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Characteristics And Risk Factors Of Diabetic Retinopathy In Multi-Ethnicity

Elsha Tiskya Azhary[1], Sitti Rukiah Syawal[2], Risna Rajab[3]
[1]Program Studi Pendidikan Profesi Dokter Umum Fakultas Kedokteran UMI, [2]Bagian Ilmu Kesehatan Mata Fakultas Kedokteran UMI, [3]Bagian Ilmu Penyakit Dalam Fakultas Kedokteran UMI

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ABSTRACT

Diabetic Retinopathy is one of the eye diseases most often experienced by Diabetes Mellitus sufferers. Diabetic Retinopathy damages blood vessels in the retina which can cause temporary or permanent blindness if treated too late. Differences in the prevalence of diabetic retinopathy between races can occur due to a combination of several things, including access to health facilities, genetic factors and other retinopathy risk factors such as ethnicity or race. Blacks and Hispanics have a much higher prevalence of diabetic retinopathy than whites and Asians. These differences were reduced when the analysis accounted for duration of diabetes, glycemic levels, and progression of diabetes, suggesting that these risk factors may partially explain the higher rates of retinopathy in blacks and Hispanics. Meanwhile, in Indonesia, according to the World Health Organization (WHO), Indonesia is fifth with the largest population of sufferers in the world, which is estimated to increase from 6.5 million to 20 million by 2030. Diabetic retinopathy is one of the eye diseases most often experienced by Diabetes Mellitus sufferers. Diabetic Retinopathy damages blood vessels in the retina which can cause temporary or permanent blindness if treated too late. Diabetic retinopathy accounts for 0.01% of causes of blindness, 0.04% of causes of moderate-severe visual impairment and overall visual impairment in Indonesia in 2020 is 13.2%.

Email :
111120212123@student.umi.ac.id,
2dr.rukiahsyawal@gmail.com

1. INTRODUCTION

Diabetes Mellitus, in Latin-Greek meaning honey urine, is a condition where the body cannot process glucose (sugar found in the blood). Glucose will accumulate in the body, this condition is called hyperglycaemia. If not treated immediately, hyperglycaemia has the potential to cause complications with damage to the eyes, heart, blood vessels, kidneys and nerves. Statista data shows that Indonesia is in seventh place in the country with the highest number of people with diabetes mellitus, 10.7 million people in 2019.

Diabetic Retinopathy (Diabetic Retinopathy) is one of the eye diseases most often experienced by Diabetes Mellitus sufferers. Diabetic Retinopathy damages blood vessels in the retina which can cause temporary or permanent blindness if treated too late. The risk of Diabetic Retinopathy increases with increasing age and the duration of suffering from Diabetes Mellitus, so older people with Diabetes Mellitus will be more susceptible to this disease.

By 2040, it is projected that approximately 600 million people will suffer from diabetes, with one third expected to suffer from diabetic retinopathy. Screening for diabetic retinopathy, coupled with timely referral and treatment, is a universally accepted strategy for the prevention of blindness. However, programs for screening for diabetic retinopathy are challenged by issues related to implementation, availability of human assessors, and long-term financial sustainability.

Diabetic Retinopathy is grouped into two types, namely Non-Proliferative Diabetic Retinopathy (NPDR) and Proliferative Diabetic Retinopathy (PDR). NPDR type Diabetic Retinopathy is characterized by weakening of the blood vessels in the retina. In certain cases, there is leakage of fluid and blood into the retina. The blood vessels look enlarged with irregular vessel edges. If the condition

of blood vessel damage in the retina becomes more severe, NPDR type Diabetic Retinopathy can become Proliferative Diabetic Retinopathy (PDR). Damage to blood vessels in the PDR type causes abnormal branching of new blood vessels in the retina so that the normal fluid circulation process in the eye is disrupted. The eyeball will experience high pressure.

The initial stage of DR development is NPDR where there is loss of retinal capillary pericytes and endothelial cells. Mild NPDR is characterized by at least one microaneurysm. Moderate NPDR includes extensive microaneurysms, intraretinal bleeding, venous beading, and/or spots on cotton wool. In the severe stage of NPDR, intraretinal microvascular abnormalities (IRMA) are also found. NPDR can affect visual function by increasing intraretinal vascular permeability (macular edema) and variable degrees of intraretinal capillary closure (macular ischemia).

The most serious complication in DR is proliferative diabetic retinopathy. The PDR stage involves the formation of new blood vessels (neovascularization) that develop from the veins due to progressive ischemia. Usually these new blood vessels are prone to leaking, so if not treated they can develop into thick and dense fibrous tissue. This fibrous tissue can attach to the posterior hyaloid membrane and at any time can contract away from the retina (traction). This traction can cause preretinal or vitreous hemorrhage, or tractional retinal detachment which causes sudden loss of vision. PDR develops in 50% of type 1 DM patients and approximately 15% of type 2 DM patients within 25 years. According to the diabetic retinopathy study, a high risk of PDR can occur in one of the signs such as mild disc neovascularization (NVD) with vitreous hemorrhage, moderate-severe disc neovascularization (1/4 to 1/3 of the disc area) with or without vitreous hemorrhage, neovascularization anywhere moderate stage (1/2 disc area) with vitreous hemorrhage.

Maculopathy is the main cause of severe visual impairment in DR patients. Maculopathy manifests as retinal thickening or edema caused by damage to the blood-retinal barrier at the level of the retinal capillary endothelium, leading to leakage of fluid and plasma constituents into the surrounding retina. There are three types of diabetic maculopathy, namely exudative (focal), edema (diffuse/cystoid), and ischemic. Focal exudative is characterized by hard exudates with microvascular abnormalities (microaneurysm, hemorrhage) in the center of the ring. Edema is characterized by accumulation of fluid in the perifoveal area and results in the formation of cysts, while ischemia is characterized by foveal enlargement due to capillary closure and causes vision loss with microaneurysms, bleeding, mild or no macular edema and hard exudates.

Figure 1: Difference Between Normal Eye Retina and Retina with Diabetic Retinopathy.

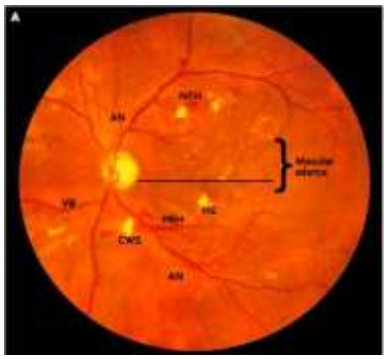

Figure 2: Clinical features of diabetic retinopathy on fundus photography include: narrowed arterioles (AN), nerve fiber hemorrhage (NFH), hard exudate (HE), cotton-wool spots (CWS), venous beading (VB), and preretinal hemorrhage (PRH).

Gambar 3 : Normal Retinal Image (1), Non Proliferative Diabetic Retinopathy (2), Proliferative Diabetic Retinopathy (3).

Several studies, one of which was research conducted by Sepalisa in 2022, said that, the results of research on prolanis patients with diabetes mellitus found that the prevalence of diabetic retinopathy at RSI Gondanglegi Semarang in 2021 was 13.2%. From this research, it can be concluded that patients with diabetic retinopathy are most likely aged 45 years - 65 years, with women more likely to experience diabetic retinopathy.

This is in line with research conducted by Wina Novianti in 2022, explaining that the results of the research prove that there is a relationship between gender in type 2 diabetes mellitus patients, where women who suffer from diabetes mellitus are more likely to suffer from diabetic retinopathy with an age range of 45 - 64. years and long suffering from type 2 diabetes mellitus with a range of 5 – 10 years.

Research conducted by Monalisa, et al in 2021, examination results related to the diagnosis of diabetic retinopathy, had a longer history of diabetes mellitus, namely more than 10 years (42.1%) and and 2-5 years (36.84%), <2 years (5.26%). Where there are more women (57.9%) and men (42.1%). Have complaints of poor vision (10.53%).

Research conducted by I Made Satria W et al, in 2018, the results of research on diabetic retinopathy patients at Sanglah Hospital Bali for the period April 2016 - April 2017, concluded that: the most diabetic retinopathy patients were in the 50-69 year age group (70.4 %), more in men (66.7%) compared to women (33.3%), the majority of diabetic retinopathy patients (37%) had an address in Denpasar, more diabetic retinopathy patients had a history of diabetes mellitus for 5- 10 years (55.6%), the most common patient's main complaint was blurred vision (77.8%), the proliferative type of diabetic retinopathy (PDR) was more common (77.8%) than the non-proliferative type (NPDR) (22 .2%), the highest visual acuity was <6/60, namely 24 eyes (44.4%).

From several research descriptions obtained, it can be concluded that diabetic retinopathy can attack diabetes mellitus sufferers of various ages, genders, whether or not they have had a history of diabetes mellitus. The findings from several studies listed above can serve as a reference for improving screening programs and referral systems for diabetic retinopathy. It is important to carry out further prevalence research with a larger sample to take into account major risk factors other than

diabetes mellitus such as hypertension, cholesterol and so on. Further research may be needed to analyze individual risk factors and prevalence of diabetic retinopathy.

Pathophysiology

Retinal tissue is the most metabolically active tissue so its oxygen demand is high. Retinal vascularization depends on two sources, namely the central retinal artery in the inner two thirds to the inner edge of the inner nuclear layer, and the choriocapillaris in the outer third (rod and cone cells, RPE, and outer nuclear layer) . The central retinal artery (a branch of the ophthalmic artery) enters the eyeball and is divided into 4 branches, each supplying each quadrant of the retina. These branches are located in the inner retina. Occasionally, the cilioretinal artery, which originates from the ciliary circulation, will vascularize the inner retina between the optic nerve and the central macula. At the tissue level, the retina is served by 4 layers of capillaries, superficial in the nerve fiber layer (NFL) and 2 on the other side of the NFL as a plexus of superficial and deep capillaries. Blood from these capillaries accumulates in the retinal vein branches, which will form veins. central retina. The walls of retinal capillaries consist of endothelial cells, pericytes and basement membrane. Capillary endothelial cells connect to each other through tight junctions and adherent junctions to form the blood-retinal barrier (BRB). The retina is protected by two BRBs, namely the inner and outer BRB8. The inner BRB surrounds all retinal blood vessels, consisting of capillary endothelial cells with their tight junctions, while the outer BRB consists of retinal pigment epithelial cells with their tight junctions. Very small molecules such as oxygen and carbon dioxide can diffuse through BRB. The integrity of the BRB plays an important role in maintaining normal visual function, and disruption of the BRB results in DME due to protein leakage resulting in the accumulation of intraretinal hard exudate.

Retinal blood flow is always normal even though there are fluctuations in systemic blood pressure and intraocular pressure. Circulation in the retina is more influenced by local factors such as nitric oxide, prostaglandins, endothelin and the renin-angiotensin system. Autoregulation is the capacity to maintain constant blood flow levels in the presence of changes in ocular perfusion pressure and various other metabolic demands. Several studies suggest that retinal blood flow increases and decreases in proportion to arterial oxygen content. However, in hyperglycemia, this condition does not occur. In the early stages of diabetes, retinal integration is able to adapt to systemic metabolic changes. But as the disease progresses, the need for retinal oxygen and nutrients results in loss of ocular homeostasis.

Hyperglycemia that lasts a long time will cause changes in the physiology and biochemistry of blood flow and end in damage to the capillary endothelium (intraretinal angiopathy). This microangiopathy on histological examination is the loss of pericytes and thickening of the blood vessel walls resulting in a reduction in the lumen of the capillary blood vessels, even in this situation, the retinal capillary blood vessels are seriously blocked, this situation is exacerbated by the phenomenon of sludge from blood rheology, giving rise to the formation of microaneurysms and areas of hypoxia. on the retina

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2. METHOD

The method used in this research uses Systematic Literature Review (SLR) to find out the most appropriate method for designing Enterprise Architecture in government agencies. This research applies three stages, namely: planning, implementation, and results analysis, which analyzes the results of the Literature Review that the author has carried out. The planning stage involves formulating the problem that you want to identify. The implementation stage involves the process of collecting papers to conduct a Literature Review. Analysis of the results, namely answering the existing problem formulation sourced from the Literature Review carried out.

3. RESULTS AND DISCUSSION

Diabetic retinopathy, the most common specific complication of type 2 diabetes, is the leading cause of blindness among Americans aged 20 to 64 years. The epidemiology of diabetic retinopathy has been described previously, mostly in white populations. In the Wisconsin Epidemiological Study of Diabetic Retinopathy (WESDR), the prevalence of retinopathy in 1980 to 1982 among people with type 2 diabetes was reported to be 39% for those not receiving insulin treatment, and 70% for those

receiving insulin treatment. data collected from eight studies suggest the prevalence of retinopathy may have decreased in recent years. However, of these eight studies, only two had data collected in the last decade, and none in the last 5 years. Thus, there is a need for new contemporary data.

Epidemiological studies, again mostly conducted in white people, have identified several risk factors for diabetic retinopathy. The most consistent was a longer duration of diabetes, hyperglycemia, and hypertension. In contrast to whites, there are fewer population-based data on the prevalence or risk factors for retinopathy in other racial/ethnic groups with diabetes in the United States. Because the prevalence of diabetes appears to vary between these racial/ethnic groups, it has been suggested that the frequency of retinopathy may also vary by race/ethnicity. Several studies conducted show that compared to studies on white people, African-Americans (blacks) and Hispanics have a higher prevalence of retinopathy. These differences were due in part to racial/ethnic differences in diabetes duration, glycemic control, and blood pressure levels in blacks, but not in Hispanics. There are no epidemiological data on diabetic retinopathy in Chinese Americans).

There are a number of possible explanations for the decline in the prevalence of diabetic retinopathy over time. First, it is possible that improvements in the clinical management of diabetes (eg, better glycemic and blood pressure control) may have led to a gradual decrease in the frequency of retinopathy.

There are limited epidemiological studies of diabetic retinopathy in nonwhites, and few have examined racial/ethnic differences in the prevalence of diabetic retinopathy although there are substantial data showing variations in diabetes prevalence by racial/ethnic group. Three population-based studies, the Atherosclerosis Risk in Communities (ARIC) study, 24 the National Health and Nutrition Examination Survey (NHANES) III, 25 and the Cardiovascular Health Study, showed that retinopathy was more common in blacks with type 2 diabetes than in whites. . In the ARIC study, the higher prevalence of retinopathy in blacks (27.7%) compared with whites (16.7%) largely disappeared after controlling for differences in glycemic control, duration of diabetes, and blood pressure, indicating that these factors may explain the differences in retinopathy prevalence between whites and blacks in the ARIC study cohort.

Similarly, Hispanics have been suggested to have a higher prevalence of diabetic retinopathy, although factors that may explain the differences between Hispanics and whites are less clear. In one study, even after adjusting for glycemic levels and other risk factors, diabetic retinopathy was still twice as common in Hispanics living in San Antonio, Texas, USA compared with whites in Madison, Wisconsin, USA. Similarly, in NHANES III, despite controlling for duration of diabetes and levels of glycemia and blood pressure, Hispanics had a higher prevalence and more severe retinopathy than whites in the study.

In the LALES study (Los Angeles Latino Eye Study), Latinos were found to have higher rates of more severe life-threatening diabetic retinopathy than whites finding no variation in the prevalence of diabetic retinopathy observed across all major ethnic groups in Mauritius.

Few studies have assessed variations in the prevalence of diabetic retinopathy among different races and most have used non-Asian populations. For example, Raymond et al, found a significantly higher prevalence of DR and higher HbA1c levels among patients of South Asian ethnicity than among white Europeans in the community. Eberhardt et al22 and Harries et al, found that blacks had higher HbA1c levels in two South Carolina communities. When social factors such as low income or geography between groups are equalized, the effects of race are neutralized, revealing predictors other than race. For example, Lim et al, did not find race to be a predictor of DR in urban, underserved white, black, Hispanic, and Asian populations. HbA1c and duration of diabetes also remain classic predictors for the onset and progression of diabetic retinopathy regardless of ethnicity and this is confirmed by research findings. This suggests that risk factors for diabetic retinopathy are similar across four racial/ethnic populations in six US communities .

4. CONCLUSION

Conclusions indicate that blacks and Hispanics have a significantly higher prevalence of diabetic retinopathy than whites and Asians. These differences were reduced when the analysis accounted for duration of diabetes, glycemic levels, and increased waist-to-hip ratio, suggesting that

these risk factors may partially explain the higher rates of retinopathy in blacks and Hispanics. It is possible that other factors not examined here, such as racial/ethnic variations at the time of diabetes diagnosis (e.g., blacks and Hispanics with diabetes may be diagnosed later than whites and Asians), may also explain these differences.

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