DOI: https://doi.org/10.54393/pjhs.v6i2.2684

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 02 (February 2025)

Original Article

OPEN ACCESS

Demographic Analysis of Ophthalmic Surgeries in a Tertiary Care Center in Khyber Pakhtunkhwa, Pakistan

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ARTICLE INFO

Keywords:
Ophthalmology, Cataracts, Intraocular Lens, Squint

How to Cite:
Ahmad, S., Tariq, H., Rehman, A. U., Saleem, S., Zaman, A., & Mahsood, Y. J. (2025). Demographic Analysis of Ophthalmic Surgeries in a Tertiary Care Center in Khyber Pakhtunkhwa, Pakistan: Demographic Analysis of Ophthalmic Surgeries in a Tertiary Care Center.Pakistan Journal of Health Sciences, 6(2), 09-14. https://doi.org/10.54393/pjhs.v6i2.2684

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Received date: 22nd December, 2024
Acceptance date: 10th February, 2025
Published date: 28th February, 2025

ABSTRACT

Different age groups and genders have unique needs when it comes to eye surgeries. Understanding these trends can help improve eye care services in resource-limited areas. **Objectives:** To study the types of eye surgeries performed in a tertiary care center in Khyber Pakhtunkhwa, Pakistan, and examine their link to age and gender. **Methods:** This retrospective observational study reviewed records of 3,016 patients. Data on age, gender, and procedures were analyzed using Chi-square tests, with $p<0.05$ considered significant. **Results:** The most common surgeries were intraocular lens (IOL) implantation (18.0%), primary repair surgeries (12.0%), phacoemulsification (11.6%), and extracapsular cataract extraction (10.4%). Older patients mostly underwent cataract-related surgeries, while younger patients had intraocular lens implantation and squint correction. Male patients had more cataract surgeries, while females had more primary repair surgeries. **Conclusions:** It was concluded that significant associations between age, gender, and surgical procedures were found, underscoring the need for more focused resource allocation and easier access to ophthalmic care, especially for women and older adults.

INTRODUCTION

Ophthalmic diseases pose a significant global health burden, affecting people of all ages and socioeconomic backgrounds. The World Health Organization (WHO) estimates that over 2.2 billion individuals suffer from some visual impairment, however, 1 billion of these instances may be avoidable or cured with the right care, such as medication and surgery [1, 2]. The frequency of blindness and impaired vision is quite high; according to research, the prevalence among Pakistanis aged 30 and over is about 2.5%, which corresponds to over 1.25 million blind people nationwide [3, 4]. The burden of vision loss has steadily increased over the past 20 years, beginning in 1990, and is predicted to continue to rise until at least 2025 [5]. Pakistan is among the countries with the highest burden of blindness and visual impairment in South Asia, with significant public health implications [4]. The demand for ophthalmic care is increasing in Khyber Pakhtunkhwa (KP) due to improved awareness, better access to healthcare facilities, and an ageing population vulnerable to age-related eye diseases [6, 7]. The most common causes of

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blindness and visual impairment in Pakistan are age-related macular degeneration, diabetic retinopathy, cataracts, and glaucoma. 15 million of the 33.6 million instances of blindness globally are caused by cataracts alone, making cataract surgery one of the most common operations done anywhere in the globe, including Pakistan [11-13]. The need for ophthalmic care is anticipated to rise with the increasing prevalence of diabetes and other systemic disorders that impact ocular health [8]. Timely diagnosis and appropriate treatment can help prevent loss of vision and improve the quality of life [8]. Early diagnosis and prompt treatment are essential to avoid vision loss and enhance quality of life. But getting access to specialist eye care is still difficult, especially in Pakistan's rural areas. To close this gap, tertiary care facilities offer crucial treatments, such as intricate surgical operations [8].

Ophthalmic diseases contribute substantially to visual impairment, yet there is limited localized evidence describing the demographic patterns of surgical interventions in tertiary care settings of Khyber Pakhtunkhwa, Pakistan. Existing literature largely focuses on global or single-procedure trends, with insufficient attention to how age and gender influence the distribution of ophthalmic surgeries in resource-limited regions. This creates a gap in understanding service utilization patterns and surgical demand across different population groups. Therefore, this study aimed to analyze the frequency and distribution of ophthalmic surgeries and to assess their association with age and gender in a tertiary care hospital setting.

METHODS

This retrospective, observational study was carried out at the Ophthalmology Department of the Hayatabad Medical Complex in Peshawar, Khyber Pakhtunkhwa, Pakistan, from September 2022 to October 2024. A standardized data collection protocol was implemented to ensure reliability. Open-Epi software was used to determine the necessary sample size, which had a 1% margin of error and a 95% confidence level. Based on previous epidemiological studies and local hospital records, the projected prevalence of cataracts among Peshawar's 2,480,550 population was 8.6%, resulting in a target sample size of 3,016 individuals [9]. Data were separately retrieved from medical records by two trained researchers, and reliability was evaluated by an interobserver agreement analysis using Cohen's kappa coefficient. Disagreements were settled after consulting with a senior ophthalmologist. Age, gender, and information on ocular treatments received during the research period were among the demographics that were retrieved. Included were all patients with complete medical records who had ophthalmic operations performed in the indicated departments. Patients treated outside of the hospital or with insufficient medical data were not included. Because medical records were inconsistent, socioeconomic status, comorbidities, and other patient-specific characteristics that could affect the kind of operation or its result were not evaluated. In the discussion section, this shortcoming is recognized and discussed. Data analysis was conducted using SPSS version 26.0. Using means and standard deviations for continuous data and frequencies and percentages for categorical variables, descriptive statistics provided an overview of the distribution and frequency of ophthalmic operations. Associations between categorical variables, including age group, gender, and procedure type, were evaluated using the chi-square test. Cohen's kappa coefficient was used to further assess interobserver reliability. Associations between categorical variables were evaluated using the Chi-square test; a p-value of less than 0.05 was considered statistically significant. The Hayatabad Medical Complex's Institutional Review Board granted ethical approval (Ref. No: HMC-QAD-F-1155), guaranteeing rigorous commitment to patient confidentiality and privacy throughout the investigation.

RESULTS

A total of 3,016 patients were included in the study, with a mean age was 35.16 years (SD ± 26.52), with a median age of 33 years, indicating a wide distribution of ages among patients. The majority of the participants were aged ≤18 years (40.5%), followed by those ≥61 years (25.0%). Other age groups included 51–60 years (13.0%), 19–30 years (8.1%), 41–50 years (7.1%), and 31–40 years (6.3%). Detailed distributions are presented in table 1.

Table 1: Age-Wise Distribution of the Participants

Variable		Frequency (%)
Age Groups	≤18 Years	1221 (40.5%)
	19 to 30 Years	243 (8.1%)
	31 to 40 Years	189 (6.3%)
	41 to 50 Years	215 (7.1%)
	51 to 60 Years	392 (13.0%)
	≥ 61 Years	756 (25.0%)
	Total	3016 (100.0%)

In terms of gender, male represented a larger portion of the sample, with 57.3% (n=1,727) of the patients, while female made up 42.7% (n=1,289), as illustrated in Figure 1.

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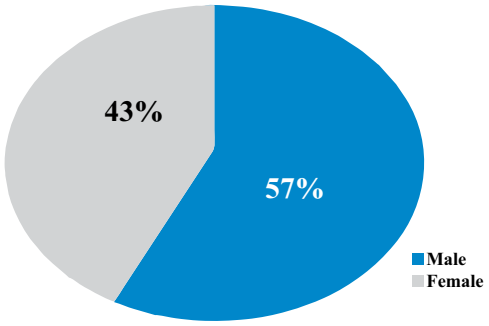

Figure 1: Gender-Wise Distribution of the Participants

The study analyzed 3,016 patients who underwent various ophthalmic procedures. The most commonly performed procedures were cataract-related, including intraocular lens (IOL) implantation (18.0%, n=543), phacoemulsification (11.6%, n=349), and extracapsular cataract extraction (ECCE) (10.4%, n=314). Other notable procedures included primary repair surgeries (12.0%, n=361), scleral tunnel manual small incision cataract surgery (MSICS) with IOL insertion (4.7%, n=143), keratoplasty and keratectomy (4.7%, n=141), and dacryocystorhinostomy (DCR) for tear duct obstruction (4.6%, n=139). Less frequent procedures included pars plana vitrectomy (PPV) at 3.7% (n=113), squint horizontal muscle surgery (2.8%, n=85), anterior chamber wash with diagnostics (2.9%, n=87), and conjunctivoplasty (2.1%, n=63). Rarely performed surgeries such as enucleation (0.1%, n=2), pterygium excision (0.6%, n=18), levator resection (0.5%, n=14), and the Weiss procedure (0.2%, n=6) were also noted. Additional recorded procedures included evisceration (1.7%, n=50), benign eyelid lesion removal (1.6%, n=47), orbital implants (1.9%, n=57), and Fasanella-Servat & sling for ptosis (1.9%, n=57). Excision of conjunctival lesions (1.8%, n=55), tectonic graft (0.9%, n=27), cryopexy (1.3%, n=39), and foreign body removal (0.7%, n=22) were also documented as shown in figure 2.

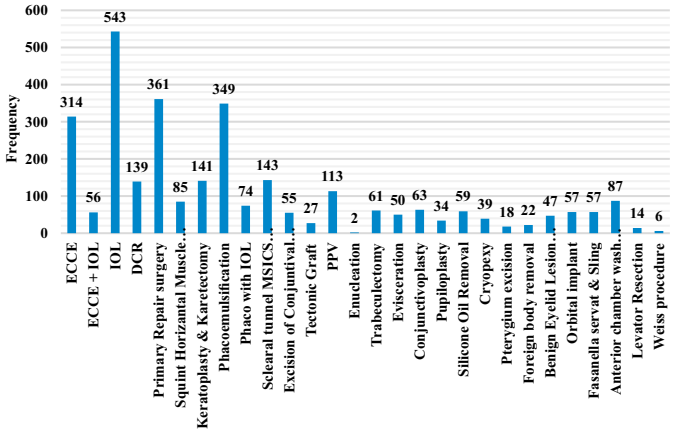

Figure 2: Different Types of Procedures Performed at the Facility

A significant association was observed between age group and the type of procedure performed (Pearson Chi-Square =1543.656, df=135, p<0.001). Among the ≤18 years' age group (n=1,221), IOL implantation (n=439) and ECCE (n=48) were the most common procedures, while squint horizontal muscle surgery (n=52) was also performed frequently. In the ≥61 years' age group (n=756), ECCE (n=143) and phacoemulsification (n=154) were the most frequently performed procedures, reflecting the prevalence of cataract-related surgeries in older patients. Younger age groups, such as 19-30 years (n=243) and 31-40 years (n=189), underwent primary repair surgeries (n=206) and squint horizontal muscle surgeries (n=20 and n=17, respectively), focusing on conditions like strabismus and refractive errors. The analysis between gender and type of procedure also showed a significant association (Pearson Chi-Square=151.052, df=27, p<0.001). Male patients (n=1,727) were more likely to undergo cataract-related procedures, including ECCE (n=159) and IOL implantation (n=350), while female patients (n=1,289) had higher frequencies of primary repair surgeries (n=127). The distribution of ophthalmic procedures across different age groups and genders was analyzed using crosstabs and Chi-square tests, as presented in table 2.

Table 2: The Demographic Factors Influencing Procedure Selection

Variable		Ophthalmic Procedure							
		ECCE	IOL	Primary Repair	Squint	Keratoplasty	Orbital implant	Cryopexy	p-value
Age Groups	≤18 Years	48	439	206	52	64	25	12	<0.001
	19 to 30 Years	12	26	42	20	26	7	7	
	31 to 40 Years	13	23	30	1	21	0	2	
	41 to 50 Years	26	16	17	3	7	3	2	
	51 to 60 Years	72	13	23	3	11	4	4	
	> 61 Years	143	26	43	6	12	18	12	
	Total	314	543	361	85	141	57	39	
Gender	Male	159	350	234	49	95	31	27	0.049
	Female	155	193	127	36	46	26	12	
	Total	314	543	361	85	141	57	39	

DOI: https://doi.org/10.54393/pjhs.v6i2.2684

DISCUSSION

This study analyzed ophthalmic procedures performed in a tertiary care center. The findings show that the kind of therapies administered depending on these demographic factors varied significantly.The data provided by these patterns might potentially guide operations and the allocation of medical resources in the region. This study examined the kinds of eye care treatments carried out in Khyber Pakhtunkhwa's tertiary care facilities, paying particular attention to demographic differences. Significant disparities in procedure distribution between age groups and genders are highlighted by the data, which are important for informing regional healthcare policy and allocating resources.Male made up 57.3% and female 42.7% of the 3,016 patients that were examined [10]. IOL implantation accounted for 18% of procedures, with primary repair operations (12%), phacoemulsification (11.6%), and extracapsular cataract extraction (ECCE) (10.4%) following closely behind.These patterns highlight the strong demand for cataract-related operations, especially among patients who are older than 61. According to a gender-specific analysis, women had a greater rate of primary repair procedures while men had more surgeries associated with cataracts [10].This emphasizes the necessity of removing any possible obstacles to women's access to healthcare in the area. The differences observed between this study and Jeon *et al.*, could be attributed to variations in regional healthcare accessibility, patient demographics, and surgical preferences. The higher incidence of IOL implantation (51.2%) reported by Jeon *et al.*,compared to our findings (18.0%), may be due to differences in population demographics or variations in access to cataract treatment services [11]. Jeon *et al.*, reported a significantly higher rate, with intraocular lens (IOL) implantation accounting for 51.2% of each patient in their research,compared to our analysis where IOL implantation was the most popular operation at 18% [11]. Hashemi *et al.*, and Mees *et al.*, studied that elevated IOL operation frequency could be a sign of a higher percentage of older patients or a greater focus on cataract therapy [12, 13]. The higher frequency of pars plana vitrectomy (PPV) (49.6%) reported by Riaz *et al.*, suggests differences in the availability of specialized retinal care services, which may not be as widely accessible in our study setting. Similarly, the disparity in primary repair surgeries (31.6%) reported by Al-Khersan *et al.*, compared to 12.0% in our findings, could be influenced by variations in trauma-related cases or differing healthcare priorities across study populations [14, 15]. This variation may result from regional deviations in the prevalence of cataracts and other eye disorders that call for lens implantation,changes in patient demographics,or discrepancies in healthcare accessibility. In contrast to Riaz's findings, our analysis reveals a distinct trend for pars plana vitrectomy (PPV) and PPV together with IOL therapies [14]. PPV alone accounted for 49.6% of the activities in their analysis, whereas PPV with IOL accounted for 27.1%. On another hand, PPV was only used in 3.7% of the cases in our analysis, and it was strange to see PPV and IOL coupled [14]. Unlike our findings, Al-Khersan *et al.* claimed that primary repair operations were the most common, making up 31.6% of patients [15]. However, primary repair only made up 12.0% of all surgeries in our analysis. Variations in patient demographics, injury rates, or the focus of the healthcare settings in each research might be the cause of this discrepancy. Furthermore, the average age of patients obtaining primary repair operation was 50 years old, according to Al-Khersan *et al.*, which is considerably older than the average age of almost 35 years (SD ± 26.52) in our study. These age differences may reflect variances in the sorts of eye illnesses or injuries that lead to primary repair, as well as injustices in the age distribution of the patient groups. In line with our results of age-related trends in optical operations, the statistical significance of age in the Al-Khersan *et al.*, study ($p<0.0001$) indicates the need to modify treatment methods to age demographics [15]. Our study aligns partially with the findings of those who reported that older age, female gender, and lower socioeconomic status are associated with a higher cataract burden [16]. Similar to their findings, our data show that cataract-related procedures, including IOL implantation, are indeed more common among older age groups. However, unlike Fang et al., observations, we found a slightly higher representation of male patients undergoing these procedures, which could reflect gender-specific health-seeking behaviours or accessibility differences in our study setting [16]. The impact of socioeconomic status, which we didn't directly assess in our study, is an important factor that should be explored in future research. Socioeconomic challenges may affect access to eye care services in the region, possibly causing delays in cataract treatment or leading to a higher demand for procedures when patients eventually seek care [17, 20]. Moreover, due to the nature of the available data used for this study, patient factors that might influence the types and frequency of procedures, such as comorbidities or socioeconomic status, were not reviewed.This study acknowledges the potential for selection bias, as the data is derived from a single tertiary care center, which may not fully represent the broader population of the region. Furthermore, adding assessments of socioeconomic factors and access to care could point out potential barriers and thus enable health authorities and hospitals to improve accessibility and distribute resources more properly among the at-risk groups.

This study is limited by its retrospective, single-center

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design, which may restrict generalizability to the broader population. Important variables such as socioeconomic status, comorbidities, and access to healthcare were not analyzed due to incomplete records, potentially introducing residual confounding. Selection bias may also exist as only hospital-based surgical cases were included. Future research should incorporate multicenter, prospective designs with more comprehensive patient profiling, including socioeconomic and clinical risk factors, to better understand barriers to eye care access and improve equitable distribution of ophthalmic surgical services.

CONCLUSIONS

It was concluded that this retrospective observational study demonstrated important patterns in ophthalmic surgical interventions across different age groups and genders. Cataract-related procedures, such as phacoemulsification and extracapsular cataract extraction (ECCE), were predominantly performed on older patients aged 61 years and above, emphasizing the need to allocate resources for this demographic. Interestingly, intraocular lens (IOL) implantation was the most common procedure among children and adolescents under 18 years, likely due to the prevalence of congenital or traumatic cataracts in this group, which require timely intervention to prevent long-term vision issues. Gender differences were also observed, with men undergoing more cataract-related surgeries, while women had a higher frequency of primary repair procedures. These findings suggest the importance of targeted outreach to address potential barriers women may face in accessing timely eye care.

Authors' Contribution

Conceptualization: SS, AZ
Methodology: SA, SS
Formal analysis: HT, AUR, YIM
Writing and Drafting: AUR, AZ, YJM
Review and Editing: AUR, AZ, YJM

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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