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Original Research

Low household income increases the risk of tuberculosis recurrence: a retrospective nationwide cohort study in South Korea

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ABSTRACT

Objectives: We assessed the impact of household income on tuberculosis (TB) recurrence and the long-term impact of TB on household income.
Study design: This was a retrospective nationwide cohort study of patients with drug-susceptible TB (DS-TB) and TB recurrence.
Methods: Using the South Korean national TB cohort database, we identified a sub-set cohort of patients with newly diagnosed drug-susceptible TB between 2013 and 2016 and tracked their TB recurrence and longitudinal income data from 2007 to 2018. Income levels were evaluated as 'Medical aid' and quintile categories. To assess risk factors associated with TB recurrence, we used a sub-distribution hazard model, adjusting for the competing risks of death.
Results: Of 66,690 patients successfully treated with DS-TB, 2095 (3.1 %) experienced recurrence during a median follow-up of 39 months. The incidence of TB recurrence was 982.1/100,000 person-years, with 50.3 % of the recurrences occurring within 1 year of treatment completion. The risk of TB recurrence increased with decreasing income levels, with the highest risk observed in the lowest income group. The effect of income on TB recurrence was prominent in males but not in females. Overall, patients with TB recurrence experienced a linear decline in income levels, compared with those without recurrence.
Conclusions: Household income during the initial TB episode was an important risk factor for TB recurrence, particularly in males.

Introduction

Globally, tuberculosis (TB) is a leading cause of morbidity and mortality.[1] Patients who have been successfully treated for TB are at risk of its recurrence.[2] The rate of recurrent TB reflects the effectiveness of TB care programs, the long-term efficacy of TB treatment, and the underlying TB prevalence in the community.[3] Recurrent TB accounts for approximately 7 % of incident TB cases worldwide.[1] Globally, the incidence of recurrent TB was estimated at 2.26/100 person-year (PY), ranging from 0.05 to 29.52/100 PY.[4] Patients with recurrent TB have poor treatment outcomes, such as high mortality and low treatment completion rates.[5] Furthermore, patients with recurrent TB have a higher risk of multidrug-resistant/rifampin-resistant TB (MDR/RR-TB), compared with patients with newly developed TB.[1]

Previous studies have reported several risk factors for TB recurrence, including male sex, old age, underweight, smoking, human immunodeficiency virus (HIV) infection, diabetes, chronic obstructive pulmonary disease (COPD), and lung cavitation.[6–9] Additionally, poor socioeconomic status, including low household income, unemployment, and immigration, has been suggested as an important risk factor for TB recurrence.[6,9–11] Low household

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income is a risk factor for poor TB treatment outcomes.[12] Furthermore, even after treatment completion, TB-affected individuals have an increased risk of long-term mortality[13] and remain economically vulnerable, with limited household income recovery.[14] Thus, identifying TB patients with low household income may be important for both healthcare providers and TB care programs. However, the relationship between household income and TB recurrence has not been articulated well. Therefore, we evaluated the impact of household income as a risk factor for TB recurrence and the long-term impact of TB on household income after the successful completion of TB treatment, using the integrated national database of patients with TB in South Korea.

Methods

Data source

The integrated national database of patients with TB was developed by linking the following three databases: 1) the Korean National Tuberculosis Surveillance System (KNTSS) database established by the Korea Disease Control and Prevention Agency (KDCA), containing TB notification data for those reported between 2013 and 2018; 2) the National Health Information Database (NHID), established by the National Health Insurance Service (NHIS); and 3) the Health Insurance Review & Assessment Service (HIRA) data of people with a history of TB. In total, 137,661 patients with TB reported in the KNTSS were linked with the matched data in the NHID and HIRA. The KNTSS TB notification database contains individual patient data, including notification date, age, sex, nationality, type of TB, sputum acid-fast bacilli (AFB) smear results, and previous TB history. Matching the KNTSS database with the NHID and HIRA databases provided additional patient-level information on the following: 1) socio-demographic information (age, sex, household income level, death, and disability), 2) health services use types (inpatients procedure, operation, prescription, etc.), 3) disease diagnosis and classification (according to the International Classification of Disease 10th revision, ICD-10), 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 matched patients with TB reported to the KNTSS and those with medical claims for TB and TB-related diseases in the NHID and HIRA.

Study design and population

This was a retrospective nationwide cohort study of patients with drug-susceptible TB (DS-TB) and TB recurrence. Fig. 1 illustrates the patient inclusion process in this study. The integrated national database identified 137,661 patients with TB between 2013 and 2018. We excluded 3098 patients with MDR-TB (defined as any insurance claim of ICD-10 codes of drug resistance: U88.0, U88.1, U84.30, or U84.31 during treatment), and 48,320 patients with insufficient data or treated between 2017 and 2018. We designed to follow up their TB recurrence at least two years after their treatment completion. This time frame was chosen because TB recurrence has been mostly reported within the initial two years after the treatment completion.[6,15] We identified 86,243 patients with DS-TB treated between 2013 and 2016 and further excluded 19,553 patients who died or did not complete treatment. Consequently, 66,690 patients with DS-TB who completed treatment were included in this study. Among them, 2095 were identified as having TB recurrence.

Operating definitions of TB treatment outcome and recurrence

Treatment outcomes at patient treatment end point were assessed as follows. First, we considered patients to have completed TB treatment (treatment completion) if they received >80 % of the recommended dose over a 6-month regimen within 9 months, or a 9-month regimen within 12 months. Second, we considered patients not to have completed TB treatment (treatment incompletion) if they did not meet the treatment completion criteria. Third, we considered death as a treatment outcome only if

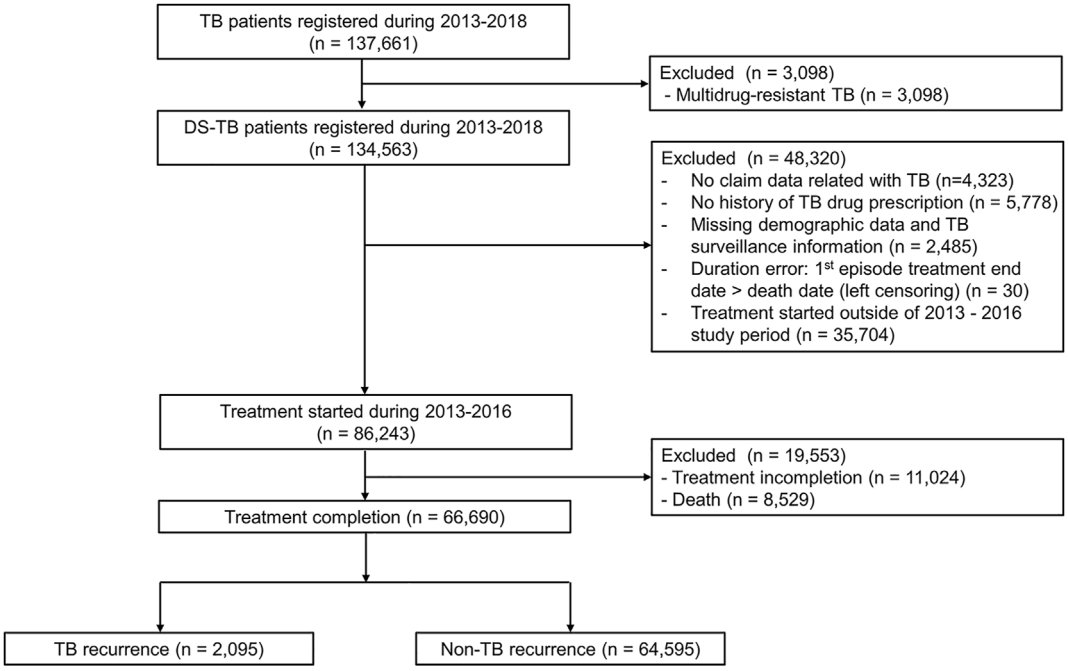

Fig. 1. Study flowchart. TB, tuberculosis; DS-TB, drug susceptible tuberculosis.

the patient died during TB treatment. We considered TB recurrence in patients with more than one occurrence of TB notification in the KNTSS database after treatment success for their initial TB episode.[16]

Covariates

Longitudinal household income data were collected between 2007 and 2018. The NHIS provided universal health insurance to 97 % of the population and 'Medical aid' to the remaining 3 %, who are in the lowest income bracket. Household income level was categorised into deciles (1 = the lowest, 10 = the highest). Patients receiving 'Medical aid' benefits were assessed as a separate income group (coded as '0').

Variables that might influence treatment outcomes and recurrence, including age, sex, residential region, nationality, disability, TB lesion site, sputum AFB smear results, previous TB history, and Charlson comorbidity index (CCI), were measured as covariates.[17] Residential regions were categorised as metropolitan (Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, Ulsan, and Sejong) and other regions (Gyeonggi, Gangwon, Chungcheongbuk, Chungcheongnam, Jeollabuk, Jeollanam, Gyeongsangbuk, Gyeongsangnam, and Jeju). Previously reported comorbidities related to TB prevalence, such as organ transplantation, cancer chemotherapy, and diabetes, were also included as covariates.[18,19] Comorbidities were identified by operational definitions using ICD-10 codes, treatments, and drug claims data from 1 year prior to the TB index date (Supplementary Table 1).

Statistical analyses

Descriptive analyses were performed to assess the distribution of individual covariates. Continuous variables were assessed as means with 95 % confidence interval (or standard deviation) if they were normally distributed. Otherwise, summaries of data are presented as medians with interquartile ranges (IQR) or proportions/percentages (e.g. categorical variables). The Student's t-test if the variable was normally distributed or Mann–Whitney U test was used to compare continuous variables, while the chi-square test or Fisher's exact test was used to compare categorical variables appropriately. The incidence rates of recurrent TB were calculated as the ratio between the number of recurrent cases of TB and the number of person-years at risk (per 100,000). The cumulative incidence function was used to estimate the recurrence rate, in which the Gray's k-sample test was performed for statistical significance. To assess the risk of TB recurrence related to income level, a sub-distribution hazard model was used, considering competing risks for death. In the multivariate model, household income levels were categorised into four groups: 0 (Medical aid, the lowest income group) and quintiles 1–2, 3–4, and 5 (the highest income group). The covariates included in the regression models were sex, age, residential region, nationality, and disability (Model 1); those in Model 1 plus lesion of TB, sputum AFB smear, and previous TB history (Model 2); those in Model 2 plus CCI score and comorbidities (Model 3, main analysis model). Changes in household income levels around the initial and recurrent TB episodes were plotted using linear regression analysis, in which household income levels were categorised into 11 groups ranging from decile 0 to 10. All *P*-values were two-tailed, and a *P*-value <0.05 was deemed statistically significant. All statistical analyses were performed using SAS Enterprise Guide (SAS Institute Inc., Cary, NC, USA) and STATA/MP version 17 (Stata Corp LLC, College Station, TX, USA).

Results

General characteristics of study population

Table 1 shows the general characteristics of the study participants according to TB recurrence. The median age of the participants was 54 (IQR, 39–69) years, and 38,799 (58.2 %) were male. Patients with TB recurrence were predominantly male (70.0 % vs. 57.8 %, $P < 0.001$). They had a lower household income, more severe disease features, and more immunosuppressive comorbidities. The baseline characteristics of the study participants by sex are presented in Supplementary Table 2. Severe disease features, such as positive AFB smears (32.0 % vs. 27.0 %, $P < 0.001$) and a history of TB (18.0 % vs. 12.4 %, $P < 0.001$), were observed more in male than in female patients. Similar tendencies, such as a lower household income and more immunosuppressive comorbidities, were observed in male patients with TB recurrence but not in their female counterparts, except for disease severity (Supplementary Tables 3 and 4).

TB recurrence after successful treatment

Of the 66,990 patients who completed treatment, 2095 (3.1 %) experienced TB recurrence over a median span of 12 (IQR, 6–22) months between the two TB episodes. The median follow-up duration was 39 (IQR 26–52) months. The incidence of TB recurrence was 982.1/100,000 PY, with 50.3 % of the recurrences (male 51.1 %; female, 48.3 %) occurring within 1 year of treatment completion (Supplementary Figure 1). Among comorbidities which might influence immune status, tumor necrosis factor (TNF) -alpha inhibitor use and diabetes were significantly associated with the TB recurrence in the multivariate analysis (Supplementary Table 5).

Impact of household income on TB recurrence

The cumulative recurrence rate in the lowest income group (1684.6/100,000 PY) was significantly higher than that in the other income groups ($P < 0.001$). Furthermore, the hazard ratio (HR) of TB recurrence increased with decreasing income levels, with the highest HR observed in the lowest income group (adjusted HR [aHR] 1.76, 95 % CI 1.49–2.07) relative to the highest income group (Table 2 and Supplementary Table 5) in the adjusted multivariate analysis (Model 3). The effect of income on TB recurrence was prominent in males (aHR 2.08, 95 % CI 1.71–2.52), but this effect was not observed in females (aHR 1.08, 95 % CI 0.78–1.50, Table 2 and Fig. 2). Overall, patients with TB recurrence, particularly males, experienced a significant linear decline in income levels, compared with those without recurrence ($P < 0.001$), and this declining income trend started several years before the initial TB episode, continuing well beyond treatment completion, even for 5 years (Fig. 3). This declining income trend was also observed in their recurrent episode of TB (Supplementary Figure 2 and 3).

Discussion

In this study, we evaluated TB recurrence rate and household income level as a risk factor for TB recurrence after TB treatment completion, using an integrated national database. TB recurrence rate was 3.1 % during a median follow-up period of 39 months, with an incidence of 982.1/100,000 PY. The rate of TB recurrence increased with decreasing household income level, and it was the highest in the lowest household income group. The effect of low household income on TB recurrence was prominent in male patients. Patients with TB recurrence experienced a significant household income decline prior to their initial episode, compared

Table 1
General characteristics of study population according to tuberculosis recurrence.

N	Total		Recurrence		Non-recurrence		*P*-value
	66,690		2095		64,595		
	n	%	n	%	n	%	
Male sex	38,799	58.2	1466	70	37,333	57.8	<0.001
Age groups							<0.001
≤19 years	2636	4.0	61	2.9	2575	4.0	
20–29 years	6443	9.7	208	9.9	6235	9.7	
30–39 years	7624	11.4	215	10.3	7409	11.5	
40–49 years	10,477	15.7	331	15.8	10,146	15.7	
50–59 years	13,440	20.2	499	23.8	12,941	20.0	
60–69 years	9878	14.8	320	15.3	9558	14.8	
≥70 years	16,192	24.3	461	22.0	15,731	24.4	
Age, median [IQR]	54 [39–69]		54 [41–67]		54 [39–69]		0.690
Region							0.202
Metropolitan	32,398	48.6	989	47.2	31,409	48.6	
Others	34,292	51.4	1106	52.8	33,186	51.4	
Nationality							0.004
Korean	64,834	97.2	2058	98.2	62,776	97.2	
Others	1856	2.8	37	1.8	1819	2.8	
Disability	7629	11.4	290	13.8	7339	11.4	<0.001
Household income							<0.001
0 (Medical aid)	5403	8.1	268	12.8	5135	7.9	
1	10,880	16.3	409	19.5	10,471	16.2	
2	10,575	15.9	349	16.7	10,226	15.8	
3	11,244	16.9	326	15.6	10,918	16.9	
4	12,668	19.0	357	17.0	12,311	19.1	
5 (Highest)	15,920	23.9	386	18.4	15,534	24.0	
Lesion of TB							<0.001
Pulmonary	52,808	79.2	1800	85.9	51,008	79.0	
Extra-pulmonary	13,882	20.8	295	14.1	13,587	21.0	
Positive AFB smear	19,962	29.9	1020	48.7	18,942	29.3	<0.001
Previous TB history	10,426	15.6	560	26.7	9866	15.3	<0.001
Comorbidity							
Organ transplant	88	0.1	6	0.3	82	0.1	0.060[a]
Silicosis	308	0.5	11	0.5	297	0.5	0.660
TNF-inhibitor use	93	0.1	9	0.4	84	0.1	<0.001[a]
ESRD	528	0.8	13	0.6	515	0.8	0.370
Cancer chemotherapy	876	1.3	21	1.0	855	1.3	0.200
Steroid use	5766	8.6	207	9.9	5559	8.6	0.040
Diabetes	13,353	20.0	508	24.2	12,845	19.9	<0.001
Charlson comorbidity index score							0.374
0	29,325	44.0	885	42.2	28,440	44.0	
1	15,608	23.4	510	24.3	15,098	23.4	
2	7926	11.9	247	11.8	7679	11.9	
≥3	13,831	20.7	453	21.6	13,378	20.7	

IQR, interquartile range; TB, tuberculosis; AFB, acid-fast bacilli; TNF, tumor necrosis factor; ESRD, end stage renal disease.
[a] Fisher's exact analysis was performed.

with those without TB recurrence, and this declining income trend continued even after TB recurrence. Therefore, low household income in patients with TB at the time of their initial episode is an important risk factor for TB recurrence.

Until now, TB recurrence has not been routinely monitored in the Korean national TB program; however, people with recurrent TB have poorer treatment outcomes[5] and higher rates of drug resistance.[1] Recurrent TB cases can pose a challenge to dedicated programs, and recurrence rate could be an important indicator of the effectiveness of TB treatment strategies.[3] In this study, TB recurrence rate was 3.1 % with an incidence rate of 982.1/100,000 PY, which was significantly lower than the global rates of 7 % and 2.26/100 PY,[1,4] similar to the findings of a previous study, which included patients newly diagnosed with TB in South Korea between 2011 and 2017 and followed up until 2020.[8] Thus, these low rates of TB recurrence indicate that the national TB program has been successfully implemented in South Korea.[20]

Previous studies have identified various risk factors for TB recurrence, including demographics, bacteriological factors, medical comorbidities, and socioeconomic factors.[6–11] Socioeconomic factors, such as immigration, injection drug use, unemployment, cigarette smoking, alcohol drinking, illiteracy, migration from villages to cities, and low household income, have been suggested as risk factors for TB recurrence.[6,10,11,21,22] Poverty is a well-known socioeconomic risk factor that can contribute to the incidence of TB through unhealthy behaviours and malnutrition.[23] In addition, the initial cost of TB diagnosis and treatment can lead to a catastrophic financial burden on household income, especially in low-income households,[24,25] resulting in poor treatment outcomes.[26] However, the relationship between household income at TB diagnosis and TB recurrence has not been well elucidated yet.[27] In this study, TB recurrence increased with decreasing household income, and low household income at the initial TB episode was a significant risk factor for TB recurrence after adjusting for other potential risk factors.

A previous study conducted in Malawi showed that TB-affected individuals remained economically vulnerable even after treatment completion, with limited recovery of household income until 12 months after TB treatment.[14] Similarly, in our study, people with TB experienced a decline in household income before TB diagnosis,

Table 2
Impact of household income status on tuberculosis recurrence.

	Household income	N	Event	Duration (years)	IR, per 100,000 PY (95 % CI)	HR (95 % CI)			
						Not adjusted	Model 1	Model 2	Model 3
Total	Total	66,690	2095	213311.7	982.1 (941.0–1025.1)	NA	NA	NA	NA
	0	5403	268	15908.7	1684.6 (1494.5–1898.9)	2.10 (1.77–2.42)	2.01 (1.71–2.36)	1.79 (1.52–2.1)	1.76 (1.49–2.07)
	1–2	21,455	758	68717.2	1103.1 (1027.3–1184.5)	1.50 (1.30–1.66)	1.42 (1.26–1.61)	1.29 (1.14–1.46)	1.30 (1.15–1.47)
	3–4	23,912	683	77726.3	878.7 (815.2–947.2)	1.20 (1.04–1.34)	1.16 (1.02–1.32)	1.12 (0.99–1.27)	1.12 (0.99–1.27)
	5	15,920	386	50959.5	757.5 (685.5–836.9)	1 (Ref.)	1 (Ref.)	1 (Ref.)	1 (Ref.)
Male[a]	Total	38,799	1466	121754.1	1204.1 (1144.0–1267.3)	NA	NA	NA	NA
	0	3113	214	8827.6	2424.2 (2120.2–2771.8)	2.50 (2.10–3.02)	2.40 (1.98–2.91)	2.11 (1.74–2.55)	2.08 (1.71–2.52)
	1–2	12,780	552	40164.0	1374.4 (1264.4–1493.9)	1.60 (1.35–1.82)	1.53 (1.32–1.78)	1.35 (1.16–1.57)	1.36 (1.17–1.58)
	3–4	13,989	451	44651.5	1010.0 (921.0–1107.7)	1.20 (1.00–1.36)	1.15 (0.99–1.35)	1.10 (0.94–1.28)	1.10 (0.94–1.29)
	5	8917	249	28111.0	885.8 (782.3–1002.9)	1 (Ref.)	1 (Ref.)	1 (Ref.)	1 (Ref.)
Female[a]	Total	27,891	629	91557.6	687.0 (635.4–742.8)	NA	NA	NA	NA
	0	2290	54	7081.1	762.6 (584.1–995.7)	1.20 (0.87–1.64)	1.18 (0.85–1.63)	1.11 (0.80–1.53)	1.08 (0.78–1.50)
	1–2	8675	206	28553.2	721.5 (629.4–827.0)	1.20 (0.98–1.51)	1.20 (0.97–1.50)	1.15 (0.93–1.44)	1.15 (0.92–1.43)
	3–4	9923	232	33074.8	701.4 (616.7–797.8)	1.20 (0.97–1.47)	1.18 (0.95–1.46)	1.15 (0.92–1.43)	1.14 (0.92–1.42)
	5	7003	137	22848.5	599.6 (507.2–708.9)	1 (Ref.)	1 (Ref.)	1 (Ref.)	1 (Ref.)

Model 1: Adjusted for sex, age, residential region, nationality, and disability.
Model 2: Adjusted for lesion of TB, sputum AFB smear, and previous TB history additionally to model 1.
Model 3: Adjusted for Charlson comorbidity index (CCI), and comorbidities additionally to model 2.
IR, incidence rate; PY, person-year; HR, hazard ratio; CI, confidence interval; NA, not applicable; Ref., reference.
Household income levels were categorised into four groups: 0 (Medical aid, the lowest income group) and quintiles 1-2, 3-4 and 5 (the highest income group).
[a] Sex was excluded from multivariate models.

which continued to decline after TB treatment completion, even for 5 years. Income decline was more prominent in patients who experienced TB recurrence. Among those with TB recurrence, the proportion of people in the lowest-income group (Medical aid) was much higher at TB recurrence (18.6 %) than that at the initial TB episode (12.8 %, Supplementary Figure 2). Therefore, continued financial vulnerability after the initial TB episode, even for several years, may be a risk factor for TB recurrence. Low household income and an accumulated financial burden after the initial TB episode may result in psychosocial stress and more unhealthy behaviours.[28] Emotional stress related to financial instability may deteriorate immune function and lead to unhealthy behaviours such as cigarette smoking and alcohol consumption, and can mediate TB recurrence.[29] In addition, financial deterioration can affect nutritional status and lead to malnutrition and TB recurrence.[30]

In the present study, the risk of TB recurrence was only related to household income in male patients. Males are known to have a higher risk of TB recurrence than females,[6,9,11] which does not sufficiently explain the difference in the effect of low household income on TB recurrence between males and females. One reason could be the association between financial vulnerability and other important social risk factors for TB recurrence, including cigarette smoking, alcohol consumption, unemployment, and non-adherence to treatment.[7,10,21] These social risk factors for TB recurrence are predominant in males in Korea,[31,32] and this association could contribute to the visible impact of low household income on TB recurrence in males. However, we could not collect these variables in our study owing to the limitation of source data. Another possible explanation is the different positions in the household economic system according to sex. Traditionally, males are responsible for the household economy, and the income level in the national health insurance system better reflected the real income level of males rather than females in this study. Therefore, the effect of income level on TB recurrence in females should be further investigated.

This study has some strengths. This was a nationwide cohort study based on the national TB registry database, which included all patients with TB in South Korea during the study period, particularly those with recurrent TB. Currently, the national TB registry does not routinely monitor recurrent TB for long-term follow-up; however, in our study, TB recurrence was evaluated by constructing a long-term longitudinal cohort. Furthermore, owing to the integration of the NHIS and HIRA databases, we analysed important medical comorbidities related to TB recurrence as covariates and tracked longitudinal household income changes before and after TB treatment for almost 15 years, 10 years before TB episodes and 5 years after TB treatment. The long-term economic effect of TB and its impact on health outcomes have important implications for policies and TB-related programs. Recent data suggest that the mortality rate among TB survivors is higher than that among people without TB.[13] The socioeconomic impact of TB on health outcomes, including mortality and recurrence, should be further investigated.

This study also has limitations. Owing to the limitations of the source database, we could not evaluate some important factors related to TB recurrence, such as body weight, HIV infection, smoking status, and alcohol consumption.[7,10,11,21,33] To overcome this limitation, we collected data on other important socioeconomic factors and immunosuppressive medical comorbidities as covariates, such as residential region, nationality, disability, organ transplant, TNF-alpha inhibitor use, end stage renal disease, cancer chemotherapy, steroid use and diabetes; with this careful design of multivariate models, a significant relationship could be described between household income and TB recurrence. Nevertheless, household income level data were collected based on the patient's annual national health insurance premium, which may be more representative of men's income, rather than women's income. In addition, we could not distinguish between reinfection and relapse because of the lack of information on the mycobacterial genotyping results. Nevertheless, our findings emphasise that economically vulnerable individuals are more susceptible to TB recurrence.

In conclusion, this study demonstrated that low household income in patients with TB at the time of their initial episode was an important risk factor for TB recurrence, particularly in male patients. Moreover, patients with TB recurrence experienced a linear decline in income levels, a trend that started several years prior to the initial episode and continued well beyond treatment completion, even for 5 years. This declining income trend was also

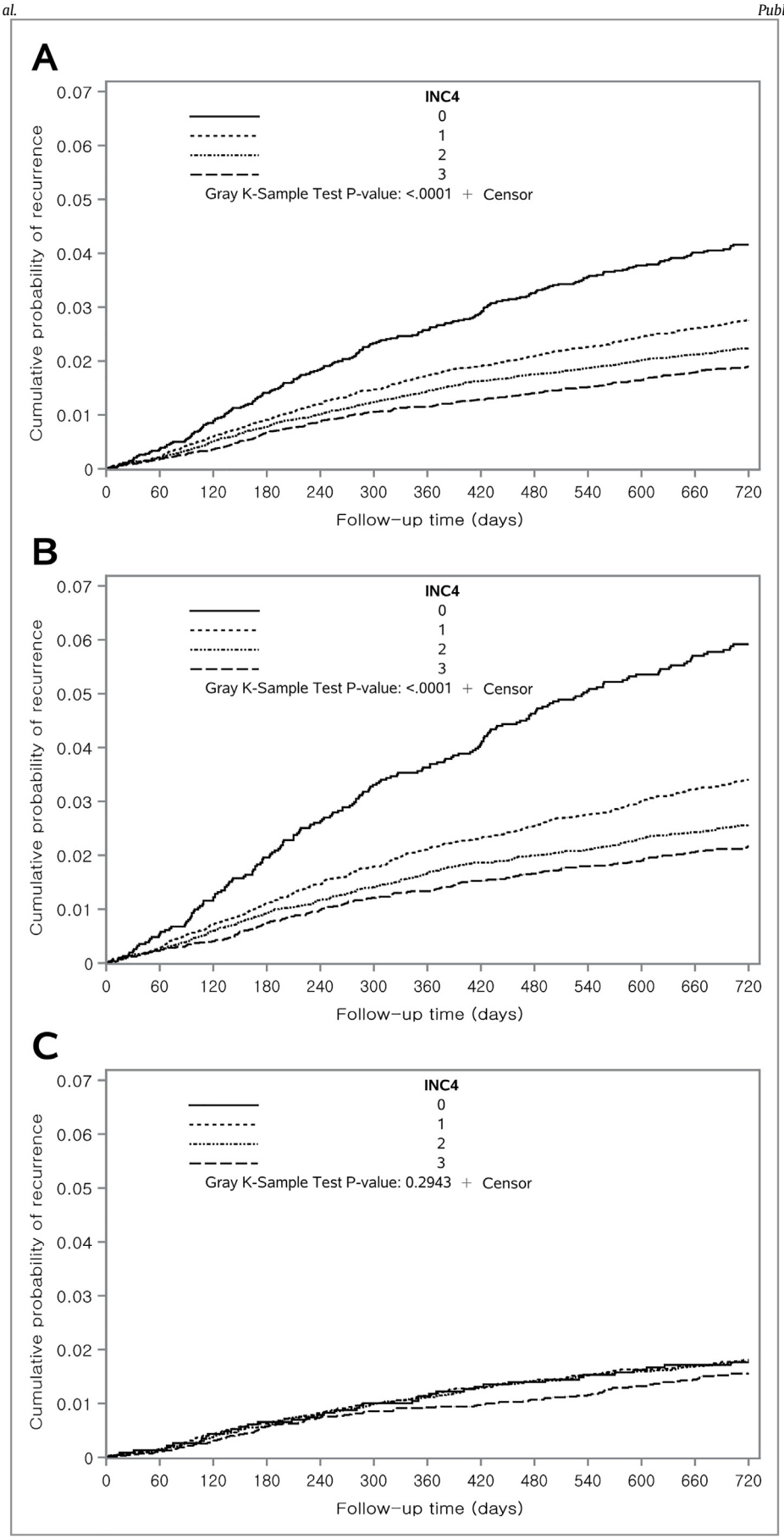

Fig. 2. Cumulative tuberculosis recurrence rate after treatment completion stratified by household income level. (a) Total. (b) Male. (c) Female. Household income levels were categorised into four groups: 0 (Medical aid, the lowest income group) and quintiles 1–2 (group 1), 3–4 (group 2), and 5 (the highest income group, group 3).

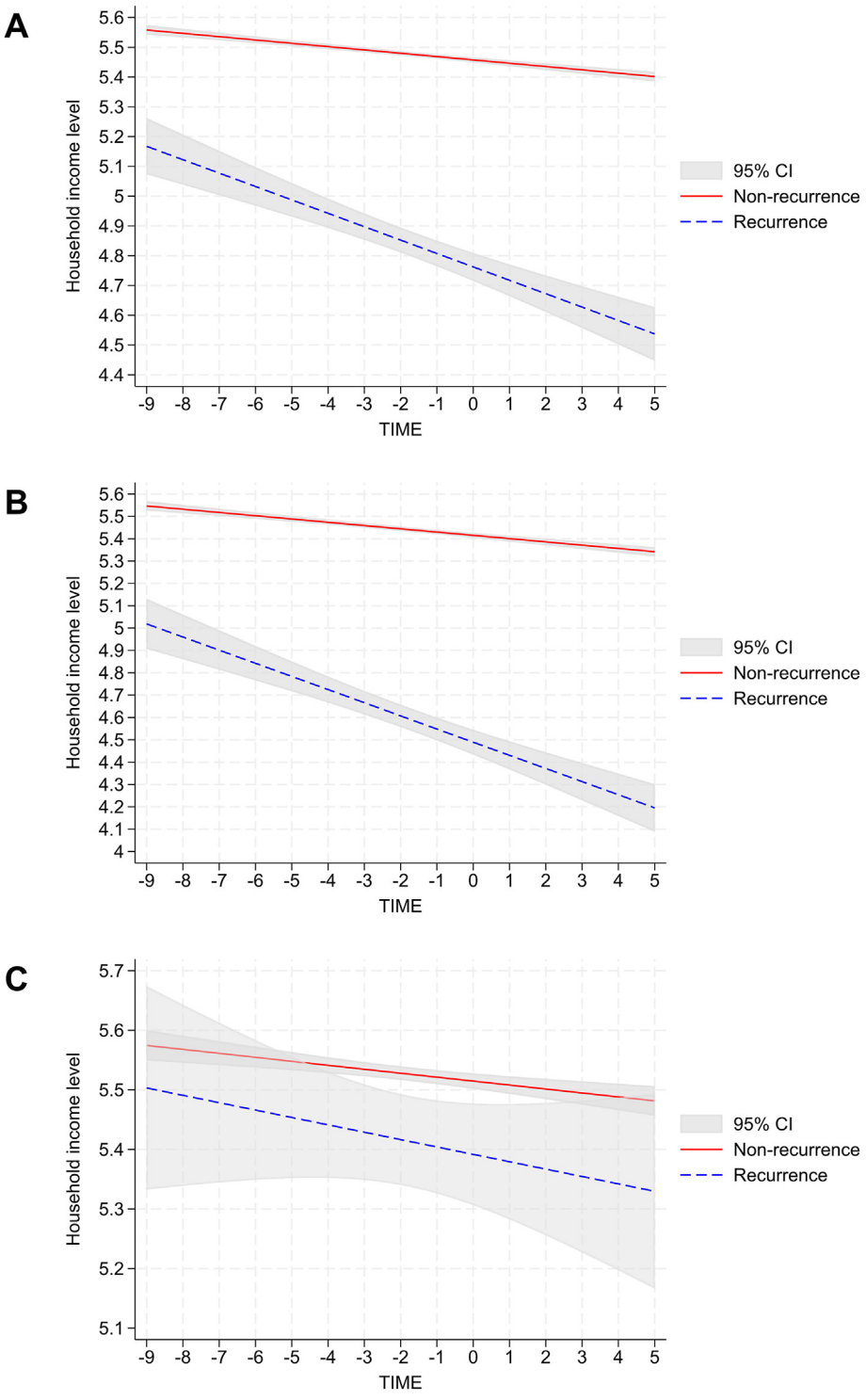

Fig. 3. Change in household income level before and after the initial TB episode (a) Total. (b) Male. (c) Female. The '0' point in x-axis means the 'initial tuberculosis episode point' and the unit of 'time' in x-axis is year. CI, confidence interval.

observed during their recurrent episode of TB. These findings suggest that both attending physicians and the national TB program should focus on a more vigilant follow-up of TB patients with low household income, even after successful TB treatment. Long-term social protection policies for these high-risk groups may be necessary to improve TB care and economic benefits.

Author statements

Acknowledgments

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Ethical approval

The study protocol was approved by the Independent Institutional Review Board of Severance Hospital (approval number: 4-2019-0917). The requirement for informed consent was waived, owing to the retrospective nature of the study, which used publicly de-identified data. This study complied with the guidelines stipulated in the Declaration of Helsinki, and all methods were performed in accordance with the relevant guidelines.

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Competing interests

The authors declare that the research was conducted in the absence of commercial or financial relationships that could be construed as potential conflicts of interest. The funder did not have any role in the design of the study and will not have any role in the collection, analysis, and interpretation of data and in writing the manuscript.

Author contributions

CC, DJ, HS, HC, and YAK conceived and designed the study, and contributed to data collection and analysis. CC, DJ, HS, and YAK interpreted the data and drafted the manuscript. All authors revised and approved the final version of the manuscript. All authors accept responsibility for the accuracy of the content of the final manuscript.

Consent for publication

Not applicable.

Data availability

Data cannot be shared publicly because of the regulation of 'National health Insurance Sharing Service'. Data are available from the 'National Health Insurance Sharing Service' Institutional Data Access/Ethics Committee (https://nhiss.nhis.or.kr) for researchers who meet the criteria for accessing confidential data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2023.11.014.

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