

Original Article



Mortality After Acute Coronary Syndrome in Human Immunodeficiency Virus Infection with Optimal Adherence: A Nationwide Study

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ABSTRACT

Background: There have been few studies on the outcome of acute coronary syndrome (ACS) in human immunodeficiency virus (HIV) infection in the era when antiretroviral therapy (ART) is generalized and most of them have achieved viral suppression. Using claims data, we aimed to assess the mortality after atherosclerotic cardiovascular events in people with HIV (PWH) who maintain optimal adherence to ART.

Materials and Methods: We used claims data from the National Health Insurance of the Korea to confirm newly diagnosed PWH from 2009 to 2019, and measured ART adherence. ACS and mortality were confirmed in PWH who showed optimal adherence to ART.

Results: Among 7,100 PWH with optimal adherence and during 27,387 person-year of follow-up duration, ACS was confirmed in 140 (2.0%) cases, which was 1.3 times greater than statistics of the Korean general population (511.0 vs. 383.1 per 100,000). Acquired immunodeficiency syndrome, hypertension, dyslipidemia, and diabetes mellitus were associated with the development of ACS in PWH with optimal adherence. Mortality was confirmed in 10 cases, which is 7.1% overall and 2.9% when limited to myocardial infarction. It was comparable with the mortality rate of the Korean general population after myocardial infarction (8.9%).

Conclusion: ACS prevalence was higher in PWH even when optimal adherence was maintained. However, mortality after ACS was comparable to that in the HIV-negative population.

Keywords: HIV; Insurance claim review; Myocardial infarction; Anti-retroviral agents; Epidemiology

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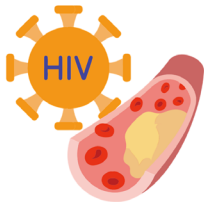
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GRAPHICAL ABSTRACT

Mortality after Acute Coronary Syndrome in Human Immunodeficiency Virus Infection with Optimal Adherence: A Nationwide Study



Background



People with HIV infection face a higher risk of acute coronary syndrome (ACS), even when their HIV RNA levels are controlled, and ACS events have become a significant cause of death. The introduction of antiretroviral treatment (ART) reduced ACS mortality, but optimal adherence to ART and careful evaluation of ACS prognosis in people with HIV in the ART era are crucial as their life expectancy increases.

Methods

This study analyzed claims data from the Korean National Health Insurance System to investigate adherence to ART and its effects on the incidence of ACS and mortality. Medication compliance was calculated using Medication Possession Rate. In the study, the population with optimal adherence (more than 95%) was divided into those who experienced an ACS event and those who did not, confirming suspected cardiovascular risk factors and mortality rate. To evaluate ACS mortality among people with HIV who started ART early, a subgroup analysis was conducted for those starting in 2014 or later.

Result

Table 1. Characteristics of people with HIV with optimal adherence according to ACS

Variables	ACS (n=140)	Non-ACS (n=6,960)	p-value
ACS incidence (/100,000py)	511.0		
Time to ACS from HIV diagnosis (days)	1,127.3		
Hospital mortality	10	154	0.0003
Hospital mortality rate (per 100,000py)	1703.6	574.4	

Table 2. Factors related with hospital mortality of ACS in patients with optimal adherence to antiretroviral therapy

Variables	Odds ratio	95% confidence interval		p-value
AIDS	1.481	1.048	2.092	0.0259
Hypertension	3.974	2.712	5.823	<0.0001
Dyslipidemia	2.537	1.555	4.140	0.0002
Diabetes mellitus	2.270	1.569	3.286	<0.0001

Conclusion

ACS prevalence was higher in people with HIV even when optimal adherence was maintained. However, mortality after ACS was comparable to that in the HIV-negative population.

INTRODUCTION

People with human immunodeficiency virus (HIV) infection are one and a half to two times more likely to be at risk of atherosclerotic cardiovascular disease than the HIV-negative population [1]. The underlying mechanisms for HIV-associated cardiovascular disease include the effects of the HIV proteins on immune and vascular cells, the immunodeficiency caused by the HIV infection, co-infection with cytomegalovirus, microbial translocation from the gut, chronic inflammation, and immune cell activation [2]. People with HIV-1 RNA levels of less than 500 copies/mL still have an excess risk of 1.39 times compared to HIV-negative individuals [3]. The incidence of cardiovascular disease is expected to rise further as people with HIV (PWH) aging becomes more pronounced.

Cardiovascular events have become a significant cause of death in PWH [4]. There are reports that PWH have worse outcomes after cardiovascular events than the HIV-negative population. HIV infection is related to a higher mortality [5], and a higher incidence of ischemic heart failure after myocardial infarction [6]. In the United States, cardiovascular disease is the third highest cause of death or hospitalization for PWH [7].

Higher HIV viral load and lower CD4-positive cell count were found to be predictors of mortality [8]. However, the introduction of antiretroviral therapy decreased mortality of cardiovascular disease between 1995 and 2001 [9]. As the widespread use of highly active antiretroviral therapy increases the life expectancy of PWH, a low CD4-positive T cell count is no longer associated with an increased risk of cardiovascular mortality [10]. Optimal adherence to ART reduces inflammation. Incomplete adherence is associated with an increased risk of death even in patients with viral suppression [11]. Because the majority of PWH are in controlled viral status and maintain optimal adherence, the prognosis of cardiovascular events in PWH needs to be re-evaluated in the anti-retroviral therapy (ART) era.

The Korea has a national health insurance (NHI) system. As the incidence of acute coronary syndrome (ACS) is as low as 1.2 myocardial infarction (MI) case per 1,000 person-years in PWH [12], assessing the difference of outcome according to ART adherence is limited at the individual hospital level. Therefore, we aimed to elucidate the outcome of ACS in PWH based on adherence to ART using the claims data of NHI.

MATERIALS AND METHODS

1. Data source

This study used claims data for reimbursement to the hospital from NHI. Korean National Health Insurance System is a universal health insurance system for the whole nation. Ninety seven percent of citizens have this form of medical insurance, and 3% of them in the form of medical aid. After a clinic visit by a patient, medical institutions file claims, which are evaluated by the Health Insurance Review & Assessment Service [HIRA]. All diagnostic codes and orders recorded by the medical institution, and all test items and medication prescriptions, are collected. Information about national regions and medical visits, such as inpatient, emergency room, or outpatient, are included.

2. Ethics statement

The institutional review board of the Seoul National University Boramae Medical Centre (IRB No. 07-2017-8/052) approved this study. The board waived informed consent due to the use of an existing secondary database.

3. Study population

We screened our study population using the International Classification of Diseases 10th Revision (ICD-10) code of HIV diagnosis from 2007 to 2019. We included newly diagnosed PWH in calculating compliance with ART after excluding PWH who visited the clinic for two years between 2007 and 2009. Then we collected PWH who were prescribed ART for more than six months to investigate the long-term effect. We excluded individuals believed to be having treatment for hepatitis B considering the contents of prescription (e.g., tenofovir monotherapy) and who were prescribed ART as postexposure prophylactic measures.

4. Definitions of variables

PWH were defined as people with any ICD-10 codes including HIV (B20-B24) and prescription of antiretroviral agent in combination use. Underlying diseases was confirmed with ICD-10 codes. Acquired immunodeficiency syndrome (AIDS) was confirmed by specific antibiotics prescription for prophylaxis of opportunistic infections (*i.e.*, prophylactic dosage of trimethoprim-sulfamethoxazole or dapsone).

A related diagnosis, which was recorded during admission confirmed the presence of ACS (I20-I23). MI was defined similarly in diagnostic codes (I21-I23) [13, 14]. Patients with

ACS were selected when there was (or were) at least one ACS diagnosis (or diagnoses) on the claims issued after HIV infection diagnosis. ACS diagnosis without admission event was classified as underlying diseases. The date of the first admission with an ACS diagnosis was defined as the date of the ACS event. Mortality rates after ACS were collected using mortality codes, and hospital mortality of ACS admission was defined as ACS group mortality. In the non-ACS group, all-cause hospital mortality cases were collected. Moreover, major cardiovascular risk factor comorbidities were searched by diagnosis.

5. Statistical analysis

The medication possession ratio (MPR) was used to calculate medication adherence to ART. We followed the same procedure as in our previous study [15]. Briefly, MPR calculated as the total sum of HAART prescribed days, divided by the time elapsed between the date of the first ART prescription date to December 31, 2019, the last day of the follow-up period. Optimal adherence was defined as more than 95% of MPR.

Descriptive analyses were performed for independent variables/time-dependent outcome variables in total person-years. The incidence rate was re-calculated as 100,000 person-years for standardization. The study population was divided into two groups: those who had an ACS event, and those who did not, and the results were compared using the Chi-square test or Fisher's exact test were used along to the frequency of cell. Then a logistic regression model was designed using variables that showed significant differences in univariate analysis and suspected cardiovascular risk factors.

Then a subgroup analysis was performed for the population after 2014, when the general ART guideline was distributed in Korea. For the 2013 Korean guideline, ART was recommended in all PWH regardless CD4-positive T cell count. The subgroup analysis for PWH patients who started ART after 2014 was conducted, to determine the ACS mortality in relatively healthy PWH who started ART early. All data analysis was conducted using SAS Enterprise Guide 7.1 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Total 24,459 had HIV diagnostic ICD-10 codes on their claim data during the study period (2007 - 2019). After excluding patients who had an HIV diagnosis prior to

2009, the number of newly diagnosed people in the study period was 17,179. We retrieved 15,764 after ruling out mono-treatment for hepatitis B. Then, 10,363 PWH who had been on ART for more than 180 days were confirmed. Finally, 68.5% of them (n = 7,100) were classified as population with the optimal adherence. Total follow-up period of the study population was 27,396 person-year.

The population aged 40 - 59 was 35.1% (n = 2,491) and the population aged over 60 was 7.1% (n = 504, **Supplementary Table 1**). Men were 93.2% (n = 6,620). AIDS was confirmed in 32.1% (n = 2,279). ACS was confirmed in 140 PWH with optimal adherence and mortality was confirmed in 10 cases in the ACS group. Among 140, MI was 41 (29.3%). It is calculated as 511.0 per 100,000py of ACS events incidence. The mean time to ACS event from HIV diagnosis was 1,127.3 days.

There were more older people in the ACS group, compared to the non-ACS group, such as those aged 40-59 as 62.9% vs. 34.5% and those aged over 60 as 27.1% vs. 6.7% (**Table 1**). There was no significant difference in the male to female ratio. There were more AIDS patients in the ACS group (44.3% vs. 31.9%, $P = 0.0006$). By insurance type, beneficiaries of the Medical Aids were more likely in ACS group without statistical significance (7.1% vs. 3.7%, $P = 0.2130$). Regards to underlying diseases, hypertension, dyslipidemia, diabetes, chronic kidney disease, malignancy and psychiatric disease were more in the ACS group. Chronic hepatitis B and C were more common in ACS group without statistical significance.

All-cause hospital mortality cases of whom experienced ACS among PWH with optimal adherence were 10 (7.1% of ACS group). Non-ACS group showed all-cause mortality of 154 cases (2.2%) during the study period. The all-cause hospital mortality rate was higher as 1,703.6 per 100,000 person-year, compared to 574.4 per 100,000 person-year in the non-ACS group. The duration of ACS to death was 357.7 days. MI events were confirmed in 41 (29.3%) in the ACS group with hospital mortality rate of 9.8% (4 cases).

In the logistic regression model, variables such as AIDS, hypertension, dyslipidemia, and diabetes mellitus showed a significant association with the occurrence of ACS in PWH with optimal adherence (odd ratio [OR] for AIDS 1.481, 95% confidence interval [CI]: 1.048 - 2.092; OR for hypertension 3.974, 95 CI: 2.712 - 5.823, OR for dyslipidemia 2.537, 95 CI: 1.555 - 4.140; OR for diabetes mellitus 2.270, 95 CI: 1.569 - 3.286, **Table 2**).

Table 1. Characteristics of people with human immunodeficiency virus infection with optimal adherence according to acute coronary syndrome (n = 7,100)

Variables	ACS (n = 140)	Non-ACS (n = 6,960)	P-value
Follow-up duration (py)	742	26,654	
Age (yrs)			<0.0001
Under 20	0	198 (2.8)	
20 - 39	14 (10.0)	3,893 (55.9)	
40 - 59	88 (62.9)	2,403 (34.5)	
Over 60	38 (27.1)	466 (6.7)	
Male	133 (95.0)	6,487 (93.2)	0.7072
National Medical Aid	10 (7.1)	260 (3.7)	0.2130
Tertiary hospital	90 (64.3)	4,397 (61.7)	0.7005
Region of clinics			0.6163
Greater Seoul ^a	95 (67.9)	4,762 (68.4)	
Others	45 (32.1)	2,217 (31.9)	
AIDS	62 (44.3)	2,217 (31.9)	0.0006
Comorbidities			
Hypertension	87 (62.1)	1,342 (19.3)	<0.0001
Dyslipidemia	120 (85.7)	4,158 (59.7)	<0.0001
Diabetes mellitus	69 (49.3)	1,154 (16.6)	<0.0001
Chronic hepatitis B	5 (3.6)	309 (4.4)	1.0000
Chronic hepatitis C	7 (5.0)	236 (3.4)	0.2942
Chronic kidney disease	11 (7.9)	141 (2.0)	0.0378
Malignancy	74 (57.1)	2,488 (35.7)	0.0012
Psychiatric disease	80 (57.1)	2,971 (42.7)	0.0139
Clinical outcomes			0.0003
Hospital mortality	10	154	
Hospital mortality rate (per 100,000 py)	1,703.60	574.4	

The value denotes the subject number (%) unless otherwise indicated.

^aSeoul, Incheon, and Gyeonggi-do.

ACS, acute coronary syndrome; py, person-year; yrs, years; AIDS, acquired immunodeficiency syndrome.

Malignancy showed a marginal association. Variables that showed significant differences in univariate analysis such as National Medical Aid chronic kidney disease, and psychiatric disease lost their statistical significance.

The incidence of ACS in PWH diagnosed after 2014 was 602.9 per 100,000 person-year (py) (48 ACS patients among 11,445 total follow-up py) and their case fatality were 7.2% (5/69, **Table 3**). By the characteristics of the ACS and the non-ACS subgroups after 2014, there were more patients between 20 and 40 in the non-ACS group than in the ACS group (4.3% vs. 59.5%, $P < 0.0001$, **Table 3**). The fact that the middle age of 40 - 59 years of age accounted for half of the ACS group was similar to the entire study population. AIDS were significantly more in the ACS group, along with the entire study population (47.8% vs. 28.0%, respectively). There was no difference between the ACS group and the non-ACS group in grade and region of hospital, the same as the entire study population. In

Table 2. Factors related with hospital mortality of acute coronary syndrome in patients with optimal adherence to anti-retroviral therapy (n = 140)

Variables	Univariate				Multiple		
	Odds ratio	95% confidence interval		P-value	Odds ratio	95% confidence interval	P-value
Age at diagnosis							
Under 20	<0.001	<0.001	>999.999	0.9571			
20 - 39	Ref	Ref	Ref	Ref			
40 - 59	10.183	5.781	17.939	0.9451			
Over 60	22.675	12.195	42.162	0.9327			
Male	1.384	0.644	2.976	0.4051			
National medical aid	1.983	1.030	3.817	0.0405	1.096	0.557	2.160
Tertiary hospital	1.116	0.787	1.582	0.5939			
Region of clinics	0.974	0.681	1.394	0.8868			
AIDS	1.701	1.214	2.383	0.0020	1.481	1.048	2.092
Comorbidities							
Hypertension	6.872	4.859	9.719	<0.0001	3.974	2.712	5.823
Dyslipidemia	4.043	2.512	6.507	<0.0001	2.537	1.555	4.140
Diabetes mellitus	4.890	3.490	6.852	<0.0001	2.270	1.569	3.286
Viral hepatitis B	0.797	0.324	1.961	0.6218			
Viral hepatitis C	1.500	0.694	3.242	0.3030			
Chronic kidney disease	4.124	2.179	7.804	<0.0001	1.339	0.688	2.607
Malignancy	2.015	1.441	2.819	<0.0001	1.430	1.011	2.022
Psychiatric disease	1.790	1.277	2.510	0.0007	1.160	0.815	1.651

Ref, reference; AIDS, Acquired immune deficiency syndrome.

terms of underlying diseases, the subgroup analysis after 2014 showed the same distribution as the entire study population analysis, as hypertension, dyslipidemia, diabetes mellitus, malignancy, and chronic kidney disease were more in the ACS group. Chronic hepatitis B and C were more common in ACS group, however, still were not different significantly. Hospital mortality was also significantly higher in the ACS group as the entire study population analysis. In the logistic regression model, the relationship trends for most variables were the same in the subgroup analysis (Table 4). However, dyslipidemia lost a positive relationship with ACS and chronic kidney diseases showed an association with ACS as OR = 2.553, 95 CI: 1.123 - 5.807.

DISCUSSION

The ACS incidence and mortality rate of ACS in PWH with optimal adherence were confirmed using a large-scale cohort for PWH from data of the Korean universal health insurance system, NHI. PWH with optimal adherence had a higher incidence of ACS than in the HIV-negative population. The incidence of ischemic heart disease in Korea in 2018 was 383.1 per 100,000 people, according to the Korean annual statistics report [13]. According to our findings, incidence of ACS was about 1.3 times higher in PWH with optimal adherence. However, the hospital mortality rate was 7.1% (10/140), whereas the mortality rate after hospitalized myocardial infarction in Korea's

general population reported to the OECD in 2019, was 8.9% [16, 17]. The mortality rate of optimal adherent PWH was similar to the general population.

Proposed mechanisms for HIV-related cardiovascular risk are HIV-specific immune dysfunction, upregulation of inflammatory and thrombotic markers, and vascular injury and dysfunction [15]. These factors increase the incidence of ACS as well as the mortality of PWH. We confirmed that conventional risk factors, such as hypertension, diabetes mellitus, and dyslipidemia were still significant in PWH. These results were consistent with previous reports [18]. As the life expectancy of PWH increases, it is expected that more attention may need to be paid to the presence of chronic metabolic diseases.

HIV viremia itself, gut microbiome translocation, cytomegalovirus, and chronic hepatitis C infection could provoke inflammatory response, which have been suggested as a triggering factor of cardiovascular diseases [19]. Diagnosing PWH early and connecting them to treatment offers various benefits. Additionally, it plays a role in mitigating risk associated with ACS. Chronic HCV co-infection is also known to be a risk factor for ACS in PWH, as it was reported to increase 24 - 33% risk of cardiovascular disease [20]. Chronic inflammation is thought to be related with the complications in coinfecting patients since inflammatory markers were decreased after HCV eradication [21]. Our findings also indicated a higher

Table 3. Characteristics of people with human immunodeficiency virus infection after 2014 with optimal adherence according to acute coronary syndrome (n = 4,836)

Variables	ACS (n = 69)	Non-ACS (n = 4,767)	P-value
Follow-up duration (py)	198	11,246	
Age (yrs)			<0.0001
Under 20	0 (0)	130 (2.7)	
20 to 39	3 (4.3)	2,853 (59.5)	
40 to 59	42 (60.9)	1,489 (31.2)	
Over 59	24 (34.8)	295 (6.2)	
Male	65 (94.2)	4,457 (93.5)	1.0000
National medical aid	4 (5.8)	152 (3.2)	1.0000
Tertiary hospital	48 (69.6)	2,856 (59.9)	0.1399
Region of clinics			0.5366
Greater Seoul ^a	47 (68.1)	3,265 (68.5)	
Others	22 (31.9)	1,502 (31.5)	
AIDS	33 (47.8)	1,334 (28.0)	0.0002
Comorbidities			
Hypertension	44 (63.8)	769 (16.2)	<0.0001
Dyslipidemia	56 (81.2)	2,639 (55.4)	0.0011
Diabetes mellitus	38 (55.1)	657 (13.8)	<0.0001
Chronic hepatitis B	2 (2.9)	169 (3.5)	0.6870
Chronic hepatitis C	2 (2.9)	90 (1.9)	0.6041
Chronic kidney disease	3 (4.3)	80 (1.7)	0.0485
Malignancy	40 (58.0)	1,587 (33.3)	0.0018
Psychiatric disease	29 (42.0)	2,848 (59.7)	0.1059
Clinical outcomes			0.0003
Hospital mortality	5	57	
Hospital mortality rate (per 100,000py)	4,807.7	502.6	
MI events	15 (39.5)		
Hospital mortality in MI patients	2		
Case fatality in MI patients (%)	13.3		
Duration of ACS to death (mean, days)	65.0		

The value denotes the subject number (%) unless otherwise indicated.

^aSeoul, Incheon, and Gyeonggi-do.

py, person-year; yrs, years; ACS, acute coronary syndrome; AIDS, acquired immunodeficiency syndrome; MI, myocardial infarction.

prevalence of hepatitis C coinfections in the ACS group, although this difference was not statistically significant, possibly due to the limited sample size of outcome.

With early ART initiation, our study found that the hospital mortality rate was 7.1%, when all ACS were counted and 2.9%, when MI was counted. Hospital mortality rates vary widely when an ACS event occurs in patients with optimal compliance. It was 4.0% in the 1997 - 2006 PWH and 2.0% in the non-HIV population in another study [5]. Another study analyzing myocardial infarction at PWH from 1996 to 2014 found that the 1-year mortality rate after myocardial infarction was 27.0% [8]. However, PWH might get suboptimal treatment than the HIV-negative population, as a previous study detected

[5, 22, 23]. It is unreliable to compare differing study designs. As previous studies were conducted in the early stages of the ART era, this study can provide evidence for cardiovascular outcomes in PWH who start ART early and maintain it with optimal adherence.

PWH who received ART after 2014 are, strictly speaking, people in the universal ART era. We again analyzed mortality rates for MI after 2014. Mortality after MI case was reported in a few cases, so statistical analysis could not be applied. The variables showing a significant difference between the ACS group and the non-ACS group were not much different with the total study population, such as age, AIDS, hypertension, dyslipidemia, diabetes mellitus, chronic kidney disease, and malignancy. The logistic regression model demonstrated a similar trend in the total population, but it showed a significant association between chronic kidney disease which is one of traditional risk factors in cardiovascular events and mortality. This study's findings reveal inconclusive evidence regarding any significant difference in chronic kidney disease across the overall population. It is uncertain whether chronic kidney disease displayed a significant increase in impact post-2014, as the absolute number of cases in the ACS group (7/140 vs. 2/69) was too limited to draw clear conclusions.

Our study is significant in that the account of atherosclerotic cardiovascular complications, which occurs in only a small percentage of patients was confirmed in the optimal adherence group by using a large cohort of PWH using claims data. Based on our findings and existing epidemiological data from the general population in Korea, we discovered that PWH with optimal adherence had no higher hospital mortality than the HIV-negative population.

This study has some limitations. This is a secondary analysis based on claims data. We could not get access to conventional atherosclerotic risk factors like smoking or body mass index. However, it is possible to get more attention for lifestyle modification through the regular HIV clinic visits in PWH with optimal adherence. In one study, women with HIV had better control of their hypertension and diabetes than HIV-negative women [24]. Second, using annual statistics from the Korean government, this study compared mortality among HIV-negative people. Age-matched analysis was not used to obtain the results.

In conclusion, even with ideal adherence, PWH had a higher prevalence of ACS. However, their mortality

Table 4. Factors related with hospital mortality of acute coronary syndrome in patients with optimal adherence to anti-retroviral therapy after 2014 (n = 69)

Variables	Univariate			Multiple				
	Odds ratio	95% confidence interval	P-value	Odds ratio	95% confidence interval	P-value		
Age at diagnosis								
Under 20	<0.001	<0.001	>999.999	0.9634				
20 - 39	Ref	Ref	Ref	Ref				
40 - 59	26.825	8.301	86.687	0.9541				
Over 60	77.369	23.159	258.473	0.9408				
Male	1.130	0.409	3.122	0.8134				
National medical aid	1.869	0.672	5.195	0.2307				
Tertiary hospital	1.529	0.913	2.562	0.1066				
Region of clinics	0.983	0.590	1.636	0.9466				
AIDS	2.359	1.465	3.799	0.0004	1.980	1.211	3.236	0.0065
Comorbidities								
Hypertension	9.152	5.568	15.042	<0.0001	4.152	2.383	7.236	<0.0001
Dyslipidemia	3.474	1.895	6.368	<0.0001	1.804	0.953	3.415	0.0700
Diabetes mellitus	7.669	4.739	12.411	<0.0001	3.291	1.936	5.595	<0.0001
Viral hepatitis B	0.812	0.197	3.343	0.7733				
Viral hepatitis C	1.551	0.374	6.429	0.5450				
Chronic kidney disease	8.205	3.793	17.747	<0.0001	2.553	1.123	5.807	0.0253
Malignancy	2.764	1.707	4.475	<0.0001	1.828	1.109	3.013	0.0181
Psychiatric disease	2.049	1.265	3.313	0.0035	1.327	0.803	2.193	0.2691

Ref, reference; AIDS, Acquired immune deficiency syndrome.

after ACS was comparable to that of the HIV-negative population in the generalized ART era.

Author Contributions

Conceptualization: JB. Data curation: HJ, JR. Formal analysis: HJ, EL, JR, JYL, JB. Methodology: EL, JB. Resources: JB. Writing - original draft: EL. Writing - review & editing: HJ, JYL, JB.


SUPPLEMENTARY MATERIAL

Supplementary Table 1


Characteristics of patients with human immunosuppression virus who have optimal adherence of antiretroviral therapy

[Click here to view](#)


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Conflict of Interest

No conflict of interest.

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