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RISK FACTORS FOR CATARACT AT PRIMAYA HOSPITAL HERTASNING, INDONESIA: A CASE-CONTROL STUDY

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ABSTRACT

Cataracts are the most frequent cause of blindness and vision impairment in developing countries. This study aimed to analyze the risk factors influencing the incidence of cataracts and to quantify their magnitude of risk. The study was an observational case-control analysis conducted at Primaya Hospital Hertasning, Makassar, Indonesia, including 158 cases and 158 controls, with a mean age of 53.52 ± 15.44 years. Several risk factors demonstrated statistically significant associations with cataract incidence, including age ≥60 years (defined as the high-risk age group) ($p < 0.001$), male sex ($p < 0.001$), outdoor occupation ($p = 0.025$), history of trauma ($p = 0.005$), diabetes mellitus ($p < 0.001$), and hypertension ($p < 0.001$). Bivariate odds ratios were as follows: history of trauma [OR 11.748 (95% CI: 1.498–92.125)], high-risk age group [OR 11.491 (95% CI: 6.676–19.780)], diabetes mellitus [OR 6.559 (95% CI: 2.213–19.444)], and hypertension [OR 6.064 (95% CI: 3.470–10.536)]. The wide confidence interval for trauma history reflects the limited number of trauma cases in the sample. Multivariate logistic regression identified trauma history as the most dominant independent risk factor, with individuals with a history of trauma having approximately 20 times the risk of developing cataracts compared to those without (Exp(B) = 20.014). A comprehensive understanding of these risk factors is essential for developing targeted strategies to reduce the burden of cataract-related blindness.

Kata Kunci:

Katarak; Katarak Terkait Usia; Diabetes Melitus; Trauma; Hipertensi

ABSTRAK

Katarak merupakan penyebab kebutaan dan gangguan penglihatan yang paling sering terjadi di negara berkembang. Penelitian ini bertujuan untuk menganalisis faktor-faktor risiko yang memengaruhi kejadian katarak dan mengukur besarnya risiko tersebut. Penelitian ini merupakan analisis observasional dengan desain kasus-kontrol yang dilaksanakan di Rumah Sakit Primaya Hertasning, Makassar, Indonesia, dengan melibatkan 158 kasus dan 158 kontrol, serta rerata usia 53,52 ± 15,44 tahun. Beberapa faktor risiko menunjukkan hubungan yang bermakna secara statistik dengan kejadian katarak, meliputi usia ≥60 tahun (didefinisikan sebagai kelompok usia berisiko tinggi) ($p < 0,001$), jenis kelamin laki-laki ($p < 0,001$), pekerjaan di luar ruangan ($p = 0,025$), riwayat trauma ($p = 0,005$), diabetes melitus ($p < 0,001$), dan hipertensi ($p < 0,001$). Odds ratio bivariat adalah sebagai berikut: riwayat trauma [OR 11,748 (95% CI: 1,498–92,125)], kelompok usia berisiko tinggi [OR 11,491 (95% CI: 6,676–19,780)], diabetes melitus [OR 6,559 (95% CI: 2,213–19,444)], dan hipertensi [OR 6,064 (95% CI: 3,470–10,536)]. Interval kepercayaan yang lebar pada riwayat trauma mencerminkan terbatasnya jumlah kasus trauma dalam sampel penelitian. Analisis regresi logistik multivariat mengidentifikasi riwayat trauma sebagai faktor risiko independen yang paling dominan, dengan individu yang memiliki riwayat trauma berisiko sekitar 20 kali lebih besar untuk menderita katarak dibandingkan mereka yang tidak memiliki riwayat trauma (Exp(B) = 20,014). Pemahaman yang komprehensif mengenai faktor-faktor risiko ini sangat penting dalam mengembangkan strategi yang tepat sasaran untuk mengurangi beban kebutaan akibat katarak.

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INTRODUCTION

As new subcortical lens fibers grow, the human lens continues to expand. The most frequent cause of blindness in developing countries and vision impairment in the elderly is cataracts, which are clouding of the lens (Erdurmuş et al., 2019). In 2020, 295 million people had moderate to severe visual impairment, with 43.3 million blind across all age groups. Moderate to severe visual impairment has a socioeconomic impact (Pesudovs et al., 2024). Cataracts are the leading cause of blindness worldwide, and the risk increases with each decade of life, beginning at around the age of 40.5 years (American Academy of Ophthalmology, 2021).

An estimated 0.1% of Indonesians are predicted to have cataracts annually, representing one new case per 1,000 persons per year (Haryono et al., 2019). Smoking, diabetes mellitus, high blood pressure, age, gender, and occupation are risk factors for senile cataracts, which are very common (Rizal et al., 2023). Diabetes mellitus and hypertension are two risk factors that affect the occurrence of cataracts in patients who visited the Eye Health Center in Makassar in 2017 (Harun et al., 2020). With advancing age, oxidative stress in the human lens increases, leading to elevated protein concentrations in opaque lenses, disruption of fiber cell membranes, and subsequent protein aggregation and structural damage (Nartey, 2017).

Makassar City, as the capital of South Sulawesi Province, serves as a primary referral center for health services in Eastern Indonesia. Primaya Hospital Hertasning was selected as the study site due to its designation as a center of excellence for ophthalmology services in Makassar, serving not only local residents but also patients from surrounding regions. As a referral-based ophthalmology center, the hospital captures a broader and more diverse patient population with varying demographic backgrounds, occupational exposures, and comorbidity profiles, thereby providing more representative data on cataract risk factors. Early detection of cataracts at this facility enables prompt intervention, ultimately contributing to improved quality of life among affected individuals.

The prevalence of cataract is approximately 50% among individuals aged 65-74 and increases to approximately 70% in individuals aged 75 and older (Harper, 2018). Both modifiable and non-modifiable risk factors have an impact on the development of cataracts. The primary risk factor that is unchangeable is age, and the risk doubles every ten years (Kumar et al., 2021). Compared with indoor professions, outdoor occupations that are directly exposed to UV light, including farming and military service, are more likely to contribute to cataract development. In contrast, nurses, teachers, and midwives, are not immediately exposed to ultraviolet light (Suparti & Purwanti, 2017). The pathogenesis of UV radiation-induced cataracts involves impairment of the phagocytic capability of lens epithelial cells following UV exposure, leading to accumulation of toxic cellular debris, collectively contributing to UV-mediated cataract development (Löfgren, 2017).

The development of cataracts in diabetes occurs through the polyol pathway, which leads to sorbitol accumulation, causing osmotic stress and damage to lens fibers (Miricescu et al., 2020). Under hyperglycemic conditions, activation of the polyol pathway leads to sorbitol accumulation within the lens, increasing osmotic pressure and drawing water into the lens, resulting in lens hydration and subsequent cataract development (Budiono et al., 2013). Regarding traumatic cataracts, mechanical injury disrupts both the macroscopic and microscopic structures of the lens, altering its structural integrity and metabolic balance, ultimately leading to opacification. In addition, intraocular diseases such as recurrent uveitis, glaucoma, retinitis pigmentosa, and retinal detachment can directly impair lens physiology through chronic inflammation and elevated intraocular pressure, progressively affecting the entire lens structure (Budiono et al., 2013). A comprehensive understanding of these multifactorial pathogenic mechanisms is essential for developing effective strategies to reduce the global burden of cataract-related blindness (Ang & Afshari, 2021).

This study aimed to analyze the risk factors influencing the incidence of cataracts and to quantify the magnitude of risk associated with age, sex, occupation, history of diabetes mellitus, history of hypertension, history of trauma, and history of intraocular disease, using an observational case-control design conducted at Primaya Hospital Hertasning.

METHOD

This study employed an observational analytic unmatched case-control design to retrospectively assess the association between several risk factors and cataract incidence. This study was conducted at Primaya Hospital Hertasning, Makassar City, Indonesia, from August to November 2024. The study population consisted of outpatients at the eye department of Primaya Hospital Hertasning aged over 20 years, recruited through convenience sampling using secondary data obtained from medical records. All cataract patients documented in the medical records between January and July 2024 were assigned to the case group, while patients without cataracts who attended the eye polyclinic for routine examination were assigned to the control group, resulting in an equal number of cases and controls (1:1 ratio).

The inclusion criteria for the case group were patients diagnosed with cataracts, including senile cataract or other cataract types, based on the diagnosis of an ophthalmologist at Primaya Hospital Hertasning. The inclusion criteria for the control group were individuals without a cataract diagnosis who had an equal probability of exposure to the same risk factors as the case group and had a documented history of visiting the eye polyclinic. The exclusion criteria for the case group were patients with a diagnosis of congenital cataract and patients with incomplete medical record data.

Based on the unpaired categorical analytic study sample size formula, the minimum required sample size was 158 cases and 158 controls. Data analysis included bivariate analysis to determine statistical significance and Odds Ratios (ORs), followed by multivariate logistic regression analysis to identify the most dominant independent risk factors.

Research Ethics

This study was approved by the Research Ethics Committee of Universitas Muslim Indonesia. (Approval No. 523/A.1/KEP-UMI/X/2024). The researchers maintained and respected the dignity of the participants. All data collected were kept confidential to protect participants' privacy.

RESULT

In this study, patient age ranged from 20 to 89 years, with a mean of 53.52 ± 15.44 years. As presented in Table 1, bivariate analysis was performed for all variables. Age was categorized into high-risk (≥60 years) and low-risk (<60 years) groups. Patients in the high-risk age group had a significantly higher risk of developing cataracts ($p < 0.001$), with an 11.491-fold increased risk compared to the low-risk group [OR 11.491 (95% CI: 6.676–19.780)].

Regarding sex distribution, 86 male patients (54.4%) were in the case group, while 107 female patients (67.7%) comprised the majority of the control group. Male sex was identified as a statistically significant risk factor for cataract incidence ($p < 0.001$), with male patients having a 2.506-fold higher risk of developing cataracts compared to female patients [OR 2.506 (95% CI: 1.586–3.960)].

In terms of occupation, the majority of subjects in both the case and control groups were employed in indoor occupations (86.1% and 93.7%, respectively), while outdoor occupations accounted for 13.9% of the case group and 6.3% of the control group. Outdoor occupation was associated with a 2.394-fold increased risk of developing cataracts [OR 2.394 (95% CI: 1.094–5.238)].

Among the study subjects, a history of trauma was reported in only 11 patients (7.0%) in the case group and one patient (0.6%) in the control group. A history of trauma was identified as a statistically significant risk factor for cataract incidence ($p = 0.005$), with a 11.748-fold increased risk compared to those without trauma history [OR 11.748 (95% CI: 1.498–92.125)].

Regarding diabetes mellitus, 23 patients (14.6%) in the case group had a history of DM compared to 135 patients (85.4%) without DM. A history of diabetes mellitus was a statistically significant risk factor for cataract incidence ($p < 0.001$), with a 6.559-fold increased risk of developing cataracts [OR 6.559 (95% CI: 2.213–19.444)].

Table 1. Results of Bivariate Analysis of Variables

Variables	Case (n = 158)		Control (n = 158)		Total (n = 316)		*p* value	OR	95% CI
	n	%	n	%	n	%			
Age									
High Risk	108	68.4	25	15.8	133	42.1	0.000	11.491	6.676 - 19.780
Low Risk	50	31.6	133	84.2	183	57.9			
Gender									
Male	86	54.4	51	32.3	137	43.4	0.000	2.506	1.586 - 3.960
Female	72	45.6	107	67.7	179	56.6			
Occupation									
Outdoor	22	13.9	10	6.3	32	10.1	0.025	2.394	1.094 - 5.238
Indoor	136	86.1	148	93.7	284	89.9			
History of Trauma									
Yes	11	7	1	0.6	12	3.8	0.005	11.748	1.498 - 92.125
No	147	93	157	99.4	304	96.2			
Diabetes Mellitus									
Yes	23	14.6	4	2.5	27	8.5	0.000	6.559	2.213 - 19.444
No	135	85.4	154	97.5	289	91.5			
Hypertension									
Yes	76	48.1	21	13.3	97	30.7	0.000	6.064	3.470 - 10.536
No	82	51.9	137	86.7	219	69.3			
Intraocular disease									
Yes	11	7	13	8.2	24	7.6	0.671	0.835	0.362 - 1.924
No	147	93	145	91.8	292	92.4			

Significant level of *p* value < 0.05, n = number of participants, statistical analysis: *chi-square*

A history of hypertension was recorded in 76 patients (48.1%) in the case group and 21 patients (13.3%) in the control group, and was significantly associated with cataract incidence ($p < 0.001$), with a 6.064-fold increased risk [OR 6.064 (95% CI: 3.470–10.536)]. In contrast, a history of intraocular disease was present in 11 patients (7.0%) in the case group and 13 patients (8.2%) in the control group, with no statistically significant association with cataract incidence observed ($p = 0.671$).

As presented in Table 2, multivariate logistic regression analysis identified trauma history as the most dominant independent risk factor, with an Exp(B) of 20.014, indicating a 20-fold increased risk of developing cataracts compared to those without trauma history. High-risk age (≥60 years) followed with an Exp(B) of 9.725, representing a 9.725-fold increased risk compared to the low-risk age group (<60 years). History of diabetes mellitus demonstrated an Exp(B) of 9.466, followed by hypertension with an Exp(B) of 3.430, outdoor occupation with an Exp(B) of 2.044, and male sex with an Exp(B) of 1.987, each indicating progressively lower but still meaningful independent contributions to cataract risk.

Table 2. Results of Multivariate Analysis of Variables

Variables	B	S.E.	Wald	df	Sig.	95% CI for Exp (B)		EXP (B)
						Lower	Upper	
Age	2.275	0.310	53.860	1	0.000	5.298	17.854	9.725
Gender	0.687	0.317	4.678	1	0.031	1.067	3.702	1.987
Occupation	0.715	0.534	1.791		0.181	0.717	5.826	2.044
History of Trauma	2.996	1.119	7.168	1	0.007	2.232	179.475	20.014
Diabetes Mellitus	2.248	0.634	12.586	1	0.000	2.734	32.768	9.466
Hypertension	1.233	0.344	12.816	1	0.000	1.747	6.736	3.430
Constant	-17.696	3.161	31.347	1	0.000			0.000

Significant level of *P* value < 0.05, n = number of participants Statistical analysis: logistic regression

DISCUSSION

In this study, 108 patients (68.4%) were classified as high-risk based on age ≥60 years. The prevalence of cataracts increases significantly with age, consistent with findings across various populations (Hong et al., 2022; Hugosson & Ekström, 2020; Singhal et al., 2020). A study by Detty et al. (2021) reported that the majority of cataract patients were aged above 50 years, accounting for 75.9% of the study population. This age-related progression is attributed to the accumulation of oxidative stress within the lens, where progressive depletion of antioxidant defenses leads to protein oxidation, aggregation, and eventual lens opacification (Nartey, 2017). These findings are consistent with Indonesian and developing country studies reporting a high burden of age-related cataracts among elderly patients.

Regarding sex distribution, the majority of cataract patients in this study were male (54.4%). The role of sex in cataract development remains inconsistent across the literature, with some studies reporting a higher prevalence in women (Hugosson & Ekström, 2020), while others suggest that female sex may be protective due to hormonal influences (Harun, 2021).

Outdoor occupation was recorded in 22 cases (13.9%), reflecting the predominantly indoor occupational profile of the urban Makassar population. Nevertheless, outdoor work remains a recognized risk factor for cataract development, as prolonged ultraviolet radiation exposure induces photochemical damage to lens proteins, generates reactive oxygen species, and impairs lens epithelial cell repair mechanisms, collectively accelerating lens opacification (Gupta et al., 2020; Harun, 2021). Prevalence rates and associated risk factors may vary considerably between rural and urban populations, which may partly explain the relatively low proportion of outdoor workers in this study (Singh et al., 2019).

A history of trauma was present in only 11 cases (7.0%), representing a notably small subgroup. Traumatic cataracts are a recognized consequence of ocular injury, particularly in young males, and may also develop following non-ocular trauma such as traumatic brain injury and polytrauma (Singhal et al., 2020; Viswanathan et al., 2024). Diagnosis typically involves clinical examination and may be supplemented by ultrasound imaging (Grither & Stickles, 2021). However, given the limited number of trauma cases in this study, the corresponding odds ratio should be interpreted with caution, as small subgroup sizes can produce unstable effect estimates and excessively wide confidence intervals, as reflected by the wide 95% CI observed [OR 11.748 (95%

CI: 1.498–92.125)]. This limitation is acknowledged and future studies with larger trauma case numbers are warranted.

Diabetes mellitus was significantly associated with cataract incidence, consistent with previous studies in elderly populations (Pék, 2020; Shaifullah et al., 2024). Following aging, DM represents the most significant independent risk factor for cataract formation, with the prevalence of cataracts in diabetic patients estimated to be approximately 35% higher than in non-diabetic individuals (Pék, 2020). Biologically, chronic hyperglycemia activates the polyol pathway, leading to sorbitol accumulation within the lens, which induces osmotic stress, disrupts lens fiber integrity, and promotes the formation of advanced glycation end-products (AGEs) that further impair lens protein transparency (Nisha, 2022).

Hypertension was also identified as a significant risk factor for age-related cataract, in agreement with existing literature (Chen, 2020; Li et al., 2021). The proposed biological mechanism involves hypertension-induced vascular degeneration, which reduces perfusion to the lens and surrounding ocular tissues, thereby impairing nutrient delivery and metabolic waste clearance, ultimately promoting oxidative damage and lens opacification. The risk is further compounded when hypertension coexists with diabetes mellitus (Li et al., 2021).

In this study, history of intraocular disease showed no statistically significant association with cataract incidence ($p = 0.671$). Although intraocular diseases such as uveitis, glaucoma, and retinal detachment are recognized comorbidities that can affect lens physiology, mature cataracts frequently coexist with posterior segment pathologies, with a reported prevalence of 32.2% (Kim et al., 2022). The absence of a significant association in this study may reflect the limited number of intraocular disease cases recorded, and cataract surgery in such patients presents unique clinical challenges that warrant careful preoperative evaluation.

Limitations

This study has several limitations. First, this study did not differentiate cataract types based on lens structure, as not all diagnoses were classified according to the affected lens structure. Differences in the affected lens structures may be associated with more specific risk factors. Second, this study used data from medical records so that incomplete documentation of medical history may have occured.

CONCLUSION AND SUGGESTION

The conclusion from this study is that age group, sex, occupation, history of trauma, diabetes mellitus, and hypertension were identified as determinants of cataract incidence. Among these variables, trauma history was the most influential factor, with individuals who had a history of trauma having approximately a 20-fold higher risk of developing cataracts.

Based on the results of this study, there are several suggestions that the researchers would like to put forward, including the need for further studies to investigate risk factors according to specific cataract types. Further research should be conducted using a cohort study design with a larger sample size. It is also recommended that future studies use population- or survey-based data to provide findings that are more representative.

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