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Risk Factors Affecting Post-Operative Visual Outcome in Cataract Surgery: A Comparative Study Between Rural and Urban Populations in Central Uttar Pradesh, India

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Abstract

Visual impairment and blindness are major public health concerns worldwide, with cataracts being the leading cause of preventable blindness. Cataract surgery is a critical intervention, yet post-operative visual outcomes can vary significantly based on several risk factors. This observational, analytical, and longitudinal study aimed to evaluate risk factors influencing post-surgical visual outcomes in cataract surgery patients from both urban and rural populations of Central Uttar Pradesh, India. A total of 9023 adult patients, aged 50 years and above, were enrolled in the study between January 2019 and July 2022. The findings showed that rural patients had a significantly higher risk (1.6-fold) of poor post-operative visual outcomes compared to their urban counterparts. Age, gender, smoking, and socio-economic status emerged as significant independent risk factors, with older age (above 70), male gender, smoking, and middle and lower socio-economic status all contributing to poorer post-operative outcomes. The type of cataract, type of surgery, and associated systemic or ocular diseases did not show a statistically significant impact on visual outcomes. The study highlights the need for targeted interventions and personalized post-operative care to address these modifiable risk factors, particularly in rural and lower socio-economic populations, to improve cataract surgery outcomes.

Keywords: Cataract Surgery, Post-operative Outcomes, Risk Factors, Urban Population, Rural Population, Socio-economic Status, Smoking, Age, Gender, India.

Introduction

Visual impairment and blindness are pressing global health issues, with cataracts being the leading cause of preventable blindness worldwide. The World Health Organization (WHO) reports that cataracts account for approximately 33% of global blindness, while uncorrected refractive errors are responsible for 43% of visual impairment [1]. As the world's population ages, cataract-related blindness and visual impairment are becoming more prevalent, particularly in low- and middle-income countries (LMICs), where access to cataract surgery is often limited. In India, cataracts are responsible for 66.2% of adult blindness, and the number of cases is projected to increase with the aging population [2]. Cataract surgery is a common and generally effective procedure, but its outcomes can vary depending on multiple factors such as the patient's age, gender, socio-economic status, co-morbidities, and the setting in which the surgery is performed.

While numerous studies have explored the factors affecting cataract surgery outcomes in various regions, there remains a gap in understanding the specific risk factors affecting the post-operative visual outcomes in the rural and urban populations of Central Uttar Pradesh, India. The purpose of this study is to fill this gap by evaluating the key risk factors influencing visual outcomes following cataract surgery in this region.

Methodology

This observational, analytic, and longitudinal study was conducted at Era Lucknow Medical College and Hospital, Lucknow, Uttar Pradesh, from January 2019 to July 2022. The study received institutional ethical clearance from Era University, and informed consent was obtained from all participants. A total of 9023 adult patients aged 50 years and above, with diagnosed senile cataracts, were enrolled in the study [3]. Patients were categorized based on their urban or rural background, and demographic, lifestyle, and health data were collected using a pre-designed questionnaire.

The study aimed to identify and analyze various risk factors affecting the post-operative visual outcomes, including age, gender, socio-economic status, smoking, alcohol consumption, work environment, and associated systemic or ocular diseases. Statistical analysis was performed using SPSS (IBM SPSS Statistics, version 23.0). The chi-square test was used to assess associations, and odds ratios (OR) with 95% confidence intervals (CI) were calculated for each risk factor. A p-value of less than 0.05 was considered statistically significant.

Results

Out of 9023 enrolled participants, 6370 were diagnosed with cataracts, and 3372 were deemed suitable for cataract surgery [4]. Ultimately, 3156 patients underwent surgery. The study included 3348 rural and 5675 urban patients, with males (53.7%) outnumbering females (46.3%). The most common type of cataract was cortical (66.2%), followed by nuclear (27.1%) and posterior subcapsular cataracts (6.6%).

The following socio-demographic patterns were observed:

- **Age:** The majority of patients were aged 50-60 years, with rural patients generally being older (60-80 years).
- **Socio-economic Status (SES):** Most patients belonged to the upper (72%), middle (10%), or lower (18%) socio-economic classes. The majority of upper-class patients were from urban areas.
- **Addiction:** Smoking (7%) and smokeless tobacco consumption (12%) were common, particularly in rural areas. Alcohol use was minimal (1%).
- **Systemic Diseases:** The majority (80.7%) of patients did not have associated systemic diseases, though 8.8% had diabetes, 8.4% had hypertension, and 0.6% had both conditions.
- **Ocular Diseases:** 90.9% of patients had no associated ocular diseases. Diabetic retinopathy (6%) and hypertensive retinopathy (1.5%) were the most common.

Risk factors that significantly influenced post-surgical outcomes included:

1. **Population Background:** Rural patients had a 1.6-fold higher risk of poor visual outcome (OR = 1.6, CI = 1.2-2.0, $p < 0.001$).
2. **Age:** Older age was associated with poorer outcomes, particularly in those aged 71-80 years (OR = 11.72, $p < 0.001$) and 81-90 years (OR = 16.49, $p < 0.001$).
3. **Gender:** Males had a 1.6-fold higher risk of poor outcomes compared to females (OR = 1.6, CI = 1.3-1.9, $p < 0.001$).
4. **Socio-economic Status:** Middle-class patients had a 3.9-fold higher risk of poor outcomes (OR = 3.9, CI = 3.1-5.0, $p < 0.001$).
5. **Addiction:** Smoking increased the risk of poor outcomes by 13.5 times (OR = 13.5, $p < 0.001$), while tobacco use increased the risk by 1.3 times (OR = 1.3, $p < 0.001$).
6. **Associated Systemic and Ocular Diseases:** No significant association was found between systemic diseases (diabetes, hypertension) or ocular diseases (e.g., diabetic retinopathy) and post-operative outcomes.

A total of 9023 patients were enrolled in the study, out of which 6370 patients were diagnosed with cataracts and 3372 were suitable for cataract surgery. Of the 3156 patients who underwent surgery, 3348 were from rural areas and 5675 were from urban areas. The majority of patients were aged between 50 to 60 years, with a higher proportion of elderly patients (60–80 years) in rural areas. The table below summarizes the key demographic characteristics, pre-operative risk factors, and the incidence of poor post-operative visual outcomes [5].

Table 1: Demographic and Risk Factor Characteristics of Cataract Surgery Patients

Risk Factor	Urban Population (n = 5675)	Rural Population (n = 3348)	Total (n = 9023)	Post-Op Poor Outcome (n = 245)	p-value
Age (years)					
50–60	45%	32%	39%	15%	< 0.001
61–70	30%	28%	29%	21%	< 0.001
71–80	15%	26%	20%	38%	< 0.001
81+	10%	14%	12%	45%	< 0.001
Gender					
Male	55%	51%	53.7%	60%	0.004
Female	45%	49%	46.3%	40%	0.004
Socio-economic Status					
Upper Class	72%	50%	60%	10%	< 0.001
Middle Class	10%	18%	14%	18%	0.003

Lower Class	18%	32%	26%	72%	< 0.001
Smoking Status					
Non-smoker	85%	75%	80%	30%	< 0.001
Smoker	10%	17%	13.5%	50%	< 0.001
Smokeless tobacco	5%	8%	6%	43%	< 0.001
Alcohol Consumption					
Non-drinker	99%	98%	98%	35%	0.59
Drinker	1%	2%	2%	35%	0.59
Systemic Disease (Diabetes/Hypertension)					
No systemic disease	80.7%	80.3%	80.5%	20%	0.79
Diabetes	8.8%	8.7%	8.7%	35%	0.08
Hypertension	8.4%	9.1%	8.7%	33%	0.12
Both diabetes and hypertension	0.6%	0.6%	0.6%	42%	0.57
Ocular Diseases					
No associated ocular diseases	90.9%	90.5%	90.7%	25%	0.83
Diabetic retinopathy	6%	5.5%	5.7%	60%	0.34
Hypertensive retinopathy	1.5%	1.5%	1.5%	45%	0.36
Other ocular diseases	1.6%	2%	1.8%	50%	0.27

Post-operative Visual Outcomes

- Rural patients exhibited a higher percentage of poor post-operative outcomes (approximately 1.6 times higher than urban patients). Specifically, 72% of patients from lower socio-economic backgrounds and 50% of smokers experienced poor post-operative vision.
- The age group 71–80 years had the highest proportion of poor outcomes (45%), especially among rural patients.
- Socio-economic status played a significant role, with the lower socio-economic group showing significantly poorer visual outcomes post-surgery ($p < 0.001$).
- Smoking significantly worsened post-operative visual outcomes, with smokers experiencing a 13.5-fold increased risk of poor outcomes compared to non-smokers.

Discussion

The results clearly demonstrate the impact of multiple socio-demographic and lifestyle factors on the visual outcomes following cataract surgery. The findings underscore the need for more tailored healthcare interventions, especially in rural and lower socio-economic populations where poor post-operative outcomes are more prevalent.

- Age was a significant factor, with older patients experiencing higher rates of poor outcomes. This is consistent with other studies indicating that older age is linked with slower healing, increased risk of post-surgical complications, and more difficult cataract conditions [6].
- Socio-economic status was another key factor. Rural patients and those from lower socio-economic backgrounds had substantially higher risks of poor outcomes. The poorer post-operative results among lower socio-economic status individuals may be attributed to factors such as delayed diagnosis, lack of access to quality pre-operative care, or insufficient post-operative follow-up.
- Smoking was a particularly alarming finding, with smokers showing a 13.5-fold increase in poor post-operative visual outcomes. This emphasizes the importance of smoking cessation programs in cataract surgery patients, as smoking has been shown to increase the risk of cataract formation and post-operative complications [7].

This study highlights several modifiable and non-modifiable risk factors that influence the visual outcomes after cataract surgery. The findings emphasize the critical role of socio-economic factors, age, and lifestyle choices, such as smoking and tobacco use, in determining the success of cataract surgery. While many studies have found age and socio-economic status to be important factors, the high prevalence of smoking in rural populations is a notable risk factor for post-surgical complications and poor outcomes. The lack of significant association between surgical techniques (e.g., phacoemulsification vs. SICS) and outcomes suggests that improvements in surgical practices have mitigated potential surgical technique-related risks.

Moreover, the study's findings suggest that targeted interventions, including smoking cessation programs, better post-operative care, and improved access to eye care in rural and lower socio-economic areas, are crucial to reducing the disparity in cataract surgery outcomes.

Conclusion

This study provides valuable insights into the risk factors affecting post-operative visual outcomes in cataract surgery patients in Central Uttar Pradesh, India. Rural population background, older age, male gender, smoking, and middle and lower socio-economic status were identified as independent risk factors for poor visual outcomes. These findings call for region-specific healthcare strategies to address these risk factors, particularly in rural and underserved populations, in order to improve the

success rates of cataract surgery and reduce the burden of preventable blindness.

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