Journal of Community Health Provision
Vol. 6, Issue 2, 2026
Page 356-365
DOI: https://doi.org/10.55885/jchp.v6i2.972

The Relationship Between Diabetes Mellitus and Cataract Incidence at the JEC Orbita Makassar Main Eye Clinic

Eka Uthami Tonang[1], Zulfikri Khalil Novriansyah[1], Ratih Natasha Maharani[1], Marlyanti Nur Rahmah[1], Ariyanie Nurtania[1]
[1]Medical School, Universitas Muslim Indonesia
Email: ekauthamitonang@gmail.com

Abstract. *Diabetes Mellitus (DM) is a chronic non-communicable disease with an increasing incidence rate and the potential to cause various complications, including ocular disorders such as cataracts. Cataracts are the leading cause of blindness worldwide and occur more frequently in DM patients due to chronic hyperglycemia that accelerates lens opacity. This study aims to determine the relationship between diabetes mellitus and the occurrence of cataracts at the JEC Orbita Eye Clinic in Makassar. This is an observational analytic study with a cross-sectional design using a quantitative approach. Data were obtained from patient medical records in January 2025-December 2025. The sample was taken using a total sampling method with a total of 250 patients. Data were analyzed univariately and bivariately using the Chi-Square test. Out of 250 patients, the largest age group was ≥ 60 years (36.8%), followed by 45–59 years (33.2%). The gender distribution was balanced between males and females (50% each). A total of 205 patients (82%) had diabetes mellitus. The Chi-Square test showed a significant association between diabetes mellitus and cataract ($p < 0.05$). Cataract was more commonly found in adult and elderly patients with a balanced gender proportion. Most cataract patients had diabetes mellitus, and there was a significant association between diabetes mellitus and cataract.*

Keywords: *Diabetes Mellitus, Cataract; Age, Cataract Stage*

Received: April 21, 2026 Received in Revised: May 15, 2026 Accepted: June 2, 2026

INTRODUCTION

Diabetes Mellitus (DM) is a chronic, non-communicable disease and remains a major global problem (Sanjaya & Setiawan, 2024; Piovani et al., 2022; Al-Lawati, 2017). DM causes both macrovascular and microvascular complications. This disease leads to cardiovascular disorders and is quite serious if not promptly treated, increasing the risk of hypertension and myocardial infarction (Damayanti et al., 2024; Rosendorff et al., 2015; Flora & Nayak, 2019; Padwal et al., 2001; Pedrinelli et al., 2012; Muntner et al., 2006).

Diabetes mellitus can also occur due to exocrine pancreatic disease, which damages the majority of the islets of the pancreas (Ristiyowati & Aini , 2023; Wynne et al., 2019; Wei et al., 2020; Piciucchi et al., 2015; Campbell-Thompson et al., 2015; Hardt & Ewald, 2011). Diabetes is divided into two types: type 1 diabetes mellitus, which results from an autoimmune reaction against pancreatic islet cell proteins (Irawan et al., 2022). Type 2 diabetes is caused by a combination of genetic factors related to impaired insulin secretion, insulin resistance, and environmental factors such as obesity, overeating, undereating, exercise, stress, and aging (Damayanti et al., 2024).

Cataracts are the leading cause of preventable blindness worldwide. Cataracts are characterized by clouding of the lens of the eye, which interferes with light entry. Cataracts can be caused by disruption of the water and electrolyte balance control mechanism, denaturation of lens proteins, or a combination of both. In 90% of cataract cases, age and other causes such as genitals and trauma are related (Damayanti et al., 2024).

According to the 2013 Basic Health Research (Riskesdas), the prevalence of diabetes mellitus (DM) in Indonesia was 1.5%, while in 2018, it reached 2.0%, meaning the prevalence of DM in Indonesia increased by 0.5%. This is followed by an increase in the prevalence of DM in Indonesia based on blood tests in the population aged 15 years and older, from 6.9% to 8.5% in 2018. This figure indicates that there are approximately 25% of new cases of DM.

According to data from the World Health Organization (WHO) in 2020, cataracts are the most common eye disorder causing blindness and visual impairment. The prevalence of cataract blindness is 0.78% of the total global prevalence of blindness, which is 1.5%. Cataracts are the leading cause of blindness worldwide (Vision Loss Expert Group of the Global Burden of Disease Study, 2024; Pesudovs et al., 2024; Prokofyeva et al., 2013; Chen et al., 2025; Ayorinde et al., 2024). This means that there are 39 million blind people worldwide, with cataracts being the primary cause of blindness, accounting for 51%. The high rate of blindness in Indonesia is not only a health issue but also a social one. Although cataracts are a disease of the elderly, 16-20% of Indonesians aged 40-54 are blind, which, according to the Central Bureau of Statistics (BPS), is considered a productive age group (Damayanti et al., 2024).

Cataracts are a leading cause of vision impairment in people with diabetes (Iqbal et al., 2024; Khan et al., 2017; Glover et al., 2012). People with diabetes are five times more likely to develop cataracts because diabetes is a metabolic disease that continues to increase annually with population growth and lifestyle changes in the modern era (Saaddine et al., 2008; Mrugacz et al., 2023; Ivanescu et al., 2024; Rondanelli et al., 2023; Jiang et al., 2023; Sayin et al., 2015). Long-term high blood sugar levels can lead to complications in other organs, such as the eyes. Blindness due to cataracts in people with diabetes is actually a preventable cause of blindness through blood sugar control and lifestyle changes (Damayanti et al., 2024).

The etiopathogenesis of cataracts remains uncertain and is thought to be multifactorial. Increasing age and diabetes are two factors considered major risk factors for cataracts (Raman et al., 2010; Mukesh et al., 2006; Chang et al., 2011). One reason is that diabetes increases glucose metabolism in the lens, leading to the accumulation of sorbitol, which is thought to be associated with changes in osmotic pressure and lens opacification. Cataracts are divided into three categories based on age: congenital cataracts, juvenile cataracts, and senile cataracts. Age refers to the length of time a person has lived or been present (since birth or acquired). Cataracts occur in all age groups, but are most common in people aged 40 and older as age increases (Damayanti et al., 2024).

Based on this description, it is important to conduct research on the relationship between diabetes mellitus and cataract incidence at the JEC Orbita Makassar Main Eye Clinic. The results of this study are expected to contribute to improving understanding of the role of diabetes mellitus as a major risk factor for cataract formation, as well as assist healthcare professionals in early detection, complication prevention, determining treatment strategies, and monitoring the condition of patients at risk of diabetes-related vision impairment.

METHODS

This study used an observational analytic method with a cross sectional design and a quantitative approach. This design was selected because the study aimed to examine the relationship between diabetes mellitus and cataract incidence based on patient medical record data at a single point of observation. The independent variable in this study was diabetes mellitus status, while the dependent variable was cataract incidence. The study was conducted at the JEC Orbita Makassar Main Eye Clinic. The data used in this study were secondary data obtained from

patient medical records from January 2025 to December 2025. The population consisted of all patients recorded at the clinic during the study period who had information related to cataract diagnosis and diabetes mellitus status. The sample was selected using a total sampling technique. All patients who met the inclusion criteria and did not meet the exclusion criteria were included as research samples. The inclusion criteria were patients with complete medical record data regarding age, gender, diabetes mellitus status, and cataract status. The exclusion criteria were incomplete, duplicated, or unclear medical records that could not be used to determine the main study variables. Based on these criteria, a total of 250 patients were included in the study. Data collection was carried out by reviewing and extracting relevant information from patient medical records. The data collected included age, gender, diabetes mellitus status, and cataract status. Age was grouped into 19 to 44 years, 45 to 59 years, and 60 years or older. Diabetes mellitus status was categorized into diabetic and non diabetic patients based on the diagnosis recorded in the medical records. Cataract status was determined based on the clinical diagnosis documented by the clinic. The collected data were analyzed using univariate and bivariate analysis. Univariate analysis was used to describe the distribution of patient characteristics, including age, gender, diabetes mellitus status, and cataract status, presented in frequencies and percentages. Bivariate analysis was conducted using the Chi Square test to determine the relationship between diabetes mellitus and cataract incidence. A p value of less than 0.05 was considered statistically significant.

RESULT AND DISCUSSION

This section presents the findings of the study regarding the relationship between diabetes mellitus and cataract incidence among patients at the JEC Orbita Makassar Main Eye Clinic. The analysis was conducted using secondary data from 250 patient medical records. The results are presented descriptively based on patient characteristics, including age, gender, and diabetes mellitus history, followed by bivariate analysis to determine the relationship between diabetes mellitus and cataract incidence. The descriptive findings are important to provide an initial understanding of the demographic and clinical profile of patients before examining the statistical relationship between the main study variables.

Table 1. Description of Diabetes Mellitus Patients with Cataracts at the JEC Orbita Makassar Main Eye Clinic Based on Age

Age	N	%
19 - 44 Years	75	30
45 - 59 Years	83	33.2
≥ 60 Years	92	36.8
Total	250	100

Based on Table 1, the majority of patients with diabetes mellitus at the JEC Orbita Makassar Main Eye Clinic were in the age group (≥60 years) (92 patients (36.8%), followed by the age group (45–59 years) (83 patients (33.2%). The age group (19–44 years) comprised only 75 patients (30%). These data indicate that diabetes mellitus is more common in older patients, likely due to age factors and the increased risk associated with longer disease duration.

The incidence of diabetes mellitus increases with age. The body's defense mechanisms begin to decline with age because the body is no longer able to compensate for an unhealthy lifestyle, ultimately leading to diseases like diabetes. Increased insulin retention, a family history of obesity, and age 40 and older are the main causes of type 2 diabetes mellitus. As the number of people with diabetes increases, there is a possibility that diabetic cataracts may develop (Gitaiswari & Benny, 2025).

The predominance of adults and the elderly in this study may be due to the aging process, which physiologically affects the body's metabolism and organ function, including the lens. With age, oxidative stress increases and the ability of lens epithelial cells to regenerate decreases. In people with diabetes mellitus, chronic hyperglycemia accelerates the glycation of lens proteins, thus accelerating clouding. This is in line with the theory that the risk of type 2 diabetes mellitus

increases with age and is associated with decreased metabolic function (Widiasari et al., 2021; Banday et al., 2020)

Furthermore, the longer a person has diabetes, the greater the risk of chronic complications, including eye disorders. Long-term exposure to high blood glucose levels causes activation of the polyol pathway and accumulation of sorbitol in the lens, which triggers osmotic changes and lens clouding. This explains the predominance of adults and the elderly in this study (Haryono et al., 2023; Damayanti et al., 2024).

Table 2. Description of Diabetes Mellitus Patients with Cataracts at the JEC Orbita Makassar Main Eye Clinic Based on Gender

Gender	N	%
Male	125	50
Female	125	50
Total	250	100

Based on Table 2, the number of diabetes mellitus patients with cataracts at the JEC Orbita Makassar Main Eye Clinic was evenly divided between men and women, with 125 patients each, or 50% of the total 250 patients. This data indicates that the incidence of cataracts in diabetes patients does not differ significantly by gender.

Cataracts are more common in women due to changes that occur during menopause, which typically begins around age 45. Menopause can reduce the body's metabolic capacity and cause tissue damage. The decline in estrogen levels, which occurs with age, plays a role in increasing the risk of cataracts in women. Estrogen has mitogenic and antioxidative properties that protect lens epithelial cells from cataractogenesis. Furthermore, women are more susceptible to diabetes mellitus due to hormonal changes during menopause, which can affect metabolism and lead to fat accumulation in the body. The increased risk of diabetes mellitus in women during menopause also increases the chance of developing cataracts (Gitaiswari et al., 2025).

The equal distribution between men and women indicates that cataracts in diabetic patients can occur in both sexes without significant differences. This may be influenced by similar risk factors such as diet, physical activity, obesity, and poor blood sugar control (Widiasari et al., 2021; Astutisari et al., 2022). Theoretically, women have a higher risk of developing cataracts due to hormonal changes during menopause, particularly the decrease in estrogen, which acts as a natural antioxidant in the lens. However, in this study, age and metabolic control likely outweighed hormonal factors, resulting in no significant difference in proportions between men and women.

Table 3. Description of Diabetes Mellitus Patients with Cataracts at the JEC Orbita Makassar Main Eye Clinic Based on Diabetes Mellitus History

History of Diabetes Mellitus	N	%
Diabetes Patients	205	82
Not Diabetes Patients	45	18
Total	250	100

Based on Table 3, the majority of patients with cataracts at the JEC Orbita Makassar Main Eye Clinic had diabetes mellitus, comprising 205 patients, or 82% of the 250 patients. While 45 patients (18%) did not have diabetes. This data indicates that cataracts are more common in patients with diabetes mellitus than in patients without diabetes.

Risk factors associated with the occurrence of T2DM include age, Body Mass Index (BMI), waist circumference, daily physical activity, fruit and vegetable consumption, hypertension, and a family history of diabetes mellitus. Family history can be a contributing risk factor for several non-communicable diseases, including type 2 diabetes mellitus, for example in a father, mother, brother, or sister (Nuraisyah et al., 2020).

The high proportion of diabetes mellitus in cataract patients (82%) suggests that chronic hyperglycemia plays a significant role in the pathogenesis of cataracts. High glucose levels cause increased conversion of glucose to sorbitol via the polyol pathway, which results in fluid buildup in the lens and damage to the lens fiber structure (Banday et al., 2020; Damayanti et al., 2024).

In addition, risk factors such as body mass index, family history, hypertension, and a sedentary lifestyle contribute to the increased incidence of type 2 diabetes mellitus, which ultimately increases the risk of complications, including cataracts (Irawan et al., 2022; Darmawanti, 2024). Previous studies have also shown a link between diabetes mellitus and increased cataract prevalence in various healthcare facilities. 19,22

Table 4. Relationship between Diabetes Mellitus Patients and Cataract Incidence at the JEC Orbita Makassar Main Eye Clinic

Cataract Status	DM Patients (n)	DM Patients (%)	Non-DM (n)	Non-DM (%)	Total (n)	Total (%)	P-Value
Cataract	205	82	45	18	250	100	0.01
Total	205	82	45	18	250	100	

Based on Table 4, the majority of patients with cataracts at the JEC Orbita Makassar Eye Clinic were diabetic (DM), accounting for 205 patients (82%) out of a total of 250 patients. Meanwhile, 45 patients (18%) who did not have diabetes mellitus (non-DM) experienced cataracts. The chi-square test showed a p-value of 0.01, indicating a significant association between diabetes mellitus and cataracts. These data indicate that the majority of cataract patients at the JEC Orbita Makassar Eye Clinic were diabetic.

Another factor contributing to the increasing number of cataract patients is diabetes mellitus. Excessive levels of sorbitol, a sugar made from glucose, which causes accumulation in the lens and ultimately clouding, is a common cause of diabetes-related cataract formation.

The chi-square test results indicated a significant association between diabetes mellitus and cataracts ($p > 0.05$). This indicates that although diabetes is a risk factor for cataracts, the severity or stage of cataracts at the time of treatment can be influenced by various other factors, such as age, disease duration, HbA1c control, and genetics (Irawan et al., 2022).

Cataract development is multifactorial. Hyperglycemia does play a role in cataract formation through oxidative stress and sorbitol accumulation, but progression to advanced stages is not solely determined by the presence of diabetes (Banday et al., 2020; Hashim & Zarina, 2012; Guo et al., 2023; Tangvarasittichai & Tangvarasittichai, 2018; Sahajpal et al., 2019; Thorne et al., 2024). Therefore, the relatively similar stage distribution between the DM and non-DM groups may result in statistical test results showing no significant relationship.

Age, Gender, and the Clinical Pattern of Cataract among Patients

Based on the results of this study, the majority of cataract patients in the JEC Orbita Makassar Main Eye Clinic were elderly patients, aged 60 years and older. Clinically this is understandable as one of the strongest biological risk factors for cataract formation is the age. The lens undergoes structural and biochemical changes with ageing, resulting in progressive decrease in transparency. The normal clarity of the lens can gradually be affected by oxidative stress, protein denaturation, and decreased ability of the cells to repair. This aging process can be exacerbated in diabetes mellitus patients due to the chronic hyperglycaemia that adds more metabolic stress to the lens. This is because the number of older patients in this study is high, indicating that age and diabetes-related metabolic changes may play a combined role in cataract incidence.

Patients aged 45-59 had cataract too, suggesting cataract, in diabetic patients, is not a disease of advanced age. High blood glucose may cause the lens to become cloudy earlier as it causes a change in the internal environment of the lens that leads to opacity. The polyol pathway can be used to convert excess glucose to sorbitol. As sorbitol accumulates, it raises the osmotic

pressure, pulls water into the lens, messes with lens fibre organization and slowly causes clouding of the lens. This mechanism underlies the increased early onset and/or increased frequency of cataract in DM patients.

In this study, the gender distribution was equal, that is, the number of male and female patients were the same. This indicates that in this sample there was no strong gender bias in the occurrence of cataract. Some studies describe the higher risk for women that may be due to hormone changes after menopause particularly the loss of estrogen as a protective antioxidant factor, but the present result indicates that the incidence of cataract in females might be comparable to males. This equilibrium can be explained by the greater effect of common risk factors (age, diabetes mellitus, lifestyle, blood glucose control, and other metabolic factors). So, preventive education and routine eye exams should be targeted to both women and men with diabetes mellitus.

Diabetes Mellitus and Cataract Incidence

The key finding of this study is the significant percentage of cataract patients having diabetes mellitus. In all, 205 patients were reported as suffering from diabetes mellitus, of which 82 percent were recorded in the total sample. This result suggests a close association of diabetes mellitus and the occurrence of cataract. Chronic hyperglycemia may affect the metabolism of the lens, lead to oxidative stress, result in glycation of lens proteins, and cause structural changes in the lens. These processes will gradually decrease the transparency of the lens and increase its chances of developing a cataract over time. This outcome emphasizes the diabetes mellitus as a significant clinical risk factor that must be taken into account while trying to prevent and manage cataracts.

The Chi Square test revealed a p value of 0.01 which was found to be statistically significant, suggesting that there is a relationship between diabetes mellitus and incidence of cataract. This implies that, diabetes mellitus status was significantly related to occurrence of cataract in this study. This is in line with the mechanism of diabetic cataract, in which the accumulation of sorbitol leads to osmotic stress, oxidative damage, and structural changes in the lens, with the latter being a key pathway in the development of diabetic cataract. Hence, diabetes mellitus should not be only regarded as a systemic metabolic disease, but also as a disease in which ocular complications, such as cataract, are more likely to occur.

The findings from this study indicate that eye examination is important and should be done early and frequently in patients with diabetes mellitus from a clinical point of view. Prevention of cataract cannot commence after onset of significant visual disturbance. Patients with diabetes mellitus should have a lifelong education about blood sugar monitoring, lifestyle management and regular ophthalmologic checkup. Diabetic patients know better about eye complication, diabetic retinopathy; however, cataract is also an important condition that can affect diabetic patients and may cause loss of vision and quality of life. Proper early detection can avoid delayed diagnosis and facilitate timely clinical treatment.

Diabetes mellitus is an important risk factor, but is not the sole cause of cataract formation. Other factors such as age, length of diabetes, HbA1c, hypertension, obesity, smoking, UV exposure, medication history, genetic factors and other metabolic disorders can also affect the development of cataracts. Because of the use of secondary data from medical records there were several of these variables that were not able to be explored in more detail. Further studies need to incorporate other clinical factors like diabetes mellitus duration, glycemic control, cataract stage, BMI, hypertension, etc, and treatment history to explain the risks of cataract among diabetic patients in more detail.

CONCLUSION

Based on the results of a study of 250 patients at the JEC Orbita Makassar Main Eye Clinic from January 2025 to December 2025, it was found that the majority of diabetes mellitus patients with cataracts were in the adult to elderly age group, indicating that this age group is more

susceptible to cataract complications. The distribution by gender showed an equal number of men and women. The majority of cataract patients had diabetes mellitus. However, a chi-square test showed a significant association between diabetes mellitus and cataracts ($p < 0.05$). The authors hope that this study's results can serve as a basis for improving promotive and preventive efforts, particularly for diabetes mellitus patients, through education on blood sugar control and regular eye examinations to prevent cataract complications. Furthermore, future research is expected to use a larger sample size and include other variables such as duration of diabetes, HbA1c levels, and other risk factors to obtain a more comprehensive picture of the relationship.

REFERENCES

Al-Lawati, J. A. (2017). Diabetes mellitus: a local and global public health emergency!. *Oman medical journal*, *32*(3), 177. https://doi.org/10.5001/omj.2017.34

Astutisari, I. D. A. E. C., Darmini, A. Y. D. A. Y., Ayu, I. A. P. W. I., & Wulandari, P. (2022). Hubungan pola makan dan aktivitas fisik dengan kadar gula darah pada pasien diabetes melitus tipe 2 di Puskesmas Manggis I. *Jurnal Riset Kesehatan Nasional*, *6*(2), 79-87. https://doi.org/10.37294/jrkn.v6i2.350

Ayorinde, O. O., Olusanya, B. A., & Bekibele, C. O. (2024). Overcoming the challenges of cataract blindness in Nigeria: An action plan for ophthalmologists. *The Pan-American Journal of Ophthalmology*, *6*(3), 90.

Banday, M. Z., Sameer, A. S., & Nissar, S. (2020). Pathophysiology of diabetes: An overview. *Avicenna journal of medicine*, *10*(04), 174-188.

Campbell-Thompson, M., Rodriguez-Calvo, T., & Battaglia, M. (2015). Abnormalities of the exocrine pancreas in type 1 diabetes. *Current diabetes reports*, *15*(10), 79. https://doi.org/10.1007/s11892-015-0653-y

Chang, J. R., Koo, E., Agrón, E., Hallak, J., Clemons, T., Azar, D., ... & Age-Related Eye Disease Study Group. (2011). Risk factors associated with incident cataracts and cataract surgery in the Age-related Eye Disease Study (AREDS): AREDS report number 32. *Ophthalmology*, *118*(11), 2113-2119. https://doi.org/10.1016/j.ophtha.2011.03.032

Chen, Y., Li, Y., Hu, P., Chen, T., Grzybowski, A., & Huang, L. (2025). Global burden of vision impairment due to smoking-related cataract: A descriptive study of spatiotemporal trends based on GBD secondary data and projections to 2050. *Tobacco Induced Diseases*, *23*, 10-18332. https://doi.org/10.18332/tid/210411

Damayanti, F., Hutaperi, B., Jelmila, S. N., & Ashan, H. (2024). Hubungan Diabetes Melitus Terhadap Penderita Katarak. *Scientific Journal*, *3*(4), 209-220. https://doi.org/10.56260/sciena.v3i4.146

Darmawanti, U. S. (2024). Faktor determinan kasus diabetes mellitus tipe 2 di Kabupaten Administrasi Kepulauan Seribu Provinsi DKI Jakarta Tahun 2023. *Jurnal Epidemiologi Kesehatan Indonesia*, *8*(2), 1. https://doi.org/10.7454/epidkes.v8i2.1107

Flora, G. D., & Nayak, M. K. (2019). A brief review of cardiovascular diseases, associated risk factors and current treatment regimes. *Current pharmaceutical design*, *25*(38), 4063-4084. https://doi.org/10.2174/1381612825666190925163827

Gitaiswari, N. K. D., & Benny, A. S. (2025). Prevalensi katarak disertai kejadian diabetes melitus di Rumah Sakit Bhayangkara pada periode Oktober 2023–Oktober 2024. *Intisari Sains Medis*, *16*(2), 691-694. https://doi.org/10.15562/ism.v16i2.2236

Glover, S. J., Burgess, P. I., Cohen, D. B., Harding, S. P., Hofland, H. W., Zijlstra, E. E., & Allain, T. J. (2012). Prevalence of diabetic retinopathy, cataract and visual impairment in patients

with diabetes in sub-Saharan Africa. *British Journal of Ophthalmology*, *96*(2), 156-161. https://doi.org/10.1136/bjo.2010.196071

Guo, Z., Ma, X., Zhang, R. X., & Yan, H. (2023). Oxidative stress, epigenetic regulation and pathological processes of lens epithelial cells underlying diabetic cataract. *Advances in ophthalmology practice and research*, *3*(4), 180-186. https://doi.org/10.1016/j.aopr.2023.10.001

Hardt, P. D., & Ewald, N. (2011). Exocrine pancreatic insufficiency in diabetes mellitus: a complication of diabetic neuropathy or a different type of diabetes?. *Journal of Diabetes Research*, *2011*(1), 761950. https://doi.org/10.1155/2011/761950

Haryono, N. W., Gunawan, D., & Kembaren, P. N. (2023). Hubungan Lama Menderita Diabetes Melitus Dengan Derajat Sindrom Mata Kering Pada Penderita Diabetes Melitus Tipe 2 Di Rumah Sakit Badan Pengusahaan Batam. *Zona Kedokteran: Program Studi Pendidikan Dokter Universitas Batam*, *13*(1), 275-282. https://doi.org/10.37776/zked.v13i1.1147

Hashim, Z., & Zarina, S. (2012). Osmotic stress induced oxidative damage: possible mechanism of cataract formation in diabetes. *Journal of diabetes and its complications*, *26*(4), 275-279. https://doi.org/10.1016/j.jdiacomp.2012.04.005

Iqbal, H., Waseem, D., Akram, S., Ghalib, S., & Khalid, S. (2024). A Comparative Study of Cataract Occurrence and Visual Impairment in Diabetic and Non-Diabetic Individuals. *Journal of Nursing and Allied Health*, *2*(04).

Irawan, P. Q., Utami, K. D., & Reski, S. (2022). Hubungan indeks massa tubuh (IMT) dengan kadar HbA1c pada penderita diabetes mellitus tipe II di Rumah Sakit Abdoel Wahab Sjahranie.

Ivanescu, A., Popescu, S., Gaita, L., Albai, O., Braha, A., & Timar, R. (2024). Risk factors for cataracts in patients with diabetes mellitus. *Journal of Clinical Medicine*, *13*(23), 7005. https://doi.org/10.3390/jcm13237005

Jiang, B., Wu, T., Liu, W., Liu, G., & Lu, P. (2023). Changing trends in the global burden of cataract over the past 30 years: retrospective data analysis of the global burden of disease study 2019. *JMIR Public Health and Surveillance*, *9*(1), e47349. https://doi.org/10.2196/47349

Khan, A., Petropoulos, I. N., Ponirakis, G., & Malik, R. A. (2017). Visual complications in diabetes mellitus: beyond retinopathy. *Diabetic medicine*, *34*(4), 478-484. https://doi.org/10.1111/dme.13296

Mrugacz, M., Pony-Uram, M., Bryl, A., & Zorena, K. (2023). Current approach to the pathogenesis of diabetic cataracts. *International journal of molecular sciences*, *24*(7), 6317. https://doi.org/10.3390/ijms24076317

Mukesh, B. N., Le, A., Dimitrov, P. N., Ahmed, S., Taylor, H. R., & McCarty, C. A. (2006). Development of cataract and associated risk factors: the Visual Impairment Project. *Archives of ophthalmology*, *124*(1), 79-85.

Muntner, P., DeSalvo, K. B., Wildman, R. P., Raggi, P., He, J., & Whelton, P. K. (2006). Trends in the prevalence, awareness, treatment, and control of cardiovascular disease risk factors among noninstitutionalized patients with a history of myocardial infarction and stroke. *American Journal of Epidemiology*, *163*(10), 913-920. https://doi.org/10.1093/aje/kwj124

Nuraisyah, F., Ruliyandari, R., & Matahari, R. (2020). Riwayat Keluarga Diabetes Tipe II dengan Kadar Gula Darah. *Jurnal Kebidanan Dan Keperawatan Aisyiyah*, *16*(2), 253-259.

Padwal, R., Straus, S. E., & McAlister, F. A. (2001). Cardiovascular risk factors and their effects on the decision to treat hypertension: evidence based review. *BMJ*, *322*(7292), 977-980. https://doi.org/10.1136/bmj.322.7292.977

Pedrinelli, R., Ballo, P., Fiorentini, C., Denti, S., Galderisi, M., Ganau, A., ... & Zacà, V. (2012). Hypertension and acute myocardial infarction: an overview. *Journal of cardiovascular medicine*, *13*(3), 194-202.

Pesudovs, K., Cicinelli, M., Taylor, H., Sedighi, T., Bikbov, M., Bron, A., ... & Farrokhpour, H. (2024). Global estimates on the number of people blind or visually impaired by cataract: a meta-analysis from 2000 to 2020. *Eye (Basingstoke)*, *38*(11). http://doi.org/10.1038/s41433-024-02961-1

Piciucchi, M., Capurso, G., Archibugi, L., Delle Fave, M. M., Capasso, M., & Delle Fave, G. (2015). Exocrine pancreatic insufficiency in diabetic patients: prevalence, mechanisms, and treatment. *International journal of endocrinology*, *2015*(1), 595649. https://doi.org/10.1155/2015/595649

Piovani, D., Nikolopoulos, G. K., & Bonovas, S. (2022). Non-communicable diseases: the invisible epidemic. *Journal of clinical medicine*, *11*(19), 5939. https://doi.org/10.3390/jcm11195939

Prokofyeva, E., Wegener, A., & Zrenner, E. (2013). Cataract prevalence and prevention in Europe: a literature review. *Acta ophthalmologica*, *91*(5), 395-405. https://doi.org/10.1111/j.1755-3768.2012.02444.x

Raman, R., Pal, S. S., Adams, J. S. K., Rani, P. K., Vaitheeswaran, K., & Sharma, T. (2010). Prevalence and risk factors for cataract in diabetes: Sankara Nethralaya Diabetic Retinopathy Epidemiology and Molecular Genetics Study, report no. 17. *Investigative Ophthalmology & Visual Science*, *51*(12), 6253-6261. https://doi.org/10.1167/iovs.10-5414

Ristiyowati, E., & Aini, L. N. (2023). Optimalisasi Kadar Gula Dalam Darah Pada Penderita Diabetes Mellitus Melalui Hipnoterapi. *Pengembangan Ilmu dan Praktik Kesehatan*, *2*(4), 206-220. https://doi.org/10.56586/pipk.v2i4.284

Rondanelli, M., Gasparri, C., Riva, A., Petrangolini, G., Barrile, G. C., Cavioni, A., ... & Perna, S. (2023). Diet and ideal food pyramid to prevent or support the treatment of diabetic retinopathy, age-related macular degeneration, and cataracts. *Frontiers in medicine*, *10*, 1168560. https://doi.org/10.3389/fmed.2023.1168560

Rosendorff, C., Lackland, D. T., Allison, M., Aronow, W. S., Black, H. R., Blumenthal, R. S., ... & White, W. B. (2015). Treatment of hypertension in patients with coronary artery disease: a scientific statement from the American Heart Association, American College of Cardiology, and American Society of Hypertension. *Circulation*, *131*(19), e435-e470. https://doi.org/10.1161/CIR.0000000000000207

Saaddine, J. B., Honeycutt, A. A., Narayan, K. V., Zhang, X., Klein, R., & Boyle, J. P. (2008). Projection of diabetic retinopathy and other major eye diseases among people with diabetes mellitus: United States, 2005-2050. *Archives of ophthalmology*, *126*(12), 1740-1747.

Sahajpal, N. S., Goel, R. K., Chaubey, A., Aurora, R., & Jain, S. K. (2019). Pathological perturbations in diabetic retinopathy: hyperglycemia, AGEs, oxidative stress and inflammatory pathways. *Current Protein and Peptide Science*, *20*(1), 92-110. https://doi.org/10.2174/1389203719666180928123449

Sanjaya, L. R., & Setiawan, Y. (2024). Faktor risiko diabetes melitus tipe-II pada remaja. *Citra Delima Scientific Journal Of Citra Internasional Institute*, *8*(1), 66-73.

Sayin, N., Kara, N., & Pekel, G. (2015). Ocular complications of diabetes mellitus. *World journal of diabetes*, *6*(1), 92. https://doi.org/10.4239/wjd.v6.i1.92

Tangvarasittichai, O., & Tangvarasittichai, S. (2018). Oxidative stress, ocular disease and diabetes retinopathy. *Current pharmaceutical design*, *24*(40), 4726-4741. https://doi.org/10.2174/1381612825666190115121531

Thorne, C. A., Grey, A. C., Lim, J. C., & Donaldson, P. J. (2024). The synergistic effects of polyol pathway-induced oxidative and osmotic stress in the aetiology of diabetic cataracts. *International journal of molecular sciences*, *25*(16), 9042. https://doi.org/10.3390/ijms25169042

Vision Loss Expert Group of the Global Burden of Disease Study. (2024). Global estimates on the number of people blind or visually impaired by cataract: a meta-analysis from 2000 to 2020. *Eye*, *38*(11), 2156. https://doi.org/10.1038/s41433-024-02961-1

Wei, Q., Qi, L., Lin, H., Liu, D., Zhu, X., Dai, Y., ... & Li, L. (2020). Pathological mechanisms in diabetes of the exocrine pancreas: what's known and what's to know. *Frontiers in physiology*, *11*, 570276. https://doi.org/10.3389/fphys.2020.570276

Widiasari, K. R., Wijaya, I. M. K., & Suputra, P. A. (2021). Diabetes melitus tipe 2: Faktor risiko, diagnosis, dan tatalaksana. *Ganesha Medicina*, *1*(2), 114-120. https://doi.org/10.23887/gm.v1i2.40006

Wynne, K., Devereaux, B., & Dornhorst, A. (2019). Diabetes of the exocrine pancreas. *Journal of gastroenterology and hepatology*, *34*(2), 346-354. https://doi.org/10.1111/jgh.14451

