Prevalence and Associated Factors of Diabetic Retinopathy in Quzhou, China: A Cross-Sectional Study

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Research Article

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Abstract

Objectives

To assess the prevalence and risk factors for fundus status among patients with type 2 diabetes mellitus (T2DM) using fundus screening in four towns of Quzhou city, Zhejiang province of China.

Methods

This cross-sectional study included 230 T2DM patients of four towns in Quzhou city, Zhejiang province of China. Participants were examined for the diabetes related fundus abnormalities and possible risk factors.

Results

Almost half of the T2DM patients (53.04%) reported with diabetic retinopathy (DR). Patients with diabetic retinopathy had longer duration of diabetes ($P < 0.001$) and higher HbA1c ($P < 0.01$). Risk factors for development of diabetic retinopathy included duration of diabetes and HbA1c. The prevalence of DR increased with the prolongation of the disease duration. The prevalence of DR was 28.79% in the group of disease duration < 5 years, 46.25% in the group of disease duration 5–10 years, 72.92% in the group of disease duration 10–15 years and 88.57% in the group of disease duration ≥ 15 years. What's more, the prevalence of DR also increased with the increment of HbA1c levels. The prevalence of DR was 44.62% in the group of HbA1c < 7%, 53.13% in the group of HbA1c 7%-8%, 62.92% in the group of HbA1c ≥ 8%.

Conclusion

The prevalence of DR was disturbingly high. Risk factors for DR were similar to other studies and included duration of diabetes and HbA1c. Thus, good glycemic control remains the core foundation of managing DR.

1. Introduction

Diabetes has assumed epidemic proportions, representing one of the leading causes of morbidity and mortality worldwide [1, 2]. The global prevalence of diabetes mellitus (DM) among adults (age 18–99 years) is estimated to be 451 million in 2017 and is expected to increase to 693 million by 2045 [3]. DM can lead to many complications, such as macrovascular complications (cardiovascular disease and stroke), and microvascular complications [kidney disease and diabetic retinopathy (DR)]. DR, as the specific microvascular complication of DM, now is mainly responsible for the vision loss in middle-aged and elderly individuals [4, 5]. As reported, after living with the disease for 20 years about 99% people with type 1 diabetes and about 60% of people with T2DM will have some degree of retinopathy [6]. According

to the statistical data, Zheng et al estimated that the global number of people with DR will grow from 126.6 million in 2010 to 191.0 million by 2030 [7]. Patients with severe degrees of DR have limited quality of life, restricted physical capacity, and use many health-care resources. Thus, fundus screening and early intervention should be performed in DM patients.

Nowadays, researchers have used both cross-sectional and longitudinal studies to estimate the prevalence of DR and identify some factors associated with a higher risk of DR, including hyperglycemia, hypertension, duration of diabetes, dyslipidemia, puberty, pregnancy, and cataract surgery [8]. Acquired the outlined above is an essential step to reduce blindness from diabetes. What a pity, population-based data in rural areas of China remained limited. To fill this gap, our study was performed to assess the prevalence and risk factors for fundus status among patients with T2DM using fundus screening in four towns of Quzhou city, Zhejiang province of China.

2. Materials And Methods

2.1 Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki, and the protocol of the study was approved by the human ethics committee of the Quzhou Center for Disease Control and Prevention. Written informed consent was obtained from all participants after clarifying the nature of the study and possible outcomes.

2.2 Study population

A total of 236 T2DM patients of four towns in Quzhou city, Zhejiang province of China were referred to the project of epidemiological investigation to evaluate the diabetes related fundus abnormalities. According to the WHO, the criteria of DM are symptoms of diabetes and a casual plasma glucose concentration ≥ 11.1 mmol/L or a fasting plasma glucose ≥ 7.0 mmol/L or 2-hour plasma glucose ≥ 11.1 mmol/L after 75 g oral glucose tolerance test. Patients whose data could not be collected for any reasons (n=6) were excluded from the study and the flow diagram of the study was showed in Figure 1.

2.3 Data Collection

Name, age, hypertension history and other health-related information of each participant were collected by standardized face-to-face questionnaires performed by the clinicians. The data regarding fundus screening and laboratory test were also collected for the study purposes.

2.4 Fundus screening

For all participants, two fundus photographs (the macular fovea and the optic center) of each eye of each patient were taken by well-trained clinicians (minimum 3-years of experience) using handheld fundus camera (Optomed, Finland). The photographs were used for diagnosis and grading, respectively. The patients who needed treatment were referred to an ophthalmologist. The Fundus staging of diabetic

retinopathy was according to the international clinical classification standard of diabetic retinopathy (2002).

2.5 Laboratory tests

The blood samples were drawn from an antecubital vein in the morning after at least 8 hours. The collected blood samples were subjected to evaluate glycated hemoglobin A1c (HbA1c).

2.6 Statistical analysis

The Statistical Package for the Social Sciences version 25 (IBM Corporation, Armonk, New York, NY) was used for statistical analysis. χ^2 tests were performed for categorical data. All data were tested for normal distribution using the Kolmogorov-Smirnov test. Measurement data conforming to the normal distribution were expressed by means ± standard deviation (X±S), paired t test was used for intergroup comparison. The measurement data that did not conform to the normal distribution were expressed by median (interquartile range), Mann-Whitney U test was used for intergroup comparison. Binary logistic regression analysis was used to evaluate factors associated with diabetic retinopathy. A *P* value <0.05 was considered statistically significant.

3. Results

3.1 Demographical and physical parameter and laboratory tests

Almost half of the T2DM patients (53.04%) reported with diabetic retinopathy. Patients had history of T2DM from 2-months to 31-years and 10-months. Patients with diabetic retinopathy had longer duration of diabetes (*P*<0.001) and higher HbA1c (*P*<0.05). The other demographical parameters of sex, age, BMI and prevalence rate of hypertension were not different between non-diabetic retinopathy (NDR) and DR. The results were showed in Table 1.

Table 1. Baseline characteristics of patients with T2DM

Group	N	Male N (%)	Age (year)	BMI (kg/m^2)	Hyper tension N (%)	Duration（year）	HbA1c（%）
NDR	108	40 (37.0%)	63.83±8.54	23.44 (3.98)	53 (49.07%)	5.75 (6.50)	7.30 (2.00)
DR	122	50 (41.0%)	64.87±8.69	23.78 (4.86)	56 (45.90%)	10.17 (8.19)***	7.80 (2.20)**

Notes: NDR: Non-diabetic retinopathy; DR: Diabetic retinopathy; BMI: Body mass index; HbA1c: Glycated hemoglobin A1c. *P***<0.01, *P****<0.001

3.2 Association of parameters with diabetic retinopathy

Demographical parameters, clinical conditions, and the laboratory tests were selected in the multivariate analyses for prediction of association with diabetic retinopathy. Duration of diabetes (*P*<0.001) and HbA1c (*P*=0.044) were associated with diabetic retinopathy (Table 2).

Table 2. Logistic Regression Analysis of the Risk Factor for Diabetic Retinopathy in T2DM

Risk Factor	B	S.E	Wald	df	Sig	Exp(B)	Exp(B) 95%CI
BMI	0.071	0.047	2.268	1	0.132	1.073	(0.979, 1.177)
Hypertension	0.436	0.320	1.855	1	0.173	1.546	(0.826, 2.894)
Duration	0.200	0.037	30.046	1	0.000***	1.222	(1.137, 1.313)
HbA1c	0.215	0.107	4.045	1	0.044*	1.240	(1.005, 1.529)
Constant	-5.110	1.494	11.689	1	0.001	0.006	

Notes: BMI: Body mass index; HbA1c: Glycated hemoglobin A1c; *P**<0.05, *P****<0.001.

3.3 The prevalence of DR in dependence on diabetes duration and HbA1c

The prevalence of DR increased with the prolongation of the disease duration. The prevalence of DR was 28.79% in the group of disease duration <5 years, 46.25% in the group of disease duration 5-10 years, 72.92% in the group of disease duration 10-15 years and 88.57% in the group of disease duration ≥15 years.

What's more, the prevalence of DR also increased with the increment of HbA1c levels. The prevalence of DR was 44.62% in the group of HbA1c <7%, 53.13% in the group of HbA1c 7%-8%, 62.92% in the group of HbA1c≥8%. All the results were showed in figure 2.

Discussion

According to the guidelines for clinical diagnosis and treatment of diabetic retinopathy in China [9], T2DM patients without fundus lesions should have the examinations of ocular fundus at least once every year. However, due to the lack of medical resources, most of patients do not comply with this standard. In this community -based cross-sectional study, we examined the retinopathy profile of 230 consecutive patients with T2DM. Our study estimated that about 53.04% of the T2DM developed DR in our research, that was much higher than some studies in China [10, 11]. We considered this phenomenon might be partly attributed to the study population. The study population in our study coming from rural areas are lack of health knowledge, many of them have had asymptomatic hyperglycemia for many years prior to the

diagnosis of T2DM. Thus, we emphasized the early recognition of DM, improved awareness, self-help and lifestyle.

Our study demonstrated that the duration of diabetes as independent risk factors for diabetic retinopathy, which were consistent with cross-sectional study of the first hospital of Shijiazhuang of China [12] and the multi-hospital-based cross-sectional studies on the Chinese community [13]. Results from the United Kingdom Prospective Diabetes Study (UKPDS) also showed that with the prolongation of the course of diabetes, the prevalence of DR is increasing and the symptoms of DR aggravated in different degrees [14].

Further, we also identified that the prevalence of DR increased with the prolongation of the disease duration. The retina is particularly sensitive to hyperglycemia. The literatures had suggested that the retinal damage was induced by chronic hyperglycemia through different mechanisms, such as polyol and hexosamine pathways, PKC pathway activation, generation of advanced glycation end products (AGEs) and ANG-II induced oxidative damage of retina [15, 16]. The two landmark clinical trials including the Diabetes Control and Complications Trial (DCCT) and UKPDS showed intensive blood glucose control (to achieve HbA1c of 7% or less) could reduce the risk of DR development and progression in T1DM and T2DM patients, respectively [14, 17]. Thus, good glycemic control remains the core foundation of managing DR.

The increasing burden of DR might bring enormous pressure on available infrastructure and resources. It is estimated that patients with DR can reduce blindness from diabetes by 30-50% after systematic, national screening programs [18, 19]. Thus, the screening and early treatment of DR should be well established into the primary health care system, in order to reducing DR progression.

There are several limitations of the study, for example, the cross-sectional study and lack of random sampling. The sample size in our study was small, in future, we need to expand the sample size for prospective study to confirm the risk factors for fundus status among patients with T2DM.

Abbreviations

AGEs: Advanced glycation end products; BMI: Body mass index; DCCT: Diabetes Control and Complications Trial; DM: Diabetes mellitus; DR: Diabetic retinopathy; HbA1c: Glycated hemoglobin A1c; NDR: Non-diabetic retinopathy; T2DM: Type 2 diabetes mellitus; UKPDS: United Kingdom Prospective Diabetes Study

Declarations

Ethics approval and consent to participate The protocol of the study was approved by the human ethics committee of the Quzhou Center for Disease Control and Prevention.

Availability of data and materials: Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Conflict of interest disclosures: The authors declare that there is no conflict of interest regarding the publication of this article.

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Author contributions：Zian Cheng: Conceptualization, Methodology, Data processing. Weifen Zhu: Data processing, Writing-Original draft. Xinxin Zhang: Writing-Reviewing and Editing. Xiaofang Ying: Data processing. Shanshan Liu: Validation. Qian He: Methodology. Xianchen Jiang: Data collection.

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Figures

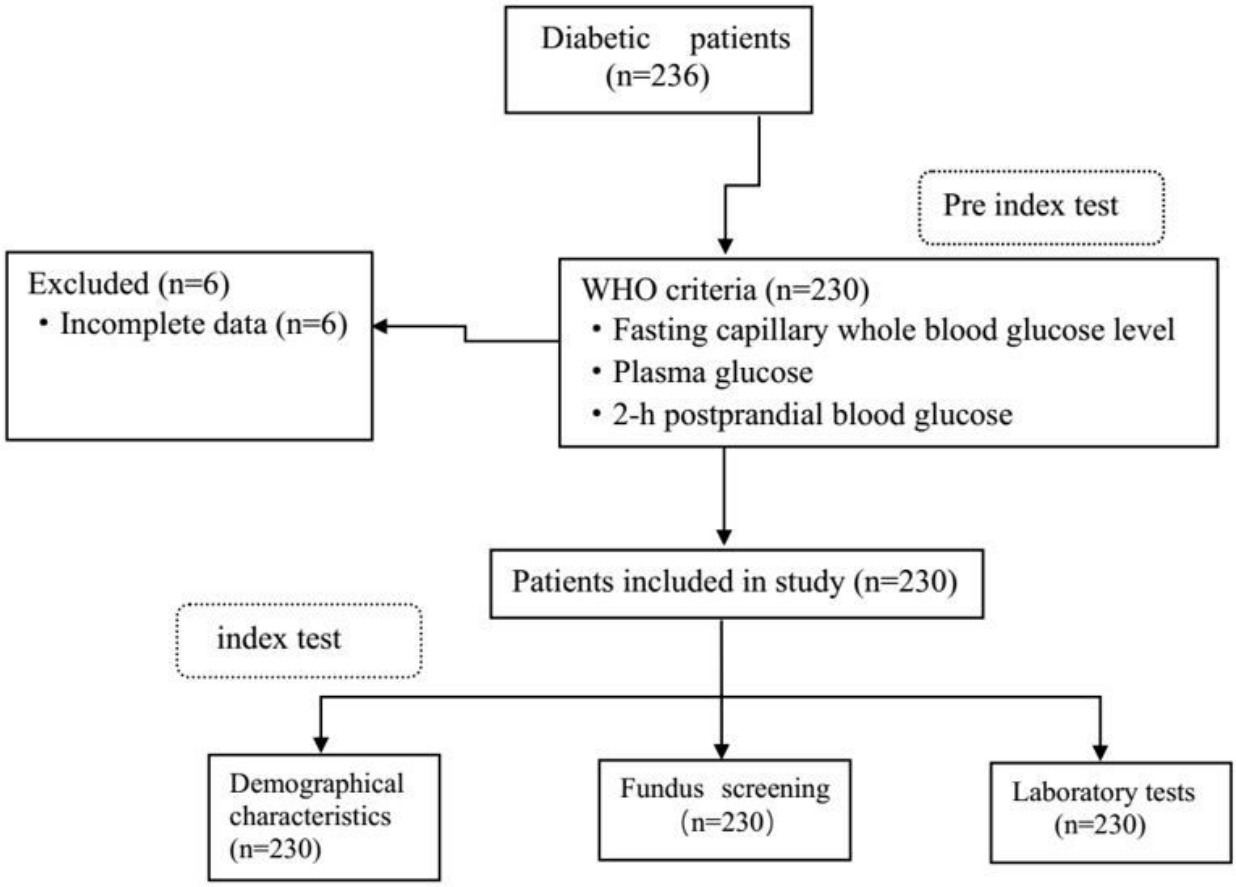

Figure 1

The flow diagram of the study

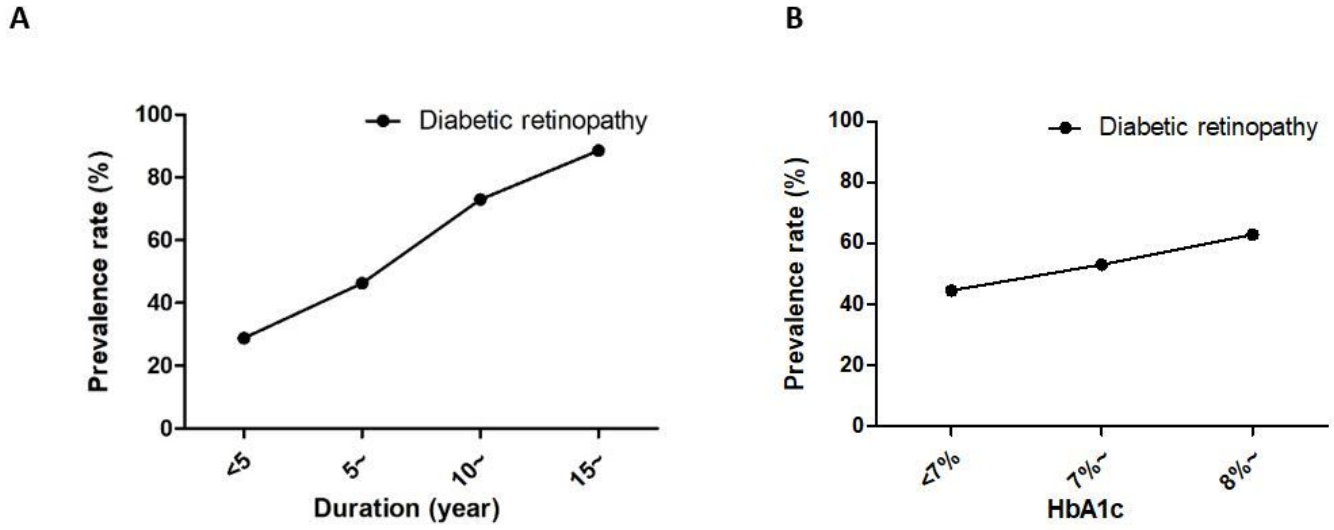

Figure 2

The prevalence of DR in dependence on diabetes duration and HbA1c (A) The prevalence of DR increased with the prolongation of the disease duration. (B) The prevalence of DR increased with the increment of HbA1c levels.