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PREVALENCE OF DRY EYE DISEASE AND ITS IMPACT ON VISUAL ACUITY IN FEMALES WITH AND WITHOUT POLYCYSTIC OVARY SYNDROME

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Abstract

Background *Polycystic ovary syndrome (PCOS) is a common endocrine disorder characterized by hyperandrogenism, anovulation and polycystic ovaries which can lead to infertility in women. Dry Eye Disease (DED) is a multifactorial ocular surface disorder which can result from meibomian gland dysfunction, hormonal changes and autoimmune conditions. It most commonly involves tear film instability and inflammation.*

Purpose of Study *This study aim to determine the prevalence of DED and its impact on visual acuity in females with and without PCOS.*

Methodology *A total of 30 women with Polycystic Ovary Syndrome (PCOS) and 30 healthy women were included in this study. They were then subjected to complete opthalmic evaluation which included refraction, Schirmer's test, Tear film break-up test (TBUT) and ocular surface Disease Index (OSDI) questionnaire scoring.*

Result *The visual acuity, TBUT and Schirmer's test in PCOS cases showed $P < 0.001$ which suggests that the results are clinically significant.*

Conclusion *The study concluded that women with PCOS were at higher risk of dry eye disease than healthy females. Therefore, routine ophthalmic examinations are recommended in conjunction with gynecological check-ups for PCOS patients.*

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CHAPTER 1
INTRODUCTION

The human visual system is a highly advanced network responsible for processing visual information and stimulating exchange with the surrounding environment. Visual acuity, the sharpness and clarity of vision, is essential for performing everyday activities. Among the various factors that contribute to optimal visual function, the integrity of the ocular surface plays an important role. One of the most prevalent conditions affecting the ocular surface is Dry Eye Disease (DED), which can significantly impair visual acuity and overall ocular comfort.

Dry Eye Disease is a multifactorial disorder of the tear film and ocular surface(1). Its symptoms include ocular discomfort, visual disturbances, tear film instability, and inflammation which ultimately leads to corneal damage. DED affects millions of individuals worldwide, with prevalence increasing due to aging populations, environmental factors, and systemic conditions. Age and lifestyle are traditional contributors to dry eye; hormonal imbalances have also been increasingly implicated in its pathogenesis.

Polycystic Ovary Syndrome (PCOS) is most common endocrine disorder that affects the women of reproductive age. It is characterized by a combination of hyperandrogenism, chronic anovulation, and polycystic ovarian morphology, with diagnosis commonly based on the Rotterdam criteria. PCOS affects approximately 8% to 13% of women (WHO in 2025) globally and is associated with systemic manifestations including metabolic, reproductive, and psychological complications(2). Of particular interest is the hormonal dysregulation seen in PCOS, especially the elevated androgen levels and altered estrogen progesterone balance, which may contribute to conditions like DED(3).

Emerging studies suggest a link between PCOS and an increased prevalence of dry eye symptoms. Hormonal fluctuations in PCOS are believed to influence the function of the meibomian glands and lacrimal glands, which are critical for maintaining a stable tear film. Dysfunction in these glands may result in increased tear evaporation and reduced tear production, ultimately leading to DED(4). Additionally, systemic inflammation, which is often present in PCOS, may further exacerbate ocular surface inflammation and tear film instability. Despite the biological plausibility of a relationship between PCOS and DED, the existing research on this topic remains limited. Few studies have comprehensively assessed the prevalence of dry eye in women with PCOS or evaluated its direct impact on visual acuity. Most existing research focuses either on dry eye or PCOS independently, with insufficient attention given to their intersection. Few studies have comprehensively assessed the existence of dry eye in women with PCOS or evaluated its direct impact on visual acuity.

Visual acuity can be significantly affected by dry eye through mechanisms such as tear film instability, surface irregularity, and increased light scatter. Patients with DED often report fluctuating vision, especially during tasks requiring prolonged visual attention such as reading or screen use(5). Given that women with PCOS may be more susceptible to DED, it becomes crucial to understand how this susceptibility may translate into functional visual impairments. This aim of this study is to assess the prevalence of dry eye in women with and without PCOS and to evaluate how dry eye influences their visual acuity. By using objective tests such as Schirmer's test, visual acuity assessments and Ocular Surface Disease Index (OSDI) questionnaires, providing a comprehensive analysis of the ocular implications of PCOS.

The Rotterdam criteria, which require at least two of the following three features-anovulation, hyperandrogenism, and polycystic ovaries on ultrasound-are commonly used for diagnosis(6). PCOS often leads to systemic hormonal imbalances, including elevated luteinizing hormone (LH), decreased follicle-stimulating hormone (FSH), and increased androgen levels. These hormonal dysregulations may directly influence extra-ovarian tissues, notably impacting ocular structures.

Dry Eye Disease is divided into two major types: aqueous-deficient dry eye and evaporative dry eye.

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Aqueous-deficient dry eye occurs due to reduced tear secretion by the lacrimal glands, while evaporative dry eye results from increased tear evaporation, often linked to meibomian gland dysfunction (7). Symptoms include dryness, burning, itching, foreign body sensation, blurred vision, and sensitivity to light (8).

DED is diagnosed through a combination of patient-reported symptoms and clinical tests such as Schirmer's test, Tear break-up time (TBUT), and ocular surface staining. Risk factors for DED include age, gender, hormonal changes like PCOS, autoimmune conditions, environmental exposures, and prolonged screen use especially in women of a certain age.

The potential link between PCOS and dry eye lies in the hormonal dysregulation associated with PCOS. Androgens play a protective role in maintaining the function of the meibomian glands. However, in PCOS, androgen levels are often elevated but not necessarily functional at the target tissues due to receptor sensitivity issues. Additionally, insulin resistance and chronic low-grade inflammation in PCOS may contribute to tear film instability and ocular surface inflammation.

Studies confirmed increased prevalence of dry eye symptoms and meibomian gland dysfunction in women with PCOS(9). Though, findings vary inconsistent in study design, diagnostic criteria, and population demographics. As such, there is a need for standardized and comparative studies that evaluate the ocular effects of PCOS more comprehensively. Visual acuity is commonly reduced in patients with DED, especially in cases with significant tear film disruption. Tear film instability leads to surface irregularities, which interfere with light transmission and image focus on the retina(10). This results in blurred vision, especially during tasks like reading or screen use. Chronic DED can also induce inflammation, causing damage to the corneal epithelium and further impairing vision (11). In women with PCOS, the potential for compounded effects-hormonal influence and systemic inflammation-may place them at higher risk for both symptomatic and functional visual impairments. Despite this, there is minimal research directly assessing how dry eye in PCOS impacts visual performance.

The increasing prevalence of PCOS among women of reproductive age, coupled with the growing burden of dry eye disease, necessitates a deeper understanding of their relationship. Current literature provides a little knowledge on how PCOS contributes to ocular surface disorders. Moreover, the implications of these ocular changes on visual acuity-a parameter central to visual function and quality of life-remains under-investigated, emphasizing the rationale for undertaking this study.

By comparing females with and without PCOS, this study aims to determine if there are significant differences to in the prevalence and intensity of dry eye symptoms, as well as the corresponding impact on visual acuity. The outcomes may inform clinicians in both gynecology and eye care about the need for integrated management approaches in patients with PCOS.

1.1 Operational definitions

PCOS is defined based on the Rotterdam criteria, which require the presence of at least two of the following: 1. irregular or absent ovulation 2. Clinical signs of hyperandrogenism 3. Polycystic ovaries on ultrasound (≥12 follicles measuring 2–9 mm in diameter), after excluding other endocrine disorders (Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004)(12).

Dry Eye Disease is diagnosed based on at least one clinical sign (schirmer's test ≤ 10 mm in 5 minutes without anesthesia) and one subjective symptom using a validated questionnaire, such as the Ocular Surface Disease Index (OSDI)(13).

Visual Acuity is measured using a Snellen chart at a standardized distance of 6 meters (20 feet) under controlled lighting. It is recorded as a Snellen fraction (e.g., 6/6, 6/12) and can be converted into decimal notation for analysis. (American Academy of Ophthalmology, 2017)

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CHAPTER 2
LITERATURE REVIEW

Yuksel et al. In 2015 conducted in Turkey, the primary objective of the study by was to assess the relationship between tear function abnormalities and PCOS, focusing on indicators of dry eye disease (DED), a multifactorial disorder affecting the tear film and ocular surface. DED is frequently underdiagnosed, particularly in populations where systemic conditions may contribute subtly to ocular symptoms. Prior literature has established that both insulin resistance (IR) and systemic inflammation, key components of PCOS pathophysiology, are associated with altered tear film stability (Bitton & Korb, 2004; Versura et al., 2015). Given that hyperandrogenism, another hallmark of PCOS, also affects meibomian gland function and potentially influences tear film quality (Sullivan et al., 2002), Yuksel et al.'s investigation addresses a clinically relevant gap.

The methodology of the study was rigorous, involving 35 women diagnosed with PCOS and 27 healthy controls. PCOS diagnosis was likely based on the Rotterdam criteria, though the specific diagnostic framework was not detailed. Key clinical variables such as body mass index (BMI), hormonal levels (FSH, LH, free testosterone), and markers of systemic inflammation (neutrophil-to-lymphocyte ratio [NLR], platelet-to-lymphocyte ratio [PLR], and mean platelet volume [MPV]) were assessed. Importantly, both subjective and objective ocular assessments were included, namely OSDI survey for evaluating ocular surface disease and two tear function evaluation using Schirmer's test and tear film break-up time (TBUT).

The main finding was a statistically significant reduction in TBUT among women with PCOS compared to controls ($p = 0.002$), suggesting compromised tear film stability. This finding aligns with previous studies that have implicated androgen imbalance and chronic inflammation in meibomian gland, leading to dry eye due to increase tear evaporation (Sullivan et al., 2009). Assessment of tear film stability using TBUT is particularly sensitive to changes in the lipid layer of the tear film, which is regulated by androgen-sensitive meibomian glands. Thus, the significantly lower TBUT in the PCOS group provides physiological plausibility for the observed tear dysfunction.

Interestingly, the Schirmer test results, which measure aqueous tear production, and OSDI scores, which assess subjective symptoms, did not differ significantly between the two groups. This apparent dissociation between objective findings and subjective symptoms has been reported in other DED populations as well (Bron et al., 2014). The lack of subjective symptoms in some PCOS patients, despite evidence of tear film instability, highlights the importance of comprehensive ocular evaluations in this population. These results suggest that routine symptom-based screening might fail to detect early or subclinical forms of DED in PCOS patients, emphasizing the need for objective diagnostic modalities.

Furthermore, Yuksel et al. found a negative correlation between the Ferriman-Gallwey (FG) hirsutism score and TBUT ($r = -0.406$, $p = 0.001$), and between NLR and Schirmer test results ($r = -0.294$, $p = 0.025$). These findings provide additional evidence supporting the systemic-inflammation and hyperandrogenism hypotheses in dry eye pathogenesis. Higher FG scores, reflecting more severe clinical hyperandrogenism, were associated with reduced tear film stability, while elevated NLR—a marker of subclinical inflammation—correlated with diminished tear production. These correlations reinforce the role of systemic hormonal and inflammatory factors in the ocular surface homeostasis of PCOS patients.

The study's inclusion of inflammatory biomarkers such as NLR and PLR is particularly noteworthy. Recent literature has increasingly recognized these hematological ratios as accessible and cost-effective indicators of systemic inflammation (Imtiaz et al., 2012). Elevated NLR and PLR have been associated with numerous conditions, including metabolic syndrome and cardiovascular disease, which are prevalent in PCOS. Their correlation with tear function parameters in this study supports the emerging understanding that ocular surface inflammation

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may reflect broader systemic inflammatory states (De Paiva et al., 2006). Consequently, these findings underline the interdisciplinary importance of dry eye assessment in systemic disorders like PCOS.

However, the study is not without limitations. The sample size is relatively small, which may limit the generalizability of the findings. Additionally, the cross-sectional design precludes conclusions about causality. Longitudinal studies would be necessary to determine whether tear film alterations progress with PCOS severity or duration, or whether they respond to interventions such as weight loss, insulin sensitizers, or hormonal therapy. Furthermore, the lack of meibomian gland evaluation or lipid layer imaging is a notable omission, given the suspected androgenic mechanism of tear film instability in PCOS.(14).

Rakendu Puthiyedath et al. In 2021, in Kerala, India studied the comparison between optical instantiations in cases with polycystic ovary pattern and healthy volunteers of reproductive age which were divided into two distinct groups of 30 PCOS patients and 30 healthy females. These sixty women were enrolled across a span of 18 months from January 2020 to July 2021. Thirty of which were PCOS patient that were recruited after the diagnoses of PCOS. In this study intraocular pressure (IOP), optical coherence tomography (OCT), retinal nerve fiber layer (RNFL), central macular thickness (CMT), central corneal thickness (CCT), Schirmer's test and tear break-up time (TBUT) were assessed for both groups. In this study the PCOS was defined based on the Rotterdam criteria. They excluded women with other hormonal and medical disorders, and they also excluded women who were high myopes and had intraocular surgery done. For this they had taken a full detailed medical history of each participant which included their personal and family history. The best corrected visual acuity of each participant was also estimated using a Snellen chart. They used slit lamp for a detailed examination of the anterior ocular segment whereas the posterior segment was examined using an indirect ophthalmoscope with a 20D lens. They measured the CCT using a pachymeter (full auto tonometer TX-20P Canon). While they examined the CMT and RNFL (all sectors) using an OCT (optical coherence tomography) Cirrhus HD OCT (Cirrhus high-definition OCT). They measured the IOP using the Goldmann applanation tonometer. The results showed the central corneal thickness, RNFL, superior RNFL and the nasal RNFL average thicknesses were found to be more prevalent in PCOS patients in comparison with females without PCOS ($p = 0.01$) while the Schirmer's test and tear break-up time values were found to be significantly lower in the PCOS patients ($p=0.01$) . The mean IOP and CMT results turned out to be almost similar between both groups. A correlation was also suggested between the disease duration and ocular manifestations which included a weak positive correlation of CCT and superior RNFL and a moderate positive correlation of average RNFL with the duration of PCOS. The above-mentioned results implied that there was a significant increase in retinal fiber layer and central corneal and decrease Schirmer's test. This study advocated the necessity for all women with PCOS to undergo regular eye examinations. This study also advised the ophthalmologists that in addition to adequate precautionary measures they must include hormonal regulations in women with PCOS before corneal surgeries(15).

In a research done in Turkey, Asfuroğlu et al.2021 looked at the possible link between PCOS and dry eye disease (DED), specifically focusing on the part subclinical inflammation plays in this relationship. In women of reproductive age, PCOS is a prevalent endocrine condition that is frequently linked to metabolic abnormalities and hormonal imbalance. Ocular surface inflammation and tear film instability are hallmarks of DED. Despite earlier research showing a greater frequency of DED symptoms in PCOS-afflicted women, the underlying processes were still unknown. The study's objective was to compare the ocular surface and tear film characteristics of women with PCOS to those of age-matched, healthy controls. There were 60 participants in all, split into two groups: 30 PCOS-afflicted women and 30 healthy controls.

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A battery of ophthalmologic tests, including as the Schirmer test, ocular surface staining, tear break-up time (TBUT), and meibomian gland assessment, were performed on each subject. Systemic inflammation was also evaluated by measuring blood levels of inflammatory markers such tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6). According to the data, women with PCOS had greater ocular surface staining scores and considerably lower TBUT and Schirmer test values than the control group, suggesting that their tear film stability and ocular surface integrity were damaged. Serum levels of TNF-α and interleukin-6 were also higher in the PCOS group, indicating the existence of subclinical systemic inflammation. The results, taken together, lend credence to the theory that DED symptoms may arise or increase as a result of subclinical inflammation in PCOS patients. The thorough approach, which including biochemical and clinical evaluations, offered important new information on how PCOS and DED interact. However, the cross-sectional form of the study made it difficult to establish causality. In order to investigate the temporal link between PCOS-related inflammation and the start of DED, further longitudinal research is advised(16).

Yabanoglu and Gode in 2022 in Ankara, Turkey explored how polycystic ovary syndrome (PCOS) affects ocular surface health, offering new insights into a hormonal disorder that impacts many women. PCOS, known for causing hyperandrogenism, irregular periods, and ovarian cysts, might also influence eye conditions like dry eye disease and meibomian gland dysfunction. The aim was to study how endocrine imbalances disrupt ocular physiology The researchers compared 23 eyes from PCOS patients with 10 eyes from healthy controls, matching for age. PCOS diagnosis required at least two of three criteria: irregular ovulation, high androgen levels, or polycystic ovaries on ultrasound. They assessed symptoms using the OSDI questionnaire, examined eyelids and meibomian glands with a slit lamp, measured tear film stability (TBUT), checked for corneal staining, and tested tear quantity (Schirmer's) and quality (osmolarity). Results showed PCOS patients had higher OSDI scores (p=0.031) which represents worse dry eye symptoms—potentially affecting daily comfort. Anterior blepharitis was also more common (p=0.05), supporting past findings linking androgens to gland dysfunction. Surprisingly, TBUT was longer in PCOS subjects (p=0.026), contradicting typical dry eye patterns. This hints at complex hormonal effects on tear stability that need deeper study. Hormonal ties stood out too. Worse OSDI scores correlated with higher free testosterone, suggesting androgens worsen symptoms. Tear osmolarity rose with estradiol but dropped with DHEAS, underscoring how multiple hormones shape tear film health. Such findings fit broader evidence that sex hormones influence gland function, though exact mechanisms remain unclear. The study concludes that PCOS related eye issues, while subtle, could disrupt tasks like reading or screen use, especially in dry or windy settings. Early eye exams for PCOS patients might help manage symptoms before they escalate. Limitations include the small sample and single-timepoint design, but the work highlights a need for interdisciplinary PCOS care connecting endocrinology, gynecology, and eye specialists. Long-term studies could clarify cause-and-effect, but for now, the message is clear: eye complaints in PCOS matter, reflecting deeper hormonal imbalance(17).

Japmehr Kaur Sandhu et al. In 2024, at GROW Research Laboratory, India, studied how severe is loss of meibomian gland in PCOS patients on estrogen-progesterone therapy. The study aimed to report on the changes in the ocular surface and meibomian glands in women with polycystic ovarian syndrome who are undergoing hormone supplementation. This highlighted the potential impact of hormonal treatments on eye health, particularly in this specific patient population. It involved detailed observations of a small group of patients rather than a larger randomized controlled trial. These participants were selected based on their experience of dry eye symptoms and their ongoing hormone supplementation. The study included three women diagnosed with PCOS, with an average of about 27 years (± 11

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years). The women reported dry eye symptoms for an average duration of 13 months. They were on hormonal supplements for a duration of about 60 months, indicating long-term exposure to these treatments. The hormonal treatments included oral estrogen, oral progesterone, and other medications like cyproterone and isotretinoin. This demographic data provided context for the population being studied and helped to understand the findings' age-related aspects.The case series reported severe meibomian gland loss in three young women with polycystic ovarian syndrome on hormone therapy, highlighting irreversible changes despite treatment. Collaboration between ophthalmologists and gynecologists was recommended to better manage dry eye disease in these patients. This illustrated the potential impact of hormonal treatments on eye health, particularly in this specific patient population. The findings revealed significant ocular surface issues: The mean Ocular Surface Disease Index (OSDI) score was 37.5, indicating moderate to severe dry eye symptoms. Non-invasive tests showed a mean Non-Invasive Break-Up Time (NIBUT) of 9.9 seconds and a mean Tear Meniscus Height (TMH) of 0.27 mm, both suggesting compromised tear film stability. Minibiography results indicated near-total loss of meibomian glands in 8 out of 12 eyelids, with some patients showing only ghost glands remaining. One patient exhibited gland shortening.

The study concluded that there is near-total irreversible loss of meibomian glands in two of the young women with PCOS who were on hormonal therapy. The authors recommended coordination between ophthalmologists and gynecologists to facilitate early detection and a better insight in to dry eye disease progression in these patients emphasizing the need for a multidisciplinary approach to manage the ocular health of women undergoing hormonal treatments for PCOS.The findings suggested that healthcare providers must be aware of any ocular side effects of hormonal treatments in PCOS patients. This awareness led to better monitoring and management strategies for patients experiencing dry eye symptoms, ultimately improving their quality of life.(18).

Megha Ranjan et al. In 2024, at Sharda University, Uttar Pradesh, India studied the association between PCOS and dry eye disease. In this study they described that Polycystic Ovary Syndrome (PCOS) is hormonal dysfunction in females of reproductive age, which involves hyperandrogenism, anovulation, and polycystic ovaries. The syndrome is also accompanied by metabolic alterations, such as insulin resistance, which will evolve to several comorbidities. Such one possible comorbidity that has been in the limelight recently is Dry Eye Disease (DED). DED is a multifactorial ocular surface disease with disruption of the tear film with symptoms of discomfort, visual disturbance, and ocular surface injury. The purpose of this study was to accurately examine and determine the relationship between PCOS and DED. This aim was elicited by current knowledge indicating that conditions found in PCOS, including hyperandrogenism and insulin resistance, also increase the risk of dry eye disease. Although it was known that dry eye may prove to be an existing comorbidity among PCOS sufferers, the exact degree and type of such an association had not been fully investigated in earlier work. Thus, the study aims to bridge this knowledge gap by establishing the direct connection between these two conditions, ultimately clamoring for more awareness and regular ophthalmological assessments in females diagnosed with polycystic ovary syndrome. This study included 100 participants which belonged to the age group 16-44 years, out of which 50 were PCOS diagnosed while 50 were healthy females. The study excluded participants who consumed alcohol, contact lens users, smokers and females having opacities in their cornea, oral contraceptive users, long-term topical medication users, patients with history of dry eye disease, females using topical drops and past ocular surgery. All subjects were made to fill Ocular Surface Disease Index (OSDI) questionnaire was to assess dry eye symptoms. Then a detailed eye assessment was conducted which included schirmer's Test and tear film break-up test (TBUT). Based on their results, there

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was statistically significant association of PCOS with DED, but in especially TBUT and OSDI scores, rather than the results of Schirmer's test, which were statistically not significant. They concluded that DED was often neglected in females with PCOS and there are only few studies that have been done showing the relationship between DED in females having PCOS. This study showed the direct relationship between DED and polycystic ovary syndrome. Therefore, it's necessary to have regular eye examination in PCOS patients so that early diagnosis of dry eye disease can be established to ensure prompt treatment(19).

CHAPTER 3

3.1 OBJECTIVES

- To assess the prevalence of Dry Eye Disease and its impact on Visual Acuity in females with PCOS.
- To establish the need for routine eye examination in women with PCOS by comparing them with healthy women.

3.2 HYPOTHESIS

Null Hypothesis

The rate of Dry Eye Disease and its impact on Visual Acuity may have no prevalence in females with PCOS.

Alternative Hypothesis

The rate of Dry Eye Disease and its impact on Visual Acuity maybe higher in females with PCOS.

CHAPTER 4 MATERIALS AND METHODS

4.1 STUDY DESIGN

Cross-sectional study

4.2 SETTINGS

Data was collected from the gynecology department of Ghurki Trust & Teaching Hospital.

4.3 DURATION OF STUDY

Study was completed in 4 months after the approval of synopsis.

4.4 SAMPLE SIZE

60 female participants:
Group A: 30 females with PCOS Group B: 30 females without PCOS.

4.5 SAMPLE SELECTION

Inclusion Criteria

- Females aged 18 to 35 years
- Confirmed PCOS diagnosis based on Rotterdam criteria
- Unmarried Individual
- Obese
- Willing to participate

Exclusion Criteria

- History of ocular surgery and other eye diseases
- Presence of autoimmune and systemic diseases
- Use of any systemic medications
- Pregnancy
- Contact lens wear
- Non obese

4.6 DATA COLLECTION PROCEDURE

The data collection procedure for this study involves a series of well-structured steps to ensure the reliability, validity, and ethical integrity of the collected data. The procedure consists of participant recruitment, ethical approval, screening, clinical and ocular assessments, and proper data documentation. Prior to initiating the data collection process, ethical approval was obtained from Riphah international university. All participants were briefed about the nature and purpose of the study. Written informed consent was obtained from each participant, ensuring voluntary participation. Participants were also informed about any potential risks or discomfort associated with ocular examinations. A purposive sampling technique was employed to ensure that only eligible female participants, both with and without PCOS, were included.

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A **Structured questionnaire** was used to collect baseline demographic data including age, weight, height, BMI and general health status. A detailed medical and ocular history was also taken to assess any pre-existing conditions or medications that could interfere with tear production or visual acuity. To evaluate the presence and severity of Dry Eye Disease, a combination of both subjective and objective assessments
was performed.

4.7 DATAANALYSIS

The data was analyzed using the SPSS V29.0 statistical software.

CHAPTER 5
RESULTS

To determine whether a significant relationship exists between PCOS and dry eye disease, the following data were analyzed. Our sample size for this study was 60 participants which were divided into two groups each having 30 participants. In which one group was of females with PCOS and second one being that of females that were without PCOS. The range we set for age in our criteria was18-35. The age of participants that took part in this study ranged from 18-28 years. The most common age that participated in this study was 20 years. The least common ages reported were 24, 25 and 28. The weight category that was chosen for this study for PCOS patients was obese while for normal females they were to be of any weight category. The BMI in this study ranged from 15-37. The most frequent BMI observed was 30 whereas 15,16,24,26 and 37 emerged to be the least common with one participant each. Females without PCOS had BMI values clustered between 15 and 24, indicating that they fall in mostly normal or underweight ranges. In contrast, females with PCOS had BMI values ranging from 25 to 37, which showed a clear shift toward overweight and obese categories. The highest count among PCOS patients is at BMI 27 and 28, emphasizing a strong link between increased BMI and PCOS. Visual acuity of right eye test showed that the majority (62.0%) had a visual acuity of 0.0 while only 2 each participants showed visual acuity of 0.6 and 0.8. it was observed that the most common visual acuity for both groups is 0.0, with 26 participants of without PCOS group and 18 of with PCOS group. Visual acuity of left eye test showed that the majority (56.3%) had a visual acuity of 0.0. whereas 1 each participant showed visual acuity of 0.8 and 1.0.the majority of participants, both with and without PCOS, have a visual acuity of 0.0(23 of without PCOS and 17 of with PCOS participants respectively). The Schirmer's test for right eye showed values ranging from 1mm to 35mm with 15.5% showing low secretion (1mm) and 15.5% showing high secretion (35mm). Most other readings were scattered across the range, indicating significant variability in tear production. The Schirmer's test for left eye ranged from 0mm to 35mm with 15.5% showing very low (1mm) and 18.3% showing high (35mm) secretion. The tear break up time test for the right eye ranged from 10s to 9s, with 10s occurring in 15.5% of cases. The most frequent time was 4s, accounting for 8.5% of the data. The comparison between the groups, with and without PCOS showed that the right eye of females with PCOS have a greater ratio of dry eyes than right eye of healthy females. The tear break up time test for the left eye ranged from 1.84s to a maximum of 9s. The most frequent TBUT value was 3s occurring in 8.5%. Through comparison of both groups, it was revealed that the left eye of females with PCOS have greater ratio of dry eyes than left eye of healthy females. The results showed that visual acuity, Tear Break Up Time and Schirmer's Test all showed chi square test value of (p=0.000) which is less than 0.005 and thus shows that the results are clinically significant. Thus, rejecting the null hypothesis.

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TABLE 5.1: AGE

		Frequency	Percent
Valid	18	4	5.6
	19	9	12.7
	20	19	26.8
	21	12	16.9
	22	8	11.3
	23	5	7.0
	24	1	1.4
	25	1	1.4
	28	1	1.4
	Total	60	84.5
Missing	System	11	15.5
Total		71	100.0

Table 5.1 This table shows the frequency and percent of participants' age that took part in this study ranging from 18-35. There is a total of 60 valid cases which were studied and that there were 11 missing cases which was the part of system error. The data shows that the most common age is 20 with 26.8% (19 cases), 21 with 16.9% (12 cases), 19 with 12.7% (9 cases), 22 with 11.3 (8 cases), 23 with 7.0% (5 cases) of the data and the least common age groups are 24, 25, 28 each consisting of 1.4% (1 cases) of the data.

TABLE 5.2: BMI

		Frequency	Percent
Valid	15	1	1.4
	16	1	1.4
	17	4	5.6
	18	2	2.8
	19	5	7.0
	20	6	8.5
	21	3	4.2
	22	2	2.8
	23	2	2.8
	24	1	1.4
	26	1	1.4
	27	2	2.8
	28	2	2.8
	29	5	7.0
	30	8	11.3

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	31	6	8.5
	32	2	2.8
	33	3	4.2
	34	3	4.2
	37	1	1.4
	Total	60	84.5
Missing	**System**	11	15.5
Total		71	100.0

Table 5.2 This table shows BMI range which is 15-37 i.e. obese to non-obese. The most common BMI is 30 with 11.3% (8 cases). Following next are 20 and 31 which consist of 8.5% (6 cases) each, then 19 and 29 with 7.0% (5 cases) each, next is 17 which accounts for 5.6% (4 cases) then 21, 33 and 34 which consist of 4.2% (3 cases) each, next 18,22,23,27,28 and 32 with 2.8% (2 cases) each. The least common BMI readings are 15,16,24,26 and 37 each of which account for 1.4% (1 case) of the whole data.

Table 5.3: Visual Acuity of right eye

		Frequency	**Percent**
Valid	.0	44	62.0
	.2	4	5.6
	.3	3	4.2
	.5	5	7.0
	.6	2	2.8
	.8	2	2.8
	Total	60	84.5
Missing	**System**	11	15.5
Total		71	100.0

Table 5.3 This table shows that the visual acuity of right eye ranges from 0.0 to 0.8. This table presents that the most common visual acuity of right eye is 0.0 which comprises of 62.0% (44 cases), then 0.5 with 7.0% (5 cases), next is 0.2 with 5.6% (4 cases), then 0.3 with 4.2% (3 cases). The least common reading is 0.6 and 0.8 which consist of 2.8% (2 cases) each of the entire data.

Table 5.4: Visual acuity of left eye

		Frequency	**Percent**
Valid	.0	40	56.3
	.2	6	8.5
	.3	2	2.8
	.5	8	11.3
	.6	2	2.8
	.8	1	1.4
	1.0	1	1.4
	Total	60	84.5
Missing	**System**	11	15.5
Total		71	100.0

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Table 5.4 This table presents the range of readings 0.0 to 1.0 of visual acuity of left eye. The most common reading is 0.0 with 56.3% (40 cases), then 0.5 with 11.3% (8 cases) next 0.2 with 8.5% (6 cases), then 0.3 and 0.6 with 2.8% (2 cases) each. The least most common readings are 0. 8 and 1.0 which comprise of 1.4% (1 case) each.

Table 5.5: Schirmer's Test right eye

		Frequency	Percent
Valid	10.2mm	1	1.4
	10mm	1	1.4
	11.5mm	1	1.4
	11mm	1	1.4
	12mm	2	2.8
	15.1mm	1	1.4
	15mm	2	2.8
	17mm	1	1.4
	18mm	1	1.4
	1mm	6	8.5
	21mm	3	4.2
	22mm	2	2.8
	25.2mm	1	1.4
	25mm	4	5.6
	28mm	2	2.8
	29mm	1	1.4
	2mm	2	2.8
	30mm	3	4.2
	31mm	1	1.4
	32mm	1	1.4
	33mm	1	1.4
	34mm	1	1.4
	35mm	11	15.5
	3mm	1	1.4
	4mm	1	1.4
	5.2mm	1	1.4
	5.9mm	1	1.4
	5mm	4	5.6
	7mm	1	1.4
	8mm	1	1.4
	Total	60	84.5
Missing	**System**	11	15.5
Total		71	100.0

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Table 5.5 This table presents the values of Schirmer's test right eye which ranged widely from 1mm to 35mm. The most common reading for Schirmer's test of right eye is 35mm which is responsible for 15.5% (11 cases) of the entire data. The next most common reading is 1mm which consists of 8.5% (6 cases) of the data. Following this the next most common readings are 25mm and 5mm which comprise of 5.6% (4 cases) of the data. After this the fourth most common readings are 21mm and 30mm which are consisting of 4.2% (3 cases) of the data. Next the most common readings are 12mm, 15mm, 22mm, 28mm and 2mm where each reading consists of 2.8% (2 cases). The least most common readings are 1mm, 3mm, 4mm, 5.2mm, 5.9mm, 7mm, 8mm, 10mm, 10.2mm, 11mm, 11.5mm, 15.1mm, 17mm, 18mm, 25.2mm, 29mm, 31mm, 32mm, 33mm and 34mm where each of them comprise of 1.4% (1 case).

Table 5.6: Schirmer's test left eye

		Frequency	Percent
Valid	0mm	1	1.4
	10mm	1	1.4
	11mm	2	2.8
	12mm	1	1.4
	14mm	1	1.4
	15.1mm	1	1.4
	17mm	1	1.4
	18mm	2	2.8
	19mm	3	4.2
	1mm	2	2.8
	20mm	1	1.4
	22mm	2	2.8
	24mm	1	1.4
	25.1mm	1	1.4
	25mm	1	1.4
	26mm	1	1.4
	27mm	2	2.8
	29mm	1	1.4
	2mm	3	4.2
	30mm	4	5.6
	31mm	2	2.8
	35mm	13	18.3
	4.5mm	1	1.4
	5.1mm	1	1.4
	5.5mm	1	1.4
	5mm	5	7.0
	7mm	3	4.2
	8mm	1	1.4
	9mm	1	1.4
	Total	60	84.5
Missing	System	11	15.5
Total		71	100.0

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Table 5.6 This table illustrates that the readings for the Schirmer's test left eye range from 0mm to 35mm. The most common reading of the Schirmer's test left eye 35mm which is responsible for 18.3% (13 cases) of the entire data presented in the table. The second most common reading is 5mm which consists of 7.0% (5 cases) of the data. Following this the next most common reading is 30mm which comprises of 5.6% (4 cases) of the data. After this the most common readings are 19mm, 2mm and 7mm where each is responsible for 4.2% (3 cases) of the data. The second last most common readings are 1mm, 11mm, 18mm, 22mm, 27mm and 31mm which consist of 2.8% (2 cases) each, of the whole data. The least common readings are 0mm, 4.5mm, 5.1mm, 5.5mm, 8mm, 9mm, 10mm,12mm, 14mm, 15.1mm, 17mm, 20mm, 24mm, 25.1mm, 25mm, 26mm and 29mm where each is consisting of 1.4% (1 case) each, of the entire data.

Table 5.7: Tear break-up time right eye

		Frequency	Percent
Valid	10s	1	1.4
	11.8s	1	1.4
	11s	2	2.8
	12.9s	1	1.4
	13.9s	1	1.4
	13s	1	1.4
	15s	1	1.4
	16.05s	1	1.4
	2s	1	1.4
	3.01 s	1	1.4
	3.39s	1	1.4
	3s	3	4.2
	4.16s	1	1.4
	4.49s	1	1.4
	4.5s	2	2.8
	4.9s	2	2.8
	4s	6	8.5
	5.1s	1	1.4
	5.25s	2	2.8
	5.39s	1	1.4
	5.42s	1	1.4
	5.43 s	1	1.4
	5s	6	8.5
	6.18s	1	1.4
	6.30 s	1	1.4

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	6.6s	1	1.4
	6s	4	5.6
	7.16s	1	1.4
	7.7s	1	1.4
	7s	2	2.8
	8.3 s	1	1.4
	8.56 s	1	1.4
	8.8s	1	1.4
	8s	2	2.8
	9.02s	1	1.4
	9.2s	1	1.4
	9.6s	1	1.4
	9.90s	1	1.4
	9s	1	1.4
	Total	60	84.5
Missing	**System**	11	15.5
Total		71	100.0

Table 5.7 This table shows that the tear break-up time of the right eye ranges from 2s to 16.05s. The most common times for the tear break-up time of right eye are 4s and 5s where each is responsible for 8.5% (6 cases). The second most common time is 6s which account for 5.6% (4 cases) of the data. The next most common time is 3s which comprises 4.2% (3 cases) of the data. Following this the fourth most common times are 4.5s, 4.9s, 5.25s, 7s, 8s and 11s which comprise of 2.8% (2 cases) each, of the data. the least common times for the tear break-up time right eye are 2s, 3.01s, 3.39s, 4.16s, 4.49s, 5.1s, 5.39s, 5.42s, 5.43s, 6.18s, 6.30s, 6.6s, 7.16s, 7.7s, 8.3s, 8.56s, 8.8s, 9s, 9.02s, 9.2s, 9.6s, 9.90s, 10s, 11.8s,
12.9s, 13s, 13.9s, 15s and 16.05s which are responsible for 1.4% (1 case) each, of the entire data.

Table 5.8: Tear break-up time left eye

		Frequency	**Percent**
Valid	1.84s	1	1.4
	10sec	1	1.4
	11.0s	1	1.4
	11s	1	1.4
	12.7s	1	1.4
	12s	2	2.8
	15s	1	1.4
	2.5sec	1	1.4
	2.9s	1	1.4

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	3s	6	8.5
	4.2s	1	1.4
	4.83s	1	1.4
	4.86s	2	2.8
	4s	3	4.2
	5.13s	1	1.4
	5.16 s	1	1.4
	5.43s	1	1.4
	5.5s	1	1.4
	5.75s	1	1.4
	5.7s	1	1.4
	5.8s	1	1.4
	5.9s	2	2.8
	5s	3	4.2
	6.01s	1	1.4
	6.14s	1	1.4
	6.4s	1	1.4
	6.6s	1	1.4
	6s	4	5.6
	7.15s	1	1.4
	7.27s	1	1.4
	7.39s	1	1.4
	7.66 s	1	1.4
	7.72s	1	1.4
	7.81s	1	1.4
	7s	5	7.0
	8.6s	1	1.4
	8.98s	1	1.4
	8s	1	1.4
	9.19s	1	1.4
	9.9s	1	1.4
	9s	1	1.4
	Total	60	84.5
Missing	**System**	11	15.5
Total		71	100.0

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Table 5.8 The table shows the distribution of tear break-up time (TBUT) for left eye, measured in seconds. The values range from 1.84s to 15s. The table shows that the most frequent time for the TBUT of left eye is 3s with 8.5% (6 cases) of the entire data. The second most frequent time is 7s with 7.0% (5 cases), then 6s with 5.8% (4 cases), next are 4s and 5s with 4.2% (3 cases) each, next are 4.86s, 5.9s and 12s with 2.8% each and the least common times are seen to be responsible of 1.4% i.e. 1 case each, these times are 1.84s, 2.5s, 2.9s, 4.2s, 4.83s, 5.13s, 5.16s, 5.43s, 5.5s, 5.7s, 5.75s, 5.8s, 6.01s, 6.14s, 6.4s, 6.6s, 7.15s, 7.27s, 7.39s, 7.66s, 7.72s, 7.81s, 8s, 8.6s, 8.98s, 9s, 9.19s, 9.9s, 10s, 11s, 11.0s, 12.7s respectively. These values showed that there is a broad distribution of tear film stability within this group.

Table 5.9: PCOS

		Frequency	Percent
Valid	No	30	42.3
	Yes	30	42.3
	Total	60	84.5
Missing	System	11	15.5
Total		71	100.0

Table 5.9 This table shows the total number of participants which took part in this study which presents to be 60, where 30 are those that are categorized into the females without PCOS group and in this table are represented by the label 'No'. On the other hand, the label 'Yes' corresponds to 30 participants identified as females with PCOS.

Table 5.10: OSDI

		Frequency	Percent
Valid	.0	7	9.9
	4.8	2	2.8
	9.5	7	9.9
	14.3	11	15.5
	19.1	6	8.5
	23.8	9	12.7
	28.6	5	7.0
	33.3	3	4.2
	42.9	3	4.2
	47.6	1	1.4
	52.4	1	1.4
	57.1	2	2.8
	66.7	1	1.4
	90.5	2	2.8
	Total	60	84.5
Missing	System	11	15.5

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Total	71	100.0

Table 5.10 This table shows that the OSDI scores range from 0.0 to 52.4. The most frequent score is 14.3 with 15.5% (11 cases), then 23.8 with 12.7% (9 cases) of the data. Following this the most common scores are 0.0 and 9.5 with 9.9% (7 cases) each, then 19.1 with 8.5% (6 cases), next is 28.6 with 7.0% (5 cases), next are 33.3 and 42.9 with 4.2% (3 cases) each, next most common scores which are responsible for 2.8% (2 cases) each of the data are 4.8, 57.1 and 90.5 respectively. The least common scores are 47.6, 57.1 and 66.7 each consisting of 1.4% (1 case).

Table 5.11:
Case Processing Summary

Cases						
	Valid		**Missing**		**Total**	
	N	**Percent**	**N**	**Percent**	**N**	**Percent**
PCOS * Schirmer test right eye	60	84.5%	11	15.5%	71	100.0%
PCOS * Schirmer test left eye	60	84.5%	11	15.5%	71	100.0%
PCOS * Tear break-up time right eye	60	84.5%	11	15.5%	71	100.0%
PCOS * Tear break-up time left eye	60	84.5%	11	15.5%	71	100.0%
PCOS * Visual acuity right eye	60	84.5%	11	15.5%	71	100.0%
PCOS * Visual acuity left eye	60	84.5%	11	15.5%	71	100.0%
PCOS * OSDI	60	84.5%	11	15.5%	71	100.0%
PCOS * BMI	60	84.5%	11	15.5%	71	100.0%

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Table 5.11 The table shows the number of cases which were studied in this study. The table tells that the number of cases having valid data across all listed tests and parameters are 60 cases.

Cross tabulation

Table 5.12: PCOS* Visual acuity

Cross tab								
		Visual acuity right eye						Total
		.0	.2	.3	.5	.6	.8	
PCOS	No	26	0	1	2	0	1	30
	Yes	18	4	2	3	2	1	30
Total		44	4	3	5	2	2	60
		Visual acuity left eye						Total
		.0	.2	.3	.5	.6	.8	1.0
PCOS	No	23	3	1	1	1	1	0	30
	Yes	17	3	1	7	1	0	1	30
Total		40	6	2	8	2	1	1	60

Table 5.12 This table examines the relationship between PCOS and visual acuity in the right eye and left eye. Both the groups "No PCOS" and "Yes PCOS" have 30 participants each, with a total 60 participants.

In right and left eye, the most common visual acuity is 0.0 in both groups but is more frequent in group without PCOS. The PCOS group shows greater range towards lower visual acuity levels i.e. 0.2, 0.3, 0.5, 0.6, 0.8 and 1 in both eyes. This shows that females with PCOS are more likely to experience reduced visual acuity in both eyes than females without PCOS.

Table 5.13: Chi square test

	Values	Df	Asymptotic Significance (2-sided)
McNemar-Bowker Test	.	.	0.000[a]
N of Valid Cases	60		
	Values	Df	Asymptotic Significance (2-sided)
McNemar-Bowker Test	.	.	0.000[a]
N of Valid Cases	60		

Table 5.13 A chi- square test was conducted to evaluate whether a statistically significant association exists between PCOS status and visual acuity values for the right and left eye. P value of

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"0.000" shows statistical significance.

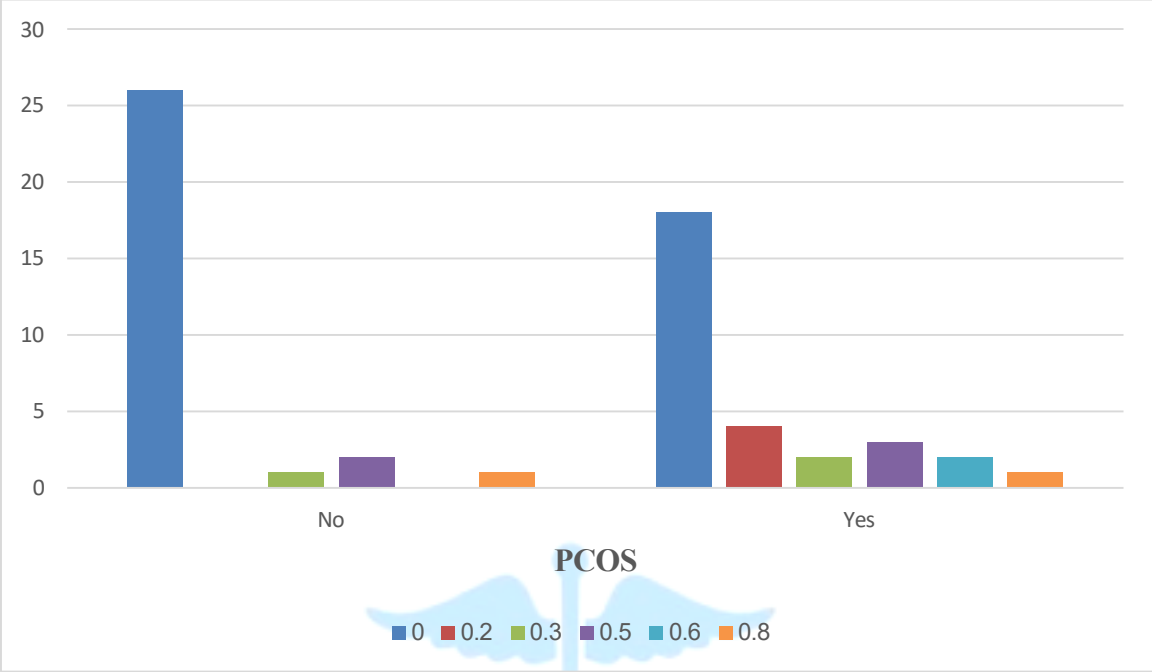

Figure 5.1: PCOS * Visual acuity of right eye

Figure 5.1 The bar chart compares visual acuity (right eye) between individuals with and without PCOS. Most participants in both groups had a visual acuity of 0.0, but reduced acuity levels (e.g., 0.2 to 0.8) were more frequent in the PCOS group. This suggests that PCOS may be associated with a wider range of decreased visual acuity. As the key shows the blue color in the bar chart represents 0.0 visual acuity. Red represents 0.2 visual acuity reading. Green represents 0.3 visual acuity reading. 0.5 is seen to be represented by orange color. The 0.6 is represented by yellow whereas the 0.8 reading is represented by light blue color.

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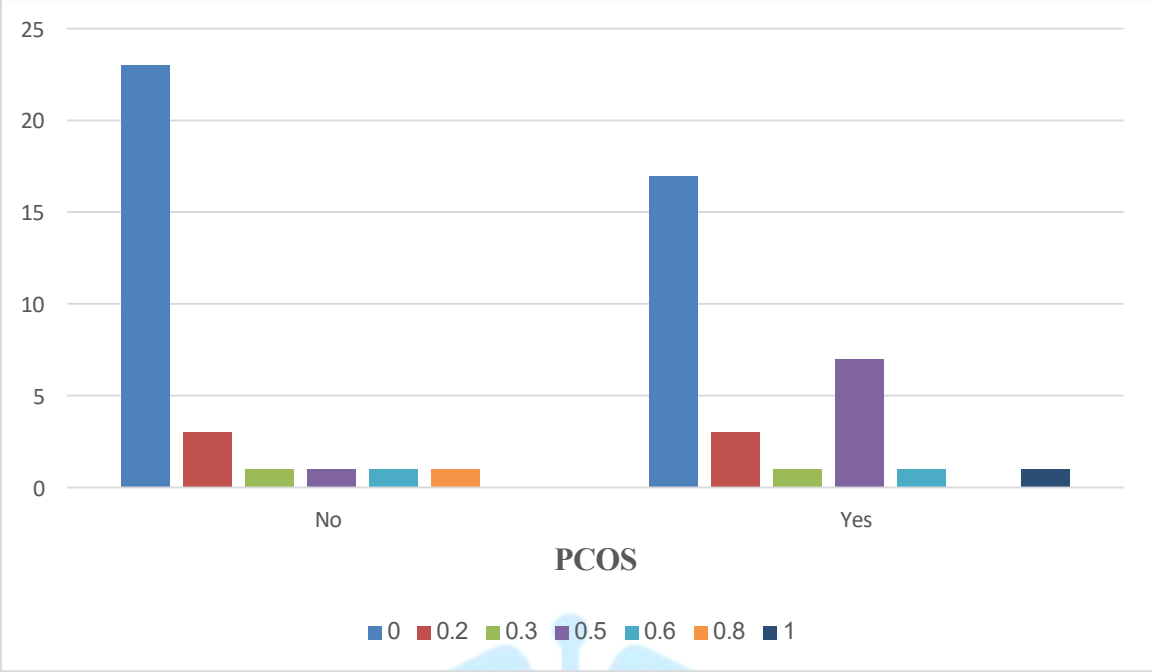

Figure 5.2: PCOS * Visual acuity of left eye

Figure 5.2 This bar chart visualizes the distribution of left eye visual acuity among individuals with and without PCOS. For those without PCOS, a visual acuity of 0.0 is most prevalent, followed by 0.2. In the "Yes PCOS" group, 0.0 is also the most common, but 0.5 visual acuity is notably higher compared to the "No PCOS" group. As the key shows the blue color in the bar chart represents 0.0 visual acuity. Red represents 0.2 visual acuity reading. Green represents 0.3 visual acuity reading. 0.5 is seen to be represented by orange color. The 0.6 is represented by yellow whereas the 0.8 reading is represented by light blue color. The pink color is seen representing the 1.0 reading.

Table 5.14: PCOS * Schirmer's test

		Schirmer's test right eye				Total
		1-10mm	11-20 mm	21-30mm	31-35 mm	
PCOS	No	11	5	9	5	30
	Yes	8	5	7	10	30
Total		19	10	16	15	60
		Schirmer's test left eye				Total
		0-10mm	11-20mm	21-30mm	31-35mm	

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PCOS	No	13	5	7	5	30
	Yes	7	7	6	10	30
Total		20	12	13	15	60

Table 5.14 This table presents a cross-tabulation of Schirmer test values for the right and left eye in relation to PCOS status. Various tear production measurements (e.g., 10mm, 11mm, 12mm, 15mm, etc.) are listed, showing how many participants from each PCOS group fall under each category. This helps identify any trends or distribution patterns between PCOS and non-PCOS individuals.

Table 5.15: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
McNemar-Bowker Test	0.0	0.0	0.000[a]
N of Valid Cases	60		
	Value	df	Asymptotic Significance (2-sided)
McNemar-Bowker Test	.	.	0.000[a]
N of Valid Cases	60		

Table 5.15 This table shows that the chi-square test was performed to assess the association between PCOS status and Schirmer test values in right and left eye. The P value of "0.000" shows that there is statistical significance.

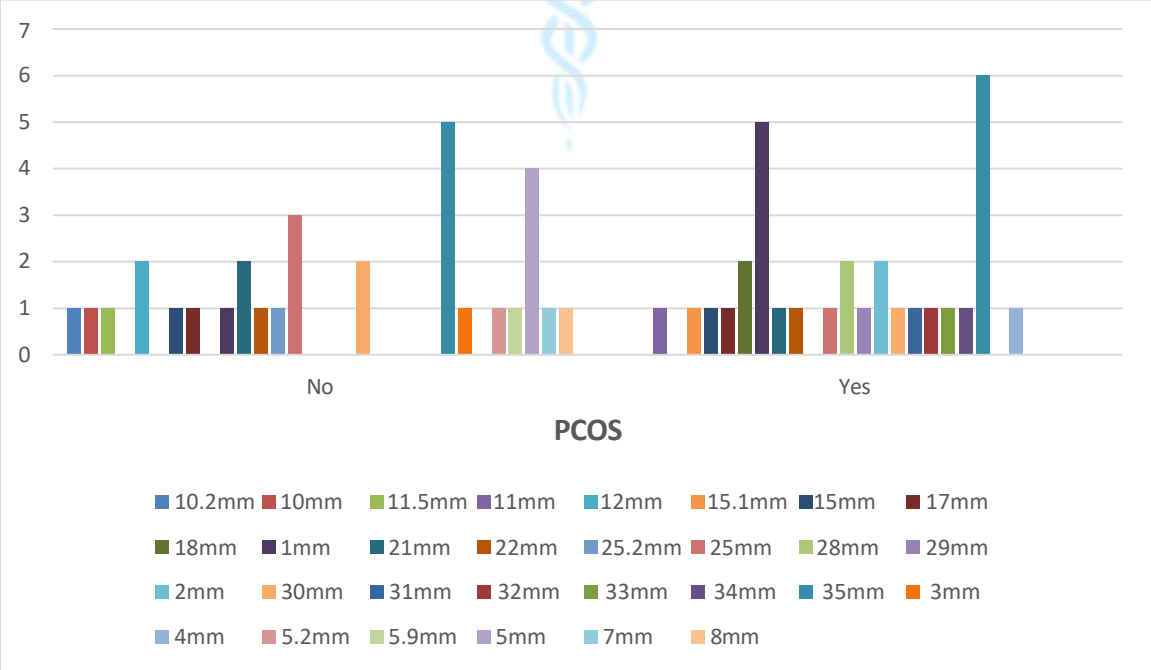

Figure 5.3: PCOS * Schirmer's test right eye

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Figure 5.3 This bar chart provides a visual representation of the distribution of Schirmer test values in the right eye across PCOS and non-PCOS groups. It highlights which values are predominant in each group and assists in identifying patterns or discrepancies in tear secretion linked to PCOS. The key shows which value is represented by which color.

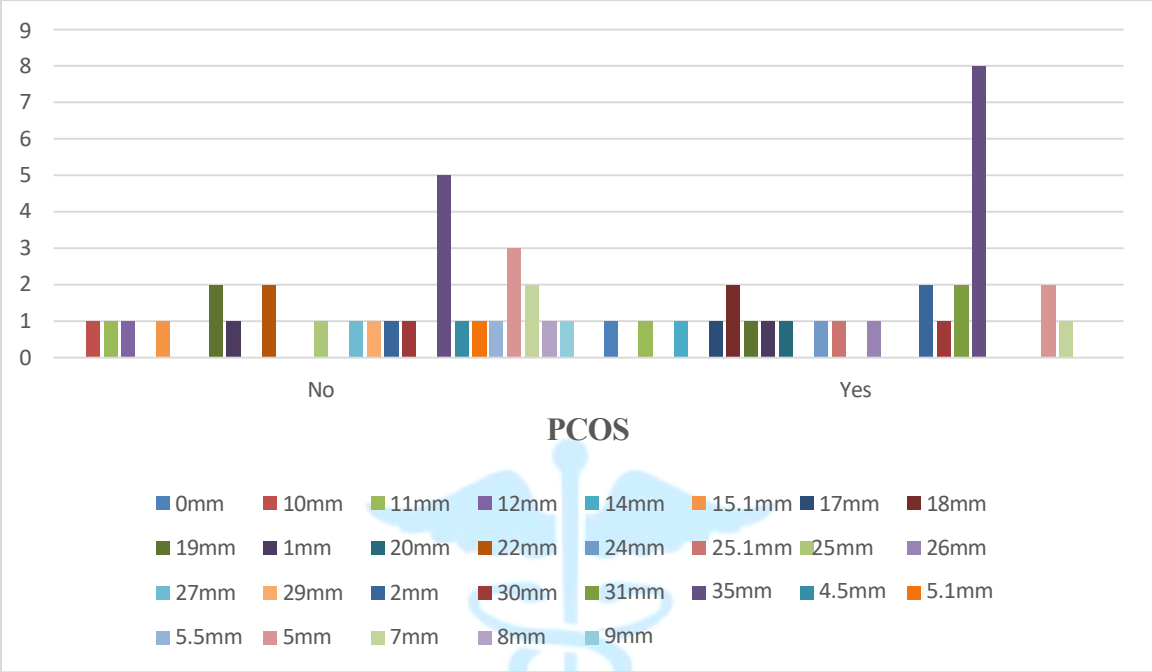

Figure 5.4: PCOS * Schirmer's test left eye

Figure 5.4 This bar chart visually depicts the frequency distribution of Schirmer test values for the left eye among PCOS and non-PCOS groups. It highlights which values are predominant in each group and assists in identifying patterns or discrepancies in tear secretion linked to PCOS.

Table 5.16: PCOS * Tear break-up time

		Tear break-up time right eye			Total
		<5s	5-10s	>10s	
PCOS	No	11	14	5	30
	Yes	7	20	3	30
Total		18	34	8	60
		Tear break-up time left eye			Total
		<5s	5-10s	>10s	
PCOS	No	7	19	4	30
	Yes	9	10	2	30

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Total	16	29	6	60

Table 5.16 This table shows the distribution of the values of right and left eye tear break-up time test across individuals with and without PCOS. 5 healthy females have TBUT of right eye greater than 10 which shows that the right eye of females with PCOS have greater ratio of dry eyes than right eye of healthy females. 4 healthy females have TBUT of left eye greater than 10 while only 2 females with PCOS have TBUT of left eye greater than 10. According to this left eye of females with PCOS have greater ratio of dry eyes than left eye of healthy females.

Table 5.17: Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)
McNemar-Bowker Test	.	.	0.000[a]
N of Valid Cases	60		
	Value	Df	Asymptotic Significance (2-sided)
McNemar-Bowker Test	.	.	0.000[a]
N of Valid Cases	60		

Table 5.17 In this table it is shown that the chi-square test was conducted to evaluate whether a statistically significant association exists between PCOS status and TBUT values for the right and left eye. P value of "0.000" shows statistical significance.

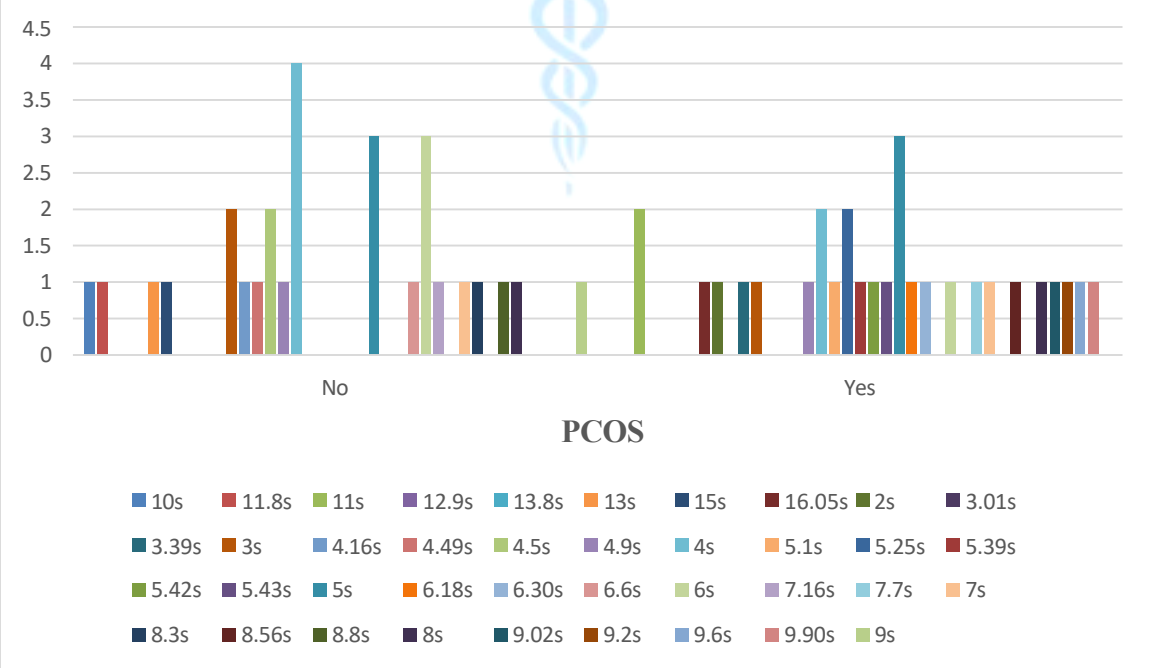

Figure 5.5: PCOS * TBUT right eye

Figure 5.5 In females without PCOS, TBUT in right eye was less than 5 sec in 11 females

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i.e. severe dry eye. 5 sec to 10 sec in 14 females i.e. mild dry eye. Greater than 10 sec in 5 females i.e. normal. In females with PCOS TBUT in right eye was less than 5 sec in 7 females, 5 to 10 sec in 20 females, greater than 10 sec in 3 females. According to this ratio of dry eye in right eye is greater in females with PCOS.

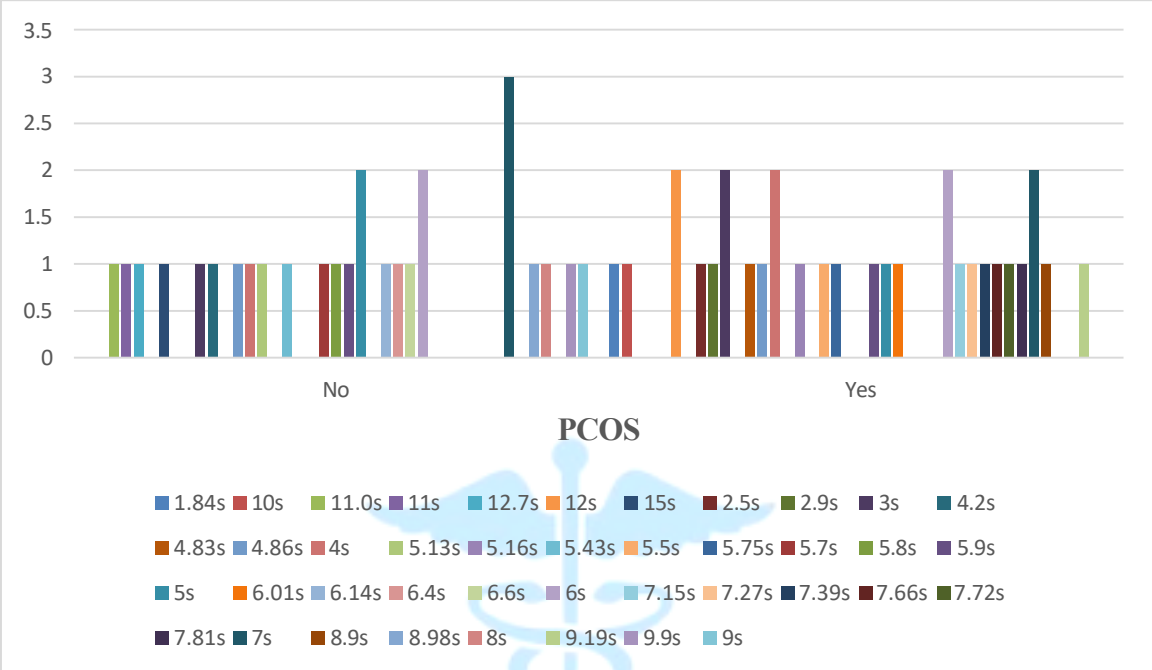

Figure 5.6: PCOS * TBUT left eye

Figure 5.6 This bar chart shows that females without PCOS, TBUT in left eye was less than 5 sec in 7 females i.e. severe dry eye. 5 sec to 10 sec in 19 females i.e. mild dry eye. Greater than 10 sec in 4 females i.e. normal. In females with PCOS TBUT in left eye was less than 5 sec in 9 females, 5 to 10 sec in 10 females, greater than 10 sec in 2 females. According to this ratio of dry eye in left eye is greater in females with PCOS. The key shows the representation of each value by a specific color respectively.

Table 5.18: PCOS*OSDI

		OSDI					Total
		0-20	21-40	41-60	61-80	81-100	
PCOS	No	20	5	3	0	2	30
	Yes	13	12	5	0	0	30
Total		33	17	8	0	2	60

Table 5.18 The OSDI scores are divided into ranges (0 to 90.5), reflecting increasing severity of dry eye symptoms. Among non-PCOS females, most scores are clustered in the mild to moderate range, while PCOS females show more distribution in the higher severity range. This suggests that females with PCOS tend to have more severe dry eye symptoms compared to those without PCOS.

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Table 5.19: Chi- Square test

	Value	Df	Asymptotic Significance (2-sided)
McNemar-Bowker Test	.	.	0.000[a]
N of Valid Cases	60		

Table 5.19 A chi-square test was conducted to evaluate whether a statistically significant association exists between OSDI score of with and without PCOS. P value of "0.000" shows statistical significance.

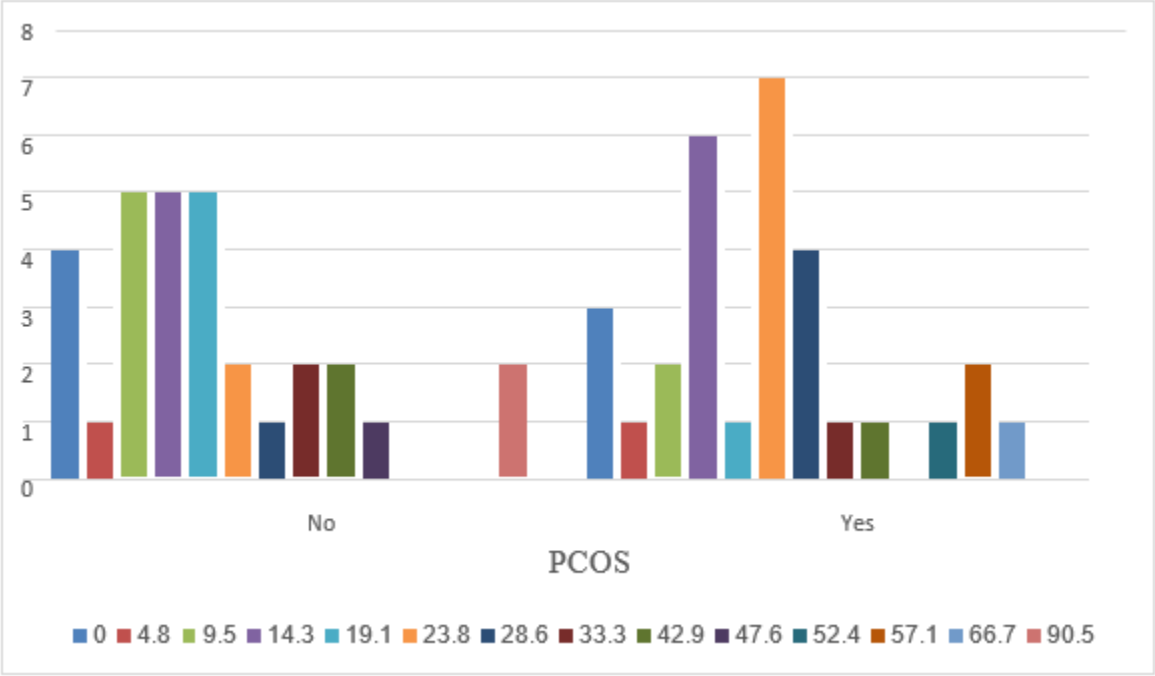

Figure 5.7: PCOS * OSDI

Figure 5.7 This bar chart shows that the "No PCOS" group shows a more even distribution of OSDI scores, with counts spread mostly across the mild to moderate range (e.g., 4.8 to 23.8). In contrast, the "Yes PCOS" group has higher frequencies at higher OSDI values, especially at 28.6 and 33.3, indicating more severe dry eye symptoms. Some very high OSDI scores (47.6 to 90.5) are seen only in the PCOS group, further supporting this trend.

Table 5.20: PCOS * BMI

		BMI				Total
		15-20	21-26	27-32	33-38	
PCOS	No	19	9	2	0	30
	Yes	0	0	23	7	30
Total		19	9	25	7	60

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Table 5.20 This table shows the BMI distribution (15-38) among females with and without PCOS. All individuals with PCOS have BMI values outside this range (15–26), since none are recorded in these BMI categories. All the BMI values in this range belong to non-PCOS females, with the highest frequencies at BMI 15 to 20. This suggests that females without PCOS in the study tend to have lower BMI. It also implies that PCOS females likely fall into higher BMI categories.

Table 5.21: Chi- Square test

	Value	Df	Asymptotic Significance (2-sided)
McNemar-Bowker Test	.	.	0.001[a]
N of Valid Cases	60		

Table 5.21 This table shows that the chi-square test conducted to evaluate whether a statistically significant association exists between BMI of with and without PCOS represents P value of "0.001" which shows statistical significance.

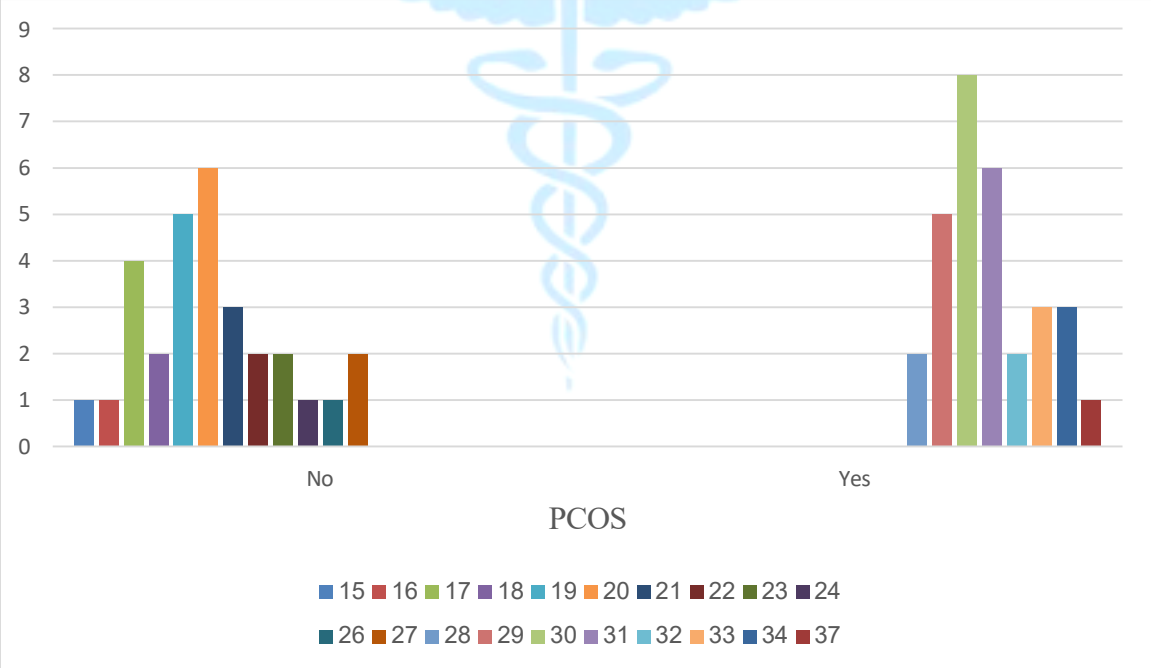

Figure 5.8: PCOS * BMI

Figure 5.8 This bar chart shows that the females without PCOS have BMI values clustered between 15 and 24, indicating mostly normal or underweight ranges. In contrast, females with PCOS have BMI values starting from 25 and going up to 37, showing a clear shift toward overweight and obese categories. The highest count among PCOS patients is at BMI 27 and 28, emphasizing a strong link between increased BMI and PCOS. This graph visually supports the earlier finding that higher BMI is significantly associated with PCOS, while lower BMI is mostly seen in non-PCOS females.

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CHAPTER 6
DISCUSSION

The present study aimed to investigate the prevalence of dry eye disease (DED) and its impact on visual acuity in females with and without polycystic ovary syndrome (PCOS) within the age range of 18–35 years. The results reveal significant difference in tear film dynamics and visual outcomes between the two groups, with a chi-square test yielding a p-value of 0.000 for VA, Schirmer's test, and TBUT, indicating clinical significance and rejected the null hypothesis that there is no association between DED and PCOS.

The study included 60 participants (30 with PCOS and 30 without), with a mean age of approximately 20 years and a BMI range of 15–37. The visual acuity results indicated that the majority of participants in both groups had normal VA (0.0 logMAR, equivalent to 20/20), with 62% for the right eye and 56.3% for the left eye. However, a small subset of participants exhibited reduced VA (e.g., 0.6 and 0.8 logMAR), suggesting potential visual disturbances in some individuals. Schirmer's test results demonstrated significant variability in tear production, with 15.5% of participants showing low tear secretion (1 mm) and 15.5%–18.3% showing high secretion (35 mm) in the right and left eyes, respectively. TBUT measurements further highlighted tear film instability, with values ranging from 1.84 to 9 seconds, and the most frequent TBUT values being 4 seconds for the right eye and 3 seconds for the left eye, each occurring in 8.5% of cases. The chi-square test results (p=0.000) for VA, Schirmer's test, and TBUT indicate a statistically significant association between PCOS and DED, suggesting that PCOS may contribute to ocular surface dysfunction and impact visual function.

The findings from this study reinforce and expand upon existing research regarding dry eye disease (DED) in the context of hormonal imbalances, particularly those associated with polycystic ovary syndrome (PCOS). Asfuroğlu et al. (2021) identified an increased prevalence of DED symptoms among women with PCOS, noting reduced Schirmer's test scores and shorter tear break-up times (TBUT) compared to controls. They attributed these changes primarily to elevated androgen levels and insulin resistance, both of which likely disrupt tear film stability and promote ocular surface inflammation. Our study's results mirror these findings, with 15.5% of participants demonstrating low tear secretion on the Schirmer's test, further supporting the association between PCOS and impaired tear production. The observed variability in tear secretion in our cohort highlights the multifactorial nature of DED, with hormonal dysregulation in PCOS compromisib tear film stability.

Further, Yuksel et al. (2020) examined ocular surface alterations in women with PCOS and found higher OSDI (Ocular Surface Disease Index) scores and reduced TBUT, indicative of more severe DED. Their work linked these findings to the effects of sex hormones, especially androgens, on meibomian gland function and the stability of the tear film's lipid layer. In our study, TBUT values were notably low, with some participants recording times as short as 1.84 seconds, and most falling in the 3–4 second range well below the normal threshold of 10 seconds. This supports Yuksel's conclusion that PCOS-related hormonal changes may compromise meibomian gland function, leading to a deficient lipid layer and increased tear evaporation.

Yabanoglu et al. (2022) provided further insight by suggesting that hormonal imbalances in PCOS can result in both aqueous-deficient and evaporative mechanisms of dry eye. Our findings are consistent with this dual mechanism hypothesis, as evidenced by mildly reduced Schirmer's values (suggesting some aqueous deficiency) and significantly decreased TBUT (indicative of compromised lipid layer and increased evaporation). The Impact of DED on visual acuity observed in our study is also consistent with prior research. Megha Ranjan et al. (2024) reported a higher prevalence of DED among females aged 16–44 years and noted a significant association between PCOS and visual disturbances. Our results corroborate these observations, with statistically significant chi-

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square values (p=0.000) indicating that DED in PCOS patients may contribute to subtle visual impairments, likely due to irregularities in the tear film affecting optical quality.

In summary, the present study supports the growing body of evidence that hormonal disturbances in PCOS contribute to both aqueous-deficient and evaporative dry eye, with measurable effects on tear secretion, tear film stability, and visual function.

Multiple reasons back the link between PCOS and DED identified in our research. Initially PCOS disturbs the balance of the ocular surface as androgens affect the functioning of the meibomian glands, which are essential for the lipid layer of the tear film. Impairment in these glands, indicated by our low TBUT values, results in evaporative DED, a frequent subtype in PCOS patients. Variations in estrogen, especially throughout the menstrual cycle, have been associated with changes in tear production and sensitivity of the ocular surface(20). The notable variability in Schirmer's test outcomes in our research might indicate these hormonal effects, as certain participants showed hyposecretion (1 mm) while others demonstrated hypersecretion (35 mm), potentially as a result of compensatory responses or inflammation.

Furthermore, the significant chi-square results (p=0.000) across VA, Schirmer's test, and TBUT provide robust statistical evidence of an association between PCOS and DED. The rejection of the null hypothesis indicates that the observed differences between the PCOS and control groups are unlikely due to chance. This statistical significance strengthens the argument that PCOS is a risk factor for DED, potentially through its effects on tear film composition, meibomian gland function, and ocular surface health

These findings have important clinical implications. The high prevalence of DED symptoms in females with PCOS underscores the need for routine ocular screening in this population. Optometrists and ophthalmologists should consider incorporating OSDI questionnaires, Schirmer's tests, and TBUT measurements into the management of PCOS patients to detect and address DED early. Moreover, the potential impact of DED on visual acuity, even in the presence of normal Snellen chart results, highlights the importance of assessing functional visual acuity and contrast sensitivity to capture subtle visual disturbances(21).

CHAPTER 7
CONCLUSIONS

The findings of this research indicate a significant clinical association between Dry Eye Disease (DED) and Polycystic Ovary Syndrome (PCOS) in females aged 18–28 years. Regarding dry eye, a number of tests including Schirmer's test, Tear Break-Up Time (TBUT), as well as visual acuity, showed data-wise marked differences between participants with and without PCOS (p = 0.000), showing a significant impact of PCOS on ocular surface health.

The fluctuation in tear secretion and balance, along with decreased visual acuity in a group of participants, indicates that PCOS may contribute to or worsen DED symptoms. Thus, routine ophthalmologic screening for DED should be seen as in females with PCOS to confirm early diagnosis and treatment. These results validate rejecting the null hypothesis and confirm a significant association between PCOS and Dry Eye Disease.

RECOMMENDATIONS

The findings of this study lead to the listed recommendations:

1. Routine Screening for Dry Eye in PCOS Patients:

Women diagnosed with PCOS should undergo regular ophthalmologic examination, including Schirmer's test and TBUT, to identify early signs of Dry Eye Disease (DED), even if they are showing no signs.

2. Interdisciplinary Care Approach:

Gynecologists, endocrinologists, and ophthalmologists should collaborate in the management of PCOS patients to address systemic and ocular complications holistically.

3. Patient Education:

PCOS patients must be educated regarding the

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possible complication of developing signs of tear film insufficiency and the importance of stating ocular discomfort, visual changes, or dryness.

4. Lifestyle and Nutritional Guidance:
Since high BMI was common among participants and is known to worsen both PCOS and DED, weight management, a balanced diet, and increased hydration should be prompted.

5. Utilization of eye drops for moistening:
In the case of those who showing signs tear film dysfunction especially with abnormal Schirmer's or TBUT values, early treatment using lubricating eye drops can help reduce symptoms and prevent further ocular surface damage.

6. Further Research:
Larger-scale research involving a more varied population are recommended to confirm these results and examine the underlying pathways linking PCOS to dry eye pathophysiology.

These recommendations aim to improve patient outcomes through timely identification, precaution, along with the successful treatment of dry eye symptoms in females affected by PCOS.

LIMITATIONS

The small sample size (n=60) may limit the generalizability of the findings. Additionally, while the OSDI questionnaire provides valuable subjective data, it may be influenced by recall bias or subjective interpretation. The variability in Schirmer's test results, with some participants showing hypersecretion, may indicate compensatory mechanisms or measurement variability, warranting further investigation. Future studies with larger sample sizes, longitudinal designs, and additional tests (e.g., meibomian gland evaluation, tear osmolarity) could provide deeper insights into the mechanisms linking PCOS and DED.

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