• Investigation •

Predictors for attending annual eye screening for diabetic retinopathy amongst patients with diabetes in an urban community of Beijing

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Abstract

• AIM: To gain a better understanding of possible factors that may influence the decision of diabetes persons to participate in annual eye screening in an urban community setting of China.

• METHODS: A structured interview including questions on attendance of eye screening, knowledge and awareness of diabetic retinopathy was conducted. The presence and degree of retinopathy were assessed using two field non-mydriatic retinal photography.

• RESULTS: Totally 720 diabetes persons were recruited and 519 were enrolled in this cross-sectional study. In this urban setting of Beijing, among diabetes patients of average of 10y duration, 77% confirmed having undergone at least one eye examination and 61% reported having at least one eye examination with dilated pupil. As for the last 12mo, the number decreased to 210 (47%) and 131 (30%) separately. Most of the participants (95%) were aware that diabetes could affect their vision and that regular eye examination was necessary. Very few of them (12%) however were aware that the early stages of diabetic retinopathy presented without symptoms of vision loss. Having attended patient education on diabetes was effective in building awareness about diabetic eye disease and was a significant positive predictor for attending eye screening [education in a year, Adj. OR=0.47 (0.29-0.74), *P*<0.001, education years ago, Adj. OR=0.56 (0.33-0.96), *P*=0.036]. The duration of disease also increased the likelihood of having undergone eye screening (Adj. OR=0.96, *P*<0.05).

• CONCLUSION: Being exposed to education about the complications of diabetes increases the probability of attending diabetic eye screening. An appropriate patient knowledge building strategy should be made available to patients from the time of diagnosis.

• KEYWORDS: diabetic retinopathy; annual screening; education; community

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INTRODUCTION

In China, diabetes mellitus type 2 (diabetes) is now considered to be the most important chronic disease and remains one of the most important challenges for public health. The most recent national survey, which included representative sample of 46 239 adults, 20 years of age or older, from 14 provinces and municipalities, found the prevalence of total diabetes (which included both previously diagnosed diabetes and previously undiagnosed diabetes) to be 9.7% (10.6% among men and 8.8% among women) accounting for 92.4 million adults[1]. A more recent (2013) systematic review of all published literature on diabetes in China found that the prevalence ranged from 0.61% to 20.85% with an average of 6.41%[2]. Cross sectional population studies in China found that some 37% of diabetes patients also have diabetic retinopathy (DR) with 5% having the more severe vision-threatening stage of DR[3]. Screening programs for DR have been proved to be effective and efficient in reducing visual loss due to diabetes[4-5] but in China eye screening programs are still not sufficiently developed. One study performed in 2009 in the southern province of Guangdong found that 66.7% of 824 patients with diabetes did not receive retinal examination in the last year and 43.2% had never been examined[6].

Currently diabetic patients in China are cared for at three levels of medical services, including 1) community health care centers; 2) secondary or district hospitals; and 3) tertiary or regional hospitals. For screening of diabetic eye complications however patients need to seek consultations in specialized eye departments of general or specialized hospitals that are found mostly in larger urban areas.

In Beijing community healthcare services are now well established throughout the urban districts. Community health providers are mandated to keep healthcare records for the local residents, with regular reporting of newly diagnosed persons with the most important chronic diseases (cardiovascular diseases, hypertension and diabetes). Public Health Education Programs have been introduced and are conducted regularly in the community. Guidelines for primary diabetes care are made available to community nurses and doctors and annual retinal examination has been included in these guidelines[7]. Despite these efforts no formal referral systems for regular eye screening has been implemented. In the previous studies that provided information on the awareness of diabetes in China, to our knowledge, no detail information was included on the actual frequency of patients usage of eye screening and how this could be related to patients' awareness and knowledge of eye complications.

In this study we report from a large urban community in Beijing on the frequency of attendance to eye screening (examinations) amongst diabetes patients and possible predictors to having undertaken such screening.

SUBJECTS AND METHODS

Subjects Data for this study are drawn from persons identified with diabetes in Desheng Community of Beijing Western District. Desheng Community is a large urban community with a population of 120 000 where the municipal government is the community health service provider. The infrastructure includes one out-patient health service center and 8 local community out-patient health service stations. These give preventative, curative and rehabilitation services for chronic diseases and mother and childcare services.

Recruitment of Study Participants Study participants from four of the eight health stations with confirmed diagnosis of diabetes were contacted through the local health stations and invited to participate in eye screening at each individual health station. Examinations were conducted over a period of 1mo at each of the four health stations.

Data Collection and Study Variables of Interest All examinations and interviews of study participants were conducted at a dedicated examination room at each of the local community health stations. Interviews were undertaken of study participants by specially trained health workers using paper preformat that also included provision for registration of data from physical examination and from results of laboratory tests.

Study Questionnaire A standard questionnaire was used consisting of 4 parts: 1) questions regarding general and demographic and socioeconomic variables including age, sex, marital status, levels of education, monthly income; 2) questions regarding medical history, especially about diabetes, hypertension, hyperlipidemia, cardiovascular, kidney and eye disease; 3) questions regarding knowledge and awareness about DR constructed in true-or-false format, using reference questions[6]; 4) questions regarding attendance of organized educational course on diabetes.

Physical Examination and Laboratory Tests 1) Anthropometric parameters: (i) body weight and height; (ii) waist and hip circumference (with subjects in light clothing and not wearing shoes). Body mass index (BMI) will be calculated as the ratio between weight and the square of height of the participant (kg/m^2). Waist-to-hip ratio will be calculated as waist circumference divided by hip circumference; 2) visual examinations for best corrected visual acuity (VA) were performed using logMAR VA chart. Vision was noted as the best corrected VA of the better eye; 3) systolic and diastolic blood pressure measurement were performed according to internationally accepted guidelines; 4) laboratory tests included random blood glucose (RBG) on the day of eye examination and lipid profile or HbA1c if available in the medical record; 5) retinal photography and assessment of DR: two-field 45º color fundus images, centered at the optic disc and macula, respectively were taken from both eyes of each participant through un-dilated pupils, using a Canon CR6-45NM camera (Canon Inc., Kanagawa, Japan) connected to a high resolution (2160×1440 pixels) Canon D30. The retinal changes were graded using an adapted version of the Scottish Diabetic Retinopathy Grading System (2003)[8].

Data Entry and Statistical Analysis Data entry was secured with Epidata, from the Epidata Association of Denmark (www.epidata.dk) and analyzed with a *t*-test, rank sum test, Chi-square test and logical regression analysis using R and Epicalc (https://cran.r-project.org/doc/contrib/Epicalc_Book.pdf). Single factor univariate analysis of previously screened versus non-screened cases (where screened was defined as any retinal examination with dilated pupil the last 12mo) was performed. Logistic regression model of predictors for retinal examination was developed that included all the factors which were statistically significant during the univariate analysis.

Ethical Considerations The study was approved by the hospital ethic committee and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

RESULTS

From November 2011 to May 2012, 720 diabetes persons (287 males, 433 females) were identified as potential study

participants from the Beijing Desheng Community, and a total of 519 diabetes patients were enrolled. The median age of participants was 71.4y of which 60% were female, 31% had graduate level education and 17% primary school education. The mean duration of diabetes was 10.1y (5.5-15.1y). The general characteristics of the participants were summarized in Table 1.

Of the 519 study participants, 416 (80%) confirmed having undergone at least one eye examination of which 344 (66%) included an examination with dilation of pupil. Totally 231 (44%) reported to having undergone an eye examination in the last 12mo but only 145 (28%) patients reported that this included a retinal examination with dilated pupil (Figure 1).

In this study we were able to capture gradable images in 446 (86%) of cases. Retinopathy was identified in 141 (31.6%) participants. Among them, 77 (54.6%) patients with moderate or severe non-proliferative DR, or proliferative DR, or maculopathy were considered to have potential threat to vision and suggest for further examination. Of the 30 participants that self-reported having DR, we could only confirm 19 or 63% that have DR. Table 2 summarizes self-reported attendance in eye screening examinations in persons with gradable images which was quite similar with the situation of the total participants.

Table 3 presents study participants awareness of diabetic eye complications. The median knowledge score of seven reference questions was 6 (5, 6), with one point for a correct response. When asked about the importance of eye screening and the association of eye complications and diabetes and its effect on vision, 97% had knowledge about this. Over 78% were also aware that vision loss was preventable and treatable. However, most patients (88%) were not aware that DR could present without any symptoms of vision loss in the early manifestation of disease.

Table 4 presents possible factors that could influence diabetes patients' decision to undergo eye screening of those study participants with gradable images. Single factor univariate analysis of previously screened cases (where screened is defined as any retinal examination with dilated pupil the last 12mo) were older (P<0.05) and with longer duration of diabetes (P<0.001). Their knowledge awareness score was higher as well as their self-reported knowledge of their own disease status (P<0.05). We found that 40% of those, who had not received a retinal exam the last 12mo, had never attended a diabetes education program. While only 26% of those who had received a retinal exam never attended, which was significantly less (P<0.01).

Table 5 presents a multiple logistic regression model of potential predictors of ever previously having a retinal examination with dilated pupil the last 12mo. Significant independent correlates included self reported DR (OR 0.38; P<0.05), duration of diabetes (OR 0.96; P<0.05), and attending diabetes education (P<0.01).

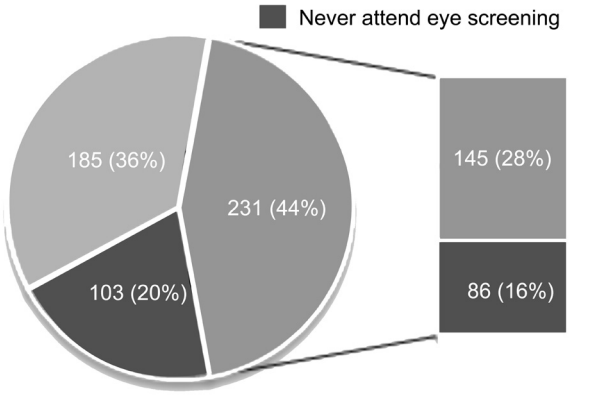

Figure 1 Basic data of attending retinal examination among diabetes participants (n=519).

Table 1 General characteristics of the diabetes participants n=519

Parameters	Values
Age (a)	71.4 (64.7-77.3)[1]
Gender (M/F)	209/310
Ethnics (Han/others)	485/34
Marital status (married/others)	443/76
Education (p/s/g)[2]	88/268/163
Monthly income (CNY)	2500 (2000-3000)[1]

[1]Median (25%, 75%); [2]p/s/g: Primary/secondary/graduate.

Table 2 Self-reported attendance in eye screening examinations in persons with and without DR n (%)

Parameters	No DR (n=305)	DR (n=141)	All (n=446)
Any eye exam	240 (79)	105 (74)	345 (77)
Any retinal exam with dilated pupil	186 (61)	85 (60)	271 (61)
Any eye exam within 12mo	146 (48)	64 (45)	210 (47)
Retinal exam with dilated pupil within 12mo	86 (28)	45 (32)	131 (30)
Self-reported diagnosis of DR	11(3.6)	19 (13)	30 (7)

Table 3 Knowledge of DR among all study participants [1]n=519

Question	No. choosing correct answer, n (%)
1) DM can affect eyes	502 (97)
2) Regular eye examinations necessary	502 (97)
3) Diabetic patients more likely to get eye disease	497 (96)
4) DR can cause blindness	492 (95)
5) DR is preventable	441 (85)
6) DR is treatable	404 (78)
7) DR usually has early symptoms	62 (12)

[1]The knowledge score was calculated based on responses to these 7 questions, with 1 point awarded for a correct response and 0 points for an incorrect or uncertain answer. Median knowledge score =6 (5, 6).

DISCUSSION

Diabetes now figures as the most prominent emerging chronic disease. There are currently over 130 million people living with diabetes in the Western Pacific and over 387 million people have diabetes globally with dramatic increases seen in countries all over the world primarily related to changing

Table 4 Univariate analysis related to attendance of retinal exam with dilated pupil the last 12mo

Parameters	No retinal exam (*n*=175)	Retinal exam (*n*=271)	Test stat	*P*
Age (a)	68.9 (62.6-76.2)	71.3 (64.6-76.4)	Ranksum	0.046
Gender (M/F)	72/103	110/161	Chi-sq	0.986
Marital status (s/m/w/d)[1]	1/155/17/2	1/238/29/3	Fisher's	0.979
Education (p/s/g)[2]	31/92/52	48/138/85	Chi-sq	0.928
Monthly income (CNY)[3]	2150 (2000-3075)	2500 (2000-3000)	Ranksum	0.201
Duration of DM (a)	8.4 (4.1-13.1)	10.7 (6.5-15.7)	Ranksum	<0.001
BMI (kg/m^2)	26.5 (23.8-28.4)	25.9 (24.1-28)	Ranksum	0.416
Random blood glucose (mmol/L)	8.5 (7-11)	8.7 (7-11.3)	Ranksum	0.649
Hypertension (with/without)	115/60	201/70	Chi-sq	0.07
Hyperlipidaemia (with/without)	88/87	134/137	Chi-sq	0.939
Family history of diabetes (with/without/not sure)	75/63/37	125/102/44	Chi-sq	0.419
[4]logMAR VA of better eye	0.2 (0-0.3)	0.2 (0.1-0.3)	Ranksum	0.146
DR (with/without)	56/119	85/186	Ranksum	0.971
Knowledge score[5]	6 (5-6)	6 (6-6)	Ranksum	0.038
Self-reported *vs* not reported DR	5/170	25/246	Chi-sq	0.015
Diabetes education (≤1a/>1a/never)	67/38/70	138/64/69	Chi-sq	0.003
Treatment level (CSS/MH/Other)	121/43/11	169/89/13	Chi-sq	0.175

[1]s/m/w/d: Single/married/widowhood/divorced; [2]p/s/g: Primary/secondary/graduate; [3]CNY: Chinese yuan; [4]logMAR VA: logMAR visual acuity; [5]Correct answer=1 point, incorrect or no answer=0 points; CSS: Community service centre; MH: Municipal hospital.

Table 5 Logistic regression model of predictors for retinal exam with dilated pupil the last 12mo

Parameters	Crude OR (95%CI)	Adj. OR (95%CI)	*P* (Wald's test)	*P* (LR-test)
Self reported DR	0.29 (0.11-0.76)	0.38 (0.14-1.04)	0.059	0.041
Diabetes education				0.004
≤1a	0.46 (0.29-0.72)	0.47 (0.29-0.74)	<0.001	
>1a	0.58 (0.34-0.98)	0.56 (0.33-0.96)	0.036	
Duration of DM	0.95 (0.93-0.98)	0.96 (0.93-0.99)	0.016	0.014
Knowledge score[1]	0.86 (0.72-1.03))	0.89 (0.74-1.06))	0.198	0.197
Age	0.98 (0.96-1)	0.98 (0.96-1.01)	0.182	0.181

[1]Correct answer =1, incorrect answer =0.

lifestyle[9]. It carries with it substantial immediate and long-term healthcare costs[10] with the greatest social and economic burden carried by low- and middle-income countries where four out of five people with diabetes are living and where general access to diagnosis and affordable care for chronic disease and diabetes is especially limited[11].

Numerous population-based studies have been conducted in Western countries using photographic evidence of DR and their results have consistently suggested that the prevalence of DR is about a third of those diagnosed with diabetes whereas proliferative DR and macular edema account for around 9% and 17%, respectively of all diagnosed cases[12-16]. In our clinical based study we found that the overall prevalence of DR (31.6%) is consistent with population studies in China[4] as could be expected. However, because of the limited condition in the community, 14% of the participants could not get gradable images and further analysis was not available. All the participants with ungradable images or any DR except for mild NPDR were suggested to see an ophthalmologist as soon as possible.

It is now well established that timely retinal eye screening is cost effective in reducing the risk of vision threatening complications of diabetes[17]. Variation in compliance rates, duration of diabetes, glycemic control and screening sensitivities influence the cost-effectiveness of screening programs[18]. Although the English Diabetic Eye Screening Programme consistently achieves over 80% attendance[19], studies in US have demonstrated that at least 30% of patients fail to comply with the recommendation to undergo regular eye screening[20]. As to developing countries, this has been shown to be even higher[21]. Studies have also shown that despite introducing formal awareness programs focused on need for adherence to guidelines-a large part of diabetic patients do not follow these guidelines[22-23]. It has also been shown that programs that seek to introduce eye screening routinely in the general practice has many challenges[24-25].

In China the importance of a combined prevention and treatment strategy to reduce the risk of vision loss in diabetes patients has been emphasized[26]. With the largest population of diabetes patients in the world, establishing an adequate system for DR screening is a complex issue.

We found in this survey that even in communities, where the availability of specialized ophthalmic services is excellent, where basic medical insurance, provided by the government, covered all the participants, few diabetes patients receive an annual eye exam with fundus photography. Despite study participants self reporting good knowledge both of the importance of regular eye screening and awareness of eye complications in diabetes disease-only 6% of those that we diagnosed with DR reported to know of this diagnosis. Despite the relative easy access to specialized eye care services we found that 20% had never undergone any form of eye examination and only 28% had received a proper retinal examination with dilated pupil the last 12mo.

In conclusion, we found that, other than the duration of diabetes disease, being exposed to education about the complications of diabetes and increased awareness of the risk of eye complications of diabetes disease increases the probability of attending diabetic eye screening. This critical knowledge seems to be an important predictor that, when all other factors are equal (*e.g.* availability of appropriate guidelines and referral systems) will influence diabetes patients decision to attend regular eye screening in a more timely manner. Based on these findings we may conclude that the implementation of an appropriate patient knowledge building strategy should be made available to diabetes patients from the time of diagnosis and this may be the first step for us to change the situation.

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Conflicts of Interest: Zou YH, None; **Li Q,** None; **Cui SS,** None; **Jia W,** None; **Zhang N,** None; **Ma K,** None; **Snellingen T,** None; **Liu XP,** None.

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Retraction Notice

Retraction: "The association of LOXL1 polymorphisms with exfoliation syndrome/glaucoma: Meta-analysis" by Qing-Shan Ji, Bing Qi, Yue-Chun Wen, *et al* published on *International Journal of Ophthalmology* 2015;8(1):163-165. DOI:10.3980/j.issn.2222-3959.2015.01.27.

This article has been retracted by the editor. This article involves in duplicate submission. After a thorough investigation, we regret to announce that this article must be retracted. We apologize to the readership of *International Journal of Ophthalmology*.

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