

The impact of diabetes on outcomes, length of stay and costs in acute kidney injury patients: a cross-sectional multicenter study in China

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Research article

Keywords: acute kidney injury, diabetes mellitus, hospitalization cost, hospital stay, outcomes

Posted Date: March 5th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-16071/v1>

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Abstract

Background : With the increasing worldwide prevalence and disease burden of diabetic mellitus, data on the impact of diabetes on acute kidney injury (AKI) patients in China are limited.

Methods: A nationwide cross-sectional and retrospective study was conducted in China, which included 2,223,230 hospitalized adult patients and covered 82% of the country's population. Diabetes was identified according to blood glucose, hemoglobin A1c levels, physician diagnosis and drug use. In total, 7604 AKI patients were identified, and 1404 and 6200 cases were defined as diabetic and non-diabetic respectively. Clinical characteristics, outcome, in-hospital stay, and costs of AKI patients with and without diabetes were compared. Multivariable logistic and linear regression analyses were conducted to evaluate the association of diabetes with mortality and renal recovery in the admitted AKI patients.

Results: In this survey, AKI patients with diabetes were older, male-dominated (61.9%), with more comorbidities, and higher serum creatinine levels. Compared to patients without diabetes, a significant upswing in all-cause in-hospital mortality, hospital stay, and costs were found in those with diabetes ($p < 0.05$). After adjusted for relevant covariables, diabetes was independently associated with failed renal recovery (OR=1.13, $p = 0.04$), rather than all-cause in-hospital mortality (OR=1.09, $p = 0.39$). Also, diabetic status was positively associated with length of stay ($\beta = 0.04$, $p = 0.04$) and costs ($\beta = 0.09$, $p < 0.01$) in hospital after adjusted for possible confounders.

Conclusions: Failed renal recovery, rather than all-cause in-hospital mortality, is independently associated with diabetes in hospitalized AKI patients. Moreover, diabetes is significantly correlated with in-hospital stay and expenditures in AKI.

Background

Acute kidney injury (AKI) is a widespread problem with high mortality and morbidity. To improve the diagnosis and treatment of AKI in the world, the International Society of Nephrology (ISN) launched the "Oby25" global target. Namely, no patient deaths occur due to untreated acute kidney failure by 2025 [1]. As part of this initiative, a nationwide survey of AKI in adults was conducted in China to estimate the burden of AKI. The incidence of AKI is increased to 8-16% in the hospital admissions [2], and its poor outcomes seriously influence quality of life in AKI patients. What's worse, the detection rate of AKI is only 2.03% and in-hospital mortality rate is 12.4%, which is revealed by the latest national survey in China [3]. Thus, it is imperative to find determinants and remedies and, subsequently, improve the prognosis of AKI patients.

Diabetes mellitus (DM) becomes a common disease in adults due to lifestyle changes and increased prevalence of obesity. Besides, DM is a major risk factor for the development of AKI [4–6]. Age-standardized rates of AKI in hospital patients increased by 139% among adults diagnosed with DM from 2000 to 2014 in the United States [7]. What's more, long duration of AKI is significantly associated with a high mortality in diabetic veterans [8]. In patients with severe sepsis or septic shock, diabetes is

associated with persistent renal dysfunction in AKI patients during their intensive care unit (ICU) days [9]. However, a recent study from the UK demonstrated that diabetic patients are less likely to be followed with severe AKI and have same acute mortality as non-diabetic [10]. Therefore, the influence of diabetes on AKI patients still remains ambiguous and worth in-depth research. In clinical practice, diabetes easily initiates several complications, which not only affect quality of life, but also cause tremendous healthcare expenditures [11,12]. In 2015, diabetes placed considerable costs to individual and global health economics, which were estimated as \$825 billion [13]. Direct medical costs in diabetic patients reached \$9.1 billion in China [14]. Nevertheless, studies regarding the prognosis and economic burden of AKI patients with diabetes are relatively rare in China, particularly in hospitalized patients.

In the present study, we compared the clinical characteristics, short-term outcome, as well as hospital stay and cost between AKI patients with and without diabetes. Specifically, we mainly aimed to evaluate the impact of diabetes on outcomes and economic burden of hospitalized AKI patients in China.

Methods

Study population and design

This study was derived from ISN AKF 0by25 China Consortiums, which is a nationwide cross-sectional survey of adult AKI in China. The study was approved by the ethics committees of Peking University First Hospital and the enrolled study hospitals. The project included 44 study hospitals and originated from 22 provinces, municipalities, and autonomous regions and four geographical regions (north, northwest, southeast, and southwest). In each region, we enrolled an academic hospital in the region's capital city and a local hospital from a smaller city or rural county. During the two months of January 2013 and July 2013, 26,086 cases were diagnosed with possible AKI in this survey. The 2012 Kidney Disease: Improving Global Outcomes (KDIGO) AKI definition was adopted as the major screening criteria for AKI. For patients who had no repeated serum creatinine assay within 7 days and who had recovering from AKI, we expanded the criteria of AKI as follows: an increase or decrease in serum creatinine by 50% during hospital stay. Second, patients with chronic kidney disease stage 5, nephrectomy, kidney transplantation and peak serum creatinine < 53 $\mu\text{mol/L}$ were excluded. Those who met the identification criteria but whose serum creatinine change could not be attributed to AKI were also excluded. Finally, 7604 AKI patients were included in the following analyses and the screen profile is presented in Figure 1.

Data on characteristics of detected AKI cases were collected, including sociodemographic status, comorbidities (cardiovascular disease (CVD), hypertension (HBP), chronic kidney disease (CKD), and malignancy), AKI classification, impairment factors (infection, crystalluria/cylindruria, operation, etc), nephrotoxic mediations (antibiotics, diuretics, nonsteroidal anti-inflammatory drugs, etc.), peak serum creatinine, serum creatinine at discharge, peak AKI staging (1 to 3), critical condition (multiple organ dysfunction, sepsis, terminal malignancy, shock, acute respiratory distress syndrome, and ventilation), renal replacement therapy (RRT) and RRT indication, AKI recognition type (timely recognition, delayed

recognition, and nonrecognition). The short-term prognosis (renal recovery, mortality, and treatment withdrawal), ICU and hospital days, and hospitalization costs were compared between AKI patients with and without DM.

Definition of associated variables

We identified DM based on the following criteria: (1) the level of fasting blood-glucose > 7.0 mmol/L (2) two-hour plasma glucose or random plasma glucose > 11.1 mmol/L (3) glycosylated hemoglobin A1c > 48 mmol/mol (6.5%) (4) physician diagnosis by or anti-diabetic medication use. However, we could not differentiate between type 1 and type 2 DM. Briefly, patients with increased serum creatinine levels at admission or within 2 days after hospitalization combined with causal factors that nephrologists determined those to be present before admission were identified as community acquired-AKI (CA-AKI) patients. Besides that, others patients were recognized as hospital acquired-AKI (HA-AKI).

Peak AKI stage (1 to 3) was defined as the highest AKI stage that a patient reached during the whole in-hospital stay [15]. AKI recognition type was classified into three categories: timely recognition (AKI was diagnosed by the physicians in charge within 3 days and before the injury progressed to severer stages), delayed recognition (AKI was not diagnosed within 3 days) and nonrecognition (AKI was not recognized during the whole hospitalization). We identified renal recovery at discharge as follows: full recovery, serum creatinine level reduced to below threshold or to the baseline; partial recovery, serum creatinine decreased by 25% or more from highest concentration but remained higher than threshold or baseline; failed recovery, patients depended on dialysis or serum creatinine decreased < 25% from peak level. Treatment withdrawal was confirmed as AKI patients with severely illness but giving up further treatment due to personal or economic reasons. Hospital cost was identified with total expenditure of one continuous turnover in an admission per patient.

Statistical analysis

Continuous variables were described as means (\pm SD) or medians (interquartile range, IQR), as appropriate. Categorical variables were reported as frequencies (proportions). Clinical characteristics, short-term prognosis, and hospital stay of AKI patients were presented among DM and non-DM groups. Student's *t*-test was used for analysis of normally distributed data. Wilcoxon rank-sum test was performed to compare the difference of skewed data. Comparison between groups were made using chi-square test for categorical variables.

We used univariable and multivariable logistic regression models to analyze the odds of all-cause in-hospital mortality, failed renal recovery with DM history in AKI patients. Relative covariates in multivariable logistic model included age (per 10 years older), gender (male or female), region (north, southeast, northwest, southwest), CVD (yes or no), HBP (yes or no), CKD (yes or no), malignancy (yes or no), AKI classification (prerenal, intrarenal, postrenal), operation (yes or no), diuretics (yes or no), AKI stage in peak (1 to 3), critical condition (yes or no) and AKI recognition type (timely recognition, delayed recognition, and nonrecognition). Linear regression model was conducted to determine the associations

of DM history with hospital stays and costs in AKI patients, adjusted for age, gender, region, HA-AKI, CVD, CKD, malignancy, classification, operation, diuretics, log (ultimate creatinine), AKI in peak stage, critical condition and AKI recognition type. The cases with missing information of the covariates were excluded in the logistic and linear regression analyses.

Data inputting and managing were done with Epidata software (version 3.1, Epidata Association, Odense, Denmark). We considered two-tailed $P < 0.05$ to be statistically significant. All analyses were performed with SAS software (version 9.4, SAS Institute, Cary, NC).

Results

Baseline characteristics in the DM and non-DM groups

We totally enrolled 7604 AKI patients in this analysis. Baseline characteristics in AKI patients with and without DM are shown in Table 1. Patients in the DM group, the majority (74.7%) of whom aged 60 years and older, were older than patients in the non-DM group (mean age: 68 vs 60 years). Both groups were male preponderance (>60%). There was no significant difference of source (hospital- or community-acquired) between the two groups. Comorbidities, including cardiovascular disease, hypertension, chronic kidney diseases, were nearly two-fold in patients with DM compared with non-DM ($p < 0.001$). In total, pre-renal AKI accounted for half of the cases in two groups. A higher proportion of DM patients developed intra-renal AKI than non-DM patients (30.8% vs 26.9%). Among nephrotoxic drugs, nearly half of patients with diabetes (46.8%) were more likely to use diuretics rather than those without diabetes (39.0%). Significantly, DM patients presented higher levels of serum creatinine both at peak and at discharge compared with non-DM patients (171.0 vs 155.3 $\mu\text{mol/L}$, 104.2 vs 93.9 $\mu\text{mol/L}$, $p < 0.001$). Less DM patients had critical conditions than patients without DM (40.6% vs 44.9%, $p = 0.004$). Additionally, there were no differences in peak AKI staging and AKI recognition type between the two groups.

Clinical outcomes, hospital stay and costs in the DM and non-DM groups

Results of clinical outcomes, hospital stay and cost in DM and non-DM patients are presented in Table 2. Only approximately 30% AKI patients achieved full renal recovery before discharge in those two groups. Besides, more cases of failed renal recovery were observed in the diabetic group (35.1% in DM group vs 31.4% in non-DM group, $p = 0.022$). More in-hospital deaths occurred in diabetes patients than in the group without diabetes (14.8% vs 11.6%, $p = 0.001$). Compared with individuals without DM, those with DM experienced longer hospital stay (median (IQR) 18 (11-32) vs. 18 (10-29), $p < 0.05$) and higher costs (median (IQR) 5329 (2486-13027) vs. 4990 (2267-11692) RMB, $p < 0.05$).

Association between mortality, failed renal recovery, and DM history

To estimate the relationships of all-cause in-hospital mortality and failed renal recovery with DM history, we used univariable and multivariable logistic regression models. As shown in Table 3, AKI patients with diabetes were more likely to encounter in-hospital mortality and failed renal recovery (OR (95% CI): 1.32

(1.12-1.56), 1.22 (1.07-1.39), $p<0.01$). Whereas, after adjusted for covariates (age (per 10 years increase), sex, region, CVD, HBP, CKD, malignancy, AKI classification, operation, diuretics, AKI stage in peak, critical condition, and AKI recognition type, DM history was not associated with all-cause in-hospital mortality (OR=1.09, $p=0.393$). However, diabetic status was an independently risk factor of failed renal recovery in AKI patients (OR=1.13, $p=0.039$).

Association between hospital stay, costs, and DM history

Table 4 depicts the association of unadjusted and multivariable-adjusted DM history with hospital stay and costs in AKI patients. Without adjustment, patients with DM appeared longer hospital stay and higher cost, compared with those without DM. In multivariable regression model, pre-existing DM showed positive associations with hospital stay and costs (β : 0.040 (0.003-0.105), 0.094 (0.026-0.162), $p<0.05$).

Discussion

This study aims at investigating the impact of diabetes on AKI patients in China, including clinical outcomes and economic burden. Diabetes patients were older and had more comorbidities and higher creatinine levels (both peak and ultimate) in this survey. Those features might partly contribute to the increased in-hospital mortality and less renal recovery of diabetes (14.8%, 60.3%) in AKI compared to without diabetes (11.6%, 65.2%). With much more complications of diabetes, longer hospital stay and higher hospitalization costs were found in the DM group. However, after adjusted for relevant covariates, diabetes was not associated with all-cause in-hospital mortality. For failed renal recovery, diabetic status was an independent risk factor in AKI patients. Simultaneously, diabetes was positively related to the length of stay as well as costs in hospital.

Recent decades, the disease and economic burden of diabetes arouse a lot of attention all over the world. Chronic Non-communicable Disease Risk Factor Collaboration estimates that the number of people with diabetes quadrupled between 1980 and 2014 [16]. Diabetes is the most important cause of chronic kidney disease in the world that easily leads to requirements for renal replacement therapy [17], resulting in enormous economic burden. In the US, Petersen *et al.* demonstrated that people with diagnosed diabetes have medical expenditures ~2.3 times higher than those without diabetes [18]. From 1990 to 2016, all-aged diabetes mortality rate increased by 63.5% and mostly distributed in patients aged 15-49 years in China [19]. Many studies focused on the susceptibility of diabetes on the episode of AKI [5,20,21]. Compared to a common reference of eGFR 80 mL/min/1.73m² in non-diabetic patients, the hazard ratios for AKI were higher in diabetic patients in a meta-analysis [6]. In our study, we found that the creatinine level was significantly increased in diabetic group, which might result in worse renal outcomes. There were also *in vitro* and *in vivo* studies elaborating the possible mechanisms of AKI onset in diabetes [22,23]. Subsequently, a recent study found that 1-year mortality of diabetes increases and periprocedural AKI in patients undergoing surgery [24] and that is coincided with our findings. However,

we observed that diabetes was not independently associated with mortality in whole AKI patients after adjusted for age, gender, and regions. The possible explanations for this phenomenon are diabetic state postponed renal injury through 'pre-conditioning' [25] and priming regeneration mechanisms [23].

A significant finding in this study was that an apparent upswing length of stay in hospital and costs has been observed in AKI with diabetes. According to a report from the Center for Disease Control and Prevention in the US, the rate of AKI hospitalizations among persons with diabetes increased from 23.1 to 55.3 per 1,000 persons during 2000-2014, the data among persons without diabetes was only 3.5 to 11.7 [7]. In China, Lin *et al.* [26] revealed that the median of length of stay and costs in AKI patients are 21.2 days and 30764.3 RMB (Renminbi), consistent with our findings. Moreover, the hospital costs of diabetes have exceeded those of patients without diabetes in our study. Besides there were remarkably increases in length of stay and expenditure of DM patients, compared with patients with non-DM. That could be partly attributable to the serious complications of diabetes during the hospitalization, such as cardiovascular disease, peripheral neuropathy, and cerebrovascular disease [12,27].

Our study has several limitations. First, this retrospective study depended on repeated serum creatinine tests without urinary output records, which would lead to the missing identification of AKI cases with inadequate serum creatinine tests or only with decreased urine output. Second, in clinical practice, severe patients tend to receive more attention and come to the hospital, therefore mild cases were more easily to be missed. That might also cause the underestimation of actual nonrecognition of AKI. Third, we could not separate the type 1 and type 2 DM among these AKI patients through the survey. The effects of diabetic complications and glucose levels on AKI were also missed. Fourth, this study selected only two months, January and July, to represent the winter and autumn in China, which hardly reflected the real status of the 4-season climates in these regions. A recent study investigated the seasonality of AKI and suggested that patients are more severely ill in winter than in other quarters [28]. In addition, the covariates in multivariate analyses might be incomplete and these unidentified residual variables may still play a part in our observation. Subsequently, the higher odds of failure to recover from AKI among patients with diabetes may be partly due to higher risk of mortality. Notwithstanding these limitations, we offered a relative comprehensive analysis about the impact of diabetes on prognosis, hospitalization stay, and costs of AKI patients.

Conclusions

In this study, our data show that diabetes is significantly associated with failed renal recovery, extended in-hospital stay, and increased medical cost in AKI patients. Thus, more attention should be paid in the management of diabetes comorbidity in AKI patients.

Abbreviations

AKI: Acute kidney injury; ISN: International Society of Nephrology; DM: diabetes mellitus; ICU: intensive care unit; KDIGO: Kidney Disease: Improving Global Outcomes; CVD: cardiovascular disease; HBP:

hypertension; CKD: chronic kidney disease; RRT: renal replacement therapy; CA-AKI: community acquired-AKI; HA-AKI: hospital acquired-AKI; IQR: Interquartile range.

Declarations

Acknowledgments

We thank all the members of the ISN AKF 0by25 China Consortium, which includes Peking University First Hospital, Beijing, China (Li Yang, MD, Yafang Wang, MD, Jinwei Wang, PhD, M. Zhao, MD, and Haiyan Wang, MD); The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China (G. Xing, MD, and Z. Liu, MD); Sichuan Provincial People's Hospital, Chengdu, China (L. Wang, MD, and F. Wang, MD); The First Affiliated Hospital of Anhui Medical University, Anhui, Hefei, China (Y. Wu, MD, and D. Huang, MD); The First Affiliated Hospital of Xinjiang Medical University, Urumqi, China (Suhua Li, MD, and S. Wang, MD); Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China (G. Xu, MD, and S. Ge, MD); Zhejiang Provincial People's Hospital, Hangzhou, China (Q. He, MD, and Q. Shen, MD); The First Affiliated Hospital of Zhejiang University, Hangzhou, China (J. Chen, MD, and P. Zhang, MD); General Hospital of Ningxia Medical University, Yinchuan, China (M. Chen, MD, and L. Wu, MD); Ningde Municipal Hospital, Fujian Medical University, Ningde, China (X. Liu, MD, and M. Pan, MD); Meishan City People's Hospital, Meishan, China (Z. Zhu, MD, and X. Zou, MD); The First College of Clinical Medical Science, China Three Gorges University, Yichang, China (Lin Yang, MD, and P. Zhu, MD); The Second Affiliated Hospital of Kunming Medical University, Kunming, China (X. Lian, MD, and J. Zhao, MD); Shanghai Ninth People's Hospital, School of Medicine, Shanghai JiaoTong University, Shanghai, China (F. Ding, MD, and M. Zhou, MD); Jiangxi Provincial People's Hospital, Nanchang, China (Y. Li, MD, and Lin Yang, MD); The Fourth Affiliated Hospital of Harbin Medical University, Harbin, China (Huamin Wang, MD, and W. Hu, MD); Lanzhou University Second Hospital, Lanzhou, China (Jianqin Wang, MD, and Jing Wang, MD); Shandong Provincial Hospital Affiliated to Shandong University, Jinan, China (R. Wang, MD, and Bing Liu, MD); Shanghai Changzheng Hospital, The Second Military Medical University, Shanghai, China (C. Mei, MD, and T. Zhang, MD); Renshou County People's Hospital, Renshou, China (Jixian Xu, MD, and J. Han, MD); The Affiliated Provincial People's Hospital of Shanxi Medical University, Taiyuan, China (R. Li, MD, and T. Wen, MD); Taixing People's Hospital, Taixing, China (J. Cao, MD); Ordos Central Hospital, Ordos, Inner Mongolia, China (L. Zhang, MD); Xinganmeng People's Hospital, Wulanhaote, Inner Mongolia, China (Yan Wang, MD); Fuyang City People's Hospital, Fuyang, Zhejiang, China (Jinhua Xu, MD); Ningbo Yinzhou Second Hospital, Ningbo, China (B. Bao, MD); Zhongda Hospital, Southeast University, Nanjing, China (Bicheng Liu, MD); Hangzhou Hospital of Traditional Chinese Medicine, Hangzhou, China (H. Chen, MD); The Second Hospital of Hebei Medical University, Shijiazhuang, China (Shaomei Li, MD); Guizhou Provincial People's Hospital, Guizhou Medical University, Guiyang, China (Y. Zha, MD); Peking University Shenzhen Hospital, Shenzhen, China (Q. Luo, MD); Hengxian People's Hospital, Hengxian, China (D. Chen, MD); Miyun County Hospital, Beijing, China (Y. Shen, MD); The First Affiliated Hospital of Guangxi Medical University, Nanning, China (Y. Liao, MD); Puer City People's Hospital, Puer, China (Z. Zhang, MD); Zoucheng City People's Hospital, Zoucheng, China (X. Wang, MD); Taihe Hospital of Traditional Chinese Medicine, Taihe, China (K. Zhang, MD); Shenzhen

Longhua New District Central Hospital, Shenzhen, China (L. Liu, MD); Tongren Hospital Shanghai Jiao Tong University School of Medicine, Shanghai, China (P. Mao, MD); Zhongwei City People's Hospital, Zhongwei, China (C. Guo, MD); Huaxian People's Hospital, Huaxian, China (J. Li, MD); Suihua City First Hospital, Suihua, China (Z. Wang, MD); Qingpu Branch of Zhongshan Hospital, Fudan University, Shanghai, China (S. Bai, MD); and Qingxuxian City People's Hospital, Qingxu, China (S. Shi, MD).

Availability of data and materials

All datasets used and/or analyzed in this study are available from the corresponding author on reasonable request.

Authors' Contributions

LiShan Tan, Li Yang and Zuying Xiong conceptualized and designed the study. Li Yang, Li Chen, Lingyan Li, Qiong Luo and ISN AKF 0by25 China Consortium members collected data. Lishan Tan and Jinwei Wang analyzed and settled data. Lishan Tan, Li Yang, Zuying Xiong and Xiaoyan Huang wrote and revised the manuscript. All authors commented, read and approved the final manuscript.

Funding

L.S.T was supported by China Postdoctoral Science Foundation (No.2018M643138). Z.Y.X. was supported by the fund of "San-ming" Project of Medicine in Shenzhen (No.SZSM201812097). L.Y. was supported by the National Natural Science Foundation of China (No.91742205 and No.81625004), the Beijing Young Scientist Program (BJJWZYJH01201910001006), and Peking University Clinical Scientist Program by the Fundamental Research Funds for the Central Universities.

Ethical approval and consent to participate

The study was approved by the ethic committees of Peking University First Hospital and the enrolled study hospitals. Due to the retrospective nature of this study, the need of consent was waived by the Ethics Committee at Peking University First Hospital.

Consent for publication

Not applicable.

Competing Interests

The authors report no conflicts of interest in this work.

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Tables

Table 1. Characteristics of AKI patients in the DM and non-DM groups.

Characteristics	Total N=7604	DM group N=1404	Non-DM group N=6200	P-value
Age (years)	62 ± 17	68 ± 14	60 ± 18	<0.001
Age group				<0.001
18-39	876 (11.5)	36 (2.6)	840 (13.6)	
40-59	2341 (30.8)	319 (22.7)	2022 (32.6)	
60-79	3120 (41.0)	748 (53.3)	2372 (38.3)	
≥80	1267 (16.7)	301 (21.4)	966 (15.6)	
Gender				0.004
Male	4955 (65.2)	869 (61.9)	4086 (65.9)	
Female	2649 (34.8)	535 (38.1)	2114 (34.1)	
Region				0.010
North	2097 (27.6)	410 (29.2)	1687 (27.2)	
Southeast	3406 (44.8)	580 (41.3)	2826 (45.6)	
Northwest	851 (11.2)	153 (10.9)	698 (11.3)	
Southwest	1250 (16.4)	261 (18.6)	989 (16.0)	
HA-AKI	3468 (45.6)	670 (47.7)	2798 (45.1)	0.078
Comorbidity				
CVD	2666 (35.1)	727 (51.8)	1939 (31.3)	<0.001
HBP	3190 (42.0)	952 (67.8)	2238 (36.1)	<0.001
CKD	1847 (24.3)	507 (36.1)	1340 (21.6)	<0.001
Malignancy	1418 (18.6)	215 (15.3)	1203 (19.4)	<0.001
AKI classification				
Pre-renal	3936 (51.8)	722 (51.4)	3214 (51.8)	0.783
Intra-renal	2100 (27.6)	432 (30.8)	1668 (26.9)	0.003
Post-renal	670 (8.8)	77 (5.5)	593 (9.6)	<0.001
Unclassified	898 (11.8)	173 (12.3)	725 (11.7)	0.510
Impairment factors				
Infection	4139 (54.4)	767 (54.6)	3372 (54.4)	0.869
Crystalluria/Cylindruria	55 (0.7)	10 (0.7)	45 (0.7)	0.949
Operation	1476 (19.4)	245 (17.5)	1231 (19.9)	0.040
Drugs				
Antibiotics	3499 (46.0)	656 (46.7)	2843 (45.9)	0.555
Diuretics	3072 (40.4)	657 (46.8)	2415 (39.0)	<0.001
NSAIDs	901 (11.9)	172 (12.3)	729 (11.8)	0.606
Traditional Chinese medicine	129 (1.7)	24 (1.7)	105 (1.7)	0.967
Contrast agents	681 (9.0)	135 (9.6)	546 (8.8)	0.338
Peak creatinine	158.4	171.0	155.3	<0.001
(μ mol/L)	(115.0-255.6)	(122.1-266.5)	(113.0-253.0)	
Ultimate creatinine*	95.0	104.2	93.9	<0.001
(μ mol/L)	(68.0-146.7)	(73.2-161.9)	(67.0-143.0)	
Oliguria/anuria*	833 (11.0)	170 (12.1)	663 (10.7)	0.125
AKI stage at peak				0.234
Stage 1	3483 (45.8)	631 (44.9)	2852 (46.0)	
Stage 2	1950 (25.6)	385 (27.4)	1565 (25.2)	
Stage 3	2171 (28.6)	388 (27.6)	1783 (28.8)	
Critical condition*	3351 (44.1)	570 (40.6)	2781 (44.9)	0.004
RRT indication	896 (11.8)	179 (12.8)	717 (11.6)	0.214
AKI recognition type*				0.047
Timely recognition	1604 (21.1)	327 (23.3)	1277 (20.6)	
Delayed recognition	343 (4.5)	72 (5.1)	271 (4.4)	
Nonrecognition	5608 (73.8)	994 (70.8)	4614 (74.4)	

Data are mean (SD), n (%), or median (IQR), unless stated otherwise.

AKI=acute kidney injury, DM=diabetes mellitus, HA-AKI= hospital acquired acute kidney injury, CVD=cardiovascular disease, HBP=hypertension, CKD=chronic kidney disease, RRT=renal replace treatment. *Data missing for ultimate creatinine in 981 cases (219 in DM group vs 762 in non-DM

group), for oliguria/anuria in 57 cases (6 vs 51), for critical condition in 4810 cases (871 vs 3939), and for AKI recognition type in 49 cases (11 vs 38). Palatino Linotype

Table 2. Outcomes, hospital stay, and costs of AKI patients in the DM and non-DM groups.

Characteristics	Total N=7604	DM group N=1404	Non-DM group N=6200	P-value
Short-term prognosis				
Renal recovery*				0.022
Full recovery	2095 (33.2)	356 (32.0)	1739 (33.5)	
Partial recovery	2071 (32.8)	338 (28.3)	1733 (31.7)	
Failed recovery	2139 (33.9)	419 (35.1)	1720 (31.4)	
In-hospital mortality*	927 (12.2)	208 (14.8)	719 (11.6)	0.001
Treatment withdrawal*	1617 (21.3)	277 (19.7)	1340 (21.6)	0.119
ICU stay (d)*	6 (3-14)	6 (3-15)	6 (3-14)	0.199
Hospital stay (d)*	18 (10-29)	18 (11-32)	18 (10-29)	0.002
Hospitalization costs (\$)*	5071 (2323-11824)	5329 (2486-13027)	4990 (2267-11692)	0.035

Data are n (%) or median (IQR), unless stated otherwise.

AKI=acute kidney injury, DM=diabetes mellitus, ICU=intensive care unit. * Data missing for renal recovery in 1299 cases (291 in DM group vs 1008 in non-DM group) mortality in 129 cases (21 vs 108), for treatment withdrawal in 129 cases (21 vs 108), for ICU stays in 5486 cases (4498 vs 988), for hospital stays in 5 cases (5 vs 0), and for hospitalization costs in 1411 cases (1127 vs 284).

Table 3. Univariable and multivariable logistic regression analysis for factors associated with all-cause in-hospital mortality and failed renal recovery in AKI patients.

DM	OR (95% CI)	P-value
All-cause in-hospital mortality*		
Univariable model	1.32 (1.12-1.56)	0.001
Model 1 ^a	1.12 (0.94-1.32)	0.210
Model 2 ^b	1.09 (0.90-1.32)	0.393
Failed renal recovery[#]		
Univariable model	1.22 (1.07-1.39)	0.004
Model 1 ^a	1.17 (1.02-1.34)	0.025
Model 2 ^b	1.13 (1.01-1.28)	0.039

*7475 cases were included in the analysis after excluding 129 cases, whose information for all-cause in-hospital mortality was missing. [#] 6305 cases were included in the analysis after excluding 1299 cases, whose information for renal recovery was missing.

^a, adjusted for age (per 10 years increase), gender, and region.

^b, adjusted for age (per 10 years increase), gender, region, CVD, HBP, CKD, malignancy, AKI classification, operation, diuretics, AKI stage in peak, critical condition, and AKI recognition type.

AKI=acute kidney injury, DM=diabetes mellitus, CVD=cardiovascular disease, HBP=hypertension, CKD=chronic kidney disease.

Table 4. Linear regression of log (hospital stay) and log (hospital costs) in AKI patients.

DM	Regression coefficient	95% CI	P-value
Log (hospital stay)*			
Univariable model	0.106	0.055-0.158	<0.001
Model 1 ^a	0.040	0.003-0.105	0.040
Log (hospital costs)#			
Univariable model	0.099	0.025-0.172	0.008
Model 1 ^a	0.094	0.026-0.162	0.007

* 7599 cases were included in the analysis after excluding 5 cases, whose information for hospital stay was missing. # 6193 cases were included in the analysis after excluding 1411 cases, whose information for hospital costs was missing.

^a, adjusted for age, gender, region, CVD, HBP, CKD, malignancy, classification, operation, diuretics, log (ultimate creatinine), AKI in peak stage, critical condition, and AKI recognition type.

AKI=acute kidney injury, DM=diabetes mellitus, CVD=cardiovascular disease, HBP=hypertension, CKD=chronic kidney disease.

Figures

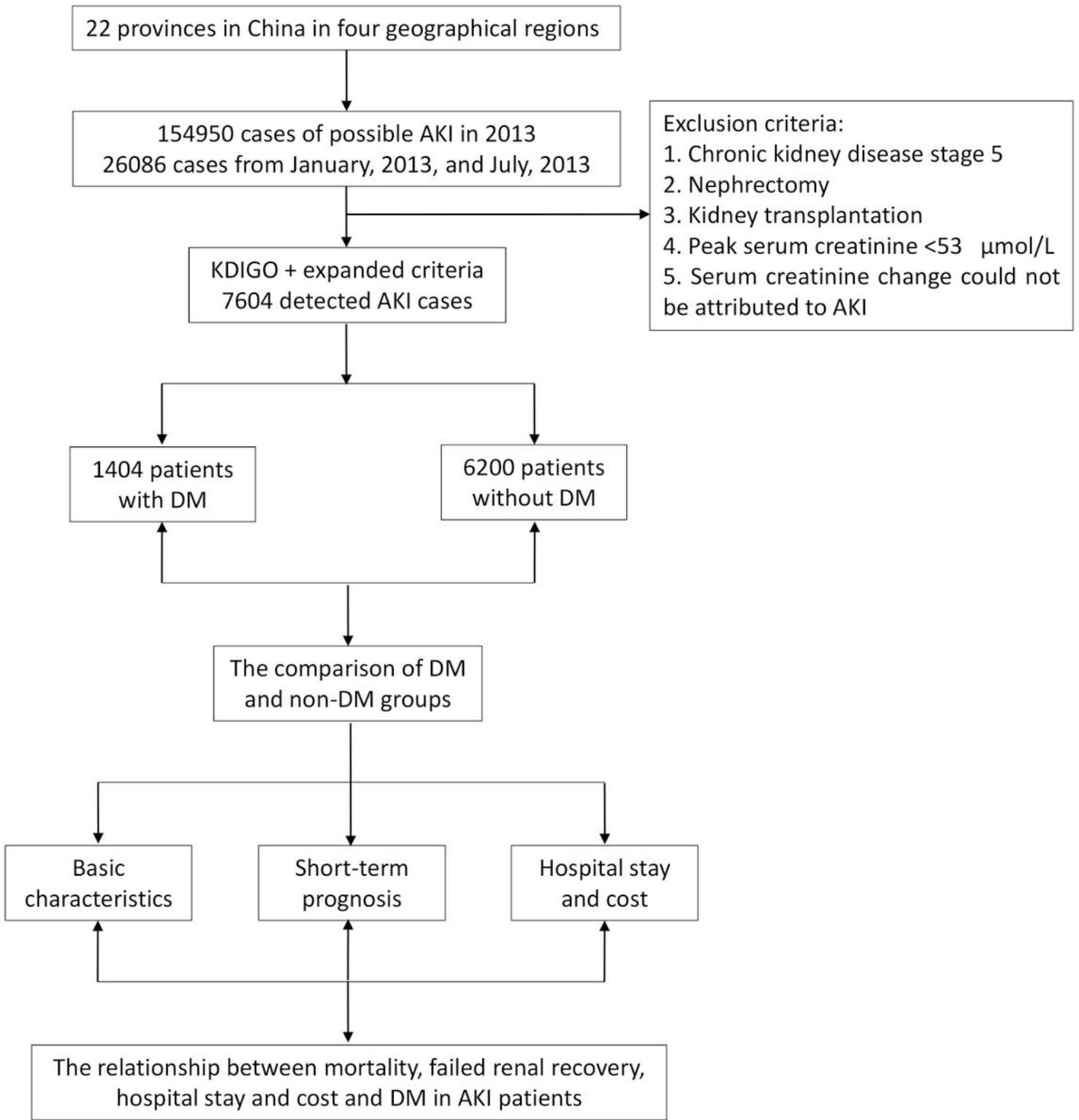


Figure 1

Study profile. AKI=Acute kidney injury, DM=Diabetes mellitus.