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Characteristics and Risk Factors of Diabetic Retinopathy Patients in West Java, Indonesia

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Abstract

Diabetic retinopathy (DR) is the major microvascular complication of diabetes mellitus (DM) and responsible as the leading cause of vision loss among working-age adults. With the estimated DM cases reaching 578 million in 2030, public health systems are faced with challenges of increasing costs of implementation and maintenance of DR screening program in people with DM. This study aimed to describe characteristics and risk factors of DR among patients of a Primary Health Care Center in West Java, Indonesia. This was a cross-sectional study during the period of March 2021 until June 2022 on 1,080 participants. Among these participants with DM, 28.89% (25.16–33.12% [95% CI]) were classified to have DR. A total of 32.69% (28.14–36.71 [95% CI]) participants with DR had vision threatening DR (VTDR). The prevalence of DR in this study was higher in women (77.23%) with a mean age of 57.26±9.17 and duration of DM of ≥5-years (56.01%), blood glucose level <200 mg/dL (63.79%), high systolic blood pressure (52.03%), high diastolic blood pressure (39.07%), normal BMI (55.5%), high waist circumference (43.7%), and high HbA1C (3.42%). A total of 1,041 (96.39%) participants were using antidiabetic drugs, and 9.63% of them were currently smoking. This study showed that diastolic blood pressure, abnormal abdominal circumference, and high HbA1C levels were more prevalent in DR and VTDR groups. The findings of this study represent the current characteristics of DR patients in West Java and can be used as a baseline or comparison data for other regions in Indonesia.

Keywords: Diabetic retinopathy, public health, screening program

Introduction

Diabetes mellitus (DM) is a chronic metabolic disease characterized by elevated blood sugar levels. The International Diabetes Federation (IDF) estimates that the global number of DM cases will continue to rise, reaching 578 million cases by 2030 and 700 million by 2045. In 2019, Indonesia ranked 7th globally for the highest number of DM sufferers, with 10.7 million cases.[1-3]

DM sufferers can experience various complications both macrovascular-such as cardiovascular or cerebrovascular abnormalities, and microvascular. Microvascular complications include diabetic retinopathy, diabetic neuropathy, and diabetic nephropathy. Lancet data in 2020 shows that diabetic retinopathy (DR) is the fifth highest cause of blindness in the world after cataracts, refractive disorders, glaucoma, age-related macular degeneration (AMD) in populations over 50 years. The prevalence of DR in type I DM patients is reported to be 0–3% and 3.2–6.7% in type 2 DM. Lee et al mentioned that as many as 30% of DM sufferers experience vision-threatening diabetic retinopathy (VTDR).[1,3,4]

Visual impairment due to DR tends to be permanent, so identification of risk factors, prevention strategies, and appropriate treatment are needed to prevent the progression of DR. A systematic review in 2019 reported several factors such as hypertension, obesity, dyslipidemia, smoking habits, Hba1C levels, and exercise had an effect on the progression of DR. Prevention strategies that can be carried out include education, screening, and management according to standards.[2,4-6]

Several efforts have been made in Indonesia

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to detect diabetes mellitus, including through the Chronic Disease Management Program (PROLANIS) and the Community Movement (Germas). The COVID-19 pandemic has caused the cessation of all mass activities across various sectors, including the healthcare sector. This observational study aims to determine the characteristics of diabetic retinopathy sufferers within the DM population enrolled in the screening program at the Community Ophthalmology Installation at the National Eye Center Cicendo Eye Hospital.

Methods

This was a cross-sectional descriptive study, approved by the Research Ethics Committee of Cicendo Eye Hospital Bandung under ethics approval number LB.02.01/2.3/2226/2021. The study used a total sampling method. The target population consisted of DM patients in the community, while the accessible population included all individuals participating in the PROLANIS program at 31 public health centers in the Bandung area between March 2021 and June 2022.

The inclusion criteria required all patients to participate in the PROLANIS screening program. All participants underwent fundus photography for retinal evaluation. The exclusion criteria included participants with fundus images of insufficient quality for assessment due to media opacity.

All participants who met the inclusion criteria were examined with a 1-field stereoscopic fundus photo examination without mid-dilation with the Smartscope Pro Portable Fundus Camera (Optomed, Oulu, Finland). Fundus photos were taken by a trained ophthalmic photographer. Fundus image quality was rated as 1 (overall rated); 2 (partially rated); 3 (cannot be rated); and 4 (no photo). All fundus photos were evaluated by 1 certified grader, and then the retinopathy status and DR classification were recorded.

The data were processed using Microsoft Excel Office 2019. Descriptive data on participant characteristics and DM risk factors are presented in tabular form.

Results

In this study, 1,166 subjects met the inclusion criteria. However, 86 participants (7.3%) were excluded due to poor fundus photograph quality caused by media opacity, such as cataracts and vitreous hemorrhage. Therefore, the final

Table 1 Demographic Characteristics of Study Subjects

Characteristics	Total (n=1,080)	Percentage (%)
Age (years)		
57.26 ± 9.17 (mean ± standard deviation)		
Range: 18–89		
<40	31	2.87
40–49	159	14.72
50–59	407	37.68
60–69	385	35.64
≥70	98	9.09
Sex		
Male	246	22.77
Female	834	77.23
Area of Residency		
Rural	565	52.31
Urban	515	47.69
Education Level		
No education	34	3.14
Elementary School	504	46.66
Junior level	175	16.20
High School	222	20.55
University	145	23.45
Occupation		
Unemployed	848	78.51
Low-class worker	53	4.90
Government employees	58	5.37
Private employees	31	2.87
Businessman/ woman	88	8.14
National security forces	2	0.28
Income (Rupiah)		
< 1.000.000	530	49.07
1.000.000 – 3.000.000	321	29.72
3.000.000 – 5.000.000	229	21.21

Table 2 Visual Acuity Based on Diabetic Retinopathy Classification

Presenting Visual Acuity	No DR (n=768)	DR (n=312)	VTDR (n=102)
Normal (%)	585 (76.17)	177 (56.73)	54 (52.94)
Mild (%)	96 (12.51)	64 (20.51)	21 (20.58)
Moderate (%)	66 (9.06)	54 (17.31)	15 (14.72)
Severe (%)	11 (1.30)	9 (2.88)	6 (5.88)
Blindness (%)	10 (0.96)	8 (2.57)	6 (5.88)

DR = diabetic retinopathy; VTDR: vision threatening diabetic retinopathy

number of participants was 1,080, with their characteristics summarized in Table 1.

Table 2 describes the ophthalmological status and classification of diabetic retinopathy (DR) in this study. Visual acuity refers to the presenting visual acuity in the best eye of each participant. A total of 586 participants (76.17%) in the group without DR had normal visual acuity, followed by 96 participants (12.51%) with mild visual impairment. The risk factors for DR assessed in this study included age, gender, duration of DM, blood glucose levels (GDS), blood pressure, DM treatment status, body mass index (BMI), abdominal circumference, HbA1c levels, and smoking status, as shown in Table 3.

Discussion

Table 3 Diabetic Retinopathy Distributions Based on Risk Factors

Variable	No DR (n=768)	DR (n = 312)	VTDR (n = 102)
Age (years)*	57.12 ± 11.09	59.75 ± 8.42	58.96 ± 7.83
Sex (%)			
Male	181 (23.59)	96 (30.9)	34 (33.33)
Female	587 (76.41)	216 (69.1)	68 (66.67)
DM duration (%)			
<5 years	346 (45.10)	129 (41.43)	41 (40.20)
≥5 years	422 (54.90)	183 (58.57)	61 (59.80)
RBG (mg/dL) (%)			
<200	522 (68)	167 (53.81)	53 (51.96)
≥200	246 (32)	145 (46.19)	49 (48.04)
SBP (mmHg) (%)			
<140	386 (50.34)	132 (42.38)	49 (48.83)
140–159	179 (23.31)	90 (29.04)	34 (33.34)
160–179	136 (17.79)	53 (17.14)	12 (11.76)
>180	67 (8.56)	37 (11.44)	7 (6.07)
DBP (mmHg)			
<90	514 (67.03)	144 (46.19)	43 (42.15)
≥90	254 (32.97)	168 (53.81)	59 (57.85)
DM Medications			
No treatment	36 (4.69)	3 (0.99)	1 (0.98)
Oral medications	678 (88.41)	280 (89.74)	76 (74.50)

Insulin	32 (4.27)	19 (6.19)	18 (17.64)
Oral and insulin	22 (2.63)	10 (3.08)	7 (6.88)
BMI			
Underweight	20 (2.68)	5 (1.61)	0 (0)
Normal	437 (56.96)	163 (52.47)	51 (50.82)
Obesity	303 (39.58)	131 (42.11)	47 (46.83)
Obesity II	8 (0.78)	13 (3.81)	4 (2.35)
Waist circumference (cm)			
Male	(n=181)	(n=96)	(n=34)
<90	102 (56.79)	49 (50.08)	16 (48.76)
≥90	79 (43.21)	48 (49.92)	18 (51.24)
Female	(n=587)	(n=216)	(n=68)
<80	351 (59.87)	107 (49.59)	32 (47.73)
≥80	236 (40.13)	109 (50.41)	36 (52.27)
HbA1c			
<6.5%	15 (2.06)	16 (5.23)	10 (9.81)
≥6.5%	6 (0.83)	31 (10.01)	28 (27.45)
No Data	747 (97.11)	265 (84.76)	64 (62.74)
Smoking status			
No smoking	447 (58.21)	177 (56.88)	53 (52.87)
Quit smoking	255 (33.24)	97 (31.22)	35 (32.94)
Smoking	66 (8,55)	38 (11.9)	14 (14.19)

DR is a potentially sight-threatening complication of diabetes mellitus. One in three people with diabetes mellitus also suffer from diabetic retinopathy. Studies show optimal control of risk factors such as blood sugar levels, blood pressure, and blood lipids can reduce and slow disease progression. Patients with a more severe degree of diabetic retinopathy cause a decrease in daily activities, have a worse quality of life and require access to health services higher than patients with a lower degree of disease.[1,10,11]

Research conducted in the Greater Bandung area in 2018 showed a prevalence rate of DR of 24.7% of a total of 1649 participants with DM. The results of this study indicate an increase of 29.77% during the period March 2021–June 2022. This increase in prevalence may be because in this study screening was carried out both in rural areas (52.31%) and urban areas (47.69%), where access to health services in rural areas is more difficult and access to screening is lower.[9-11]

The study by Sapkota et al.[12] reported that the average age of patients with diabetic retinopathy (DR) was 57 years. Similarly, a study by Kajiwara et al.[13] in Japan found that the prevalence of DR was highest at an average age of 59.4±11.7 years. The findings of this study align with those of the aforementioned studies, with a mean age of 59.75±8.42 years observed in the DR group.

Gender is a risk factor that is still being debated on the risk of developing DR. Research conducted in India and in Israel states that the prevalence of DR in women is higher than in men. This study reported that the percentage of DR in women was 56.20% and 52.3%, respectively. Another study showed that male patients have a higher risk of developing diabetic retinopathy than female patients in all age groups. In contrast to the study by Sasongko et al in Jogjakarta, it was stated that there was no significant difference in the prevalence of diabetic retinopathy between female and male patients. In this study, it was found that the number of women was more than men. The significant difference in this study is probably due to the fact that screening was carried out on working days and hours and that most prolanis members are women.[11,14,15]

DM duration, blood sugar levels, hypertension,

smoking, and obesity are risk factors that affect the progression of DR. Several studies conducted in Malaysia showed that the duration of DM that most suffer from DR is in the range of 5-10 years. Another study by Cui et al showed that longer DM duration is a significant risk factor for DR. The same results were shown in this study, where 183 participants (58.75%) with DR had a DM duration of at least 5 years.[8,16-18]

Control of blood sugar levels is a risk factor that influences the progression of DR. A randomized controlled trial (RCT) study showed that blood pressure is an important modifiable factor for the progression and severity of DR. In this study, 167 (53.81%) participants in the DR group and 53 (51.96%) in the VTDR group had blood glucose levels (GDS) <200 mg/dL. This difference in results may have occurred because the majority of participants (99.11%) had taken oral diabetes drugs, so that blood sugar was controlled at the time of examination.[11,17,19]

Hypertension is a risk factor for DR and VTDR. Research by Sasongko et al showed that hypertension correlated significantly with the incidence of DR and VTDR in a population of type II DM sufferers in Central Java. In this study, 90 people (29.4%) in the DR group had systolic blood pressure (SBP) 140–159 mmHg and 168 (53.81%) diastolic blood pressure (DBP) ≥90 mmHg, while 33.34% and 57.85% were participants in the VTDR group. has a DBP ≥140–149 and SBP ≥90 mmHg.[14,16]

The value of BMI as a risk factor for DR still shows mixed results. In the Wisconsin Epidemiologic study of Diabetic Retinopathy (WESDR) it was found that the relationship between obesity and the severity and progression of DR was not significantly significant, and in the same study, it was found that participants with low BMI (<20 kg/m^2) had a significant correlation with the occurrence of DR. This might suggest that the severity of DM and poor overall systemic health can lead to weight loss. Another study in Sweden showed different results, where there was a significant relationship between high BMI and the incidence of DR. In this study, the highest range of BMI in the DR group was in the normal range, namely 163 participants (52.47%), and the obese group in this study was found in 131 people (42.11%). Although the findings on BMI results and their relationship with DR are still diverse, individuals with DM are still advised to maintain BMI in the optimal range to prevent the progression of DR and other DM complications.[16-18]

The results of the Wei et al. study showed that the relative risk of type 2 DM is directly proportional to abdominal circumference. Another study reported that central obesity has a 2.26-fold risk of suffering from DM. This is because fat in the abdominal (visceral) area increases the risk of metabolic and cardiovascular syndromes. A total of 48 (49.92%) male participants in the DR group had an abdominal circumference of ≥ 90 cm, and 109 (50.41%) female participants had an abdominal circumference of ≥ 80 cm.[19,20]

A study by Valizadeh et al.[17] showed that HbA1C levels were significantly correlated with diabetic retinopathy (DR). Another study by Olafsdottir et al. also found a significant relationship between HbA1C levels and the incidence of DR. In contrast, the study by Olafsdottir et al.21 reported that high HbA1C levels in a single examination of type 2 DM patients did not show a significant relationship with the incidence of DR. In this study, 31 participants (10.41%) with DR had HbA1C levels ≥6.5%.

Smoking is one of the most important modifiable risk factors in diabetes mellitus (DM). Exposure to second-hand smoke is associated with vascular damage, endothelial dysfunction, and activation of the blood clotting cascade. The combination of these factors with increased blood glucose levels can exacerbate vascular damage in DM patients. One study concluded that the risk of diabetic retinopathy (DR) is higher in smokers with type 1 DM. In this study, 38 participants (11.9%) reported that they were still actively smoking. This difference may be due to the majority of participants being women.[20-22]

The findings of this study can serve as a reference for future research analyzing the prevalence and risk factors of diabetic retinopathy (DR) in populations with diabetes mellitus (DM). The study's limitations may help inform efforts to improve the quality and coverage of screening programs and referral systems for diabetic retinopathy.

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