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Delay in seeking medical care after the onset of symptoms in patients with sight-threatening diabetic retinopathy

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Abstract

Objective: To investigate the reasons for delays in seeking medical care in patients with diabetic retinopathy and associated risk factors.

Methods: We retrospectively reviewed data for patients with sight-threatening diabetic retinopathy (STDR) who attended a hospital in China. Various forms of STDR were identified, including severe non-proliferative DR, clinically significant macular edema and proliferative DR. Demographic, clinical and socioeconomic information was collected and the associated risk factors were evaluated.

Results: Of the 127 patients with STDR, 89.2% sought medical care within 1 month of developing symptoms. Those who sought treatment ≥6 months after symptoms developed had significantly lower income and less knowledge of diabetic complications than those who attended earlier. Multivariate logistic regression analysis showed that no or infrequent routine examination for diabetic complications were associated with long delays in seeking medical care (odds ratio (OR) 3.06, 95% confidence interval (CI) 1.05–9.19; and OR 2.91, 95% CI 1.04–8.40, respectively).

Conclusions: Most patients with STDR sought medical care within 1 month of symptoms developing, but no or infrequent routine examination for diabetic complications was associated

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with long delays. These results stress the importance of educational programs regarding diabetic complications to encourage timely medical care and prevent poor outcomes.

Keywords
Diabetic retinopathy, delay in seeking medical care, educational program, ocular screening, diabetes mellitus, sight-threatening, proliferative, non-proliferative, macular edema

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Introduction

Diabetes mellitus (DM) is a chronic systemic disorder that is highly prevalent worldwide. The International Diabetes Federation estimated the global prevalence of DM to be 9.3% (463 million people) in 2019, and has predicted this to rise to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045.[1] Diabetic retinopathy (DR) is a microvascular complication of DM and a primary cause of visual impairment and blindness. Nearly all patients with type 1 DM and over 60% of those with type 2 DM acquire a significant degree of DR during the first 20 years after diagnosis.[2,3] Currently, several grading systems are used to classify diabetic abnormalities; two of the most common are the Early Treatment Diabetic Retinopathy Study classification (ETDRS) and the National Screening Committee classification (NSC).[4,5] Patients without retinal microaneurysms or hemorrhages are classified as 'R0' (NSC) or '10' (ETDRS). Small hemorrhages and aneurysms can advance to mild non-proliferative diabetic retinopathy (NSC R1, ETDRS 20 to 35), moderate-to-severe non-proliferative diabetic retinopathy (NSC R2, ETDRS 43 to 53) and eventually to proliferative diabetic retinopathy (NSC R3, ETDRS $\geq$61). Approximately one in ten patients with DM develop sight-threatening DR (STDR), which may be severe non-proliferative DR, clinically significant macular edema (CSME), or proliferative DR (PDR), and all cause severe visual impairment or permanent loss of vision if not treated.[4,5]

Approximately 75% of patients with DM live in low- and middle-income countries. In 2015, China reported the largest number of cases of DM (99.6 to 133.4 million) and 1.3 million diabetes-related deaths, with 40.8% of these deaths being accounted for by patients of <60 years of age.[6] A recent epidemiological study of patients with DM in China revealed prevalences for DR and STDR of 27.9% and 12.6%, respectively.[7]

DR can be prevented by appropriate control of blood glucose and blood pressure,[8,9] and laser treatment is effective.[10] In addition, vascular endothelial growth factor inhibitors have been shown to be effective therapies for diabetic maculopathy[11,12] and PDR.[13,14] Despite recent significant advances in the treatment of DR, the implementation of these therapies in developing areas of China remains a challenge. One factor that has a major negative influence on timely and efficient treatment is a delay by patients in seeking treatment after the onset of symptoms of DR. Clinical studies have shown that a delay between the appearance of symptoms of diabetic complications and intervention by a physician significantly raises the risk of diabetic

neuropathy, gangrene, foot ulcers, and amputations.[15,16] Therefore, there is an urgent need to identify the factors that predispose toward such a delay to develop novel strategies to improve the outcomes associated with diabetic complications. However, it remains unclear whether such delays in patients who are advancing to STDR can cause a permanent loss of vision.

In the present study, we aimed to quantify the time interval between the onset of symptoms of DR and seeking medical care by patients with STDR, and to identify the risk factors contributing to this delay. We hope that the findings might be used to guide the development of educational curricula geared towards the prevention of DR and other diabetic complications.

Materials and methods

Participants

We performed a retrospective cross-sectional study in Qilu Hospital of Shandong University, one of the biggest medical centers in Shandong Province, between May 2018 and April 2019. Visual acuity examination, fundus photography and optical coherence tomography (OCT) were performed to grade the DR in each participant. Two grading systems were employed for this purpose: the NSC and the ETDRS classifications.[4,5] Patients with grades indicative of severe non-proliferative DR (R2), PDR (R3) and CSME (M1) were defined as having STDR. The exclusion criteria were: (1) communication difficulties (severe hearing loss or cognitive impairment); (2) refusal to participate in the study, and (3) severe lens or corneal opacity that would influence the retinal examination and grading. The period of time between the onset of symptoms of DR, including blurred vision, eye floaters, and black spots in the area of vision, and seeking medical care in the form of a first visit to a local clinic or Qilu Hospital was recorded. The following categories of the duration of the delay were defined: $\leq$1 month, 1 to 6 months (including 6 months), 6 to 12 months (including 12 months) and $>$12 months.

Data collection

Self-administered questionnaires were distributed by ophthalmologists to their patients who had STDR. In this way we obtained the following data: (1) demographics; e.g., sex, age, education level, and monthly income; (2) information regarding the participant's DM (the type, time since diagnosis and glycaemic control); (3) information regarding diabetic complications; e.g., diabetic nephropathy and diabetic neuropathy; (4) information regarding co-morbidities, including cardiac disease, history of stroke and hypertension; (5) frequency of examinations for diabetic complications, including those affecting the eye; (6) the participation of the patient's family in their care; and (7) the participant's knowledge regarding diabetic ocular complications. In addition, information regarding the participant's DR and the grading provided by an ophthalmologist was collected and recorded.

The study was approved by the Ethics Committee of Qilu Hospital, Shandong University (approval number KYLL-201802-167; date February 2018) before data collection was commenced. All the participants were made aware of the use of their personal data in this study and they all provided their written informed consent to participate.

Statistical analysis

A descriptive analysis was performed to evaluate the characteristics of the participants. Continuous data are presented as mean $\pm$ standard deviation and were

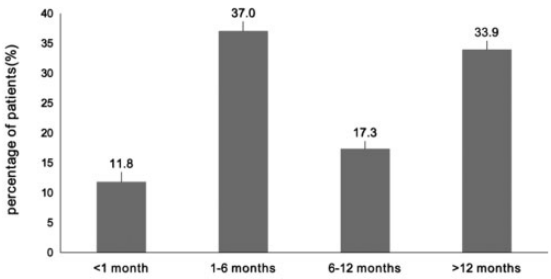

Figure 1. Time intervals between the onset of diabetic retinopathy symptoms of and seeking medical care.

analysed using one-way analysis of variance. The Kruskal–Wallis H test was applied to analyse continuous data that were not normally distributed. Categorical data are presented as proportions and the chi-square test were employed to analyse them. Ordinal Logistic Regression (OLR) analysis was performed to identify clinical variables that were independently related to the delay in seeking treatment. First, a univariate analysis was performed to screen potentially associated variables, then a multivariate analysis was performed using potential risk factors identified in previous studies and the variables shown to be significant in the univariate analysis. All the analyses were completed in R software (www.r-project.org). The "foreign" package was used for the OLR. All the statistical tests were two-tailed and $p < 0.05$ was accepted as indicating statistical significance.

Results

Characteristics of the study sample and the time interval between the onset of symptoms of DR and seeking treatment

A total of 127 verified questionnaires were collected and considered to be valid. The mean age of the participants was 53.5 ± 10.6 years, 75 (59.1%) were men and 8 (6.3%) had type 1 DM. Of these participants, 15 (11.8%) sought treatment within 1 month of symptoms of DR developing, while 47 (37.0%) sought treatment between 1 and 6 months after symptoms developed, 22 (17.3%) sought medical care between 6 and 12 months afterwards, and the remaining 43 (33.9%) waited >12 months before seeking treatment (Figure 1).

Comparisons of participants in each category of time interval between the onset of symptoms and seeking medical care

There were no differences in the sex distribution, age or education level between the four categories. However, participants who sought treatment >6 months after the onset of symptoms had significantly lower incomes than those who sought treatment within 6 months. The mean duration of DM in the participants was 10.8 years. Of these participants, 23 (18.1%) had severe non-proliferative DR, 92 (72.4%) had PDR and 21 (16.5%) had CSME. There were no significant differences in the prevalences of other complications, including diabetic nephropathy and diabetic neuropathy, or co-morbidities, such as cardiac disease, a history of stroke or hypertension. Participants who sought treatment >6 months after the onset of symptoms had significantly less knowledge of diabetic ocular complications than those who presented within 6 months (Table 1).

Table 1. Characteristics of the study sample and a comparison of participants in the four categories of delay in seeking medical care.

		Time interval between the onset of symptoms and seeking medical care				
	All (n = 127)	Group 1 (<1 month, n = 15)	Group 2 (1–6 months, n = 47)	Group 3 (6–12 months, n = 22)	Group 4 (>12 months, n = 43)	*p*-value
Demographics						
Gender (male/female)	75/52	10/5	30/17	10/12	25/18	
Age (years, mean ± SD)	53.5 ± 10.6	51.1 ± 10.6	52.8 ± 11.5	54.5 ± 10.4	54.5 ± 9.7	0.25
Education (primary/high school/college)	46/62/19	3/9/3	16/22/9	10/10/2	17/21/5	0.43
Monthly income (USD)	411.61	464.00	477.45	368.86	343.26	0.02
Diabetic history						
Type of diabetes (type 1/2)	8/119	1/14	3/44	1/21	3/40	0.98
Duration of diabetes (years)	10.83 ± 6.98	12.1 ± 9.38	10.25 ± 6.98	10.14 ± 5.23	11.06 ± 6.82	0.96
Glycaemic control (follow the treatment regimen) (always/regularly/sometimes/never)	34/73/16/4	3/8/4/0	15/30/0/2	7/13/2/0	9/22/10/2	0.06
Diabetic retinopathy information						
Severe non-proliferative diabetic retinopathy	23	4	10	2	7	0.50
Proliferative diabetic retinopathy	92	10	31	20	31	0.17
Clinically significant macular edema	21	2	6	3	10	0.58
Other complications and co-morbidities						
Diabetic nephropathy (yes/no)	13/114	1/14	4/43	2/20	6/37	0.79
Diabetic neuropathy (yes/no)	4/123	0/15	1/46	1/21	2/41	0.78
Cardiac heart disease (yes/no)	8/119	3/12	4/43	0/22	1/42	0.05
History of stroke (yes/no)	1/126	0/15	1/46	0/22	0/43	0.63
Hypertension (yes/no)	66/61	8/7	24/23	10/11	24/19	0.93
Regular examination for diabetic complications (regularly/occasional/never)	18/71/38	6/7/2	6/25/16	3/11/8	3/28/12	0.03
Participation of the patient's family in their care						
Report made by the family (yes/no)	58/69	6/9	24/23	11/11	17/26	0.67
Response by the family (observation or seeking help)	71/56	10/5	27/20	15/7	19/24	0.21
Knowledge regarding diabetic eye complications (yes/no)	35/92	9/6	19/28	10/11	10/33	0.04

Data are numbers of participants, unless otherwise stated. The chi-square test and Kruskal–Wallis H test were used and $p<0.05$ was regarded as indicating statistical significance.

n, number; SD, standard deviation; USD, United Sates dollar.

Risk factors associated with a delay between the onset of symptoms and seeking medical care

We first performed univariate logistic regression analysis (Table 2) to screen for variables that were associated with the delay, which identified income level (odds ratio [OR] 0.99, 95% confidence interval [CI] 0.99–0.99, $p < 0.05$) and no or infrequent examinations for diabetic complications (OR 3.22, 95% CI 1.12–9.62, $p < 0.05$ and OR 3.60, 95% CI 1.33–10.15, $p < 0.05$, respectively) as being associated with a long delay between the onset of symptoms and seeking treatment. Multivariate regression analysis was then performed (Table 3), which included these variables and other previously identified risk factors (educational level, duration of DM, the participation of the patient's family in their care and knowledge of diabetic eye complications). This revealed that no or infrequent examination for diabetic complications (OR 3.06, 95% CI 1.05–9.19, $p < 0.05$ and odds ratio 2.91, 95% CI 1.04–8.40, $p < 0.05$, respectively) were independently associated with a long delay in seeking medical care. This implies that patients who undergo regular and timely evaluations of their diabetic complications would seek treatment in a timely fashion after the onset of symptoms of DR).

Table 2. Results of the univariate regression analysis of factors potentially associated with a delay in seeking medical care for patients with sight-threatening diabetic retinopathy.

	Odds ratio	95% confidence interval	*p*-value
Age	1.02	0.99, 1.05	
Sex	1.42	0.75, 2.71	
Educational level			
Primary school	2.08	0.80, 5.47	
High school	1.61	0.63, 4.13	
College	Reference		
Income level	0.99	0.99, 0.99	<0.05
Duration of diabetes	0.99	0.95, 1.05	
Glycaemic control			
Never	1.86	0.27, 16.07	
Sometimes	2.95	0.90, 10.38	
Regular	1.04	0.50, 2.14	
Always	Reference		
Routine examination for diabetic complications			
Never	3.22	1.12, 9.62	<0.05
Sometimes	3.60	1.33, 10.15	<0.05
Always	Reference		
Response of the patient's family			
No	1.21	0.64, 2.30	
Yes	Reference		
Hypertension			
No	0.91	0.48, 1.72	
Yes	Reference		
Knowledge of diabetic eye complications			
No	1.59	0.77, 3.28	
Yes	Reference		

Table 3. Multivariate regression analysis of factors associated with a delay in seeking medical care.

	Odds ratio	95% confidence interval	*p*-value
Educational level			
Primary school	1.23	0.40, 3.77	
High school	1.15	0.42, 3.15	
College	Reference		
Income level	0.99	0.99, 1.00	
Duration of diabetes	1.02	0.97, 1.07	
Routine examination for diabetic complications			
Never	3.06	1.05, 9.19	<0.05
Sometimes	2.91	1.04, 8.40	<0.05
Always	Reference		
Response from family			
No	1.62	0.77, 3.46	
Yes	Reference		
Knowledge of diabetic eye complications			
No	0.80	0.28, 2.21	
Yes	Reference		

Discussion

The results of the present analysis show that most patients with STDR in this part of China do not seek medical care until more than a month has passed since the onset of symptoms of DR. Only 11.8% of the present group of patients sought medical treatment within 1 month of the onset of symptoms, while 37% delayed seeking assistance for 1 to 6 months, 17.3% delayed for 6 months to 1 year and 33.9% delayed for more than a year. Such a delay in the diagnosis and treatment of DR might lead to the development of more serious complications that could have been prevented by timely ophthalmological examination and treatment. Therefore, we propose that a delay in seeking medical care is one of the most important reasons for the development of STDR in this population. In addition to a delay in seeking care, it has been shown that a delay in follow-up can also cause permanent impairments in the vision of patients with chronic eye conditions, including DR, glaucoma and age-related macular degeneration.[17] Therefore, medical education programs are urgently needed to reduce the delay in arranging both initial and follow-up appointments with ophthalmologists, and therefore reduce the risk of severe ocular complications.

The socioeconomic status of patients might affect the promptness with which appointments are made. The results of the present analysis show that patients who seek treatment >6 months after the onset of symptoms have significantly lower income than those who seek treatment within 6 months. This finding is consistent with that of Weng *et al.*, who found that low socioeconomic status is associated with high morbidity and premature mortality in patients with DM.[18] Patients with higher incomes might have easier access to healthcare resources and better medical support, enabling them to seek immediate care upon the onset of symptoms of DR. Moreover, patients with lower incomes may tend to initially visit a primary care provider, where eye examinations are more limited in most areas of China.

Multivariate regression analysis demonstrated that no or infrequent examination for diabetic complications are associated

with long delays between the onset of symptoms of DR and seeking medical care. The National Institute for Health and Care Excellence (NICE) of the United Kingdom recommends that patients be immediately referred to a local eye screening service when they are diagnosed as having DM and that screening should be repeated at least annually. However, many patients with DM do not have regular eye examinations, and particularly in underdeveloped areas of China. This has been attributed to a lack of knowledge regarding DM and diabetes-related complications among these patients. This lack of knowledge leads to the mistaken perception that DM is not a severe disease. Therefore, patients with DM do not recognise the necessity of seeking immediate treatment when symptoms of DM or its complications develop. Another cause of delays in seeking care might be the attitude of physicians towards diabetic complications. A nationwide study of the prevalence of DR in Poland conducted between 2013 and 2017, in which the risk factors for DR were analysed, showed that the most significant risk factor was the treatment of DM by a general practitioner alone, which suggests that a limited availability of diabetes specialists and ophthalmologists is associated with poor awareness of the significance of regular examinations for DR, and therefore, a higher prevalence of DR.[19] Both the present and previous studies have suggested that regular screening for DR could reduce the risk of visual impairment in patients with DM.[20] The integration of ocular screening and education regarding DM in the primary care setting has the potential to improve the coverage of screening for retinopathy, patient self-management and the control of risk factors, and reduce healthcare expenditure.[21]

In China, screening for eye, foot, and other complications is routinely performed by most physicians in tertiary hospitals. However, limited screening is performed in primary hospitals or community health services. Therefore, educational programs that target not only patients but also physicians are urgently needed to inform these groups regarding diabetic eye complications, including their symptoms, recognition, management and consequences. NICE advises that adults with type 1 DM should receive a structured education program within the first 6 to 12 months following their diagnosis, and that those with type 2 DM should be offered a structured education program at diagnosis. Furthermore, children and young adults with DM should be offered a continuing program of education from the time of diagnosis. These programs instill the importance of patients seeking medical care promptly after the onset of symptoms of DR, promote screening for diabetic eye complications, and ultimately reduce the delay in seeking care, thereby minimising the risk of preventable sight loss.

In the present study, we have reported the characteristics of and the factors associated with delayed medical care in patients with severe DR. The findings lead us to reiterate the necessity for appropriate interventions to be developed and educational programs to be implemented to improve compliance with care instructions and prevent avoidable sight loss. This is particularly important in low-to-middle income countries, where the burden of DM is high. However, the present study had several limitations. First, it had a small sample size because there were refractive media opacities in many of the patients with STDR, which limited its statistical power. In addition, it was performed in a single population, which limits the generalisability of the findings. Larger studies should be performed in the future to confirm the present findings. Second, there are no standard criteria for the definition of short and long delays before medical care is sought. We

defined four categories according to the time interval between the onset of symptoms and an initial appointment being made for the patients to attend our hospital. However, this classification might not be appropriate for other hospitals or healthcare systems. Third, the analysis was based on questionnaires and the patients' self-reported responses, instead of an objective review of their medical records. Therefore, it may be subject to recall bias.

Conclusion

We have demonstrated that most patients with STDR do not seek medical care until >1 month after the onset of symptoms of DR in this area of China. Those patients who seek treatment >6 months after the onset of symptoms have significantly lower income and less knowledge of diabetic eye complications than those who attend within 6 months. No or infrequent examinations for diabetic complications are associated with a long delay between the onset of symptoms and seeking medical care. These findings stress the urgent need for effective educational programs regarding diabetic eye complications that encourage promptly seeking medical care to prevent adverse outcomes.

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Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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References

1. Saeedi P, Petersohn I, Salpea P, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract* 2019; 157: 107843. DOI: 10.1016/j.diabres.2019.107843.
2. Cheung N, Mitchell P and Wong TY. Diabetic retinopathy. *Lancet* 2010; 376: 124–136. DOI: 10.1016/s0140-6736(09)62124-3.
3. Yau JW, Rogers SL, Kawasaki R, et al. Global prevalence and major risk factors of diabetic retinopathy. *Diabetes Care* 2012; 35: 556–564. DOI: 10.2337/dc11-1909.
4. GROUP ETDRSR. Fundus Photographic Risk Factors for Progression of Diabetic Retinopathy. *Ophthalmology* 1991; 98: 823–833. DOI: 10.1016/s0161-6420(13)38014-2.
5. Harding S, Greenwood R, Aldington S, et al. Grading and disease management in national screening for diabetic retinopathy in England and Wales. *Diabet Med* 2003; 20: 965–971. DOI: 10.1111/j.1464-5491.2003.01077.x.
6. Ogurtsova K, da Rocha Fernandes JD, Huang Y, et al. IDF Diabetes Atlas: Global estimates for the prevalence of diabetes for 2015 and 2040. *Diabetes Res Clin Pract* 2017; 128: 40–50. doi:10.1016/j.diabres.2017.03.024.
7. Zhang G, Chen H, Chen W, et al. Prevalence and risk factors for diabetic retinopathy in China: a multi-hospital-based cross-sectional study. *Br J Ophthalmol* 2017; 101: 1591–1595. DOI: 10.1136/bjophthalmol-2017-310316.
8. Ferris FL 3rd and Nathan DM. Preventing Diabetic Retinopathy Progression. *Ophthalmology* 2016; 123: 1840–1842. DOI: 10.1016/j.ophtha.2016.05.039.

9. Matthews DR, Stratton IM, Aldington SJ, et al. Risks of progression of retinopathy and vision loss related to tight blood pressure control in type 2 diabetes mellitus: UKPDS 69. *Arch Ophthalmol* 2004; 122: 1631–1640. DOI: 10.1001/archopht.122.11.1631.
10. Chew EY, Ferris FL, Csaky KG, et al. The long-term effects of laser photocoagulation treatment in patients with diabetic retinopathy. *Ophthalmology* 2003; 110: 1683–1689. DOI: 10.1016/s0161-6420(03)00579-7.
11. Diabetic Retinopathy Clinical Research N, Elman MJ, Qin H, et al. Intravitreal ranibizumab for diabetic macular edema with prompt versus deferred laser treatment: three-year randomized trial results. *Ophthalmology* 2012; 119: 2312–2318. DOI: 10.1016/j.ophtha.2012.08.022.
12. Wells JA, Glassman AR, Ayala AR, et al. Aflibercept, Bevacizumab, or Ranibizumab for Diabetic Macular Edema: Two-Year Results from a Comparative Effectiveness Randomized Clinical Trial. *Ophthalmology* 2016; 123: 1351–1359. DOI: 10.1016/j.ophtha.2016.02.022.
13. Sivaprasad S, Prevost AT, Vasconcelos JC, et al. Clinical efficacy of intravitreal aflibercept versus panretinal photocoagulation for best corrected visual acuity in patients with proliferative diabetic retinopathy at 52 weeks (CLARITY): a multicentre, single-blinded, randomised, controlled, phase 2b, non-inferiority trial. *Lancet* 2017; 389: 2193–2203. DOI: 10.1016/s0140-6736(17)31193-5.
14. Gross JG, Glassman AR, Liu D, et al. Five-Year Outcomes of Panretinal Photocoagulation vs Intravitreous Ranibizumab for Proliferative Diabetic Retinopathy: A Randomized Clinical Trial. *JAMA Ophthalmol* 2018; 136: 1138–1148. DOI: 10.1001/jamaophthalmol.2018.3255.
15. Gavan NA, Veresiu IA, Vinik EJ, et al. Delay between Onset of Symptoms and Seeking Physician Intervention Increases Risk of Diabetic Foot Complications: Results of a Cross-Sectional Population-Based Survey. *J Diabetes Res* 2016; 2016: 1567405. DOI: 10.1155/2016/1567405.
16. Yan J, Liu Y, Zhou B, et al. Pre-hospital delay in patients with diabetic foot problems: influencing factors and subsequent quality of care. *Diabet Med* 2014; 31: 624–629. DOI: 10.1111/dme.12388.
17. Foot B and MacEwen C. Surveillance of sight loss due to delay in ophthalmic treatment or review: frequency, cause and outcome. *Eye (Lond)* 2017; 31: 771–775. DOI: 10.1038/eye.2017.1.
18. Weng C, Coppini DV and Sonksen PH. Geographic and social factors are related to increased morbidity and mortality rates in diabetic patients. *Diabet Med* 2000; 17: 612–617. DOI: 10.1046/j.1464-5491.2000.00352.x.
19. Kozioł M, Nowak MS, Udziela M, et al. First nation-wide study of diabetic retinopathy in Poland in the years 2013–2017. *Acta Diabetol* 2020; 57: 1255–1264. DOI: 10.1007/s00592-020-01540-6.
20. Leese GP, Boyle P, Feng Z, et al. Screening uptake in a well-established diabetic retinopathy screening program: the role of geographical access and deprivation. *Diabetes Care* 2008; 31: 2131–2135. DOI: 10.2337/dc08-1098.
21. Atkinson-Briggs S, Jenkins A, Keech A, et al. Integrating diabetic retinopathy screening within diabetes education services in Australia's diabetes and indigenous primary care clinics. *Intern Med J* 2019; 49: 797–800. DOI: 10.1111/imj.14309.