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Prevalence and associated factors of diabetes mellitus among patients with tuberculosis in South Korea from 2011 to 2018: a nationwide cohort study

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ABSTRACT

Objectives This study aimed to identify the prevalence of diabetes mellitus (DM) among patients with tuberculosis (TB) using a nationwide cohort in South Korea.

Design A retrospective cohort study.

Setting This study used the Korean Tuberculosis and Post-Tuberculosis cohort, which was constructed by linking the Korean National Tuberculosis Surveillance, National Health Information Database (NHID) and Statistics Korea data for the causes of death.

Participants During the study period, all notified patients with TB with at least one claim in the NHID were included. Exclusion criteria were age less than 20 years, drug resistance, initiation of TB treatment before the study period and missing values in covariates.

Outcome measures DM was defined as having at least two claims of the International Classification of Diseases (ICD) code for DM or at least one claim of the ICD code for DM and prescription of any antidiabetic drugs. Newly diagnosed DM (nDM) and previously diagnosed DM (pDM) were defined as DM diagnosed after and before TB diagnosis, respectively.

Results A total of 26.8% (70 119) of patients were diagnosed with DM. The age-standardised prevalence increased as age increased or income decreased. Patients with DM were more likely to be men, older, had the lowest income group, had more acid-fast bacilli smear and culture positivity, had a higher Charlson Comorbidity Index score and had more comorbidities compared with patients without DM. Approximately 12.5% (8823) patients had nDM and 87.4% (61 296) had pDM among those with TB-DM.

Conclusions The prevalence of DM among patients with TB was considerably high in Korea. To achieve the goal of TB control and improve the health outcomes of both TB and DM, integrated screening of TB and DM and care delivery in clinical practice are necessary.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study analysed the status of diabetes mellitus (DM) among patients with tuberculosis (TB) by the Korean Tuberculosis and Post-Tuberculosis cohort.
⇒ This study included most patients with TB in Korea based on nationwide TB cohort integrated national registry and health insurance information.
⇒ The limitations of this study are that it did not include behavioural and social factors.
⇒ The data analysed in this study may overestimated the prevalence of DM due to use only International Classification of Diseases 10th revision codes and drug prescription not laboratory information.

INTRODUCTION

The dual burden of tuberculosis (TB) and diabetes mellitus (DM) has become a major global public health concern and critical public health challenge in many countries.[1 2]

Globally, an estimated 10 million new cases, equivalent to 127 cases per 100 000 population, and over 1.5 million deaths occurred due to TB in 2020.[3] Meanwhile, DM was among the top 10 causes of death in adults (20–79 years), and in 2019, it caused an estimated 11.3% of total deaths globally.[4] The prevalence of DM among the adult population is on the rise, and diabetes is estimated to affect 537 million patients as of 2021, and this number is estimated to increase to 783 million by 2045.[5]

TB and DM have long been associated with significant morbidity and mortality.[6] Evidence shows that DM triples the risk of developing TB[7] and is also associated with adverse TB treatment outcomes.[8] Patients with DM and TB are more likely to have severe symptoms, higher mortality and a higher risk of relapse than patients with TB without DM.[9–12] Individuals with poor glucose control are more likely to develop active TB[13] and have worse treatment outcomes.[14]

Although the incidence of TB has decreased each year since 2011,[15] South Korea has been ranked at the top for incidence and the third highest for mortality among Organisation for Economic Cooperation and Development member countries in 2021.[3] The prevalence of diabetes has also steadily increased from 2001 (7.6%) to 2018 (13.8%) in Korea.[16 17]

According to data from the Korea National Health and Nutrition Examination Survey, it is estimated that 16.7% and 6.05 million adults aged ≥30 years had diabetes in 2020.[18] The prevalence of DM among patients with TB was reported as 17.4%–38.9% in several studies in South Korea.[19] In this study, we aimed to identify the prevalence and associated risk factors of DM among patients with TB using a nationwide cohort in South Korea and provide evidence for collaborative activity for TB and comorbid DM control.

METHODS

Sources of data and collection

The integrated national TB data set (the Korean Tuberculosis and Post-Tuberculosis cohort, TB-POST) was constructed by linkage of three database[20]: (1) the Korean National Tuberculosis Surveillance System (KNTSS), (2) the National Health Information Database (NHID) data and (3) Statistics Korea data on the causes of death to explore the various outcome of patients with TB registered between 2011 and 2018. The TB notification data in the KNTSS database include nationally notified patients with TB personal information, the reported date, age and sex, nationality, type of TB and acid-fast bacilli (AFB) smear result and the patient's history of TB. Matched NHID consists of additional information on health service claims reported by the country's sole health insurance agency: (1) socio-demographic information in NHID (age, sex and household income level, death), (2) health services use types (procedure, operation, prescription, etc), (3) disease diagnosis and classification code (according to the Korean Standard Classification of Diseases), (4) drug and treatment prescriptions (generic name, quantity, total days, unit price, etc) and (5) health service provider information (location, level and types of health provider). Data linkage was established for the matched patients with TB reported to the KNTSS and those with a medical claim for TB and TB-related disease in the NHID and cause of death in Statistics Korea.

Study design and population

This was a retrospective nationwide cohort study of individuals with TB to identify the prevalence of DM and its risk factors in Korea. Initially, 305 260 patients were linked through a combination of the KNTSS and NHID between 2011 and 2018. After excluding those aged <20 years (n=9389); with drug resistance (n=16 659); those who initiated treatment outside the study period (n=4173); and those with missing information on age, sex and covariates (n=13 159), 261 880 individuals were included in the final analysis (figure 1).

Patient and public involvement

To approve the study design, the study protocol was reviewed by Institutional Review Board operating National Evidence-based Healthcare Collaborating Agency where non-healthcare sectors' reviewers' participated. In addition, to approve the data utility, the study protocol was reviewed by an Independent Review Committee operating by National Health Insurance Service where representatives of civil society participated. After those approval, there was no public and patients involvement during the study implementation.

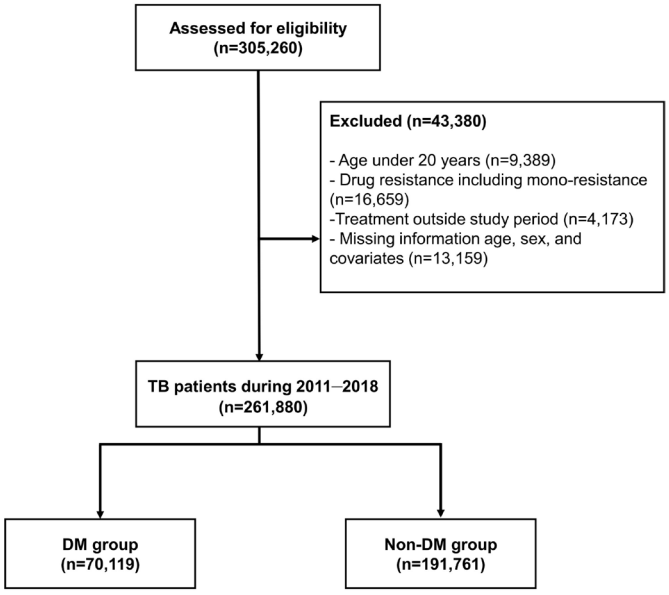

Figure 1 Flowchart of the study participants. DM, diabetes mellitus; TB, tuberculosis.

Definition and measurement

DM

DM was defined by any one of the following criteria 1 year before and after TB diagnosis: (1) at least two claims of the International Classification of Diseases (ICD) coding for DM (E11–E14), or (2) at least one claim of ICD code for DM and prescription of any antidiabetic drugs.[21–23] This definition was based on the consensus of relevant findings widely used in previous studies.[24–26]

Newly diagnosed DM (nDM) was defined as DM diagnosis after TB diagnosis among the patients with defined DM. Previously diagnosed DM (pDM) was defined as DM diagnosis before TB diagnosis among the patients with defined DM.

Covariates

Household income level was categorised into a quintile (1=the lowest and 5=the highest) based on classifications used to assess a patient's annual national health insurance premium. Patients receiving medical aid benefits were assessed as a separate income group (coded as '0'). Age; sex; previous TB treatment history; TB lesions; sputum smear and culture results; comorbidities (end-stage renal disease (ESRD), cancer and HIV status); and the Charlson Comorbidity Index (CCI) were measured as covariates.

Statistical analysis

Frequency distributions and percentages were calculated for all the study variables. The Student's t-test for

Table 1 Baseline characteristics for patients with tuberculosis (TB) according to diabetes mellitus (DM) status

	Total (n=261 880)		DM (n=70 119)		Non-DM (n=191 761)		
	n	%	n	%	n	%	P value
Sex							
Men	153 653	58.7	45 404	64.8	108 249	56.4	<0.001
Women	108 227	41.3	24 715	35.2	83 512	43.6	
Age group							
20–24	12 216	4.7	187	0.3	12 029	6.3	<0.001
25–34	30 813	11.8	947	1.4	29 866	15.6	
35–44	32 256	12.3	3595	5.1	28 661	15.0	
45–54	41 963	16.0	10 406	14.8	31 557	16.5	
55–64	42 398	16.2	14 475	20.6	27 923	14.6	
65–74	41 102	15.7	16 738	23.9	24 364	12.7	
75+	61 132	23.3	23 771	33.9	37 361	19.5	
Age median (IQR)	57 (42–74)		68 (56–77)		53 (37–71)		<0.001
Elderly (≥65 years)	102 234	39.0	40 509	57.8	61 725	32.2	<0.001
Household income							<0.001
0 (lowest)	20 987	8.0	8512	12.1	12 475	6.5	
1	42 425	16.2	10 989	15.7	31 436	16.4	
2	41 899	16.0	9593	13.7	32 306	16.9	
3	45 445	17.4	10,650	15.2	34 795	18.1	
4	49 464	18.9	12 601	18.0	36 863	19.2	
5 (highest)	61 660	23.5	17 774	25.4	43 886	22.9	
Lesion of TB							
Pulmonary	223 448	85.3	60 661	86.5	162 787	84.9	<0.001
Extrapulmonary	38 432	14.7	9458	13.5	28 974	15.1	
TB history							
New case	226 769	86.6	60 346	86.1	166 423	86.8	<0.001
Previously treated case	35 111	13.4	9773	13.9	25 338	13.2	
AFB smear							
Positive	76 007	29.0	24 475	34.9	51 532	26.9	<0.001
Negative	138 908	53.0	35 453	50.6	103 455	54.0	
Unknown	46 965	17.9	10 191	14.5	36 774	19.2	
Culture							
Positive	113 775	43.4	33 860	48.3	79 915	41.7	<0.001
Negative	73 153	27.9	18 177	25.9	54 976	28.7	
Unknown	74 952	28.6	18 082	25.8	56 870	29.7	
CCI score							
0	107 265	41.0	20 170	28.8	87 095	45.4	<0.001
1	108 029	41.3	28 856	41.2	79 173	41.3	
2	13 404	5.1	5478	7.8	7926	4.1	
3 or above	33 182	12.7	15 615	22.3	17 567	9.2	
Comorbidity							
Organ transplantation	799	0.3	493	0.7	306	0.2	<0.001
People living with HIV	373	0.1	109	0.2	264	0.1	0.285
Cancer	7133	2.7	2780	4.0	4353	2.3	<0.001
ESRD	4599	1.8	3536	5.0	1063	0.6	<0.001

Continued

Table 1 Continued

	Total (n=261 880)		DM (n=70 119)		Non-DM (n=191 761)		
	n	%	n	%	n	%	P value
Notification year							
2011	41 361	15.8	9431	13.5	31 930	16.7	<0.001
2012	39 474	15.1	9747	13.9	29 727	15.5	
2013	34 697	13.2	8822	12.6	25 875	13.5	
2014	33 275	12.7	8851	12.6	24 424	12.7	
2015	30 440	11.6	8608	12.3	21 832	11.4	
2016	29 501	11.3	8607	12.3	20 894	10.9	
2017	27 359	10.4	8324	11.9	19 035	9.9	
2018	25 773	9.8	7729	11.0	18 044	9.4	

AFB, acid-fast bacilli; CCI, Charlson Comorbidity Index; DM, diabetes mellitus; ESRD, end-stage renal disease.;

the normally distributed variables or Mann-Whitney test was used to compare continuous variables, and the χ^2 test was used to compare categorical variables. The age-standardised prevalence rate (per 100 000) of patients with TB-DM was calculated using the Korean standard population in 2015. Logistic regression analyses were performed to assess the risk factors for DM among patients with TB. All p values were two-tailed, and a p value of <0.05 was deemed statistically significant. All statistical analyses were performed using Stata/MP V.17 (StataCorp, College Station, Texas, USA), and R software (V.4.0.5, The R Foundation for Statistical Computing, Vienna, Austria).

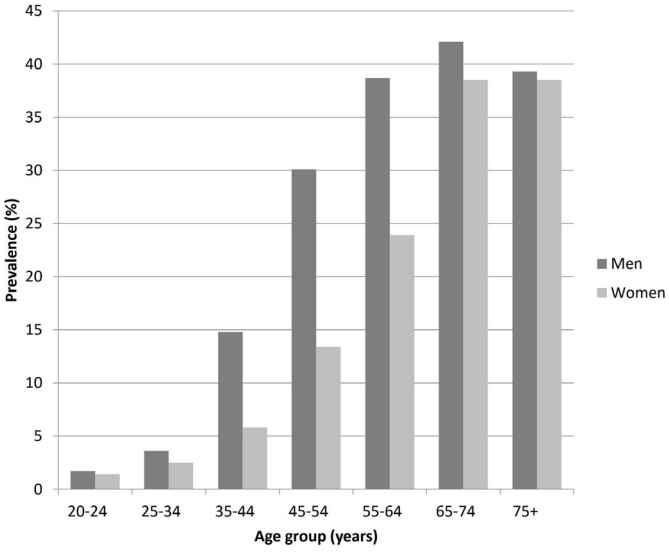

Figure 2 The prevalence of diabetes mellitus among patients with tuberculosis stratified by age group among both sexes.

RESULTS

Characteristics for patients with TB stratified by DM status

Among 261 880 patients with TB, 70 119 had DM, which was equivalent to 26.8% (95% CI 26.6% to 27.0%) of DM prevalence. The baseline characteristics of the participants are shown in table 1 according to the DM status. There were more men in the DM group compared with the non-DM group (64.8% vs 56.4%) and the median age was higher in the DM group (68 years vs 53 years, p<0.001). Regarding household income, a lower income group was observed for the DM group than that in the non-DM group (12.1% vs 6.5%, p< 0.001). Patients with TB in the DM group showed more positive results for AFB smears (34.9% vs 26.9%, p<0.001) and mycobacterial cultures (48.3% vs 41.7%, p<0.001) than those in the non-DM group. Additionally, patients with TB in the DM group had higher CCI scores and more comorbid conditions, including organ transplantation, malignant disease and ESRD than those in the non-DM group (table 1).

Prevalence of DM among patients with TB

As shown in figure 2, the prevalence of DM increased with age in both men and women. The prevalence of DM was 1.7% and 1.4% in men and women, respectively, in the age group of 20–24 years. However, the prevalence sharply increased to 14.8% in those aged 35–44 years and 42.1% in 65–74 years in men. Meanwhile, the prevalence of DM among patients with TB in women aged 35–44 years was 5.8%, lower than that in men and 38.5% in those aged 65–74 years. We calculated the age-standardised prevalence rate of TB-DM per 100 000 individuals from 2011 to 2018 by sex and income groups. The prevalence rate was higher in men than in women (29.6/100 000 vs 15.3/100 000) and increased with age, with the highest prevalence in men aged >75 years (144.5/100 000) (table 2 and figure 3A).

Additionally, the age-standardised prevalence rate of TB-DM according to the income group was significantly different. The prevalence rate was highest in the lowest income group (Q1 group) in both men (43.8/100 000)

Table 2 Age-standardised prevalence rate (per 100 000) of patients with TB-DM stratified by sex

	Cases	Population	Crude rate	95% CI	Standardised rate	95% CI
Men						
20–24	107	14 259 918	0.8	0.6 to 0.9	0.8	0.7 to 1
25–34	588	29 543 197	2	1.8 to 2.2	2	1.9 to 2.2
35–44	2840	34 096 199	8.3	8 to 8.6	9.6	9.3 to 10
45–54	8611	34 987 516	24.6	24.1 to 25.1	28	27.4 to 28.6
55–64	11 348	26 453 915	42.9	42.1 to 43.7	45.8	44.9 to 46.7
65–74	10 673	14 386 780	74.2	72.8 to 75.6	75.6	74.1 to 77.1
75+	11 237	8 005 878	140.4	137.8 to 143	144.5	141.4 to 147.7
Total	45 404	161 733 403	28.1	27.8 to 28.3	29.6	29.4 to 29.9
Women						
20–24	80	12 909 498	0.6	0.5 to 0.8	0.6	0.5 to 0.8
25–34	359	27 071 459	1.3	1.2 to 1.5	1.3	1.2 to 1.5
35–44	755	32 394 508	2.3	2.2 to 2.5	2.4	2.3 to 2.6
45–54	1795	34 054 803	5.3	5 to 5.5	5.4	5.2 to 5.7
55–64	3127	26 744 266	11.7	11.3 to 12.1	12.2	11.7 to 12.6
65–74	6065	16 489 157	36.8	35.9 to 37.7	38.2	37.2 to 39.3
75+	12 534	14 268 102	87.8	86.3 to 89.4	89.2	87.4 to 91
Total	24 715	163 931 793	15.1	14.9 to 15.3	15.3	15 to 15.5

DM, diabetes mellitus; TB, tuberculosis.

and women (18.6/100 000) and significantly decreased in the highest income group (Q5) in both men (19.9/100 000) and women (12.7/100 000, p<0.001) (figure 3B and online supplemental table S1).

Factors associated with DM among patients with TB

To identify the risk factors associated with DM among patients with TB, we performed multiple logistic regression analyses (table 3). Men (adjusted OR (aOR) 1.45, 95% CI 1.43 to 1.48), older age (aOR 2.05 for age 75+, 95% CI 1.99 to 2.11) and lower income group (aOR 1.59 for lowest income group, 95% CI 1.54 to 1.64) were significantly associated with DM. Additionally, pulmonary lesion; AFB smear positivity; culture positivity; recent notification year; and comorbid conditions (including organ transplantation, malignancies and ESRD) were positively associated with DM among patients with TB.

Comparison of prevalence and incidence of DM in patients with TB

Additionally, we compared the characteristics of pDM and nDM in patients with TB-DM (table 4). The patients with pDM and nDM were 61 296 (87.4%) and 8823 (12.5%), respectively, among 70 119 patients with TB-DM. Patients in the nDM group were younger than those in the pDM group (median age of 61 years vs 69 years) with more men in the nDM group than that in the pDM group (69.2% vs 64.1%, p<0.001). AFB smear positivity was higher in the nDM group than that in the pDM group (40.0% vs 34.2%, p<0.001). The CCI score and comorbid conditions (transplantation, ESRD) were lower in the nDM group than those in the pDM group. Additionally, nDM has slightly decreased in recent years (15.0% in 2011 and 6.7% in 2018) (table 4).

DISCUSSION

In this study, the prevalence of DM among adult patients with TB was 26.8% in the nationwide Korean TB cohort. Although DM in most patients was diagnosed before the diagnosis of TB, the nDM after the diagnosis of TB was also significant in approximately 12.5% of patients with DM.

The previous Korean studies reported the prevalence of DM among patients with TB ranging from 17.4% to 38.9%[19] and 21% to 24.2% when only recently published data based on hospital cohorts was included.[27] Our results on DM prevalence among the nationwide TB cohort were comparable and consistent with those previously reported in Korea.[28–30]

Global estimated DM prevalence among patients with active TB was reported as 13.7–15.3% and in 2013, an estimated 15% of adult cases of global TB were attributed to DM.[1] Moreover, the global prevalence of DM has continuously increased, and if the current DM epidemic continues to increase, the goal of global TB control proposed by the WHO End TB Strategy[31] by 2030 is difficult to achieve. Compared with the average global estimate, the prevalence of DM among Korean patients with TB was substantial. DM increases the risk of active TB[7 32] and individuals with TB who have DM have a poorer response to

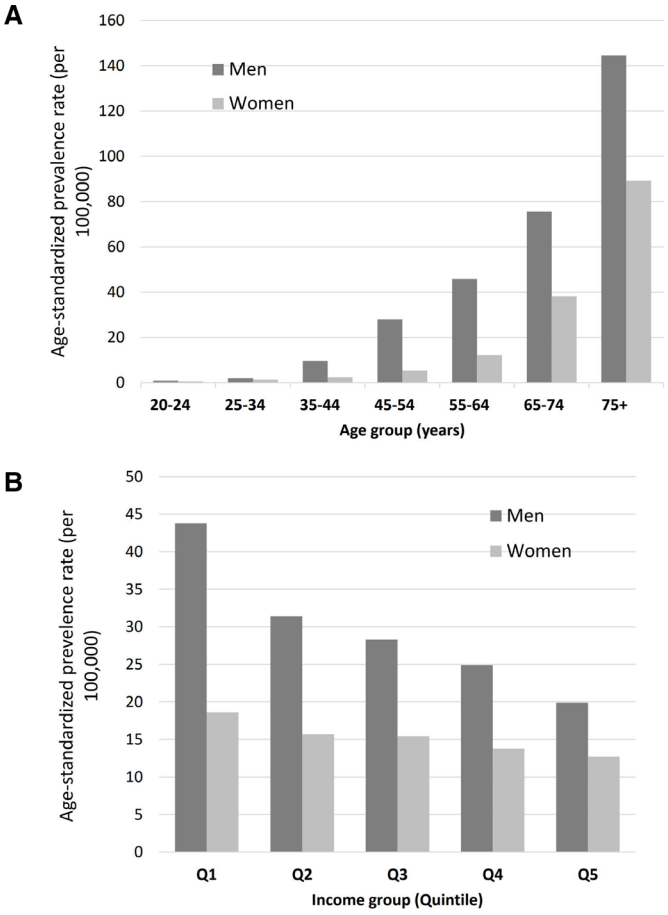

Figure 3 Age-standardised prevalence rate of diabetes mellitus stratified by age (A) and income (B) among both sexes.

treatment than those without DM, with a higher risk of TB treatment failure, death and relapse after cure.[8] Additionally, TB can worsen glycaemic control and complicate the clinical management of DM.[33] Therefore, bidirectional screening and integrated management of TB and DM, as suggested by the WHO,[34] can help improve early diagnosis and health outcomes for both diseases.[1]

The framework of collaborative activity with TB and DM recommends screening for DM in all patients diagnosed with TB and screening for TB in patients with DM in settings that have a high prevalence of TB (provisionally defined as 100 cases per 100 000 individuals).[1 34] In areas with a low TB prevalence, screening for TB in patients with DM may be cost-ineffective.[1] Thus, identifying the target group for higher DM-TB prevalence helps provide evidence for the TB screening group. In our study, the DM prevalence among patients with TB increased with age in both men and women and was the highest in the age group of 65–74 years in men with 42.1%. Men were more likely to have both TB and DM than women. DM prevalence among Korean adults aged 30 years or older was higher in men than women (19.2% in men and 14.3% in women in 2020)[18] and TB incidence was also higher in men than women (54.3/100 000 in men and 35.0/100 000 in women in 2021).[15] Additionally, current smoking and high-risk alcohol consumption were approximately seven times more prevalent in men than women in diabetic adults in South Korea.[18] Thus, these risk factors might contribute to the higher TB-DM prevalence in men than women.

The age-standardised prevalence of TB-DM among the entire population also increased with age. Additionally, lower income was a risk factor for DM among patients with TB. These results are consistent with those of previous studies in other countries. In a Danish study, TB-DM prevalence increased with age, and the prevalence was highest in men aged 75–84 years, with a rate of approximately 15/100 000.[35] Lower social and economic status was related to both TB and DM. A lower income level is a well-known social determinant of TB[36 37] and financial protection for catastrophic costs for TB is one of the important goals of the END-TB strategy.[31] The prevalence of DM was also highest in the lowest income group in Korea (30.8% in the lowest income group vs 12.3% in the highest income group)[18 38] and the glycaemic control could be poor in this lower socioeconomic group.[39 40] Thus, this group could be the target population for bidirectional TB-DM screening and clinical management in Korea.

In our data, the prevalence of DM among patients with TB was 26.8%, and nDM accounted for 12.5% of patients with DM. Additionally, patients with TB with nDM tended to be younger and have a positive AFB smear result. This could imply a diagnosis of TB in the advanced stage under unawareness of DM in the relatively younger group. The awareness rate of DM was just 65.8% among Korean adults aged ≥30 years.[18] Therefore, DM screening to detect new DM in patients with TB could be a starting point for improving health outcomes in both TB and DM.

Strength and limitations

Our study, based on a nationwide TB cohort integrated national registry and health insurance information, included most patients with TB in Korea. However, there are still a few limitations. First, we could not include other behavioural and social factors such as smoking and drinking history, occupation and education level, which are related to DM among patients with TB.[41 42] Second, patients with DM may have been overestimated by defining DM using ICD-10 codes and drug prescription history. However, the prevalence of DM in our study was comparable to that reported in previous studies that used a hospital-based cohort in Korea. Thus, the definition of DM used in our study may be acceptable. Third, there was no information regarding the glycaemic control status in patients with DM. Further studies linking hospital-based cohort information and national registry data could be a possible solution to this limitation. Fourth, to assess the nDM and pDM, we could not reflect the potential time lag between symptoms onset and TB diagnosis. According to the report of Korea Disease Control and Prevention Agency, it took median 22 days from the onset of symptoms to TB treatment initiation in 2017–2019 in South

Table 3 Factors associated with diabetes mellitus among patients with tuberculosis

Factor	OR	95% CI	P value	aOR	95% CI	P value
Sex						
Women	1			1		
Men	1.41	1.38 to 1.43	<0.001	1.45	1.43 to 1.48	<0.001
Age group						
20–24	0.05	0.04 to 0.05	<0.001	0.05	0.04 to 0.06	<0.001
25–34	0.1	0.09 to 0.1	<0.001	0.11	0.1 to 0.12	<0.001
35–44	0.38	0.37 to 0.4	<0.001	0.41	0.39 to 0.42	<0.001
45–54	1			1		
55–64	1.57	1.53 to 1.62	<0.001	1.56	1.51 to 1.61	<0.001
65–74	2.08	2.02 to 2.15	<0.001	2.13	2.07 to 2.2	<0.001
75+	1.93	1.88 to 1.98	<0.001	2.05	1.99 to 2.11	<0.001
Household income						
5 (highest)	1			1		
4	0.85	0.82 to 0.87	<0.001	1.01	0.98 to 1.04	0.398
3	0.76	0.74 to 0.78	<0.001	1.05	1.01 to 1.08	0.003
2	0.74	0.72 to 0.76	<0.001	1.05	1.02 to 1.09	0.001
1	0.87	0.84 to 0.89	<0.001	1.08	1.05 to 1.12	<0.001
0 (lowest)	1.68	1.63 to 1.74	<0.001	1.59	1.54 to 1.64	<0.001
Lesion of TB						
Extrapulmonary	1			1		
Pulmonary	1.13	1.1 to 1.16	<0.001	1.04	1 to 1.07	0.024
TB history						
New case	1			1		
Previously treated case	1.06	1.04 to 1.09	<0.001	0.87	0.85 to 0.9	<0.001
AFB smear						
Negative	1			1		
Positive	1.4	1.38 to 1.43	<0.001	1.26	1.23 to 1.29	<0.001
Unknown	0.82	0.8 to 0.84	<0.001	0.89	0.85 to 0.92	<0.001
Culture						
Negative	1			1		
Positive	1.29	1.27 to 1.32	<0.001	1.12	1.09 to 1.15	<0.001
Unknown	0.97	0.95 to 0.99	0.02	1.05	1.02 to 1	0.003
Notification year						
2011	1			1		
2012	1.11	1.08 to 1.15	<0.001	1.05	1.01 to 1.09	0.009
2013	1.16	1.12 to 1.2	<0.001	1.07	1.03 to 1.11	<0.001
2014	1.24	1.2 to 1.28	<0.001	1.1	1.06 to 1.14	<0.001
2015	1.35	1.3 to 1.4	<0.001	1.15	1.1 to 1.19	<0.001
2016	1.41	1.37 to 1.46	<0.001	1.14	1.09 to 1.18	<0.001
2017	1.5	1.45 to 1.56	<0.001	1.17	1.13 to 1.22	<0.001
2018	1.47	1.42 to 1.53	<0.001	1.08	1.04 to 1.12	<0.001
Comorbidity						
Organ transplantation	4.43	3.84 to 5.11	<0.001	2.66	2.25 to 3.13	<0.001
People living with HIV	1.15	0.92 to 1.44	0.22	1.12	0.87 to 1.44	0.37
Cancer	1.81	1.72 to 1.9	<0.001	1.16	1.1 to 1.22	<0.001
ESRD	9.69	9.04 to 10.38	<0.001	7.53	7 to 8.1	<0.001

AFB, acid-fast bacilli; aOR, adjusted OR; ESRD, end-stage renal disease; TB, tuberculosis.

Table 4 Comparative characteristics of patients with TB with newly and previously diagnosed diabetes mellitus

	Previously diagnosed DM (n=61 296)		Newly diagnosed DM (n=8823)		
	n	%	n	%	P value
Sex					
Men	39 298	64.1	6106	69.2	<0.001
Women	21 998	35.9	2717	30.8	
Age group					
20–24	97	0.2	90	1.0	<0.001
25–34	658	1.1	289	3.3	
35–44	2695	4.4	900	10.2	
45–54	8583	14.0	1823	20.7	
55–64	12 579	20.5	1896	21.5	
65–74	15 090	24.6	1648	18.7	
75+	21 594	35.2	2177	24.7	
Age median (IQR)	69 (57–78)		61 (50–74)		<0.001
Elderly(≥65 years)	36 684	59.9	3825	43.4	<0.001
Household income					
0 (lowest)	7655	12.5	857	9.7	<0.001
1	9407	15.4	1582	17.9	
2	8113	13.2	1480	16.8	
3	9218	15.0	1432	16.2	
4	11 051	18.0	1550	17.6	
5 (highest)	15 852	25.9	1922	21.8	
Lesion of TB					
Pulmonary	34 695	88.3	7921	89.8	<0.001
Extrapulmonary	4616	11.7	902	10.2	
TB history					
New case	52 768	86.1	7578	85.9	0.616
Previously treated case	8528	13.9	1245	14.1	
AFB smear					
Positive	20 942	34.2	3533	40.0	<0.001
Negative	31 426	51.3	4027	45.6	
Unknown	8928	14.6	1263	14.3	
Culture					
Positive	29 535	48.2	4325	49.0	<0.001
Negative	16 084	26.2	2093	23.7	
Unknown	15 677	25.6	2405	27.3	
CCI score					
0	16 716	27.3	3454	39.2	<0.001
1	25 030	40.8	3826	43.4	
2	5005	8.2	473	5.4	
3 or above	14 545	23.7	1070	12.1	
Comorbidity					
Transplantation	454	0.7	39	0.4	0.002
People living with HIV	92	0.2	17	0.2	0.342
Cancer	2421	4.0	359	4.1	0.592
ESRD	3326	5.4	210	2.4	<0.001

Continued

Table 4 Continued

	Previously diagnosed DM (n=61 296)		Newly diagnosed DM (n=8823)		
	n	%	n	%	P value
Notification year					
2011	8106	13.2	1325	15.0	<0.001
2012	8388	13.7	1359	15.4	
2013	7561	12.3	1261	14.3	
2014	7652	12.5	1199	13.6	
2015	7493	12.2	1115	12.6	
2016	7596	12.4	1011	11.5	
2017	7360	12.0	964	10.9	
2018	7140	11.7	589	6.7	

AFB, acid-fast bacilli; CCI, Charlson Comorbidity Index; DM, diabetes mellitus; ESRD, end-stage renal disease; TB, tuberculosis.

Korea.[43] The time lag was relatively short and it could be acceptable to assess the nDM and pDM based on the date of TB diagnosis in our cohort.

In conclusion, the prevalence of DM among patients with TB was 26.8% and considerably high in Korea. It was higher in men than in women and increased with age. To achieve the goal of TB control and improve the health outcomes of both TB and DM, integrated screening of TB and DM and care delivery in clinical practice is necessary.

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