Prevalence of diabetic retinopathy among subjects with known diabetes in China: the Beijing Eye Study

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PURPOSE. *To evaluate the prevalence of diabetic retinopathy and risk factors among patients with self-reported diabetes mellitus in China.*
METHODS. *The Beijing Eye Study, a population-based study on inhabitants aged 40+ years, included 4439 subjects. Fundus photographs of the worse eye from participants with self-reported diabetes were graded.*
RESULTS. *Fundus photographs ready for evaluation and a filled out questionnaire were available for 4127 (93.0%) subjects. The prevalence of self-reported diabetes was 235/4127 (5.7%). Among the subjects with a self-reported diagnosis of diabetes, diabetic retinopathy was detected on the fundus photographs of 86 (37.1%) subjects, with macular edema in 12 (5.2%) subjects, clinically significant macular edema in 6 (2.6%) subjects, and a vision-threatening stage of the retinopathy in 12 (5.2%) subjects. Diabetic retinopathy was associated with rural region (p=0.004), longer duration of diabetes (p=0.009), use of diabetic medications (p=0.02), and lower education background (p=0.003).*
CONCLUSIONS. *Prevalence of diabetic retinopathy among Chinese patients aged 40+ years with a self-reported diagnosis of diabetes is about 37%, with a vision-threatening stage of the retinopathy detected in 5% of the subjects. About 5.7% of the adult Chinese population report on a known diagnosis of diabetes mellitus, with about 15% of these subjects knowing about the presence of diabetic retinopathy. The frequency of known diabetes mellitus is lower in rural regions than in urban regions, while diabetic retinopathy overall and macular edema among the subjects with known diabetes mellitus were significantly more common in the rural group. (Eur J Ophthalmol 2009; 19: 91-9)*

KEY WORDS. *Diabetic retinopathy, Diabetes mellitus, China epidemiology, Retinal hemorrhage, Ischemic retinopathy*

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INTRODUCTION

Previous population-based investigations evaluating the prevalence of diabetic retinopathy in Western countries have revealed that diabetic retinopathy is one of the major causes of visual impairment (1-5). There has been, however, a paucity of data on the prevalence of diabetes-related eye diseases in China, although China is the country with the second largest number of diabetic individuals (estimated 20.8 million patients) in the world (6-9).

Various cross-sectional investigations performed in China during the past 20 years have indicated an increasing prevalence of diabetes. In 1980, a population-based study involving 300,000 persons from provinces all over

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China reported a prevalence rate of 0.67% for diabetes mellitus (10). During 1994–1995, a population-based study included 300,000 persons from 19 provinces and revealed a prevalence of diabetes as of 2.8% (11). An investigation performed during 1997–1998 showed an increasingly higher prevalence rate of 5.89% (12). Consequently, it has been estimated that the number of diabetic patients in China will further increase accompanying the rapid economic change, demographic aging, and improvement of alimentation. According to the latest World Health Organization (WHO) report, the number is expected to increase to about 42.3 million diabetic patients by the year 2030 (13). Furthermore, it is not quite clear whether in Chinese subjects, as in Indians, type 2 diabetes differs from that in Europeans in an onset at a younger age, a weaker association with obesity, and a stronger influence of genetic factors (15, 16). These possible clinical differences and the rising prevalence of diabetes mellitus in China warrant well-conducted epidemiologic studies on the prevalence of diabetes, its awareness, and diabetes-related complications, to assess the health services burden due to the disease.

Although some studies have already been conducted on the prevalence of diabetic retinopathy in the urban and rural population in China, such studies have had several limitations: most of the studies were performed outside of mainland China, or in rural regions only or in urban regions only, or the retinal examination was performed upon ophthalmoscopy instead of taking fundus photographs, or they were primarily focused on the prevalence rate of cataract as main cause for visual impairment in the population (6, 7, 17-20). It was, therefore, the purpose of the present study to assess the prevalence of diabetic retinopathy and its associated risk factors in patients who were aware of having diabetes mellitus.

METHODS

The Beijing Eye Study is a population-based prospective cohort study in Northern China. It was carried out in four communities in the urban district of Haidian in the north of central Beijing and in three communities in the village area of Yufa of the Daxing District south of Beijing. The mean family income was significantly higher in the urban region (1688±4134 RMB) than in the rural region (393±360 RMB). The study has been described in detail recently (21-23). The Medical Ethics Committee of the Beijing Tongren Hospital approved the study protocol and all participants gave informed consent, according to the Declaration of Helsinki. At the time of the survey in the year 2001, there were a total of 5324 individuals aged 40 years or older residing in the seven communities. In total, 4439 individuals (2505 women) participated in the eye examination, corresponding to an overall response rate of 83.4%. The study was divided into a rural part (43.8% of subjects) and an urban part (56.2% of subjects). Mean age was 56.2±10.6 years (range: 40–101 years).

A screening questionnaire was conducted by trained interviewers. It elicited basic demographic details, a history of medical and ocular health, a history of ophthalmic operations, family history, and a history of smoking and alcohol intake. Additional information was obtained on the gross net family income, on the level of education, and on the profession. The interview included specific questions about whether participants had ever been diagnosed with diabetes mellitus and the year in which such a diagnosis was made. Participants with previously diagnosed diabetes were asked which treatment (diet, oral hypoglycemic agents, or insulin injection) was taken. In addition, they were also asked if and when diabetic retinopathy had been diagnosed and which types of hospitals (municipal hospital or ophthalmologic hospital, county hospital, or private hospital) provided the diagnosis.

An ophthalmic examination was carried out including measurement of uncorrected and best-corrected visual acuity (Snellen charts), noncontact tonometry, frequency doubling perimetry, slit lamp examination, ophthalmoscopy, and photography of the lens (Neitz CT-R camera; Neitz Instruments Co., Tokyo, Japan) and fundus (fundus camera, type CR6-45NM, Canon Inc.). The pupils were dilated with a drop of tropicamide and phenylephrine in both eyes. Fundus photography was performed with a 45-degree nonstereoscopic camera (fundus camera, type CR6-45NM, Canon Inc.) and 35-mm color transparencies. Two photographic fields were taken of each eye; the first centered on the optic disk (field #1) and the second centered on the fovea (field #2).

We diagnosed self-reported diabetes mellitus by a history of physician provided diagnosis or in subjects who were reported to be treated with insulin, oral hypoglycemic agents, or diet only. By reference to Wong et al (24), a retinopathy severity score was assigned according to a scale modified from the Airlie House Classification system (25). Diabetic retinopathy was considered to be present if any characteristic lesion as defined by the Early Treatment Diabetic Retinopathy Study severity scale was present: microaneurysms, hemorrhages, cotton-wool spots, intraretinal microvascular abnormalities (IRMAs), hard exudates, venous beading, and new vessels (26). Macular edema was defined as hard exudates within one optic disc diameter from the center of the macula, or presence of focal photocoagulation scars in the macular area. Clinically significant macular edema was considered to be present when the macular edema involved or was located within 500 µm of the foveal center, or if focal photocoagulation scars were present in the macular area.

The photographs were examined and assigned a level of retinopathy, and the final diagnosis for each patient was determined from the grading of the worse eye. If one of the eyes was ungradable, the individual was considered to have a score equivalent to that in the other eye.

The photographs were assessed in a masked manner and by an experienced and trained ophthalmologist (X.X.). In case of doubt, the photographs were re-assessed by a panel including several ophthalmologists (X.X., L.X., J.B.J.).

Statistical analysis was performed by using a commercially available statistical software package (SPSS for Windows, version 15.0, SPSS, Chicago, IL, USA). The value of frequencies are given as mean ± standard errors, the mean values of all other parameters as mean ± standard deviations. Logistic regression was used to investigate the associations of the binary dependent variable “presence of diabetic retinopathy” with the continuous or categorical independent variables and odds ratios (OR) and 95% confidence intervals (95% CI) were offered.

RESULTS

Prevalence and characteristics of self-reported diabetes

The questionnaire was answered by 4127 subjects (93.0% of the participants of the present study or 77.5% of the eligible study population) out of whom 235 (5.7% of the participants of the present study or 4.4% of the eligible study population) subjects indicated to have diabetes mellitus. In the rural population, the prevalence of self-reported diabetes was 2.8% (50/1791) what was significantly (p<0.001) lower than the prevalence rate in the urban population group with a prevalence rate of 7.9% (185/2336). The rate in men (102/1793 [5.7%]) was equal to the rate in women (133/2334 [5.7%]).

The prevalence of self-reported diabetes increased significantly (p<0.001) with age, with a prevalence rate of 1.1% (16/1392) in persons aged 40 to 49 years, 5.2% (59/1127) in persons aged 50–59 years, 9.1% (108/1190) in persons aged 60–69 years, and 12.4% (52/418) in persons aged 70+ years. The number of subjects who reported using medications to control their hyperglycemia was 177 (177/235, 75.3%). There were 153 (65.1%) participants who used oral hypoglycemic tablets and 24 (10.2%) who used insulin. There were 55 (23.4%) participants who reported receiving diet treatment only, and 3 (1.3%) subjects indicated not applying any treatment.

The known duration of diabetes was less than 5 years in 48.6% (108/222) of the subjects, 5–9 years in 22.5% (50/222), 10–19 years in 22.5% (50/222), and 20 years or more in 6.3% (14/222). Thirteen (5.5%, 13/235) participants could not recall the specific year when the diagnosis of diabetes was made. Four of them (30.8%) kept a diet as treatment of their diabetes, 8 (61.5%) took tablets, and 1 (7.7%) subject took insulin. The prevalence of diabetic retinopathy in these 13 subjects without known year of diabetes diagnosis was 30.8% (4/13). These 13 participants who could not recall the year of their diabetes diagnosis were more likely to be rural (p=0.001), and they did not vary significantly in age (p=0.470) or gender (p=0.344) from the subjects who knew the year of diabetes diagnosis.

Prevalence and characteristics of diabetic retinopathy

Out of 235 participants with self-reported diabetes, gradable fundus photographs were available for at least one eye of 232 (98.7%) subjects. The overall prevalence of diabetic retinopathy among participants with self-reported diabetes was 86/232 or 37.1%. Mild nonproliferative diabetic retinopathy was seen in 68/232 (29.3%) subjects with self-reported diabetes, moderate nonproliferative diabetic retinopathy in 9/232 (3.9%) subjects, and severe nonproliferative diabetic retinopathy or the proliferative stage in 9/232 (3.9%%). The overall prevalence of macular edema was 12/232 (5.2%), of clinically significant macular edema 6/232 (2.6%), and of vision-threatening retinopathy 12/232 (5.2%). The prevalence of diabetic retinopathy, the severity of diabetic retinopathy, and the prevalence of macular edema were significantly (p=0.001, p=0.005, p=0.02, respectively) higher in the rural population than that in the urban population. No significant differences were found in the prevalence of clinically significant macular edema and the prevalence of vision-threatening retinopathy between rural and urban population (Tab. I).

The prevalence of diabetic retinopathy was not significantly different between men (32.4%) and women (40.8%, p=0.19). The mean age of participants with diabetic retinopathy was 63.0±7.6 years (median 65 years, range 46–81 years). The mean age of participants with self-reported diabetes but without diabetic retinopathy was 62.8±9.1 years (median 63 years, range 40–82 years), with no significant difference between the two groups (p=0.86). The prevalence of diabetic retinopathy was not significantly associated with age (p=0.25).

In three participants with the self-reported diagnosis of diabetes who did not receive any treatment, one subject was found to have mild diabetic retinopathy. The prevalence of diabetic retinopathy overall and the severity of diabetic retinopathy were significantly higher in participants who were treated with insulin and oral hypoglycemic tablets when compared with those subjects treated with diet only. Participants treated with insulin or oral hypoglycemic tablets had higher, however, not significantly higher prevalence rates of macular edema, clinically significant macular edema, and vision-threatening retinopathy than the subjects treated with diet only. Again, the subjects with insulin therapy had higher, however not significantly higher, prevalence rates of diabetic retinopathy, severity of diabetic retinopathy, macular edema, clinically significant macular edema, and vision-threatening retinopathy than the subjects with oral therapy (Tab. II).

The mean reported duration of diabetes in participants with diabetic retinopathy was 9.7±8.4 years (median 8 years, range 0–42 years), and it was 5.9±6.3 years (medi-

TABLE I - PREVALENCE OF DIABETIC RETINOPATHY IN PARTICIPANTS OF THE BEIJING EYE STUDY WITH A SELF-REPORTED DIAGNOSIS OF DIABETES MELLITUS

Retinopathy status	Total group (n=232)	Rural population (n=50)	Urban population (n=182)	p value
Any retinopathy	86 (37.1%)	29 (58.0%)	57 (31.3%)	0.001
Severity of DR				0.005
Mild NPDR	68 (29.3%)	22 (44.0%)	46 (25.3%)	
Moderate NPDR	9 (3.9%)	4 (8.0%)	5 (2.7%)	
Severe NPDR-PDR	9 (3.9%)	3 (6.0%)	6 (3.3%)	
Any macular edema	12 (5.2%)	6 (12.0%)	6 (3.3%)	0.023
Clinically significant macular edema	6 (2.6%)	2 (4.0%)	4 (2.2%)	0.610
Vision-threatening retinopathy	12 (5.2%)	4 (8.0%)	8 (4.4%)	8 (4.4%)

DR = diabetic retinopathy; NPDR = nonproliferative DR; PDR = proliferative DR.

TABLE II - PREVALENCE OF DIABETIC RETINOPATHY BY TREATMENT OF DIABETES IN PARTICIPANTS OF THE BEIJING EYE STUDY WITH A SELF-REPORTED DIAGNOSIS OF DIABETES MELLITUS

Retinopathy status	Insulin (n=24)	Oral hypoglycemics (n=150)	Diet only (n=55)
Any retinopathy	15 (62.5%)	60 (40.0%)	10 (18.2%)
Severity of DR			
Mild NPDR	11 (45.8%)	50 (33.3%)	6 (10.9%)
Moderate NPDR	1 (4.2%)	6 (4.0%)	2 (3.6%)
Severe NPDR-PDR	3 (12.5%)	4 (2.7%)	2 (3.6%)
Any ME	3 (12.5%)	6 (4.0%)	3 (5.5%)
CSME	2 (8.3%)	3 (2.0%)	1 (1.8%)
Vision-threatening retinopathy	3 (12.5%)	6 (4.0%)	3 (5.5%)

Difference between treatment groups (α=0.0167): Insulin and oral hypoglycemics: any DR, p=0.047; severity of DR, p=0.019; ME, p=0.106; CSME, p=0.137; vision-threatening retinopathy, p=0.106. Insulin and diet only: any DR, p<0.001; severity of DR, p<0.001; ME, p=0.361; CSME, p=0.218; vision-threatening retinopathy, p=0.361. Oral hypoglycemics and diet only: any DR, p=0.004; severity of DR, p=0.010; ME, p=0.701; CSME, p=1.000; vision-threatening retinopathy, p=0.701.
DR = diabetic retinopathy; NPDR = nonproliferative diabetic retinopathy; PDR = proliferative diabetic retinopathy; ME = macular edema; CSME = clinically significant macular edema.

an 4 years, range 0–43 years) in participants without diabetic retinopathy. This difference was statistically significant (p=0.001). Prevalences of diabetic retinopathy, the severity of diabetic retinopathy, macular edema, and vision-threatening retinopathy increased significantly with longer duration of diabetes (Tab. III). The prevalence of clinically significant macular edema increased with longer duration of diabetes, but this did not reach statistical significance.

Awareness of diabetic retinopathy

In 86 participants with diabetic retinopathy, 13 participants (15.1±3.9%) were aware of their diabetic retinopathy and 73 participants (84.9%±3.9%) were not. No significant difference was found in the percentage of awareness of diabetic retinopathy between the rural population (10.3±5.6%) and the urban population (17.5±5.0%, p=0.529). The percentage of awareness of diabetic retinopathy was 11.8±3.9% in participants with mild nonproliferative diabetic retinopathy, 11.1±10.5% in participants with moderate nonproliferative diabetic retinopathy, and 44.4±16.6% in participants with severe nonproliferative diabetic retinopathy or its proliferate stage. The percentage of awareness of diabetic retinopathy increased significantly with the stage of the retinopathy (X_{trend}^2=0.029). For all participants with diabetic retinopathy, the diagnosis of the retinopathy was made in municipal hospitals or ophthalmologic hospitals.

TABLE III - PREVALENCE OF DIABETIC RETINOPATHY BY DURATION OF DIABETES IN PARTICIPANTS OF THE BEIJING EYE STUDY WITH A SELF-REPORTED DIAGNOSIS OF DIABETES MELLITUS

	<5 yrs (n=107)	5-9 yrs (n=48)	10-19 yrs (n=50)	≥20 yrs (n=14)	X_{trend}^2	p value
Any diabetic retinopathy (n=82)	28 (26.2%)	17 (35.4%)	27 (54.0%)	10 (71.4%)	18.1	<0.001
Severity of diabetic retinopathy					22.6	<0.001
Mild NPDR (n=66)	24 (22.4%)	15 (31.2%)	20 (40.0%)	7 (50.0%)		
Moderate NPDR (n=7)	3 (2.8%)	1 (2.1%)	3 (6.0%)			
Severe NPDR-PDR (n=9)	1 (0.9%)	1 (2.1%)	4 (8.0%)	3 (21.4%)		
Any ME (n=12)	3 (2.8%)	2 (4.2%)	4 (8.0%)	3 (21.4%)	6.9	0.010
CSME (n=6)	2 (1.9%)		2 (4.0%)	2 (14.3%)	4.2	0.052
Vision-threatening retinopathy (n=12)	3 (2.8%)	1 (2.1%)	5 (10.0%)	3 (21.4%)	8.6	0.004

NPDR = nonproliferative diabetic retinopathy; PDR = proliferative diabetic retinopathy; ME = macular edema; CSME = clinically significant macular edema.

TABLE IV - ASSOCIATED FACTORS FOR DIABETIC RETINOPATHY AFTER ADJUSTING FOR AGE AND GENDER IN PARTICIPANTS OF THE BEIJING EYE STUDY WITH A SELF-REPORTED DIAGNOSIS OF DIABETES MELLITUS

Risk factors	Odds ratio	95% CI	p value
Area, rural versus urban	3.83	1.54–9.52	0.004
Treatment method			0.021
Diet only (reference)			
Oral hypoglycemic tablets	3.11	1.25–7.75	0.015
Insulin	5.62	1.46–21.69	0.012
Duration of diabetes			0.009
<5 yr (reference)			
5–9 yr	1.82	0.77–4.30	0.172
10–19 yr	3.39	1.49–7.72	0.004
≥20 yr	7.29	1.61–33.00	0.010
Educational Level			0.003
College education (reference)			
Illiteracy-half illiteracy	3.45	0.92–12.94	0.067
Primary school	4.25	1.37–13.16	0.012
Middle school	4.49	2.02–9.98	<0.001

p value: statistical significance of the association (two-tailed p value).

Associations with diabetic retinopathy

Univariate analysis revealed that no significant associations were found between the presence of any diabetic retinopathy and age (p=0.86; 95% CI: –2.50, 2.08), gender (p=0.19; OR: 1.44; 95% CI: 0.84, 2.48), self-reported hypertension (p=0.30; OR: 0.74; 95% CI: 1.42, 1.31), self-reported hyperlipemia (p=0.40; OR: 0.77; 95% CI: 0.42, 1.41), self-reported coronary heart disease (p=0.32; OR: 0.74; 95% CI: 0.41, 1.34), self-reported cerebral hemorrhage/infarction (p=0.40; OR: 0.68; 95% CI: 0.27, 1.70), current smoking (p=0.89; OR: 0.94; 95% CI: 0.40, 2.24), former smoking (p=0.77; OR: 0.91; 95% CI: 0.47, 1.73), and alcohol consumption (p=0.47; OR: 0.56; 95% CI: 0.11, 2.82). A multivariable binary regression model for any diabetic retinopathy is listed in Table IV. Characteristics that were significantly associated with the presence of diabetic retinopathy were rural, longer duration of diabetes, use of diabetic medications, and lower education background.

DISCUSSION

The results of the study suggest that the prevalence of diabetic retinopathy in patients with self-reported diabetes is about 37%. A direct comparison of prevalence rates of diabetic retinopathy in various population-based studies is difficult to perform due to different evaluating methods (photography versus ophthalmoscopy), different photographic techniques (stereoscopic versus monoscopic), different photographic fields taken, different grading scales, different diagnostic criteria of diabetes, and different demographic characteristics. However, the prevalence rate of diabetic retinopathy in the present study is rather similar to that found in Taiwanese (prevalence rate: 35.0%) as measured by ophthalmoscopy (27), and it is higher than that found in Chinese Americans (prevalence rate: 25.7%) as measured by assessment of fundus photographs including two fundus fields taken (24). The prevalence of diabetic retinopathy among subjects with self-reported diabetes was 37.7% in the Blue Mountains Eye Study (BMES) (28), 29.1% in the Visual Impairment Project (VIP) of Australia (29), and 26.2% in southern India (30). A recent Indian study reported that the prevalence of diabetic retinopathy among self-reported diabetics in urban population was 20.8% (14).

Our study finds the residential area is an independent associated factor of diabetic retinopathy in self-reported diabetes. Subjects with self-reported diabetes mellitus and coming from the rural region showed a 1.8-fold increased risk of diabetic retinopathy when compared with subjects from the urban population. The difference in the prevalence rates of 58.0% versus 31.3% in the rural population versus the urban population was highly significant (p=0.001). This finding is different from that in the Melbourne VIP study (31), in which no significant difference in the prevalence of diabetic retinopathy in subjects with self-reported diabetes between the rural and the urban population group was detected (rural versus urban, 21.4% versus 32.3%, p=0.10). The reason for the discrepancy between the studies may be that differences in the health care structure and socioeconomic parameters between rural and urban areas are considerably more marked in China than in Australia. In China, the rural residents usually have a lower awareness of diabetes mellitus, the diagnostic possibilities are limited, and it may be more difficult to keep a metabolic control. In that aspect, one has to consider that all the diagnoses of diabetic retinopathy were made in municipal hospitals or ophthalmologic departments, and that none of the diagnoses came from county hospitals or private hospitals. Since awareness of having a disease is of utmost importance to initiate early treatment and to prevent complications, the finding may highlight the need for further regional and national initiatives to increase awareness among the general population, particularly in the rural population, of the risk factors for diabetes mellitus and diabetic retinopathy, so that a further rapid increase in the prevalence of the diabetes and its complications may be reduced or even prevented. At the same time, it highlights the requirements for large-scale training of personnel, for educating the population about the risks of diabetes mellitus, and to supply means to screen the population at risk for diabetes mellitus.

The present study finds a 5.6-fold increased risk of diabetic retinopathy in subjects with insulin therapy and a 3.1-fold increased risk of diabetic retinopathy in those subjects treated with oral hypoglycemic medication compared with subjects treated with diet only. The difference in the prevalence rates of diabetic retinopathy between the participants treated with insulin and the subjects treated with hypoglycemic agents was not statistically significant (oral medication versus insulin, p=0.30; OR=0.55; 95% CI: 0.18, 1.68). Although the groups treated with insulin or oral medication had a significantly higher prevalence of retinopathy, one may not conclude that it was the treatment itself which led to the retinopathy. One may postulate, however, that the advanced stage of diabetes which was responsible for initiating the medical treatment may have been responsible for the higher frequency of diabetic retinopathy in the medically treated subjects. The finding that the treatment method of diabetes has significant associations with the prevalence of diabetic retinopathy has also been reported in other population-based studies (24, 27, 31, 32).

In this study, we did not find any age- or gender-related differences in the prevalence of diabetic retinopathy. It agrees with the results of other population-based studies (28, 32-34). In a similar manner, the present study detected a 1.8-fold increased risk of diabetic retinopathy in self-reported diabetes with 5–9 years of diabetic duration, 3.4-fold increased risk in those with 10–19 years of diabetic duration, and a 7.3-fold increased risk in those with 20 years of diabetic duration or more compared with less than 5 years of diabetic duration. The increased risk of diabetic retinopathy with longer duration of diabetes noted in the present investigation has also been found in other large epidemiologic studies (14, 24, 28, 33).

In addition, the educational level was found to be an independent risk factor of diabetic retinopathy in the subjects with self-reported diabetes in the present study. Compared with subjects with a college education, participants with primary school educational level had a 4.3-fold increased risk of diabetic retinopathy, and subjects with an educational level of middle school had 4.5-fold increased risk. One may postulate that a lower awareness of diabetes in combination with a reduced accessibility to the health care system for subjects with a lower educational level may lead to delayed diagnosis of diabetes mellitus, so at the time of diagnosis of diabetes mellitus a relatively high percentage of subjects may already have developed diabetic changes in the retina. Interestingly, subjects with a low educational level of illiteracy or half illiteracy and known diagnosis of diabetes mellitus had an only slightly (OR=3.45), not even statistically significantly (p=0.067), higher risk of diabetic retinopathy. A possible explanation for that may be that these subjects may have a shorter life expectancy due to a lower accessibility to the medical system, so that there may not be enough time for the diabetic retinopathy to develop.

The relatively small study size did not allow adequate statistical power to detect associated or risk factors of vision-threatening retinopathy, macular edema, and clinically significant macular edema. The prevalence of vision-threatening retinopathy was, however, 5.2% in the present study. Presently, there are estimated to be more than 20.8 million diabetic individuals in China (8). If the prevalence of vision-threatening retinopathy as found in the present study is to be extrapolated to all of China, the number would be more than 1 million patients with vision-threatening retinopathy. Furthermore, the number of diabetic subjects is expected to double by the year 2030, which could translate into a compromise in the quality of life for millions of patients and could indicate a heavy economic burden to the society. Diabetic retinopathy is one of the few ophthalmic diseases that have a defined preventive measure to delay progression and consequent visual loss. One preventive measure is to maintain strict glycemic control (35). The other is regular ophthalmologic examinations of those individuals identified as diabetics to detect early retinopathy and laser treatment at the right moment. The anticipated marked increase in patients with diabetic retinopathy underscores again the need for large-scale training of skilled personnel for screening and to provide treatment possibilities for diabetes in general and for diabetic retinopathy in particular.

The present study is part of several studies from China on diabetic retinopathy (36, 37). In the study by Liu and colleagues (36), the prevalence of retinopathy was examined in 2131 patients with type 2 diabetes attending a Beijing hospital for the first time. The median age of patients was 58 years. The overall prevalence of retinopathy was 27.3% and for proliferative retinopathy 7.8%. Similar or slightly higher figures were found in the present study.

There are limitations to the present study. One limiting factor may be that two photographic fields were taken for the detection of diabetic retinopathy. The standard of studies on the prevalence of diabetic retinopathy has usually been a 30-degree setting and seven-field stereoscopic photography. This difference in the photographic setup might have had an influence on the outcome in the sense of an artificially low rate of detected diabetic retinopathy and may be one of the reasons for the discrepancies between previous studies and the present investigation. Moss et al (38) reported a sensitivity of 80% for detecting any retinopathy when only the central fields 1 and 2 are examined instead of using all seven standard fields. Another limiting factor of the present study may be that 45-degree nonstereoscopic photographs were used instead of 30-degree stereoscopic photographs. This may be an additional factor leading to an underdetection of diabetic retinopathy, in particular of diabetic maculopathy. It may influence the estimates for maculopathy as a cause of blindness and visual impairment. A further limiting factor is that the diagnosis of diabetes mellitus was self-reported and that it was not checked by a medical examination of the whole study population in the year 2001. It strongly suggests that the rate of 5.7% of self-reported diabetes will be lower than the rate of existing diabetes mellitus in the study population. Another limitation of the study is small sample size, leading to a limited number of subjects in the various groups and reducing the value of their findings. One of the strengths of the present study is the high frequency of gradable fundus photographs and high response rate of the questionnaire. The other strength is the use of objective retinal photography and standard grading techniques. The present study is also the first study from China to report on the prevalence of diabetic retinopathy using retinal color photography.

On the whole, the present study must be considered preliminary in the sense that, as China continues its rapid economic development, changes may be expected to occur in diet, lifestyle, and life expectancy, especially in rural areas, and that these changes may have a substantial impact on the incidence and prevalence of diabetes – in particular type 2 diabetes – and its complications. Prevalence rates recorded today may change if similar Chinese populations are evaluated several years from now. However, the data obtained from the present study may be of value when compared with similar data obtained in future years, and by comparison with the results of similar studies conducted in other countries with different genetic pools and different dietary/social customs. In addition, they may be the basis for planning health care for the Chinese population.

In conclusion, the present study suggests that about 37% of subjects with self-reported diabetes have diabetic retinopathy, and that about 1 out of 20 of the subjects with self-reported diabetes have vision-threatening retinopathy. The risk factors of diabetic retinopathy in self-reported diabetes were rural versus urban residential area, treatment method of diabetes, duration of diabetes, and level of education. It highlights that the national policy guideline should be aimed at preventing the onset and delaying the progress of diabetic retinopathy such that diabetic retinopathy should not become a major cause for needless visual impairment or blindness in China in the future.

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