Epidemiology and Disease Burden of Systemic Inflammation among Atherosclerotic Cardiovascular Disease and Chronic Kidney Disease in Northern China: A Retrospective Study of Tianjin Regional Electronic Health Records

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Introduction

- ASCVD affects 500 million individuals worldwide and is one of main causes of disease burden among Chinese residents [1].
- CKD, with a global prevalence estimated between 8% and 16% [2,3], affects approximately 82 million adults in China [4].
- Systemic inflammation (SI) plays a key role in the progression of ASCVD and CKD, contributing to adverse outcomes like cardiovascular events, renal disease progression, and higher mortality [5,6].
- The burden of SI among ASCVD and CKD patients in China remains unclear, warranting further investigation.

Objectives

- To estimate the prevalence of SI among patients with ASCVD and CKD.
- To compare baseline characteristics, clinical outcomes, and economic burden between patients with and without SI in ASCVD and CKD.
- To explore the association between SI and major adverse cardiovascular events (MACE) in patients with ASCVD and CKD.

Methods

Data Source

- This study is an observational study using data from Tianjin regional electronic health record (rEHR) database in China. The data collection period spans from January 1, 2016, to December 31, 2023.

Population Identification

- Patients with ASCVD were captured based on diagnostic terms, ICD-10 codes, and surgical procedure records.
- Patients with CKD were identified using diagnostic terms, ICD-10 codes, and laboratory tests, requiring at least two estimated glomerular filtration rate (eGFR) measurements <60 mL/min/1.73 m², taken at least 3 months apart.
- Patients with SI were identified by at least one C-reactive protein (CRP) or high-sensitivity C-reactive protein (hsCRP) result ≥2 mg/L, with exception if with: 1) CRP ≥ 20 mg/L; 2) Recent antibiotics use or infection diagnosis; 3) Recent ICU stays or hospitalization for acute events (e.g., ASCVD, thromboembolism, bleeding); 4) Recent prescribed corticosteroid or immunosuppressants.

Study Design

- A **cross-sectional study** estimated the yearly prevalence of SI among ASCVD and CKD patients from 2020 to 2023, using those who had at least one eligible CRP/hsCRP test as the denominator.
- A **cohort study** compared baseline characteristics, clinical outcomes, and economic burden between SI and non-SI patients with ASCVD and CKD, and assessed the association between SI and MACE using a Cox proportional hazards model. The follow-up period extended from the index date to either the end of the data period or loss to follow-up (defined as no further visits or death). Index dates for the cohorts were defined as:
  - ➤ ASCVD, CKD, and SI population: The index date was set as the first eligible (as specified in **Population Identification**) CRP/hsCRP test ≥2 mg/L following the diagnosis of both ASCVD and CKD.
  - ➤ ASCVD, CKD, and no SI population: The index date was set as the first CRP/hsCRP test <2 mg/L following the diagnosis of both ASCVD and CKD. Only patients with no CRP results >2 during the study period were included in the non-SI cohort.

Results

Prevalence

- The prevalence of SI among ASCVD and CKD patients with at least one eligible CRP/hsCRP test has remained consistently around **56%** from 2020 to 2023, as shown in **Figure 1**.

Figure 1: Prevalence of SI among ASCVD and CKD patients with at least one eligible CRP/hsCRP test from 2020 to 2023
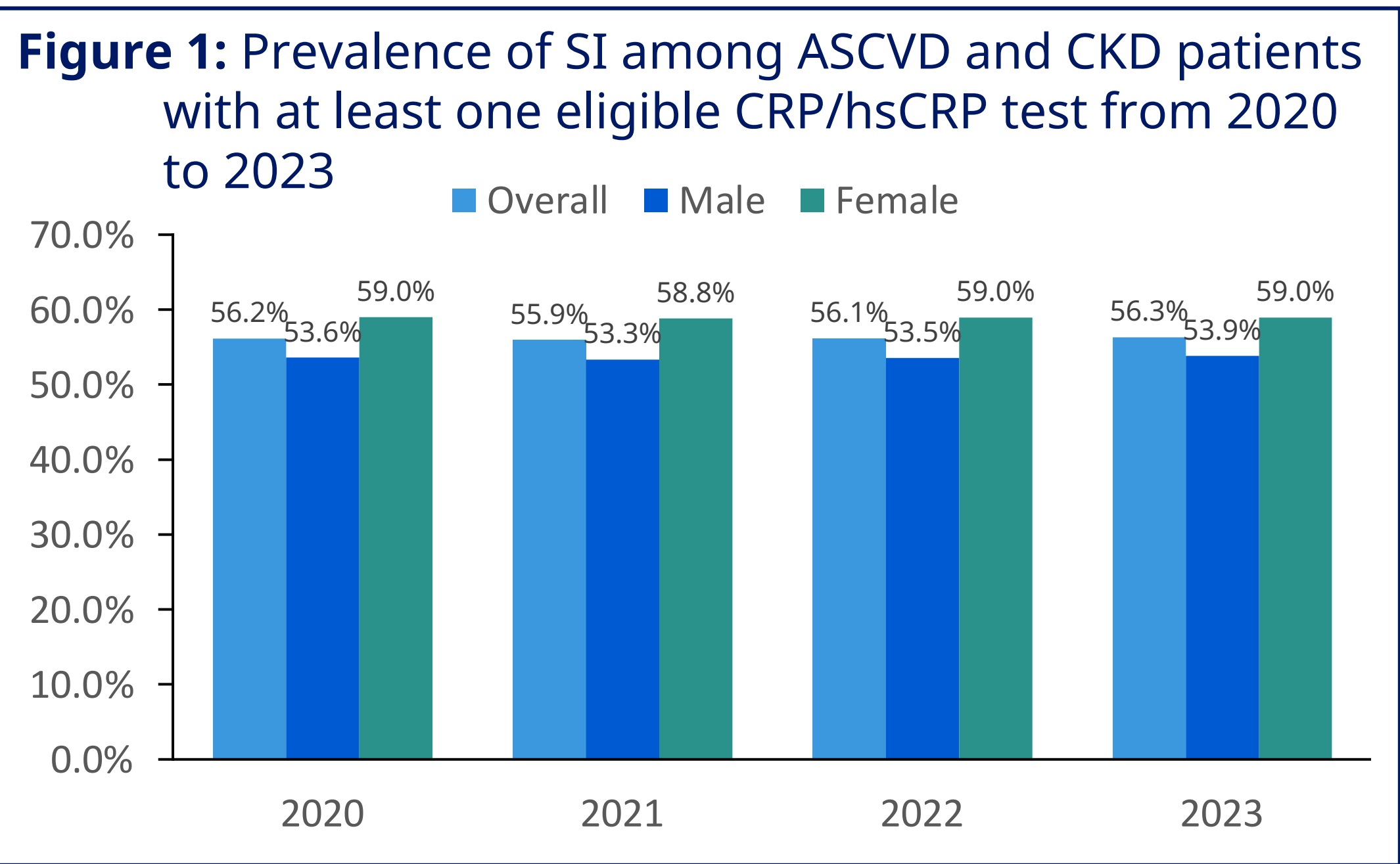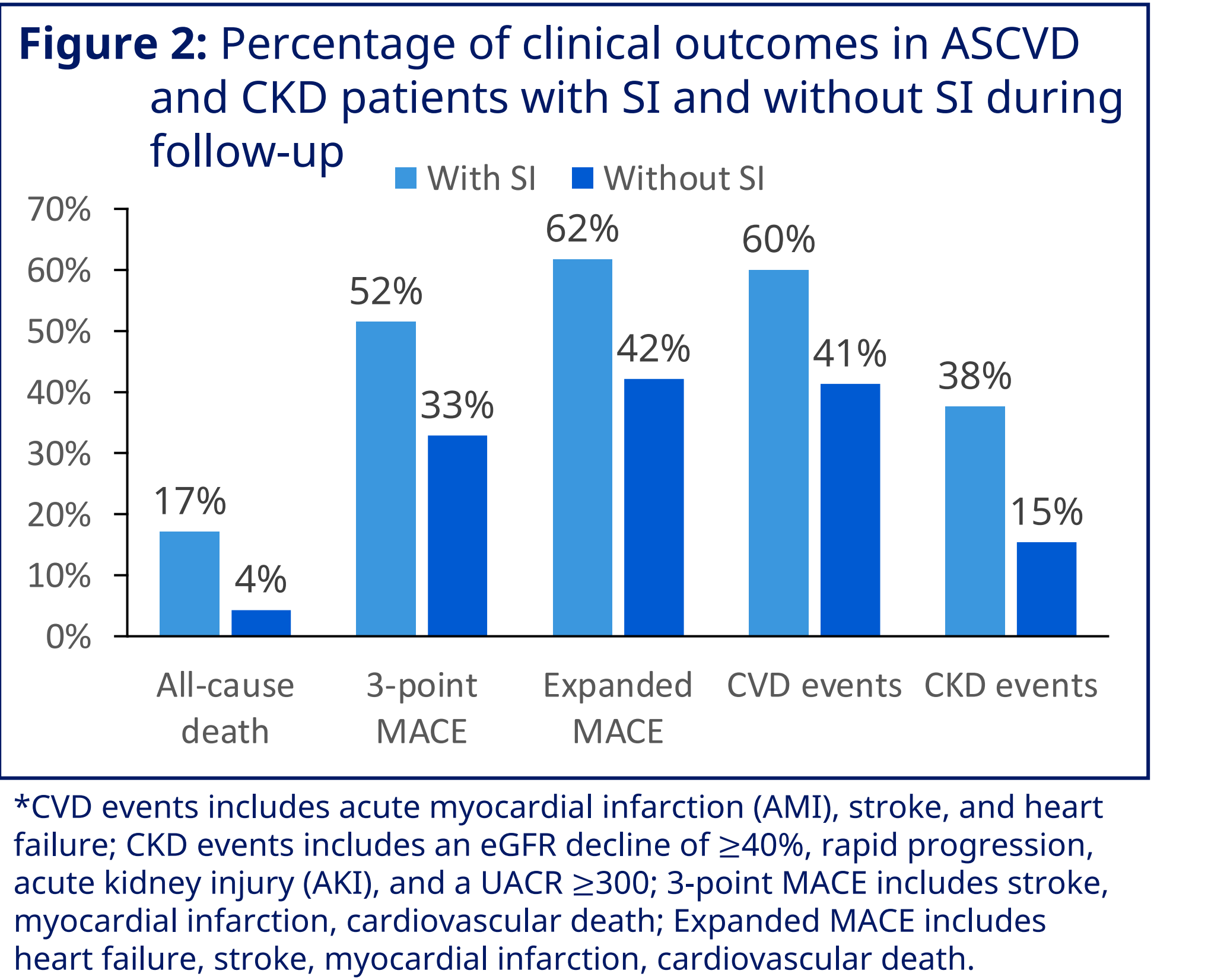

Baseline Characteristics

- **Table 1** presents the baseline characteristics of ASCVD and CKD patients with and without SI. Patients with SI were older with more comorbidities and ASCVD events.

Table 1: Baseline characteristics of ASCVD and CKD patients with and without SI

	With SI (N=42014)	Without SI (N=17751)
Age (Mean, SD)	68.6 (12.6)	64.3 (11.9)
Gender		
Female (n, %)	20898 (49.7)	8682 (48.9)
Comorbidities		
Hypertension (n, %)	28094 (66.9)	10350 (58.3)
Type 2 diabetes (n, %)	23114 (55.0)	9722 (54.8)
Heart Failure (n, %)	13534 (32.2)	2659 (15.0)
Liver disease (n, %)	6524 (15.5)	2062 (11.6)
Atrial Fibrillation (n, %)	4038 (9.6)	803 (4.5)
Malignant tumor (n, %)	3096 (7.4)	832 (4.7)
COPD (n, %)	2809 (6.7)	1037 (5.8)
History of ASCVD		
Stroke (n, %)	9482 (22.6)	2575 (14.5)
Unstable angina (n, %)	4122 (9.8)	878 (4.9)
Myocardial infarction (n, %)	3070 (7.3)	497 (2.8)
Transient ischemic attack (n, %)	287 (0.7)	85 (0.5)

Clinical Burden

- Patients with SI experienced more adverse clinical outcomes compared to those without SI, as illustrated in **Figure 2**.

Figure 2: Percentage of clinical outcomes in ASCVD and CKD patients with SI and without SI during follow-up

*CVD events includes acute myocardial infarction (AMI), stroke, and heart failure; CKD events includes an eGFR decline of ≥40%, rapid progression, acute kidney injury (AKI), and a UACR ≥300; 3-point MACE includes stroke, myocardial infarction, cardiovascular death; Expanded MACE includes heart failure, stroke, myocardial infarction, cardiovascular death.

Association Between SI and MACE

- The Cox proportional hazards model reports adjusted hazard ratios (95% CI) for SI, showing a 45% higher risk of MACE in patients with SI compared to those without SI.
- The model adjusted for age, gender, comorbidities (heart failure, atrial fibrillation, obesity, rheumatoid arthritis, COPD, liver disease, malignant tumor, dementia, diabetes, and hypertension) and history of ASCVD (prior myocardial infarction, stroke, and hospitalization for unstable angina).

Economic Burden

- Patients with SI had significantly higher healthcare utilization and financial burden, as shown in Table 3.

Table 3: Economic burden of disease in ASCVD and CKD patients with SI and without SI during follow-up

	With SI (N=42014)	Without SI (N=17751)
Number of hospitalization (Mean, SD)	2.98 (4.0)	1.3 (2.1)
Length of hospital stay, days (Mean, SD)	48.2 (96.1)	21.2 (31.0)
Total cost, CNY (Mean, SD)	120378.4 (205048.8)	45320.3 (51645.4)

*The total cost included medication, testing, examination fees, and other outpatient and inpatient expenses.

Limitations

- The regional database includes most Tertiary hospitals but covers less than half of Secondary hospital, which could potentially affect prevalence estimation.
- As a northern city, Tianjin may not represent all of China, limiting the representativeness across China.
- This study utilized EHRs collected for healthcare delivery rather than research purposes, potentially causing missing data or variable misclassification.

Conclusion

- The prevalence of SI among ASCVD and CKD patients has remained high in recent years, highlighting the serious disease burden in China.
- SI is associated with poor disease prognosis in patients with ASCVD and CKD, significantly increasing the risk of MACE and contributing to higher healthcare utilization and costs.
- Targeted interventions for SI may improve clinical outcomes and reduce economic impact.

References:
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