosis patients under 40 years old increased in 2020. Based on this, we can infer that the result of the most significant decrease in the age group in their 30s in Jeju Province may have been a more considerable decrease.

An age-period-cohort analysis is a representative analysis used to evaluate trends during the observation period.¹⁰ Since the observation period of this study was short

(5 years), the changes in the age groups of the 5-year-old unit were not sufficiently evaluated. Thus, joinpoint regression was used to calculate AAPC, which represents the annual average degree of change during the observation period. However, the statistical method cannot calculate the AAPC value when the incidence reaches zero between the observational periods. Therefore, the AAPC values for the ≥ 30 years age group were estimated based on new cases throughout the 5 years. Therefore, this study was limited because the changes in incidence among patients aged < 30 years were not examined. Although not shown in Table 2, the AAPC of men in the age group 20-24 years and women in the age group 25-29 years was -8.5 (95% CI, -42.7 to 461) and -23.8 (95% CI, -43.9 to 3.6), respectively. The *P*-value of AAPC in patients aged 25-29 years was < 0.1 .

In conclusion, a nationwide decrease in the incidence of tuberculosis was observed in Jeju Province in 2021. In particular, the incidence among patients in their 30s and 40s has significantly decreased. Despite the small number of cases, a decreasing trend was observed among patients in their 20s. Based on these findings, a further decrease in the incidence is expected. Patients aged ≥ 80 years, comprising the group vulnerable to tuberculosis, also showed a decreasing trend. These observations support the effectiveness of tuberculosis prevention and screening programs in Jeju Province.

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