*Proceedings of the Pakistan Academy of Sciences: Part B*
*Life and Environmental Sciences* 59(1): 49-56 (2022)

ISSN (Print): 2518-4261; ISSN (Online): 2518-427X
http://doi.org/10.53560/PPASB(59-1)670

Pakistan Academy of Sciences

Research Article

# Frequency of Different Types of Endothelial Corneal Dystrophies by Age, Gender, and Visual Acuity in Punjab, Pakistan

**Shagufta Naz[1*], Afia Iqbal[1], Saima Sharif[1], Haiba Kaul[2], Aysha Khush Bakht[1], and Shama Sadaf[3]**

[1]Department of Zoology, Lahore College for Women University, Lahore, Pakistan
[2]Genetics Discipline, Department of Animal Breeding and Genetics, University of Veterinary and Animal Sciences, Ravi Campus Pattoki, Pakistan
[3]Department of Home Economics, Lahore College for Women University, Lahore, Pakistan

**Abstract:** Endothelial Corneal Dystrophy (ECD) is, by definition, an endogenous degeneration that progresses slowly in the corneal endothelium as a result of genetic predisposition. A transverse study was conducted from September 2018 to June 2019, and the subjects affected with ECD were examined by visiting various city hospitals in Punjab including Sahiwal, Narowal, Okara, Gujranwala, Kasur, Lahore, and Multan. The basic objective of the current investigation was to find the frequency of different types of ECD in the population of different cities in Punjab. Data was collected based on relevant parameters such as age, gender, and visual acuity. The visual acuity was assessed by ophthalmologists via Snellen chart and Visual acuity test. Among 3000 patients, 6.6 % (n=198) cases of ECD were recognized which includes more males 52.52 % (n=104) as compared to females 47.48 % (n=94). Maximum cases of ECD 31.82 % (n=63) were observed in the 41-50 years of age group. In all types of ECD, FECD was observed most abundant with 38.38 % (n=76) and XECD with the least abundance of 6.67 % (n=13). The frequency of CHED and PPCD was 25.25 % (n=50) and 29.79 % (n=59) respectively. The results of recent research finalize that endothelial corneal dystrophy is a rare disease prevailing in Pakistan with a proportion of only 6.6 %. This study benefits in updating the data about the frequency of endothelial corneal dystrophy in Pakistan. Careful clinical evaluation, initial diagnosis, genetic counseling, genotyping, and correct treatment are necessary for the restoration of vision loss due to ECD.

**Keywords:** Endothelial Corneal Dystrophy, Frequency, Fuchs Endothelial Corneal dystrophy, Visual acuity, Cornea, Visual impairment

## 1. INTRODUCTION

The visual system constructs a mental representation of the world around us. The cornea is a dome-shaped front portion of the eye where light is focused [1]. In ophthalmology, corneal dystrophies (CD) are characterized as a group of bilateral, symmetrical inherited disorders that progress slowly with no systemic or environmental factors [2]. Corneal dystrophies can be classified as Phenotypic approaches such as "anatomic-histologic", classification based on corneal layers (epithelial layer, epithelial-stromal layer, and stromal layer or endothelial-descemet layer) and another is "anatomic-descriptive" that is based on appearance, which appears in the affected corneal layers (granular, lattice, mosaic, amyloid, etc.) and Genetic approaches, combine Mendelian genetics employing molecular genetics [3]. World Health Organization (WHO) categorizes vision loss into three classes, low vision i.e., $6/60 \leq VA < 6/18$; $10^{o} \leq VF < 20^{o}$, severe vision impairment i.e., $3/60 \leq VA < 6/60$; $5^{o} \leq VF < 10^{o}$, and profound vision impairment i.e., $VA < 3/60$; $VF < 5^{o}$, which are considered to be authentic [4]. The significant causes of blindness are corneal dystrophy which affects at least 4 million people worldwide. The major cause of blindness in these children is CD

Received: September 2021; Accepted: March 2022
*Corresponding Author: Shagufta Naz <shagufta6@gmail.com>

and nearly 1.5 million children are blind worldwide [5]. The predominance of CDs varies between different parts of the world [6]. The prevalence of CD is 13.9 % in Europe. In Japan and Australia, 17 studies were conducted which revealed frequencies of CD 12.6 % and 07 % respectively. India found a 9.6 % prevalence of CD [7]. The prevalence of CD is like 897 per million and translates it to around 278,000 individuals in individuals of 310 million in the USA [5] and 60 % are of endothelial origin [3]. In one descriptive study conducted in Islamabad, out of 63 patients 12 were diagnosed as CD [7]. In Pakistan, the occurrence of blindness is 0.9 %. Corneal blindness is the leading cause of blindness nationally afterward cataracts which also adds 11.8 % of the total blindness in Pakistan [8]. The predominant cause of corneal opacity was considered decreased visual acuity [9].

ECD is characterized as endogenous erosion of the endothelial layer of the cornea due to genetic dispositioning. It is a slow-acting disease and in most of them, the endothelium layer transports a defective active fluid causing disproportionate edema of the corneal stroma, which damages the corneal clarity and lessens the visual acuity of the affected individual [10]. Generally, CD patients may appear to be asymptomatic or may complain about blurred vision [11]. Fuchs endothelial corneal dystrophy (FECD) with drop-like conglomerates or guttae and Descemet's membrane [12] is highly prevalent amongst the corneal dystrophies [13]. In 2012, 39 % of corneal transplants were to treat FECD worldwide [14]. The occurrence of FECD is concluded as 1/2000 in females. The prevalence of over 40 years of age is about 4–11 % [15]. Posterior Polymorphism Corneal Dystrophy (PPCD) including vesicles, breaking bands, or gray haze [16] happens to affect 1/100,000 individuals in the population [3]. In Congenital Hereditary Endothelial Dystrophy (CHED) there is the appearance of edema in the affected layer along with diffuse ground glass-like corneal haze and focal gray spotting leading to blurred vision [17]. X-linked Endothelial Corneal Dystrophy (XECD) symptomize as moon crater-like endothelial cells in addition to diffuse milky opacities with band keratopathy [18].

The current study aimed to determine the frequency of different types of ECD by age in males and females and the association of visual acuity with endothelial corneal dystrophies in various cities of Punjab, Pakistan. The impact of ECD involves the deterioration of corneal transparency, potentially resulting in vision loss or blurriness. So, most specifically this study would provide awareness to the patients regarding disease and their families for the reduction of disease burden and also a way for proper investigation of the disease.

## 2. MATERIAL AND METHODS

Individuals who were affected with ECD were identified by visiting different hospitals of different cities of Punjab i.e., Sahiwal, Narowal, Gujranwala, Okara, Kasur, Lahore, and Multan. Institutional Review Board (IRB) approval was obtained from the ethical committee of Lahore College for Women University, Lahore, Pakistan along with the permission from the administration of selected hospitals was also obtained to collect data to review the records and examine patients with help of expert ophthalmologists to fulfill the inclusion criteria. We excluded all other types of corneal dystrophies (i.e. Epithelial and Stromal corneal dystrophies and their subtypes). Proforma was designed to collect initial data including address, analysis, and status of the disease from the patients at hospitals. The records of the corneal patients were also noted from the hospitals with the assistance of expert doctors and staff to complete information about ECD patients. Ophthalmologists used various methods such as the Snellen chart to test visual acuity as a fraction, Pachymetry to calculate the thickness of the cornea, and the Keratometer to calculate the curvature of the epithelial surface of the cornea, and Topography to convert surface curvature to three-dimensional maps. Case files of patients with ECD dystrophies were also evaluated. The variables which were analyzed are:

- Gender
- Age
- Far visual acuity
- Main complaint (Endothelial corneal dystrophy)
- Any associated pathologies

Data collected was arranged and chi-square was used to evaluate variables and results were measured as significant at $P < 0.05$. The analyzed variables on which chi-square is applied included

age, gender, and visual acuity.

## 3. RESULTS AND DISCUSSION

A total of 6.6 % (n=198) of 3000 patients had ECD, with men accounting for 52.52 % (n=104) and females accounting for 47.48 % (n=94). In our study, 198 patients of ECD were observed in which the frequency of males 53.52 % (n=104) is more than females 47.48 % (n=94). For age distribution, we considered seven categories (0-10, 11-20, 21-30, 31-40, 41-50, 51-60, and 61-70 years)(table 1). The most frequent age group was between 41-50 years which comprised of 31.82 % (n=63) with 46.03 % (n=29) of males and 52.96 % (n=34) females. The age group 61-70 years had the fewest cases of ECD, accounting for 2.52 % (n=5) of the total, with 40 % (n=2) of men and 60 % (n=3) of females.

Among the eyes (bilateral) of 198 patients with known visual acuity, 76 were of FECD out of which 42 were males and 34 were females. In CHED, the eyes of 50 patients were identified of which 32 were males and 18 were females. In PPCD, the eyes of 59 patients were identified of which 25 were males and 34 were females. In XECD, the eyes of 13 patients were identified of which 8 were males and 5 were females.

### *3.1.1 Frequency of Fuchs Endothelial Corneal Dystrophies in patients by Age and Gender*

Out of 198 cases of endothelial corneal dystrophies, 38.38 % (n=76) were of FECD from which 55.26 % (n=42) were males and 44.74 % (n=34) were females. Cases of FECD have only been observed in three age groups and the most prevalent group was 41-50 years with 57.89 % (n=44) cases among which 52.27 % (n=23) were males and 47.73 % (n=21) were females. On the other hand, the least group was 51-60 years with 5.26 % (n=4) cases and it was found to be 50 % (n=2) males and 50 % (n=2) females. In third age group 61-70years cases were 36.84 % (n=28) which included 60.71 % (n=17) males and 39.28 % (n=11) females. The predominance of visual disability in 76 patients of FECD concerning gender is explained in Fig. 2.

### *3.1.2 Frequency of Congenital Hereditary Endothelial Corneal Dystrophies by Age and Gender*

Out of 198 cases of endothelial corneal dystrophies, 25.25 % (n=50) were of CHED from which 64 % (n=32) were of males and 36 % (n=18) were of females. In >10 age group, only 8 % (n=4) cases were observed in which 50 % (n= 2) were males and 50 % (n=2) were females. In 11- 20 years age group, among 20 % (n=10) cases, 80 % (n=8) were males and 20 % (n=2) were females. In the age of 21-30 years, there were 26 % (n=13) cases in which 69.23 % (n=9) were males and 30.77 % (n=4) were females.

In the age group of 31-40 years, 30 % (n=15) cases were examined among which 66.67 % females. In the age group 41-50 years, 16 % (n=8) cases were observed among which 62.5 % (n=5)

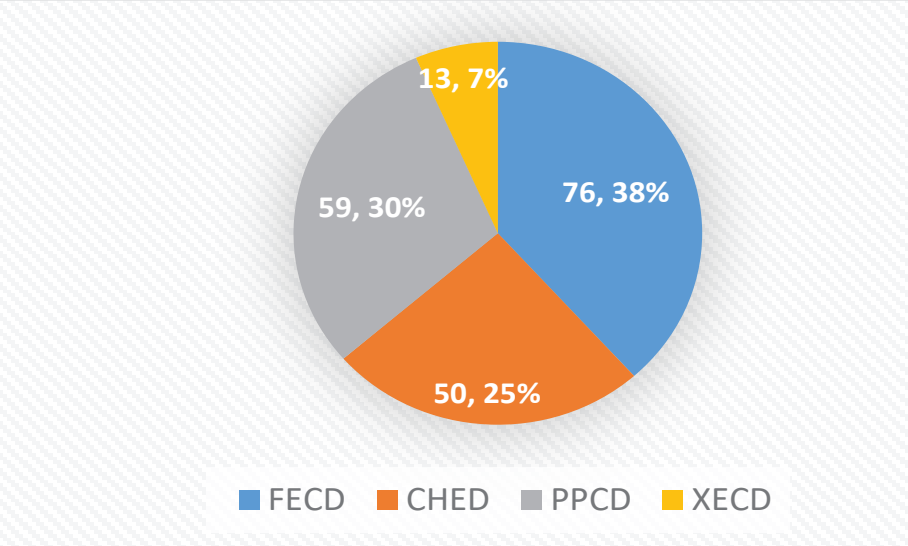


**Fig. 1.** Frequency of different types of endothelial corneal dystrophies in 198 patients

were females and 37.5 % (n=3) were males (Fig. 3).

### *3.1.3 Frequency of Posterior Polymorphous Endothelial Corneal Dystrophies by Age and Gender*

There were 198 cases of endothelial corneal dystrophies, 29.79 % (n=59) were of PPCD from which 42.37 % (n=25) were of males and 57 % (n=34) were of females. In the age group >10 years, out of 8.47 % (n=5) cases, 80 % (n=4) were males and 20 % (n=1) female was observed. Among 22.03 % (n=13) cases, 8.47 % (n=5) males and 61.54 % (n=8) females were examined in 11-20 years of age group. A total of 33.89 % (n=20) cases were observed in 21-30 years of age group among which 40 % (n=8) were males and 60 % (n=12) were females. In 31-40 years, of age group, cases were 18.64 % (n=11) among which45.45 % (n=5) were males and 54.55 % (n=6) were females. 8.47 % (n=5) cases were observed in age group of 41-50 years and they were 100 % (n=5) females. In 51-60 years, age group, among 6.78 % (n=4) cases, 75 % (n=3) males and 25 % (n=1) female were observed while only 1.69 % (n=1) 100 % (n=1) female was observed in 61-70 years age group. More males than females were examined in PPCD (Fig. 4).

### *3.1.4 Frequency of X-Linked Endothelial Corneal Dystrophies by Age and Gender*

There were 198 cases of endothelial corneal dystrophies. Out of which cases 6.57 % (n=13) were of XECD from which 61.5 % (n=8) were of males 38.5 % (n=5) were of females.7.69 %(n=1) of female was observed in the 10-20 years of age group. 7.69 % (n=1) of female was observed in the 21-30 years age group. In age group 31-40 years, there were 38.46 % (n=5) cases among which 40 % (n=2) were males and 60 % (n=3) were females. In age group of 41-50 years, among 46.15 % (n=6) cases, 50 % (n=3) were males and 50 % (n=3) were females. More females than males were examined in XECD (Fig. 5).

Corneal endothelial dystrophy is a hereditary, progressive, non-inflammatory, and bilateral disease affecting corneal transparency and refraction and leading to varying degrees of visual instability which involves dysfunction of the corneal endothelium layer. They include CHED, FECD, PPCD, and XECD and share many other characteristics including, corneal decomposition, distorted morphology of endothelial cells, and discharge of an irregular posterior collagenous layer in the posterior zone of Descemet's membrane, the endothelial basement membrane [19].

Relative findings with our recent data involve different research from different areas. In one descriptive study of the 63 patients, 12 (19 %) were diagnosed as having corneal dystrophies. In these 12 patients, 50 % (n=6) were diagnosed as stromal corneal dystrophies and 42 % (n=5) had posterior corneal dystrophies, and 8 % (n=1) had anterior corneal dystrophy [7]. In our study among 3000 patients, 6.6 % (n=198) cases of ECD were recognized which includes more males 52.52 % (n=104) as compared to females 47.48 % (n=94). In our study, 198 patients with endothelial corneal dystrophy were observed in which the frequency of males with 53.52 % (n=104) is more than females which are 47.48 % (n=94).

In our study out of 198 cases of endothelial corneal dystrophies, 38.38 % (n=76) were of FECD with a predominance of 55.26 % (n=42) of males as compared to females 44.74 % (n=34). In another study, FECD prevalence was 39.3 % in women and 30.8 % in men [20]. Twelve (or 19 %) of the 63 patients in the research were identified with corneal dystrophies. The average age was 31 ± 24.2 years, with about equal gender distribution. Males made up % of the group, while females made up 42 %. Six (50 %) of the 12 patients had stromal corneal dystrophies, five (42 %) had endothelial corneal dystrophies, and one (8 %) had anterior corneal dystrophy [21].

Of the 397 patient records reviewed and patients examined, 295 (178 women and 117 men) met our inclusion criteria. FECD prevalence among women was 39.3 % and 30.8 % among men. In men, prevalence increased for each increasing age group, from 6 % in 18-29-year olds to 69 % in 80-99 years old. The greatest increase (3.6-fold) happened amongst the age categories of 50-59 and 60-69 years. While the frequency of FECD increased by age in men, the frequency for women peaked in the 50-59 and 70-79-year age groups and was lower in other age groups. The greatest increase (4.2-fold) occurred between the age groups 30-49 and 50-59 [20]. In our study, out of 198 cases of endothelial

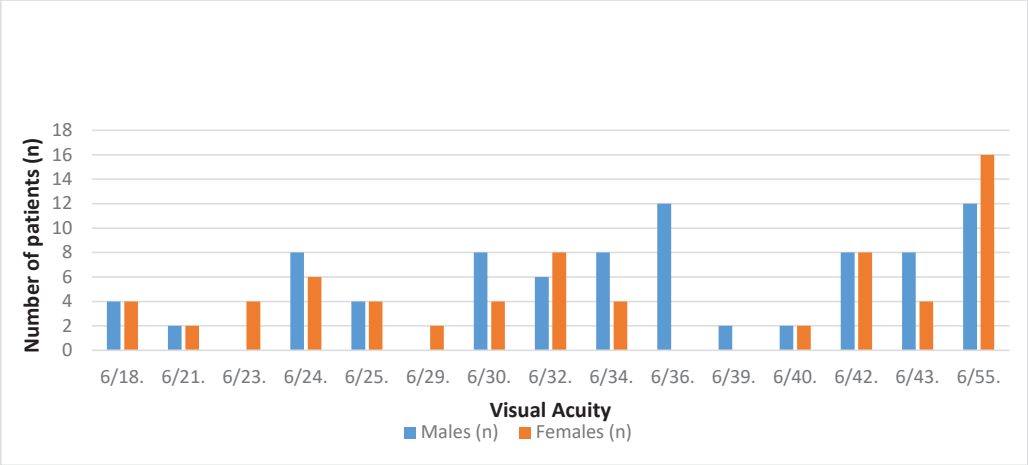


**Fig. 2.** The frequency of Visual Acuity in 152 eyes affected with FECD

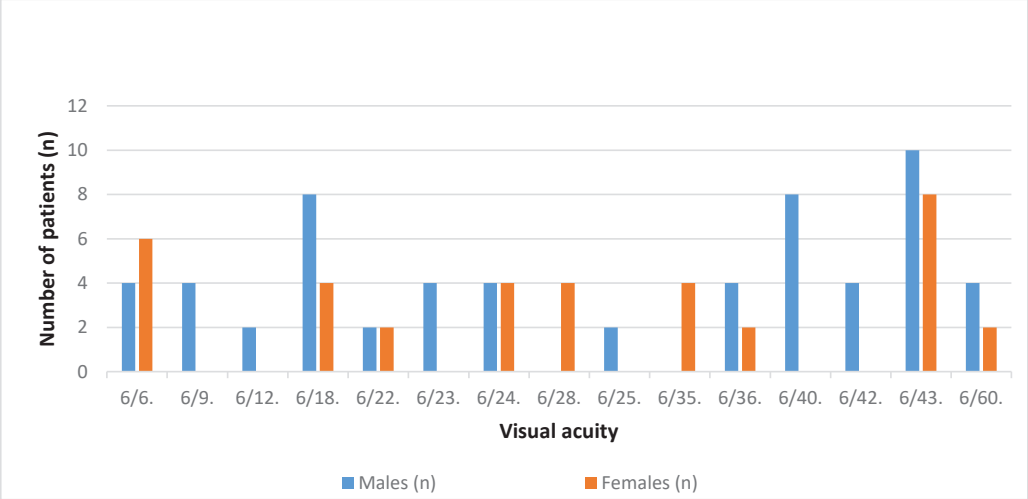


**Fig. 3.** The frequency of Visual Acuity in 100 eyes affected with CHED

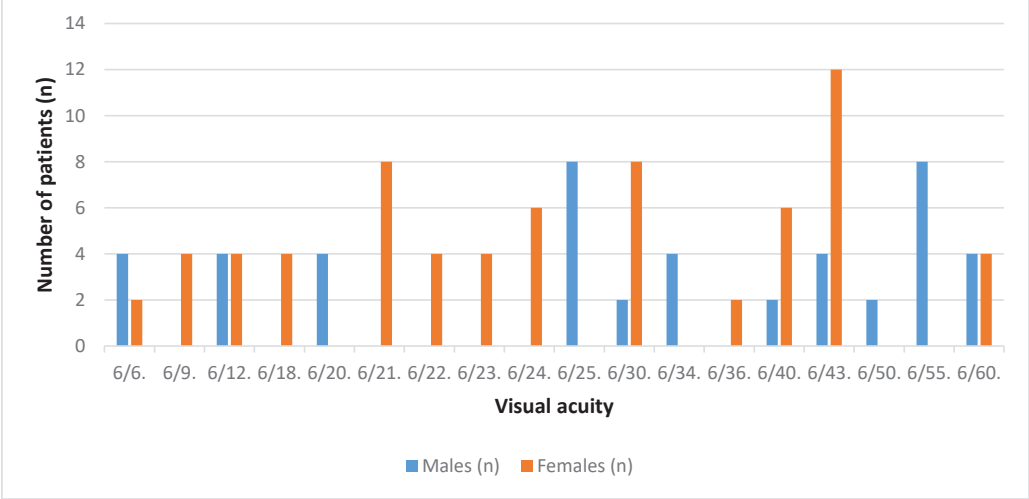


**Fig. 4.** The frequency of Visual Acuity in 118 eyes affected with PPCD

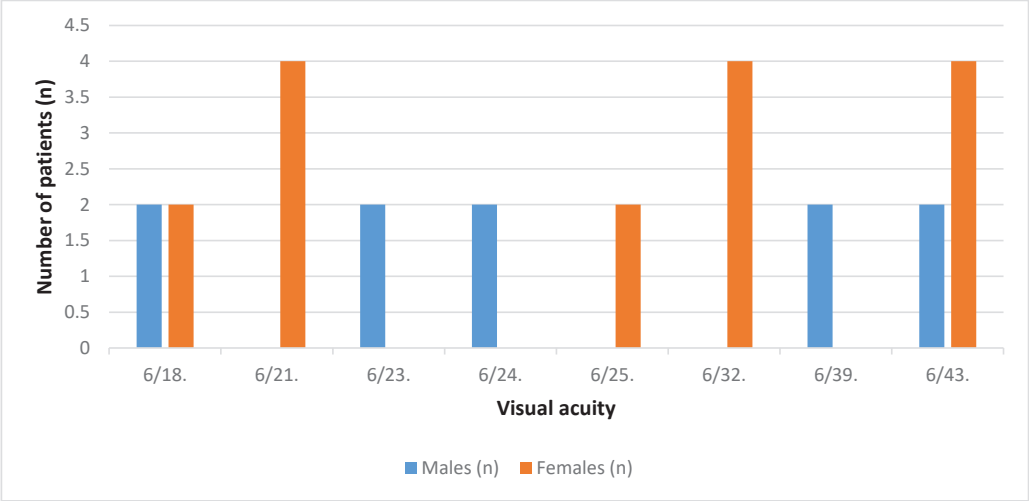


**Fig. 5.** The frequency of Visual Acuity in 26 eyes affected with XECD

**Table 1.** Age distribution of patients with Endothelial Corneal Dystrophy by gender

| Age Distribution | F | % | M | % | N | % |
|---|---|---|---|---|---|---|
| **0-10** | 4 | 4.25 | 7 | 6.73 | 11 | 5.56 |
| **11-20** | 10 | 10.64 | 12 | 11.54 | 22 | 11.11 |
| **21-30** | 17 | 18.09 | 17 | 16.35 | 34 | 17.17 |
| **31-40** | 14 | 14.89 | 17 | 16.35 | 31 | 15.66 |
| **41-50** | 34 | 36.17 | 29 | 27.88 | 63 | 31.82 |
| **51-60** | 12 | 12.77 | 20 | 19.23 | 32 | 16.16 |
| **61-70** | 3 | 3.19 | 2 | 1.92 | 5 | 2.53 |
| Total | **94** | **100** | **104** | **100** | **198** | **100** |

corneal dystrophies, 38.38 % (n=76) were of FECD from which 55.26 % (n=42) were males and 44.74 % (n=34) were females. Cases of FECD have only been observed in three age groups and the most prevalent group was 41-50 years with 57.89 % (n=44) cases among which 52.27 % (n=23) were males and 47.73 % (n=21) were females. On the other hand, the least group was 51-60 years with 5.26 % (n=4) cases and it was found to be 50 % (n=2) males and 50 % (n=2) females. In third age group 61-70 years cases were 36.84 % (n=28) which included 60.71 % (n=17) males and 39.28 % (n=11) females.

Out of 198 cases of endothelial corneal dystrophies, 25.25 % (n=50) were of CHED of which 64 % (n=32) were males and 36 % (n=18) were females. In one study PPCD appears rare and affects 1/100,000 people [3]. While in our study XECD was observed as rare.

This frequency study will help in informing the updated frequency of endothelial corneal dystrophy (ECD) in the Pakistan population. The effort done in this study will be predominantly valued in developing awareness in the patients affected with ECD which will lead to reducing the total load and pressure of the disease. ECD causes corneal transparency to deteriorate, potentially resulting in vision loss or blurriness. So, in particular, this study would raise disease awareness among patients and their families, thereby reducing the disease burden and allowing for thorough disease investigation. Appropriate clinical evaluation, initial diagnosis, genotyping, genetic awareness, and proper supervision are required for the repair of damage to

vision due to ECD.

## 4. CONCLUSION

Among 3000 patients, 6.6 % (n=198) cases of ECD were recognized which includes more males 52.52 % (n=104) as compared to females 47.48 % (n=94). Maximum cases of ECD 31.82 % (n=63) were observed in the 41-50 age group. In all types of ECD, FECD was observed most frequent with 38.38 % (n=76) and XECD with 6.67 % (n=13) was least frequent. The frequency of CHED and PPCD was 25.25 % (n=50) and 29.79 % (n=59) respectively. The results of recent research finalize that endothelial corneal dystrophy is a rare disease prevailing in Pakistan with a proportion of only 6.6 %. This study benefits in updating the data about the frequency of endothelial corneal dystrophy in Pakistan. Careful clinical evaluation, early diagnosis, genotyping, genetic counseling, and proper treatment are necessary for the restoration of vision loss due to ECD.

## 5. ACKNOWLEDGEMENTS

We sincerely thank Endothelial corneal dystrophy patients and staff of all hospitals for their assistance in the clinical evaluation and collection of data.

## 6. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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