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Original Article
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Association Between Changes in Socioeconomic Status Before and After Human Immunodeficiency Virus Infection Diagnosis and Mortality Rates in Korea

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ABSTRACT

Background: This study investigated changes in medical insurance status as a surrogate marker of socioeconomic status after human immunodeficiency virus (HIV) infection, and their association with mortality among people living with HIV in Korea.
Methods: This study included 13,112 individuals newly diagnosed with HIV between 2004 and 2018, identified from the claims data of the National Health Insurance System-National Health Information Database. Participants' medical insurance status was categorized into National Health Insurance (NHI) and medical aid (MA). Using the Cox proportional hazards model, the association between mortality and changes in medical insurance status before and after HIV infection diagnosis was assessed using hazard ratios (HRs) and confidence intervals (CIs).
Results: The insurance coverage rates before HIV diagnosis were 95.1% and 4.9% for NHI and MA recipients, respectively. After diagnosis, the insurance coverage rates were 13.4% and 86.6% for MA and NHI recipients, respectively, demonstrating a threefold increase in the proportion of MA recipients. The conversion rate from NHI to MA was highest in the 35–44 and 45–54-year age groups at HIV infection diagnosis (32.9% and 29.4%, respectively). Compared with NHI recipients, the HR was significantly higher among individuals that transitioned from NHI to MA (HR, 1.66; 95% CI, 1.39–1.97) and individuals that remained on MA (HR, 1.74; 95% CI, 1.40–2.18), suggesting a higher mortality rate in these groups.
Conclusion: In Korea, where highly active antiretroviral therapy is essentially free of charge, a significant association was observed between a decline in medical insurance status following HIV diagnosis and increased mortality.

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The authors have no potential conflicts of interest to disclose.

Data Sharing Statement
The data that support the findings of this study are available on the National Health Insurance Sharing Service website (https://nhiss.nhis.or.kr/). We accessed the database after submitting the study protocol, IRB approval document, and reviewed request form from the relevant committee. Further information is available from the corresponding author upon request.

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Keywords: Human Immunodeficiency Virus; Socioeconomic Status; Medical Aid; Mortality; Hazard Ratios

INTRODUCTION

Poverty and inequalities in socioeconomic status (SES), such as unemployment or income status, are considered significant factors associated with human immunodeficiency virus (HIV) infection, transmission,[1,2] and mortality.[3] The underlying mechanisms of the association between poverty and HIV infection include increased susceptibility to HIV and other infectious diseases caused by malnutrition and limited access to healthcare.[1] In contrast, HIV infection negatively impacts individuals' SES due to job loss, increased unemployment rates, and limited opportunities to earn additional income.[2,4,5] A low SES affects access to highly active antiretroviral therapy (HAART) in people living with human immunodeficiency virus (PLWH), leading to delayed treatment initiation[6] and increased mortality rates.[6,7] However, several previous studies examining the link between income inequality or unemployment and mortality in PLWH adopted an ecological study design, producing group-based rather than individual-level associations. Additionally, most studies were cross-sectional in design, providing only single-point "snapshots" of the data. Meanwhile, longitudinal studies investigating the association between poverty and mortality have been rarely performed.

Although the negative impact of HIV infection on SES[2,4,5] and the association between a low SES and increased HIV infection-related mortality are well-established,[6,7] studies exploring the changes in SES status after HIV infection and their association with mortality remain scarce. The higher or lower mortality observed in groups with decreased or improved SES after HIV infection, respectively, underscores the need for interventions that focus on the treatment of HIV infection, as well as on stabilizing SES after infection, to effectively reduce morbidity and mortality associated with HIV.

Therefore, this study aimed to assess changes in medical insurance status as a surrogate marker of SES before and after HIV infection and examine its association with mortality in PLWH. The analysis utilized a nationwide population-based claims database in Korea, which benefits from a mandatory HIV reporting system and a National Health Insurance (NHI) system that fully covers HIV infection treatment costs for all Korean citizens, ensuring that all PLWH are identified and have free access to HAART.

METHODS

Study design and population

In Korea, enrollment in the NHI system is mandatory for citizens as part of the country's social security services for disease prevention, treatment, and management.[8,9] Consequently, approximately 97% of the population is covered by the NHI.[9] People covered by the NHI system pay health insurance premiums based on their assets or income; the lowest income population in need of medical assistance is covered by a medical aid (MA) program, accounting for the remaining 3% of the population. This study utilized data from the National Health Insurance System-National Health Information Database (NHIS-NHID) from 2002 to 2020 to investigate PLWH. The NHIS-NHID contains detailed information on individuals, including medical and prescription records, dates of hospital visits under a fee-for-service

system, disease diagnosis codes, results of annual or biennial health checkups provided by the NHIS, responses to the questionnaires administered during the health checkup, and socioeconomic information (age, sex, income, insurance status, and mortality rate).[9-11]

HIV was diagnosed, and dates were identified using the International Classification of Diseases Tenth Revision (ICD-10) codes for HIV (B20–B24), and the rare and incurable disease codes specific to HIV infection, which ensure full coverage of treatment (V103).[12,13] Given that rare and incurable disease codes are linked to NHI coverage,[14] their combined use with ICD-10 codes is highly effective for verifying the presence of diseases. The rare and incurable disease system for HIV was established in 2004.[13] To accurately estimate the date of initial HIV infection diagnosis, individuals with a history of any ICD-10 codes related to HIV infection in 2002 or 2003 were excluded.[12,13] Additionally, individuals diagnosed with HIV in 2019 or 2020 were excluded, as changes in insurance status before and after the diagnosis of HIV could not be assessed.

In total, 13,886 individuals were newly diagnosed with HIV infection between 2004 and 2018. Among them, 774 individuals who died within 1 year of their diagnosis were excluded, as changes in insurance status could not be assessed. The final study population comprised 13,112 PLWH.

Evaluating changes in health insurance eligibility

In Korea, individuals covered by the NHI are divided into several groups: employed, self-employed, dependents of the employed, dependents of the self-employed, MA recipients, and dependents of MA recipients. For employees, health insurance premiums are based solely on income and are equally shared between the organization and the individual.[15] Self-employed insured individuals—such as sole proprietors, freelancers, and agricultural and fisheries workers—pay full health insurance premiums[15] that are calculated based on income and assets. Owing to differing criteria for calculating health insurance premiums—wage income for employed individuals versus total income (including wage, property, financial, and social insurance income) and assets for self-employed individuals—income quartiles were not used as a proxy for SES in this study.

In Korea, eligibility for MA among PLWH is determined based on HIV-specific criteria.[16] MA recipients, who are deemed unable to support themselves owing to low income and poverty, receive healthcare benefits as part of public assistance.[17,18] To qualify, individuals must have a low SES based on the income and assets of both the applicant and their family.[16] Furthermore, previous studies have shown that individuals receiving MA exhibit poorer health behaviors and lower healthcare utilization than individuals covered by the NHI.[19,20] Therefore, MA eligibility serves as a proxy indicator of comprehensive socioeconomic hardship.

In this study, dependents were not analyzed separately from insured individuals to avoid confusion arising from further segmentation. Although changes between employed and self-employed insurance were observed, the NHIS database does not specify the reasons for these changes (e.g., job loss or business establishment). Therefore, both employed and self-employed insured individuals were combined into a single category, referred to as NHI status. Finally, we classified post-diagnostic changes in insurance eligibility according to transitions between the NHI and MA.

The NHIS-NHID provides annual data on insurance eligibility and health insurance premiums based on the total income for employed insured individuals and the total

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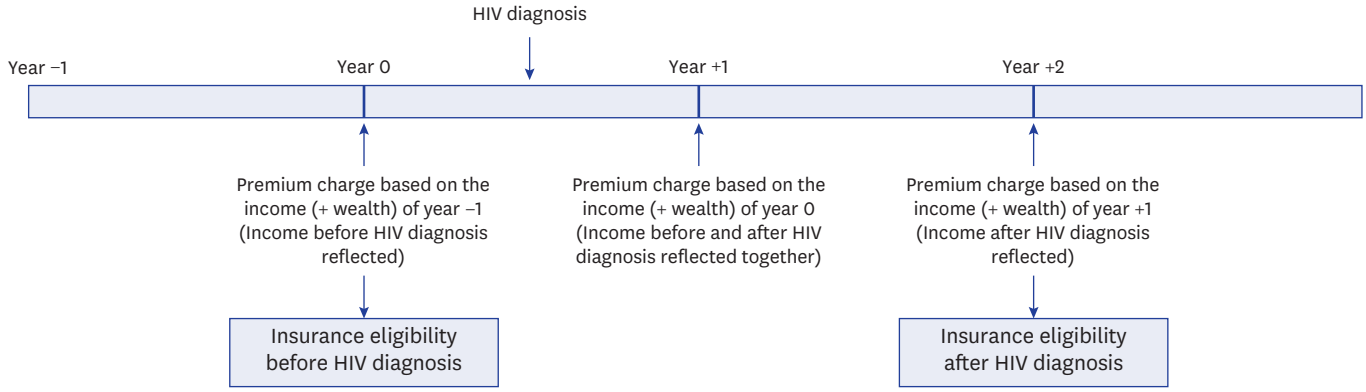

Fig. 1. Process of granting health insurance eligibility by year in Korea.
HIV = human immunodeficiency virus.

income and wealth for self-employed insured individuals in the previous year. Specifically, when referencing the timing of insurance eligibility data, it is important to note that the NHIS-NHID reflects the status as of January 1 each year; the data should therefore be interpreted as representing the eligibility for the preceding year. Thus, insurance eligibility in the year of HIV infection diagnosis (determined as the previous HIV infection diagnosis) and two years after diagnosis (**Fig. 1**) was assessed in this study.

Association with mortality

The NHIS-NHID provides data on deaths and their respective dates. For this study, the outcomes were mortality status and the duration between HIV infection diagnosis and death.

Income levels were ranked using an income quartile index, with the lowest and highest 25% classified as the first and fourth quartiles, respectively. Based on the fiscal year, we calculated the Charlson Comorbidity Index (CCI) 1 year before and 1 year after HIV infection diagnosis based on the 16 disease diagnosis codes recorded at each clinic visit.[21,22] The CCIs were categorized into four groups (0, 1, 2, and ≥ 3). To assess immune status at the time of HIV infection diagnosis, we reviewed the clinic records of patients with acquired immune deficiency syndrome (AIDS)-defining diseases coded before the HIV infection diagnosis.[23] Patients were categorized based on the presence of at least one AIDS-defining disease and subdivided into two groups according to HAART prescription status: those who had been prescribed HAART and those who had never been prescribed HAART following HIV infection diagnosis. Age and sex were included as the covariates.

Statistical analysis

Changes in insurance eligibility before and after the HIV infection diagnosis were illustrated in a Sankey chart. Therein, eligibility was classified as employed insurance, self-employed insurance, or MA recipients. The baseline descriptive statistics of the covariates were expressed as numbers and proportions according to changes in insurance eligibility before and after the HIV infection diagnosis. The differences in survival functions among these groups were assessed using the log-rank test. A multivariable Cox proportional hazards model was employed to examine the association between changes in insurance eligibility and mortality after adjusting for sex, age group at HIV infection diagnosis, income quartile at HIV infection diagnosis, CCI score 1 year before and after HIV infection diagnosis, HAART prescription status, and the presence of AIDS-defining diseases before HIV infection diagnosis. The results were expressed as hazard ratios (HRs), 95% confidence intervals (CIs),

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and *P* values. A two-sided *P* value of 0.05 was considered significant. Statistical analyses were conducted using the SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA).

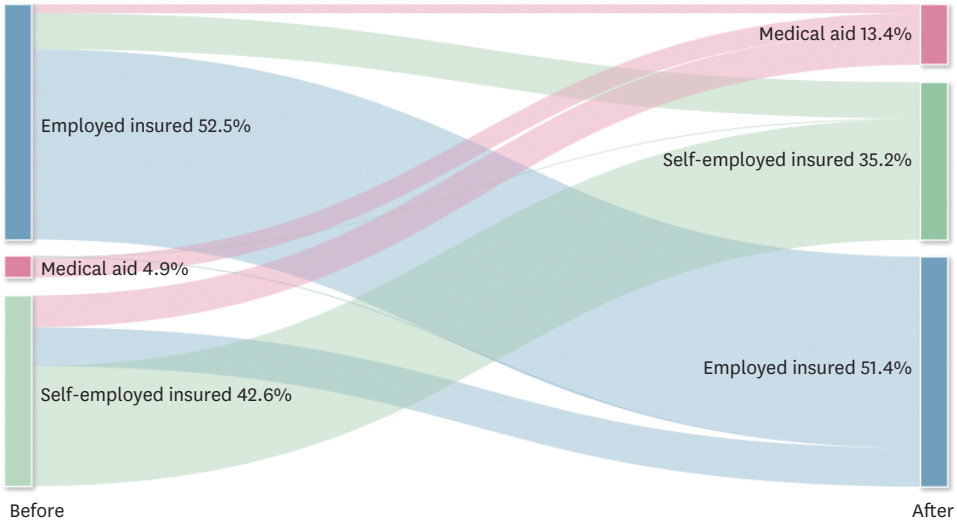
Ethics statement

The NHIS-NHID is fully anonymized, preventing individual identification and eliminating the need for obtaining participant consent. This study was approved by the Institutional Review Board of Hanyang University (approval No. HYUIRB-202309-022).

RESULTS

Evaluating changes in health insurance eligibility

Before HIV infection diagnosis, 95.1% of patients were covered by the NHI: 52.5% were employed insured individuals, 42.6% were self-employed insured individuals, and 4.9% were MA recipients. After HIV infection diagnosis, 13.4% were MA recipients, while 86.6% were NHI recipients, of whom 51.4% were employed and 35.2% were self-employed. This reflects an approximately threefold increase in the percentage of MA recipients. A notable change was observed in the transition from self-employed insured individuals to MA recipients, with 16.7% (934/5,586 PLWH who were self-employed and insured before their HIV infection diagnosis) moving to MA (**Fig. 2**).



The same year of the diagnosis	Two years after the diagnosis	No.	%
Self-employed insured (n = 5,586)	Self-employed insured	3,524	63.1
	Employed insured	1,128	20.2
	Medical aid	934	16.7
Employed insured (n = 6,886)	Self-employed insured	1,054	15.3
	Employed insured	5,572	80.9
	Medical aid	260	3.8
Medical aid (n = 640)	Self-employed insured or employed insured	67	10.5
	Medical aid	573	89.5

Fig. 2. Sankey chart illustrating the changes in health insurance status before and after human immunodeficiency virus infection diagnosis.

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Table 1 provides the baseline characteristics of the study population. Of the 13,112 PLWH, 11,916 were male (89.9%) and 1,196 were female (9.1%). The highest conversion rate from NHI to MA was observed among individuals aged 35–44 years (32.9%), followed by those aged 45–54 years at the time of HIV infection diagnosis (29.4%).

Association with mortality

Of the 13,112 PLWH, 1,059 (8.1%) died during the follow-up period. The Kaplan–Meier analysis indicated a median survival time of 5.7 years for PLWH. Stratified analysis based on insurance eligibility changes before and after the HIV infection diagnosis showed that the group that remained on NHI had the highest survival rate within 6 years after diagnosis, followed by the group that transitioned from NHI to MA, and the group that remained on MA ($P < 0.001$; **Fig. 3**).

Table 1. Descriptive analysis of the changes in health insurance status before and after HIV infection among PLWH according to socioeconomic and clinical status

Variables	NHI → NHI	NHI → MA	MA → NHI	MA → MA	*P* value
Total	11,278 (86.0)	1,194 (9.1)	67 (0.5)	573 (4.4)	
Sex					< 0.001
Male	10,266 (91.0)	1,126 (94.3)	58 (86.6)	466 (81.3)	
Female	1,012 (9.0)	68 (5.7)	9 (13.4)	107 (18.7)	
Age group at HIV infection diagnosis, yr					< 0.001
< 25	1,432 (12.7)	48 (4.0)	18 (26.9)	41 (7.2)	
25–34	3,526 (31.3)	245 (20.5)	22 (32.8)	76 (13.3)	
35–44	2,812 (24.9)	393 (32.9)	6 (9.0)	154 (26.9)	
45–54	1,946 (17.3)	351 (29.4)	14 (20.9)	175 (30.5)	
55–64	1,119 (9.9)	133 (11.1)	5 (7.5)	79 (13.8)	
≥ 65	443 (3.9)	24 (2.0)	2 (3.0)	48 (8.4)	
Income quartile at HIV infection diagnosis					< 0.001
1st quartile	2,454 (21.8)	543 (45.5)	67 (100.0)	573 (100.0)	
2nd quartile	3,069 (27.2)	413 (34.6)	0 (0.0)	0 (0.0)	
3rd quartile	2,840 (25.2)	162 (13.6)	0 (0.0)	0 (0.0)	
4th quartile	2,735 (24.3)	63 (5.3)	0 (0.0)	0 (0.0)	
Missing	180 (1.6)	13 (1.1)	0 (0.0)	0 (0.0)	
CCI score at 1 yr before HIV diagnosis					< 0.001
0	5,976 (53.0)	503 (42.1)	41 (61.2)	287 (50.1)	
1	2,203 (19.5)	253 (21.2)	15 (22.4)	78 (13.6)	
2	1,472 (13.1)	182 (15.2)	4 (6.0)	66 (11.5)	
≥ 3	1,627 (14.4)	256 (21.4)	7 (10.4)	142 (24.8)	
CCI score at 1 yr after HIV diagnosis					< 0.001
0	4,610 (40.9)	330 (27.6)	27 (40.3)	174 (30.4)	
1	3,477 (30.8)	348 (29.1)	21 (31.3)	135 (23.6)	
2	1,672 (14.8)	218 (18.3)	11 (16.4)	95 (16.6)	
≥ 3	1,519 (13.5)	298 (25.0)	8 (11.9)	169 (29.5)	
HAART treatment[a]					< 0.001
No	716 (6.3)	19 (1.6)	11 (16.4)	65 (11.3)	
Yes	10,562 (93.7)	1,175 (98.4)	56 (83.6)	508 (88.7)	
Presence of AIDS-defining diseases before HIV infection diagnosis[b]					< 0.001
No	7,212 (63.9)	497 (41.6)	45 (67.2)	293 (51.1)	
Yes	4,066 (36.1)	697 (58.4)	22 (32.8)	280 (48.9)	

Values are presented as number (%).
AIDS-defining diseases: candida; cryptococcosis, extrapulmonary; cytomegalovirus disease; mycobacterium; encephalopathy, HIV related; cryptosporidiosis, chronic intestinal; isosporiasis, chronic intestinal; herpes simplex: chronic ulcer(s) or bronchitis, pneumonitis, or esophagus; histoplasmosis, disseminated or extrapulmonary; salmonella septicemia, recurrent; pneumonia recurrent; pneumocystis pneumonia; progressive multifocal leukoencephalopathy; toxoplasmosis of the brain; wasting syndrome due to HIV; Kaposi's sarcoma; lymphoma, Burkitt's; non-Hodgkin's lymphoma; and cervical cancer.
HIV = human immunodeficiency virus, PLWH = people living with human immunodeficiency virus, NHI = National Health Insurance, MA = medical aid, CCI = Charlson Comorbidity Index, HAART = highly active antiretroviral therapy, AIDS = acquired immune deficiency syndrome.
[a]PLWH were categorized as follows based on HAART treatment status: those who had been prescribed HAART and those who had never been prescribed HAART.
[b]PLWH were classified into two groups: those with a history of at least one AIDS-defining disease and those with no such history before the date of HIV infection diagnosis.

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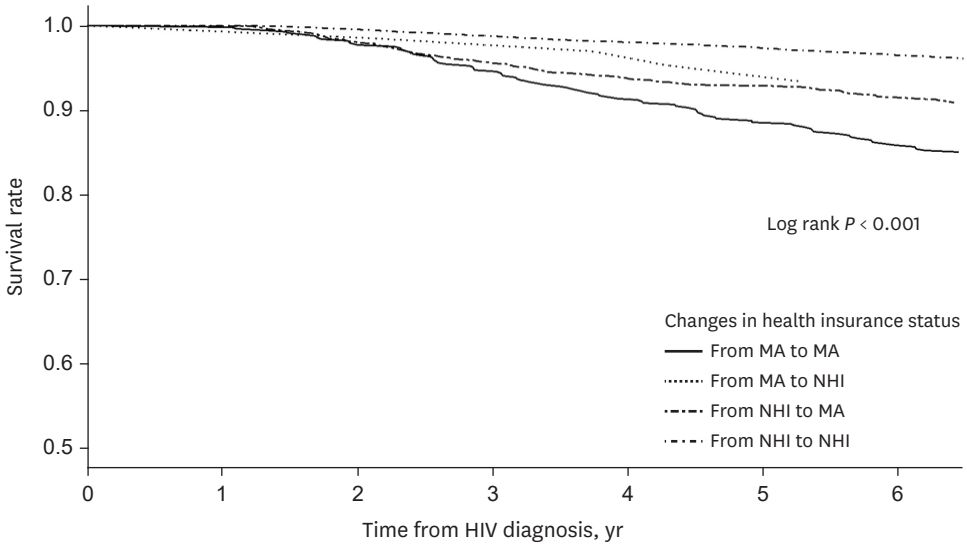

	No. of survivors Survival rate (95% confidence interval)					
Year from HIV diagnosis	1	2	3	4	5	6
NHI → NHI (n = 11,278)	11,278 1.000 (1.000–1.000)	11,230 0.996 (0.994–0.997)	11,142 0.988 (0.986–0.990)	11,059 0.981 (0.978–0.983)	10,980 0.974 (0.971–0.977)	10,884 0.965 (0.962–0.969)
NHI → MA (n = 1,194)	1,194 1.000 (1.000–1.000)	1,171 0.981 (0.973–0.989)	1,142 0.956 (0.945–0.968)	1,121 0.939 (0.925–0.952)	1,110 0.930 (0.915–0.944)	1,094 0.916 (0.900–0.932)
MA → NHI (n = 67)	67 1.000 (1.000–1.000)	67 1.000 (1.000–1.000)	66 0.985 (0.956–1.014)	65 0.970 (0.929–1.011)	64 0.954 (0.902–1.005)	63 0.934 (0.872–0.997)
MA → MA (n = 573)	573 1.000 (1.000–1.000)	561 0.979 (0.967–0.991)	543 0.948 (0.929–0.966)	524 0.914 (0.891–0.937)	508 0.886 (0.860–0.912)	492 0.859 (0.830–0.888)

Fig. 3. Kaplan–Meier survival curves stratified by changes in health insurance status before and after HIV diagnosis.
HIV = human immunodeficiency virus, NHI = National Health Insurance, MA = medical aid.

The multivariable Cox proportional hazards model (**Table 2**), adjusted for other covariates, showed significantly higher HRs in the group that transitioned from NHI to MA (HR, 1.66; 95% CI, 1.39–1.97) and in the group that remained on MA (HR, 1.74; 95% CI, 1.40–2.18), compared with the group that remained on NHI. This finding suggests a higher mortality rate in these groups. The group that transitioned from MA to NHI had an HR of 1.41, suggesting a high mortality rate; however, this result was insignificant. In contrast, individuals who had never been prescribed HAART had significantly higher mortality rates than those who had received prescriptions (HR, 1.69; 95% CI, 1.39–2.04). An older age at HIV diagnosis, lower income quartile (1st and 2nd quartiles compared with the 4th quartile), higher CCI score 1 year after the HIV infection diagnosis, and the presence of AIDS-defining diseases before the HIV infection diagnosis were associated with increased mortality in PLWH. However, a higher CCI score 1 year before the HIV infection diagnosis did not correlate with mortality.

DISCUSSION

This study used the NHIS-NHID, a nationwide claims dataset for all PLWH in Korea, to estimate the association between changes in insurance eligibility—used as a proxy marker of SES—before and after HIV infection diagnosis and subsequent mortality. Despite the lack of a cost barrier for HIV infection treatment, the proportion of MA recipients increased

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Table 2. Estimates of the association between changes in health insurance status and case fatalities among PLWH

Variables	Hazard ratio (95% confidence interval)	*P* value
Change in health insurance status		
NHI → NHI	1.00	
NHI → MA	1.66 (1.39–1.97)	< 0.001
MA → NHI	1.41 (0.69–2.86)	0.349
MA → MA	1.74 (1.40–2.18)	< 0.001
Sex		
Male	1.00	
Female	0.59 (0.48–0.72)	< 0.001
Age group at HIV diagnosis, yr		
< 25	1.00	
25–34	0.87 (0.60–1.25)	0.440
35–44	1.63 (1.16–2.30)	0.005
45–54	2.67 (1.90–3.75)	< 0.001
55–64	4.19 (2.96–5.94)	< 0.001
≥ 65	9.19 (6.40–13.20)	< 0.001
Income quartile at the year after the HIV infection diagnosis		
1st quartile	1.41 (1.16–1.71)	0.001
2nd quartile	1.24 (1.02–1.50)	0.032
3rd quartile	1.11 (0.91–1.35)	0.298
4th quartile	1.00	
CCI score at 1 yr before the HIV infection diagnosis		
0	1.00	
1	0.85 (0.67–1.07)	0.163
2	0.75 (0.58–0.97)	0.027
≥ 3	0.99 (0.78–1.25)	0.912
CCI score at 1 yr after the HIV infection diagnosis		
0	1.00	
1	0.91 (0.73–1.14)	0.418
2	1.19 (0.92–1.54)	0.188
≥ 3	1.80 (1.39–2.32)	< 0.001
HAART treatment[a]		
No	1.69 (1.39–2.04)	< 0.001
Yes	1.00	
Presence of AIDS-defining diseases before the HIV infection diagnosis[b]		
No	1.00	
Yes	1.47 (1.29–1.66)	< 0.001

AIDS-defining diseases: candida; cryptococcosis, extrapulmonary; cytomegalovirus disease; mycobacterium; encephalopathy, HIV related; cryptosporidiosis, chronic intestinal; isosporiasis, chronic intestinal; herpes simplex: chronic ulcer(s) or bronchitis, pneumonitis, or esophagus; histoplasmosis, disseminated or extrapulmonary; salmonella septicemia, recurrent; pneumonia recurrent; pneumocystis pneumonia; progressive multifocal leukoencephalopathy; toxoplasmosis of the brain; wasting syndrome due to HIV; Kaposi's sarcoma; lymphoma, Burkitt's; non-Hodgkin's lymphoma; and cervical cancer.
PLWH = people living with human immunodeficiency virus, NHI = National Health Insurance, MA = medical aid, HIV = human immunodeficiency virus, CCI = Charlson Comorbidity Index, HAART = highly active antiretroviral therapy, AIDS = acquired immune deficiency syndrome.
[a]PLWH were categorized as follows based on HAART treatment status: those who had been prescribed HAART and those who had never been prescribed HAART.
[b]PLWH were classified into two groups: those with a history of at least one AIDS-defining disease and those with no such history before the date of HIV infection diagnosis.

from 4.9% to 13.5% after HIV infection diagnosis. This finding suggests that a serious decline in SES occurred in the short-term following the diagnosis, which affected mortality in PLWH. The decline in the proportion of individuals who transitioned from NHI to MA was particularly pronounced in the prime workforce (individuals aged 35–54 years).[24] The economic burden resulting from the loss of human resources, income, and productivity due to morbidity or mortality is estimated to be relatively low in older adults,[25] but significantly higher among those in the prime working age group.[24,25] Even after adjusting for health conditions before and after the HIV infection diagnosis and HAART treatments, which

were primarily associated with survival and income status at the time of diagnosis, the results revealed increased mortality in PLWH who transitioned from NHI to MA, or who remained on MA before and after the HIV infection diagnosis, compared with individuals who remained on NHI before and after the diagnosis. The HRs and 95% CIs in these two groups were comparable, suggesting that declining and sustained low SES were both associated with similarly high mortality rates. Owing to the small number of PLWH who transitioned from MA to NHI, clear conclusions cannot be drawn. Nonetheless, the results suggest that, compared with PLWH who remained on NHI, an upward shift in SES from MA to NHI was not associated with an increased mortality rate (or with a reduced increase in mortality) relative to other groups.

A meta-analysis of PLWH in South Africa revealed significantly higher mortality rates among individuals with a low SES, such as those with low income or unemployment, than individuals with a higher income or those who were employed.[26] Similarly, in developed countries such as the United States and Southern Europe, higher mortality rates have been observed among PLWH living in poverty or deprived conditions than among those not facing such circumstances.[27,28] Regarding ethnicity, a proxy indicator of SES, the risk of mortality increased among black PLWH compared with white PLWH.[7] Although previous studies did not consider the impact of changes in SES before and after the HIV infection diagnosis on mortality, they reported that PLWH with low-income or those who experienced poverty or deprivation had higher mortality rates.[7,26-28] This study provides evidence that both low and worsened SES after HIV infection diagnosis are associated with increased mortality rates. Although Korea has established an NHI system covering all residents and provides HIV-related treatments without out-of-pocket costs, enhancing accessibility to HIV-related treatments and providing social support to maintain one's SES are necessary. Compared with approximately 3% of the general population in Korea receiving MA,[29] PLWH demonstrated a lower SES even before HIV infection diagnosis (4.9% of MA) and experienced a notable decline in SES following diagnosis.

Since the introduction of HAART, the lifespan of PLWH has significantly increased, reaching a life expectancy comparable to that of the general population.[30] However, PLWH facing socioeconomic challenges—such as low income, unemployment, and low education levels—demonstrated lower HAART adherence than those without these issues.[31-33] Poor adherence to HAART is a major factor in drug resistance, failure of viral suppression, and increased mortality.[34] Additionally, residing in rural areas, reduced access to healthcare, unstable living conditions, and the absence of insurance coverage were associated with a higher likelihood of a late diagnosis or not receiving HAART.[35-38] Comorbidities, including AIDS-defining diseases, are associated with poor health-related quality of life[39]; as life expectancy improved with HAART, early diagnosis and timely initiation of HIV treatment are crucial for optimal outcomes.[30] Factors associated with mortality in previous studies showed comparable results for PLWH in (lowercase).

This study has several limitations; first, the NHIS-NHID is primarily used for administrative and healthcare purposes and therefore does not include clinical information, such as CD4 count or viral load.[40] Instead, we considered the presence of AIDS-defining diseases as a clinical variable to identify the severity of HIV infection at diagnosis.[41] Other socioeconomic information, including individuals' educational levels and housing conditions, were unavailable.[9-11] Second, we adjusted for HAART prescription based on a previous study indicating that approximately 90% of individuals diagnosed with HIV in Korea received

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HAART,[42] with > 90% of those receiving treatment achieving viral suppression.[42] However, as survival among PLWH is associated with adherence to HAART,[34] the lack of consideration for potential differences in HAART adherence by insurance status in this study highlights the need for further research addressing this aspect. Third, as the causal direction between changes in health insurance status—reflecting socioeconomic transitions—and HIV infection remains unclear, comparisons with individuals with other diseases or without HIV are warranted. However, this study utilized claims data from the NHIS-NHID, which includes only individuals living with HIV, thereby precluding comparative analyses with HIV-negative individuals to assess whether these findings differ from those seen in other chronic conditions. Fourth, among PLWH, those aged 45–54 years accounted for the second largest proportion of individuals who transitioned from NHI to MA; this coincides with the average retirement age in Korea—approximately 50 years.[43] This temporal overlap makes it difficult to disentangle the effects of HIV diagnosis from age-related socioeconomic transitions. Fifth, this study may be affected by time-related bias. For instance, although individuals diagnosed with HIV on January 1 and December 31 are recorded as being diagnosed in the same calendar year, the actual time difference between their diagnoses is nearly one full year. Sixth, the applicability of our findings may be limited in countries with health insurance systems that differ substantially from Korea's, wherein this association was identified.

This study used claims data from all PLWH diagnosed in South Korea between 2002 and 2020. Mortality was significantly higher among PLWH whose SES declined after HIV diagnosis, or remained low, than among whose SES levels did not decline. Individuals with a low SES are more susceptible to HIV infection[44,45]; similarly, HIV infection is associated with a worsening SES.[4,5] This deterioration in SES is linked to delayed HIV diagnosis and poor treatment adherence, which are related to poor health outcomes and higher mortality rates. In Korea, PLWH can receive HAART free of charge regardless of income level; yet, some individuals still do not initiate treatment. To improve access to HAART and overall HIV prevention and management, it is essential to implement effective strategies that address financial stability, as well as other potential barriers to care.

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