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Prevalence of long-term complications in inpatients with diabetes mellitus in China: a nationwide tertiary hospital-based study

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ABSTRACT

Introduction There is absence of national data to estimate the prevalence of long-term diabetic complications among inpatients with diabetes in tertiary hospitals in China.

Research design and methods Using the national Hospital Quality Monitoring System database, inpatients with type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM) were identified by the International Classification of Diseases-10 code, and the temporal trends of microvascular and macrovascular complications 2013–2017 were calculated, and then the risk factors were analysed by multivariate regression analysis.

Results A total of 92 413 inpatients with T1DM and 6 094 038 inpatients with T2DM were identified in 2013–2017. The proportions of inpatients with microvascular complications in inpatients with T1DM and T2DM increased from 29.9% and 19.0% in 2013 to 31.6% and 21.0% in 2017, respectively. The proportions of inpatients with macrovascular complications in inpatients with T1DM and T2DM increased from 7.3% and 14.5% in 2013 to 13.2% and 18.4% in 2017, respectively. Hypertension and hyperlipidemia were risk factors for both microvascular and macrovascular complications. Among inpatients with T1DM, the adjusted ORs of microvascular complications increased in 40–49 age group and Northeast region, while older age, male and North region were risks factor for macrovascular complications. Among inpatients with T2DM, the ORs of microvascular complications increased in 40–49 age group, female, urban and North region, while older age, male, urban and Southwest region were risks factor for macrovascular complications.

Conclusions The proportions of long-term complications of inpatients with diabetes in China increased in 2013–2017. Efforts are needed to improve the management of patients with diabetes in China.

Significance of this study

What is already known about this subject?

⇒ Currently, there is absence of national data to estimate the prevalence of long-term diabetic complications among inpatients with diabetes in China.

What are the new findings?

⇒ The proportions of microvascular and macrovascular complications in inpatients with type 1 and type 2 diabetes mellitus increased between 2013 and 2017.

⇒ The risk factors of microvascular and macrovascular complications varied in inpatients with type 1 and type 2 diabetes mellitus in China.

How might these results change the focus of research or clinical practice?

⇒ For the first time, our study captures the prevalence of long-term complications in inpatients with diabetes in China and calls for the attention to the management of patients with diabetes, reducing the occurrence of long-term diabetic complications in China.

INTRODUCTION

Diabetes mellitus is a systemic chronic metabolism disease characterized by hyperglycemia, which has become one of the major diseases of global concern.[1] In the past few decades, the incidence and prevalence of diabetes mellitus had been on the rise globally.[2] The prevalence of diabetes mellitus increased from 0.67% in 1980 to 12.8% in 2017 in China.[3] The incidence of type 1 diabetes mellitus (T1DM) increased from 0.51 per 100 000 person-years in the 1990s to 1.93 per 100 000 person-years during 2010–2013 in children younger than 15 years in China.[4] China had the largest number of patients with diabetes, accounting for 27% of patients with diabetes worldwide.[5]

Long-term diabetic complications mainly included microvascular and macrovascular complications, such as diabetic retinopathy, nephropathy, neuropathy, acute myocardial infarction (AMI) and stroke. Diabetes mellitus-associated cardiac and non-cardiac atherosclerotic cardiovascular disease may lead to complications in all vascular beds, such as coronary, lower extremity and renal arteries.[6] Duration of disease,[7] blood glucose fluctuation,[8] hypertension[9] and

hyperlipidemia[10] were considered as risk factors for long-term complications. Long-term diabetic complications are major factors resulted in disability, blindness and survival loss in patients with diabetes mellitus.[11 12] An analysis of Clinical Practice Research Datalink showed that compared with patients with type 2 diabetes mellitus (T2DM) without microvascular complications, the HRs for the occurrence of cardiovascular events in patients with one, two or three microvascular complications were 1.32, 1.62 and 1.99, respectively.[13] The incidences of long-term complications in patients with diabetes in high-income countries has declined in recent decades, with the development of new antidiabetic drugs, the popularization of insulin therapy and more attention to the health education.[14–16] An analysis of German statutory health insurance data showed that the healthcare costs of patients with T2DM increased dramatically after the occurrence of diabetic complications, at the time of the event and subsequent years.[17]

Currently, only regional studies with small sample sizes had been conducted to investigate the long-term complications among patients with diabetes in China.[18–20] Information is lacking to estimate the prevalence of long-term diabetic complications among in patients with diabetes at the national level in China. In this study, we aim to estimate the prevalence of long-term complications among inpatients with diabetes in China based on a nationwide database of Hospital Quality Monitoring System (HQMS) and to provide evidence for policy-making and reallocation of medical resources.

MATERIALS AND METHODS

Data source

HQMS is a national hospitalized patient database for hospital accreditation under the auspices of the National Health Commission. Since 2013, the Commission has requested tertiary hospitals in China to submit standardized electronic inpatient discharge records on a daily basis to HQMS in an automated manner. As of 31 December 2017, HQMS covered 31 provinces throughout mainland China and 1037 tertiary hospitals (44.3% of all tertiary hospitals in China), capturing the medical data of a total of 76 263 617 inpatients. The characteristics of the tertiary hospitals in HQMS were similar to those of overall tertiary hospitals in China.[21] The average number of beds and class distribution of the tertiary hospitals in HQMS are similar to those of all tertiary hospitals in China (online supplemental appendix table 1). The number of patient visits in tertiary hospitals accounts for >50% of total patient visits in China.[22] HQMS consistently collected a dataset of information from all inpatient medical records across each tertiary hospital via a standard protocol.[23] For each patient in tertiary hospitals, information on demographic characteristics, clinical and pathological diagnoses, treatment procedures, type of health insurance and expenditure breakdowns were extracted from the standardized discharge summary known as the 'front-page' of hospital medical records. This information was recorded by the clinicians in charge of the patients. The diagnoses were then coded based on the International Classification of Diseases-10 (ICD-10) by certified coders in each hospital.

Patient identification

ICD-10 codes were used to identify patients with T1DM and T2DM in HQMS database. Inpatients with ICD-10 code E10 (T1DM) or E11 (T2DM) from January 2013 to December 2017 were included in our study. Patients without available unique personal identification number were excluded. Demographic characteristics were obtained from the first hospitalization record with the diagnosis of T1DM or T2DM. Long-term diabetic complications were divided into two types: microvascular complications (diabetic retinopathy, diabetic nephropathy, diabetic neuropathy and diabetic foot) and macrovascular complications (diabetic peripheral vascular disease, AMI stroke and heart failure). Inpatients with any ICD-10 code of diabetic retinopathy, nephropathy, neuropathy, peripheral vascular complications and diabetic foot in their medical record would be identified (online supplemental appendix table 2). Only patients with ICD-10 codes of AMI and stroke as primary diagnosis would be identified as the occurrence of AMI and stroke.

Statistical analysis

All analyses were performed separately for inpatients with T1DM and T2DM. Continuous variables were presented as mean and SD and median (IQR). Categorical variables were presented as numbers and proportions. The overall proportions of microvascular/macrovascular complications in inpatients with T1DM/T2DM 2013–2017 were defined as the number of inpatients with microvascular/macrovascular complications in any year of 2013–2017 divided by the total number of inpatients with T1DM/T2DM 2013–2017. The proportions of microvascular/macrovascular complications in inpatients with T1DM/T2DM in each year of 2013–2017 were defined as the number of inpatients with microvascular/macrovascular complications in the corresponding year of 2013–2017 divided by the number of inpatients with T1DM/T2DM in the corresponding year of 2013–2017.

Cochran-Armitage trend test was used to test the crude temporal trend of long-term complications between 2013 and 2017. Univariate and multivariate logistic regression model was used to evaluate the influence of age, gender, region, urban-rural distribution, hypertension and hyperlipidemia on long-term complications. After adjusting for the above factors, the temporal trends of long-term complications were assessed again. Results were presented as ORs and 95% CIs.

All p values are two-tailed. P value <0.05 was considered to be statistically significant. All statistical analyses were done using SAS software, V.9.4 (SAS Institute, Cary, North Carolina, USA).

Table 1 Demographic characteristics of inpatients with T1DM and T2DM in HQMS database

	T1DM (n=92 413)	T2DM (n=6 094 038)	Total (n=6 186 451)
Gender			
Male	48 846 (52.9%)	3 292 923 (54.0%)	3 341 769 (54.0%)
Female	43 567 (47.1%)	2 801 115 (46.0%)	2 844 682 (46.0%)
Age (years)			
Mean (SD)	42.62 (20.3)	62.26 (12.5)	61.97 (12.9)
Median (IQR)	42 (26–59)	63 (54–71)	63 (53–71)
Age groups (years)			
0–9	3498 (3.8%)	260 (0.0%)	3758 (0.1%)
10–19	9670 (10.5%)	6624 (0.1%)	16 294 (0.3%)
20–29	15 592 (16.9%)	47 015 (0.8%)	62 607 (1.0%)
30–39	13 614 (14.7%)	184 192 (3.0%)	197 806 (3.2%)
40–49	13 888 (15.0%)	683 388 (11.2%)	697 276 (11.3%)
50–59	14 014 (15.2%)	1 498 150 (24.6%)	1 512 164 (24.4%)
60–69	12 199 (13.2%)	1 871 206 (30.7%)	1 883 405 (30.4%)
≥70	9834 (10.6%)	1 795 789 (29.5%)	1 805 623 (29.2%)
Missing	104 (0.1%)	7414 (0.1%)	7518 (0.1%)
Region			
Northeast	9569 (10.4%)	957 878 (15.7%)	967 447 (15.6%)
North	15 554 (16.8%)	493 380 (8.1%)	508 934 (8.2%)
East	26 352 (28.5%)	1 642 371 (27.0%)	1 668 723 (27.0%)
Central	12 274 (13.3%)	904 749 (14.8%)	917 023 (14.8%)
South	9015 (9.8%)	619 822 (10.2%)	628 837 (10.2%)
Northwest	8138 (8.8%)	704 820 (11.6%)	712 958 (11.5%)
Southwest	4241 (4.6%)	444 079 (7.3%)	448 320 (7.2%)
Missing	7270 (7.9%)	326 939 (5.4%)	334 209 (5.4%)
Urban and rural distribution			
Urban	41 366 (44.8%)	3 528 449 (57.9%)	3 569 815 (57.7%)
Rural	19 276 (20.9%)	1 055 925 (17.3%)	1 075 201 (17.4%)
Missing	31 771 (34.4%)	1 509 664 (24.8%)	1 541 435 (24.9%)

We determine whether a patient is an urban or rural resident based on the type of health insurance. Data are mean (SD), median (IQR) or n (%).
HQMS, Hospital Quality Monitoring System; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

RESULTS

Demographic characteristics of inpatients with diabetes

A total of 92 413 inpatients with T1DM and 6 094 038 inpatients with T2DM were identified in HQMS database from 2013 to 2017 (table 1). Male inpatients accounted for 52.9% and 54.0% of the inpatients with T1DM and T2DM, respectively. The median age of inpatients was 42 (IQR 26–59) for T1DM and 63 (IQR 54–71) for T2DM, respectively. Online supplemental appendix table 3 shows the demographic characteristics of inpatients with diabetes each year from 2013 to 2017.

Microvascular complications of inpatients with diabetes

From 2013 to 2017, the proportions of microvascular complications in inpatients with T1DM and T2DM were 34.1% and 23.8%, respectively. The proportions of diabetic retinopathy, nephropathy, neuropathy and diabetic foot in inpatients with T1DM and T2DM are shown in online supplemental appendix table 4. The proportions of microvascular complications in inpatients with T1DM and T2DM increased from 29.9% and 19.0% in 2013 to 31.6% and 21.0% in 2017, respectively ($p<0.05$) (online supplemental appendix table 5). The proportions of diabetic retinopathy, neuropathy and foot in inpatients with T2DM and diabetic neuropathy in inpatients with T1DM increased from 2013 to 2017 (all p values <0.05) (figure 1A and B).

The results of regression analysis also showed that the proportion of microvascular complication among inpatients with T1DM and T2DM were significantly increased by year (adjusted ORs of T1DM and T2DM were 1.02 (95% CI 1.01 to 1.03, p=0.001) and 1.03 (95% CI 1.03 to 1.03, p<0.001), respectively) (online supplemental appendix table 6).

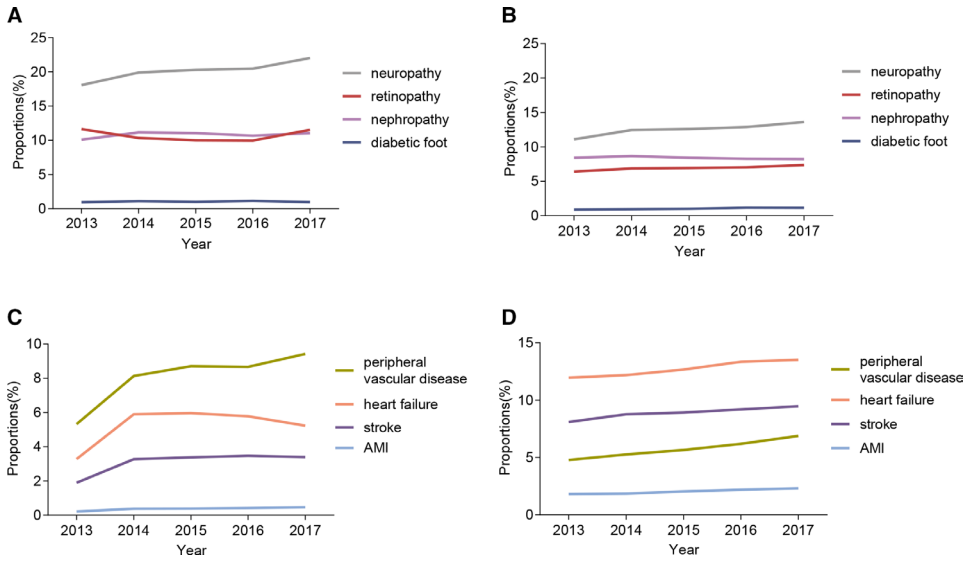

Figure 1 Temporal trends in proportions of long-term complications in inpatients with diabetes. The proportion of each year was calculated by dividing the number of inpatients with complications each year by the number of inpatients with diabetes each year. (A) Microvascular complications in inpatients with T1DM. (B) Microvascular complications in inpatients with T2DM. (C) Macrovascular complications in inpatients with T1DM. (D) Macrovascular complications in inpatients with T2DM. AMI, acute myocardial infarction; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

Macrovascular complications of inpatients with diabetes

From 2013 to 2017, the proportions of macrovascular complications in inpatients with T1DM and T2DM were 13.9% and 21.1%, respectively. The proportions of macrovascular complications in inpatients with T1DM and T2DM increased from 2013 to 2017 (online supplemental appendix table 5). The proportions of AMI, stroke, heart failure and peripheral vascular disease in inpatients with T1DM and T2DM are shown in online supplemental appendix table 4. The proportions of AMI, stroke, heart failure and peripheral vascular disease in inpatients with T1DM and T2DM increased from 2013 to 2017 (all p<0.001) (online supplemental appendix table 5, figure 1C and D). The proportions of AMI and stroke in inpatients with T1DM and T2DM increased from 2013 to 2017 (p<0.001) (online supplemental appendix table 7). Compared with non-diabetic inpatients, the proportions of AMI and stroke in diabetes inpatients increased more significantly. However, the proportions of AMI and stroke in non-diabetic inpatients changed from 0.6% and 3.4% in 2013 to 0.8% and 4.0% in 2017, respectively (online supplemental appendix table 7).

The results of regression analysis also showed that the proportions of macrovascular complication among inpatients with T1DM and T2DM were significantly increased by year (online supplemental appendix table 6).

The risk factors of microvascular and macrovascular complications among inpatients with diabetes

By the multivariate regression analysis, hypertension and hyperlipidemia were risk factors for both microvascular and macrovascular complications of inpatients with T1DM or T2DM. Among inpatients with T1DM, 40–49 age group and Northeast region were risk factors for microvascular complications, while older age, male and North region were risk factors for macrovascular complications. Among inpatients with T2DM, 40–49 age group, female, urban and North region were risk factors for microvascular complications, while older age, male, urban and Southwest region were risk factors for macrovascular complications.

The unadjusted and adjusted ORs of age, gender, urban-rural distribution, region, hypertension and hyperlipidemia for the overall proportions of microvascular and macrovascular complications among inpatients with diabetes 2013–2017 are shown in tables 2–3.

DISCUSSION

To our knowledge, this is the first nationwide study to report the prevalence of long-term complications and risk factors among inpatients with diabetes in tertiary hospitals in China. We found that from 2013 to 2017, the proportions of microvascular and macrovascular complications among inpatients with T1DM and T2DM in tertiary hospitals increased. The risk factors of microvascular and macrovascular complications varied in inpatients with T1DM and T2DM.

In recent years, advances in integrated management of patients with diabetes have contributed to the reduction of diabetic complications.[16] Studies in Hong Kong,[24] the USA[16 25] and Sweden[14] had observed that the incidences of diabetic complications and cardiovascular events declined in recent years. Contrary to the developed areas, we found that the proportions of microvascular and macrovascular complications among inpatients with T1DM and T2DM in China increased from 2013 to 2017. The increasing trend may have contributed to inadequate integrated management, poor patient compliance, increased urbanisation and poor primary healthcare

Table 2 ORs of confounding factors for the proportion of long-term complications in inpatients with T1DM

	Characteristic		Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Microvascular complication	Gender	Male	1		1	
		Female	0.91 (0.89 to 0.94)	**<0.001**	1.00 (0.96 to 1.03)	0.797
	Age (years)	0–9	1		1	
		10–19	4.50 (3.78 to 5.36)	**<0.001**	4.08 (3.28 to 5.07)	**<0.001**
		20–29	11.27 (9.51 to 13.35)	**<0.001**	10.43 (8.44 to 12.88)	**<0.001**
		30–39	15.22 (12.84 to 18.04)	**<0.001**	13.42 (10.86 to 16.58)	**<0.001**
		40–49	18.68 (15.76 to 22.14)	**<0.001**	15.80 (12.79 to 19.53)	**<0.001**
		50–59	17.05 (14.39 to 20.21)	**<0.001**	14.11 (11.42 to 17.44)	**<0.001**
		60–69	13.94 (11.75 to 16.53)	**<0.001**	11.04 (8.92 to 13.65)	**<0.001**
		≥70	8.31 (6.99 to 9.88)	**<0.001**	6.89 (5.55 to 8.55)	**<0.001**
	Urban-rural distribution	Urban	1		1	
		Rural	0.93 (0.89 to 0.96)	**<0.001**	0.97 (0.93 to 1.01)	0.096
	Region	Northeast	1		1	
		North	0.91 (0.86 to 0.96)	**<0.001**	0.67 (0.63 to 0.72)	**<0.001**
		East	0.82 (0.78 to 0.86)	**<0.001**	0.74 (0.70 to 0.79)	**<0.001**
		Central	0.83 (0.78 to 0.87)	**<0.001**	0.75 (0.70 to 0.81)	**<0.001**
		South	0.69 (0.65 to 0.73)	**<0.001**	0.64 (0.60 to 0.69)	**<0.001**
		Northwest	0.74 (0.69 to 0.79)	**<0.001**	0.69 (0.64 to 0.74)	**<0.001**
		Southwest	0.85 (0.79 to 0.92)	**<0.001**	0.76 (0.68 to 0.85)	**<0.001**
	Hypertension	Without	1		1	
		With	1.66 (1.61 to 1.71)	**<0.001**	1.58 (1.51 to 1.65)	**<0.001**
	Hyperlipidemia	Without	1		1	
		With	1.93 (1.86 to 2.00)	**<0.001**	1.58 (1.51 to 1.66)	**<0.001**
Macrovascular complications	Gender	Male	1		1	
		Female	0.80 (0.78 to 0.83)	**<0.001**	0.76 (0.72 to 0.79)	**<0.001**
	Age (years)	0–9	1		1	
		10–19	0.59 (0.46 to 0.75)	**<0.001**	0.58 (0.44 to 0.78)	**<0.001**
		20–29	1.72 (1.40 to 2.10)	**<0.001**	1.64 (1.28 to 2.10)	**<0.001**
		30–39	3.58 (2.93 to 4.37)	**<0.001**	3.09 (2.43 to 3.93)	**<0.001**
		40–49	7.09 (5.82 to 8.62)	**<0.001**	5.28 (4.16 to 6.70)	**<0.001**
		50–59	11.56 (9.51 to 14.05)	**<0.001**	7.19 (5.67 to 9.12)	**<0.001**
		60–69	14.90 (12.25 to 18.11)	**<0.001**	9.28 (7.32 to 11.77)	**<0.001**
		≥70	22.33 (18.36 to 27.16)	**<0.001**	13.59 (10.71 to 17.25)	**<0.001**
	Urban-rural distribution	Urban	1		1	
		Rural	0.59 (0.57 to 0.62)	**<0.001**	0.95 (0.89 to 1.00)	0.05
	Region	Northeast	1		1	
		North	3.14 (2.95 to 3.35)	**<0.001**	1.51 (1.39 to 1.64)	**<0.001**
		East	0.78 (0.73 to 0.83)	**<0.001**	0.66 (0.61 to 0.72)	**<0.001**
		Central	0.70 (0.64 to 0.75)	**<0.001**	0.72 (0.65 to 0.79)	**<0.001**
		South	0.67 (0.61 to 0.73)	**<0.001**	0.70 (0.63 to 0.78)	**<0.001**
		Northwest	0.53 (0.49 to 0.59)	**<0.001**	0.42 (0.38 to 0.47)	**<0.001**
		Southwest	1.17 (1.06 to 1.29)	**0.001**	0.97 (0.84 to 1.13)	0.709
	Hypertension	Without	1		1	
		With	4.77 (4.61 to 4.95)	**<0.001**	2.36 (2.25 to 2.48)	**<0.001**
	Hyperlipidemia	Without	1		1	
		With	2.06 (1.98 to 2.14)	**<0.001**	1.48 (1.40 to 1.57)	**<0.001**

The p values in bold mean statistically significant.
T1DM, type 1 diabetes mellitus.

Table 3 ORs of confounding factors for the proportion of long-term complications in inpatients with T2DM

	Characteristic		Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Microvascular complication	Gender	Male	1		1	
		Female	0.98 (0.98 to 0.98)	**<0.001**	1.04 (1.03 to 1.04)	**<0.001**
	Age (years)	0–19	1		1	
		20–29	1.91 (1.77 to 2.06)	**<0.001**	1.93 (1.75 to 2.12)	**<0.001**
		30–39	2.46 (2.29 to 2.64)	**<0.001**	2.38 (2.17 to 2.61)	**<0.001**
		40–49	2.70 (2.51 to 2.90)	**<0.001**	2.60 (2.37 to 2.85)	**<0.001**
		50–59	2.56 (2.38 to 2.75)	**<0.001**	2.43 (2.22 to 2.67)	**<0.001**
		60–69	2.16 (2.01 to 2.32)	**<0.001**	2.04 (1.86 to 2.24)	**<0.001**
		≥70	1.74 (1.62 to 1.87)	**<0.001**	1.59 (1.45 to 1.75)	**<0.001**
	Urban-rural distribution	Urban	1		1	
		Rural	0.79 (0.79 to 0.79)	**<0.001**	0.75 (0.75 to 0.75)	**<0.001**
	Region	Northeast	1		1	
		North	1.50 (1.49 to 1.51)	**<0.001**	1.36 (1.34 to 1.37)	**<0.001**
		East	0.85 (0.84 to 0.86)	**<0.001**	0.85 (0.85 to 0.86)	**<0.001**
		Central	1.19 (1.18 to 1.20)	**<0.001**	1.19 (1.18 to 1.20)	**<0.001**
		South	0.97 (0.96 to 0.97)	**<0.001**	0.93 (0.92 to 0.94)	**<0.001**
		Northwest	1.26 (1.25 to 1.27)	**<0.001**	1.26 (1.25 to 1.27)	**<0.001**
		Southwest	1.28 (1.27 to 1.29)	**<0.001**	1.22 (1.21 to 1.24)	**<0.001**
	Hypertension	Without	1		1	
		With	1.08 (1.07 to 1.08)	**<0.001**	1.07 (1.07 to 1.08)	**<0.001**
	Hyperlipidemia	Without	1		1	
		With	1.83 (1.82 to 1.84)	**<0.001**	1.66 (1.66 to 1.67)	**<0.001**
Macrovascular complications	Gender	Male	1		1	
		Female	0.87 (0.86 to 0.87)	**<0.001**	0.78 (0.78 to 0.79)	**<0.001**
	Age (years)	0–19	1		1	
		20–29	1.27 (1.14 to 1.41)	**<0.001**	1.18 (1.03 to 1.35)	**<0.001**
		30–39	2.48 (2.24 to 2.74)	**<0.001**	2.24 (1.97 to 2.55)	**<0.001**
		40–49	4.36 (3.94 to 4.83)	**<0.001**	4.09 (3.60 to 4.65)	**<0.001**
		50–59	6.02 (5.44 to 6.66)	**<0.001**	5.78 (5.08 to 6.56)	**<0.001**
		60–69	7.74 (7.00 to 8.56)	**<0.001**	7.69 (6.77 to 8.74)	**<0.001**
		≥70	11.49 (10.39 to 12.71)	**<0.001**	11.48 (10.11 to 13.04)	**<0.001**
	Urban-rural distribution	Urban	1		1	
		Rural	0.83 (0.83 to 0.84)	**<0.001**	0.94 (0.94 to 0.95)	**<0.001**
	Region	Northeast	1		1	
		North	1.10 (1.09 to 1.10)	**<0.001**	1.16 (1.15 to 1.17)	**<0.001**
		East	0.95 (0.94 to 0.95)	**<0.001**	0.91 (0.91 to 0.92)	**<0.001**
		Central	1.15 (1.14 to 1.16)	**<0.001**	1.23 (1.22 to 1.24)	**<0.001**
		South	1.01 (1.00 to 1.01)	**0.025**	1.02 (1.01 to 1.02)	**<0.001**
		Northwest	0.71 (0.70 to 0.71)	**<0.001**	0.67 (0.67 to 0.68)	**<0.001**
		Southwest	1.29 (1.28 to 1.30)	**<0.001**	1.26 (1.25 to 1.28)	**<0.001**
	Hypertension	Without	1		1	
		With	2.41 (2.40 to 2.42)	**<0.001**	2.04 (2.03 to 2.05)	**<0.001**
	Hyperlipidemia	Without	1		1	
		With	1.39 (1.38 to 1.39)	**<0.001**	1.46 (1.45 to 1.47)	**<0.001**

The p values in bold mean statistically significant.
T2DM, type 2 diabetes mellitus.

system. A recent cross-sectional study showed that only 49.0% of patients with diabetes in China received diabetes treatment, and 49.4% of them had a hemoglobin A1c (HbA1c) concentration of <7.0%.[3] As a result of increased economic development and urbanisation, changes in lifestyle and diet may lead to obesity and a reduction in physical activity.[26] Low capacity in primary healthcare system leads to inadequate availability of treatment regimens.[27] To a lesser extent, increasing life expectancy may have contributed to the increasing trends of long-term complications.[28] In our study, diabetic microvascular complications were more common among patients with T1DM than those with T2DM. Patients with T1DM may need more strict blood glucose management due to their young age of onset and longer course of disease.[29]

The proportion of long-term complications among inpatients with diabetes in China varies greatly in different studies. Among 3462 inpatients with T2DM in Beijing, Shanghai, Tianjin and Chongqing during 1991–2000, the prevalence of diabetic retinopathy, diabetic nephropathy, diabetic neuropathy, lower limb vascular complications, coronary heart disease and cerebrovascular diseases were 31.5%, 39.7%, 51.1%, 9.3%, 25.1% and 17.3%, respectively.[30] More than two-thirds of over 60 000 inpatients with T2DM in Beijing from 2006 to 2010 had diabetes-related complications. The most common long-term complications of them were peripheral neuropathy (32.8%), retinopathy (23.4%), diabetic nephropathy (20.2%), cardiovascular disease (19.8%) and peripheral vascular disease (17.1%), respectively.[20] The proportions of complications in the above studies were higher than the results of this study, which may be related to different lifestyle and diet, better access to medical services and higher screening intensity for complication in those relatively developed areas. In addition, the patients included in previous studies may have more complicated conditions and a relatively higher proportion of complications, as the hospitals included in the previous studies are top hospitals in top cities.

The gender differences in the risk of long-term complications among patients with diabetes have been controversial. In the general population, the prevalence of coronary heart disease was higher in male than in female population of the same age group.[31] A meta-analysis showed that the adjusted risk of coronary heart disease in females with diabetes was 58% higher than in males with diabetes.[32] In this study, male inpatients with either T1DM or T2DM had a much higher proportion of macrovascular complications than female inpatients. It may be related to estrogen protection among female patients and propensity for harmful lifestyles such as smoking and drinking among male patients.[33] By contrast, female was a risk factor of microvascular complication in inpatients with T2DM in this study. It had been reported that women were also more susceptible to microvascular complications in the Middle East T2DM population, but not in Caucasian population.[34 35] More research is needed to explore the potential mechanisms for gender difference in the occurrence of microvascular complications. In addition, we found that the proportions of microvascular and macrovascular complications among inpatients with T2DM were higher in urban areas than in rural areas, which is consistent with previous studies.[36–38] The difference may be related to the urbanized diet and lifestyle, or the relatively poor access to medical services in rural areas where patients with asymptomatic diabetic complications are less likely to be identified.

There are some limitations in our study. First, HQMS database covered >44.3% of the tertiary hospitals in China, rather than all the tertiary hospitals. Second, the results of this study could only be generalised for patients who attended tertiary hospitals in China, instead of the entire diabetic population in China. Third, the clinical information of prescription, duration of diabetes, HbA1c and outpatient data were not available in HQMS database. Fourth, the number and causes of hospital admissions may change over the time period under study.

For the first time, our study captures the prevalence of microvascular and macrovascular complications in inpatients with diabetes in tertiary hospitals in China, which also enriches global outlook for diabetic complications. There is an urgent need for improving the health management level of patients with diabetes and driving optimization of healthcare system.

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Supplementary material

Appendix table of Contents

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Appendix Table 1. The representativeness of HQMS

	All class 3 hospitals	Hospitals in HQMS
Hospitals, n	2340	1037
Average number of beds	1008.5	1014.6
Class		
3A, n (%)	1360 (58.1%)	647 (62.4 %)
3B, n (%)	445 (19.0 %)	176 (17.0 %)
Others, n (%)	535 (22.9 %)	214 (20.6 %)

Others: class 3C or unclassified class 3 hospitals.

Appendix Table 2. ICD-10 Codes used to define different diseases

Disease	ICD-10 Codes
T1DM	E10
T2DM	E11
Diabetic nephropathy	E10.2, E11.2, E12.2, E13.2, E14.2
Diabetic retinopathy	E10.3+H36.0*, E11.3+H36.0*, E12.3+H36.0*, E13.3+H36.0*, E14.3+H36.0*
Diabetic neuropathy	E10.4, E11.4, E12.4, E13.4, E14.4
Diabetic peripheral vascular disease	E10.5, E11.5, E12.5, E13.5, E14.5
Diabetic foot	China edition: E10.503+I79.2*, E10.504, E11.502, E11.601; Beijing edition: E10.521+I79.2*, E10.69*, E10.73, E11.521+I79.2*, E11.69*, E11.73*, E14.521+I79.2*, E14.69*, E14.73*; Clinic edition: E10.500x021+I79.2*, E10.500x04*, E10.500x05*, E10.503, E10.504, E10.505, E10.700x031, E10.700x032, E11.500x021+I79.2*, E11.500x04*, E11.500x05*, E11.503, E11.504, E11.505, E11.700x031, E11.700x032, E14.500x021+I79.2*, E14.500x04*, E14.500x05*, E14.700x031, E14.700x032
AMI[†]	I21
Stroke[†]	I61, I62, I63, I64
Kidney transplantation	Z94.0; ICD-9-CM procedure codes: 55.69*
Dialysis	Code of Hemodialysis and peritoneal dialysis
Hemodialysis	ICD-9-CM procedure codes: 39.2700*, 38.95*, 39.9500
Peritoneal dialysis	ICD-9-CM procedure codes: 54.93*, 54.98*
Heart failure	I50

*represents any possible number.

[†] Patients with the code as primary diagnosis were regarded as AMI or stroke

ICD, International Classification of Diseases; AMI, acute myocardial infarction.

Appendix Table 3. Temporal trends in inpatient demographics from 2013 to 2017

Demographic Characteristics	2013	2014	2015	2016	2017	P value
T1DM						
Total, n	12,786	20,740	19,815	20,422	18,650	
Male, n (%)	6,646 (52.0%)	10,986 (53.0%)	10,535 (53.2%)	10,772 (52.8%)	9,907 (53.1%)	0.244
Age, mean (±SD)	40.38 (19.2)	44.07 (20.3)	42.83 (20.3)	42.55 (20.5)	42.40 (20.5)	<0.0001
Age, median (IQR)	39 (25-55)	44 (27-60)	43 (26-59)	43 (26-59)	43 (26-59)	<0.0001
Rural, n (%)	2,444 (29.1%)	4,611 (34.5%)	4,078 (31.6%)	4,349 (32.6%)	3,794 (30.1%)	<0.0001
T2DM						
Total, n	897,086	1,257,244	1,298,079	1,363,837	1,277,792	
Male, n (%)	489,346 (54.6%)	673,765 (53.6%)	696,900 (53.7%)	737,717 (54.1%)	695,195 (54.4%)	<0.0001
Age, mean (±SD)	62.75 (12.7)	62.31 (12.5)	62.23 (12.5)	62.16 (12.43)	62.01 (12.4)	<0.0001
Age, median (IQR)	63 (54-72)	63 (54-72)	63 (54-71)	63 (54-71)	63 (54-71)	<0.0001
Rural, n (%)	119,783 (18.3%)	221,498 (23.3%)	223,152 (22.8%)	251,160 (24.4%)	240,332 (24.7%)	<0.0001

T1DM=type 1 diabetes mellitus. T2DM=type 2 diabetes mellitus. SD=standard deviation, IQR=inter-quartile range.

Appendix Table 4. Overall proportion of microvascular and macrovascular complications of inpatients with T1DM and T2DM from 2013 to 2017

Complications		T1DM(n=92,413)	T2DM(n=6,094,038)
Microvascular complications		34.1%	23.8%
	Diabetic retinopathy	12.1%	8.5%
	Diabetic nephropathy	12.1%	9.7%
	Diabetic neuropathy	23.2%	15.3%
	Diabetic foot	1.3%	1.4%
Macrovascular complications		18.2%	31.8%
	Diabetic peripheral vascular disease	9.8%	7.4%
	AMI	0.5%	2.9%
	Stroke	3.8%	11.5%
	Heart failure	5.7%	14.5%

T1DM=type 1 diabetes mellitus. T2DM=type 2 diabetes mellitus. AMI=acute myocardial infarction.

Appendix Table 5. The trends in the proportion of microvascular and macrovascular complications of inpatients with T1DM and T2DM from 2013 to 2017

Complications	2013	2014	2015	2016	2017	P value
T1DM						
Microvascular complications	29.9%	30.6%	30.2%	29.5%	31.6%	0.0175
Diabetic retinopathy	11.6%	10.4%	10.0%	10.0%	11.5%	0.5284
Diabetic nephropathy	10.1%	11.2%	11.1%	10.7%	11.1%	0.1813
Diabetic neuropathy	18.1%	19.9%	20.3%	20.5%	22.0%	<0.0001
Diabetic foot	1.0%	1.1%	1.0%	1.2%	1.0%	0.9417
Macrovascular complications	10.2%	16.6%	17.3%	17.3%	17.5%	<0.0001
Diabetic peripheral vascular disease	5.3%	8.1%	8.7%	8.7%	9.4%	<0.0001
AMI	0.2%	0.4%	0.4%	0.4%	0.5%	0.0002
Stroke	1.9%	3.3%	3.4%	3.5%	3.4%	<0.0001
Heart failure	3.3%	5.9%	6.0%	5.8%	5.2%	<0.0001
T2DM						
Microvascular complications	19.0%	20.3%	20.3%	20.4%	21.0%	<.0001
Diabetic retinopathy	6.4%	6.9%	6.9%	7.0%	7.4%	<0.0001
Diabetic nephropathy	8.4%	8.7%	8.4%	8.3%	8.2%	<0.0001
Diabetic neuropathy	11.1%	12.4%	12.6%	12.9%	13.6%	<0.0001
Diabetic foot	0.9%	1.0%	1.0%	1.2%	1.2%	<0.0001
Macrovascular complications	24.7%	25.8%	26.8%	28.1%	29.1%	<0.0001
Diabetic peripheral vascular disease	4.8%	5.3%	5.7%	6.2%	6.9%	<0.0001
AMI	1.8%	1.9%	2.1%	2.2%	2.3%	<0.0001
Stroke	8.1%	8.8%	8.9%	9.2%	9.5%	<0.0001
Heart failure	12.0%	12.2%	12.7%	13.3%	13.5%	<0.0001

T1DM=type 1 diabetes mellitus. T2DM=type 2 diabetes mellitus. AMI=acute myocardial infarction.

Appendix Table 6. The analysis of the trends in microvascular and macrovascular complications by logistic regression models

		Unadjusted		Adjusted	
		Odds Ratio(95%CI)	P value	Odds Ratio (95%CI)	P value
T1DM	Microvascular complications	1.01 (1.00,1.02)	**0.018**	1.02 (1.01,1.03)	**0.001**
	Diabetic nephropathy	1.01 (1.00,1.02)	0.182	1.00 (0.99,1.02)	0.544
	Diabetic retinopathy	1.00 (0.99,1.02)	0.529	1.2 (1.01,1.04)	**0.006**
	Diabetic neuropathy	1.05 (1.04,1.06)	**<0.001**	1.05 (1.04,1.06)	**<0.001**
	Diabetic foot	1.11 (1.09,1.12)	**<0.001**	1.13 (1.11,1.16)	**<0.001**
	Macrovascular complications	1.10 (1.08,1.11)	**<0.001**	1.11 (1.09,1.13)	**<0.001**
	Diabetic peripheral vascular disease	1.00 (0.96,1.04)	0.942	1.01 (0.96,1.06)	0.622
	AMI	1.14 (1.06,1.22)	**<0.001**	1.10 (1.02,1.19)	**0.016**
	Stroke	1.09 (1.06,1.11)	**<0.001**	1.09 (1.06,1.12)	**<0.001**
	Heart failure	1.05 (1.03,1.07)	**<0.001**	1.03 (1.00,1.05)	**0.026**
T2DM	Microvascular complications	1.02 (1.02,1.02)	**<0.001**	1.03 (1.03,1.03)	**<0.001**
	Diabetic nephropathy	0.99 (0.99,0.99)	**<0.001**	0.99 (0.99,1.00)	**<0.001**
	Diabetic retinopathy	1.03 (1.03,1.03)	**<0.001**	1.04 (1.04,1.04)	**<0.001**
	Diabetic neuropathy	1.05 (1.05,1.05)	**<0.001**	1.05 (1.05,1.06)	**<0.001**
	Diabetic foot	1.10 (1.10,1.10)	**<0.001**	1.10 (1.10,1.11)	**<0.001**
	Macrovascular complications	1.06 (1.06,1.06)	**<0.001**	1.05 (1.05,1.05)	**<0.001**
	Diabetic peripheral vascular disease	1.08 (1.07,1.08)	**<0.001**	1.08 (1.07,1.09)	**<0.001**
	AMI	1.07 (1.07,1.07)	**<0.001**	1.06 (1.05,1.06)	**<0.001**
	Stroke	1.04 (1.04,1.04)	**<0.001**	1.03 (1.03,1.03)	**<0.001**
	Heart failure	1.04 (1.04,1.04)	**<0.001**	1.03 (1.03,1.03)	**<0.001**

"Year" enters the model as a continuous variable.

T1DM=type 1 diabetes mellitus. T2DM=type 2 diabetes mellitus. AMI=acute myocardial infarction.

Appendix Table 7. The comparison of the proportion of AMI and stroke in inpatients with or without diabetes from 2013 to 2017

	2013	2014	2015	2016	2017	Total
T1DM						
Fatal AMI, n (%)	2 (0.01%)	12 (0.05%)	11 (0.04%)	22 (0.07%)	18 (0.06%)	65 (0.07%)
Non-fatal AMI, n (%)	30 (0.20%)	85 (0.33%)	94 (0.35%)	103 (0.35%)	111 (0.40%)	413 (0.45%)
AMI, n (%)	32 (0.21%)	97 (0.38%)	105 (0.39%)	125 (0.42%)	129 (0.47%)	478 (0.52%)
Fatal stroke, n (%)	16 (0.11%)	45 (0.18%)	42 (0.16%)	32 (0.11%)	31 (0.11%)	166 (0.18%)
Non-fatal stroke, n (%)	269 (1.79%)	791 (3.10%)	872 (3.22%)	990 (3.36%)	911 (3.28%)	3,376 (3.65%)
stroke, n (%)	285 (1.90%)	836 (3.27%)	914 (3.38%)	1,022 (3.47%)	942 (3.40%)	3,542 (3.83%)
T2DM						
Fatal AMI, n (%)	1,084 (0.10%)	1,783 (0.11%)	2,098 (0.11%)	2,496 (0.12%)	2,292 (0.11%)	9,753 (0.16%)
Non-fatal AMI, n (%)	18,752 (1.72%)	29,574 (1.76%)	37,040 (1.94%)	44,029 (2.08%)	44,905 (2.20%)	168,927 (2.77%)
AMI, n (%)	19,836 (1.82%)	31,357 (1.86%)	39,138 (2.05%)	46,525 (2.20%)	47,197 (2.31%)	178,680 (2.93%)
Fatal stroke, n (%)	1,494 (0.14%)	2,533 (0.15%)	2,829 (0.15%)	3,185 (0.15%)	2,847 (0.14%)	12,887 (0.21%)
Non-fatal stroke, n (%)	86,688 (7.96%)	145,288 (8.62%)	167,803 (8.78%)	191,401 (9.04%)	190,324 (9.33%)	687,369 (11.28%)
stroke, n (%)	88,182 (8.09%)	147,821 (8.77%)	170,632 (8.92%)	194,586 (9.19%)	193,171 (9.46%)	700,256 (11.49%)
Non-DM						
Fatal AMI, n (%)	2,867 (0.03%)	4,566 (0.03%)	5,198 (0.03%)	5,566 (0.03%)	4,888 (0.03%)	23,085 (0.03%)
Non-fatal AMI, n (%)	56,144 (0.53%)	91,462 (0.57%)	112,582 (0.64%)	129,712 (0.65%)	129,572 (0.68%)	510,986 (0.73%)
AMI, n (%)	59,011 (0.56%)	96,028 (0.60%)	117,780 (0.66%)	135,278 (0.68%)	134,460 (0.71%)	534,071 (0.76%)
Fatal stroke, n (%)	8,061 (0.08%)	11,622 (0.07%)	12,319 (0.07%)	12,579 (0.06%)	10,500 (0.06%)	55,071 (0.08%)
Non-fatal stroke, n (%)	346,556 (3.28%)	570,210 (3.55%)	636,242 (3.59%)	714,979 (3.61%)	707,669 (3.73%)	2,760,256 (3.93%)
stroke, n (%)	354,617 (3.36%)	581,832 (3.62%)	648,561 (3.66%)	727,558 (3.67%)	718,169 (3.79%)	2,815,327 (4.00%)

T1DM=type 1 diabetes mellitus. T2DM=type 2 diabetes mellitus. AMI=acute myocardial infarction.