Master of Science in Public Health

Dry eye disease among plain and hilly areas of Punjab

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Declaration

In submitting this dissertation, I certify that I have read and understood the rules and regulations of DPH and QAU regarding assessment procedures and offences and formally declare that all work contained within this document is my own apart from properly referenced quotations.

I understand that plagiarism is the use or presentation of any work by others, whether published or not, and can include the work of other candidates. I also understand that any quotation from the published or unpublished works of other persons, including other candidates, must be clearly identified as such by being placed inside quotation marks and a full reference to their source must be provided in proper form.

This dissertation is the result of an independent investigation. Where my work is indebted to others, I have made acknowledgments.

I declare that this work has not been accepted in substance for any other degree, nor is it currently being submitted in candidature for any other degree.

(Dr. Khizer)	**(Ambreen Akhtar)**
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PIO, Al Shifa Trust Eye Hospital	Date:

Dedicated to all those who have been a constant source of support and encouragement for me in my research work

I couldn't be able to accomplish this task without your support.....

ABSTRACT

Background:

Dry Eye Disease is an important ocular surface disorder that considered as a public health issue due to its impact on vision-related quality of life of the affected subject. The prevalence of DED has been reported in many countries around the world, with a range of between 9.5–90% This variation has been suggested to be influenced by geographical location.

Objectives:

- To assess the pattern of dry eye disease among geographically diverse population of Pakistan
- To find out the association of dry eye between sociodemographic variables.

Methodology:

A cross-sectional study was carried out at plain and hilly areas of Province Punjab, Pakistan. Total 400 respondents, visiting eye camps were selected through non-probability convenient sampling. Data of dry eye disease was collected using OSDI questionnaire and were entered and analyzed using SPSS. Chi-square test of association was applied to check the association of Dry eye with diverse geographical area and socio-demographic factors.

Results:

Out of total 400 respondents, majority were females in plain geographical area (n=124, 62%) and in hilly area (n=88, 44%).In plain area dry eye disease was more prevalent among age 18-28 (n=131,65%), whereas in hilly 39-49 was affected age group (n= 59, 29.50%). Among dry eye symptoms majority of the patients have experienced light sensitivity half of the time in both plain area (n=60,30%) and in hilly area (n=72,36%), vision related questions showed that most of the time participants in hilly area faced difficulty while reading (n=96,48%), dry eye disease was severe among hilly area

compared to plain area. Overall, dry eye OSDI score differed significantly between participants of hilly and plains area ($p<0.001$).

Conclusion:

DED is common in population ≥30 years of age. The prevalence of DED is high in the study population. Younger Age and Female gender were associated risk factors with the development of DED. Its prevalence is affected by extrinsic (geographic location, exposure to sunlight,) and intrinsic (age, sex,) factors.

Keywords:

Dry Eye, OSDI, Plain area, Hilly Area, Geographical diversity.

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LIST OF ABBEREVIATION

DED	Dry Eye Disease
DEWS	Dry Eye Work Shop
DEWS II	Dry Eye Work Shop II
IRR	Incidence rate ratio
QOL	Quality of Life
SPSS	Statistical package for social sciences

CHAPTER I: INTRODUCTION

Dry Eye disease (DED) is defined by the International Dry Eye workshop as, “A multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles” (Daull, P et al.,2020)

The diagnosis of dry eye and its treatment has long been approached somewhat subjectively. Even more so, it's an ocular ailment that hasn't always been treated with enough gravity given the impact this disease can have on the people who live with it. Publication of the DEWS Report. The 2007 International Dry Eye Workshop, sponsored by the Tear Film and Ocular Surface Society [TFOS] was created to provide an evidence-based critical review and summary of the classification, epidemiology, diagnosis, techniques of basic and clinical research, and management of dry eye disease. This report, recently published in The Ocular Surface, 1 provides an encyclopaedic, evidence-based review of dry eye disease. The report was a product of a team of international experts who spent three years appraising the present state of knowledge for dry eye disease and the methods used to evaluate, diagnose and manage the disorder. (Gayton, J. L. (2009)) According to the previous tear film and ocular surface, society reports the eye surface is constituted of the structures including adnexa, eyelashes, eyelids, accessory and main lacrimal gland, meibomian gland, conjunctiva, tear film and cornea. Thus, according to this both tear production and the tears which are present on the front eye surface are involved in the ocular surface. Homeostasis is defined as the state of equilibrium in the body concerning its various functions, and to the chemical composition of the fluids and tissues in Dry Eye the tear film loss, it’s homeostasis and cannot be able to perform its numerous functions properly such as failure to provide nourishment to the various ocular structures. Thus, change in tear film leads to the development of Dry Eye disease. A patient presents with symptoms when they are suffering from Dry Eye disease. The etiological role means

it involved the various pathways and we cannot say that specific measures should be taken and specific diagnostic tests should be performed (Craig, J. P et al.,2017).

1.1 Tear film structure and functions

The tear film is composed of three layers. Meibomian glands are responsible for the secretion of the lipid layer. Lacrimal glands are responsible for aqueous layer secretion. Conjunctival Goblet cells secrete a mucous layer. Tear layer constituents a many hundred complex distinct proteins that are spread over the surface. A neuronal controlled blink mechanism mechanically distributed the tear film over the ocular surface. Eye blinks that occur spontaneously concern eyelids closure which occurs without any volition and stimulation . During a normal blink for the resurfacing of tear film three factors are required, A normal corneal epithelium and contact between eyelids, epithelium and external ocular surface. (Aquavella, J. V et al.,1977)

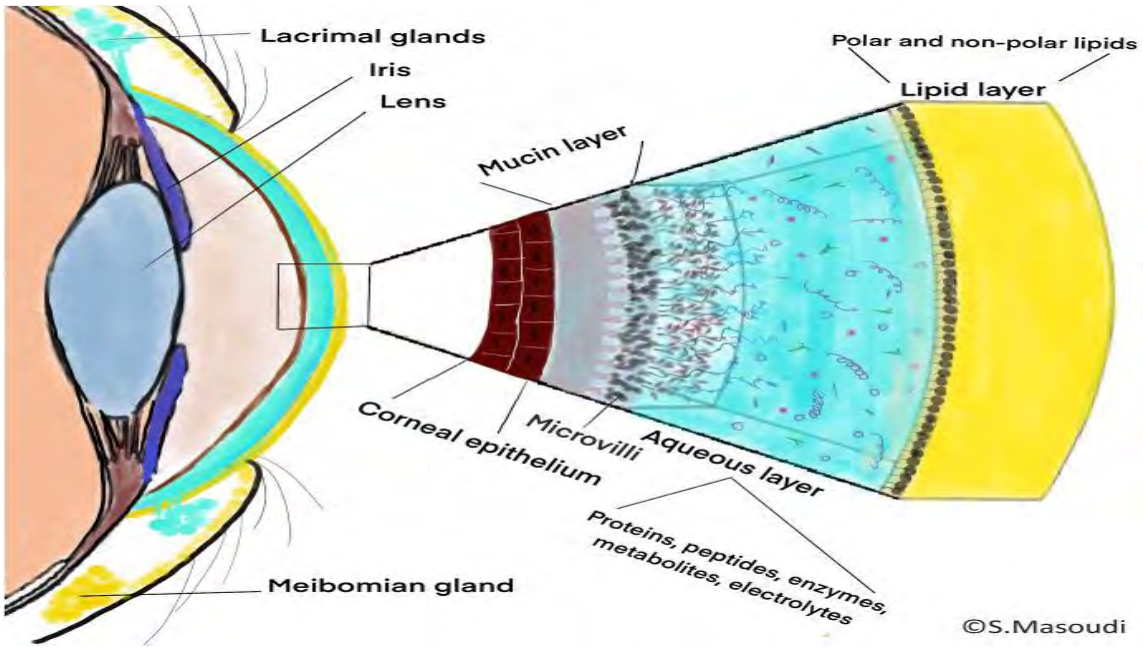


Fig 1: Layers of tear films

(Bowling, E. 2017)

A stable preocular tear film is a hallmark of ocular health, largely because it forms the primary refracting surface for light entering the visual system and it protects and moisturizes the cornea. The three layered model of the tear film proposed by Wolff that has had an overwhelming allure because it is simple and logical: a mucin layer covering the ocular surface and lowering the supposed hydrophobicity of the epithelial cells; an aqueous layer to nurse the exposed ocular epithelium by providing lubricity, some nutrients, antimicrobial proteins and appropriate osmolarity; and a lipid layer to prevent loss of the aqueous layer through overspill and evaporation. (Pflugfelder, S. C., & Stern, M. E. (2020))

1.2 Instability of tear film

Instability of the tear film (TF) protecting the ocular surface results in dry eye syndrome (DES), the most prevalent public health ophthalmic disease affecting the quality of life of 10 to 30% of the human population worldwide. Although the impact of the tear film lipid layer (TFLL) and of the aqueous tears (AT) to the TF stability is extensively studied, in contrast the contribution of the secretory mucins (SM) and of the membrane-associated mucins (MAM), i.e., one of the most abundant molecular classes in AT and in the corneal epithelium respectively, remains poorly defined. However, it is well known that in DES both types of mucins are quantitatively or qualitatively deficient. Theories will be reviewed here in the context of the classical and modern in vitro and in vivo results that allow their reappraisal and in view of the novel mucin secretion enhancing pharmaceuticals, which have opened innovative routes for the therapy of DES. (Georgiev, G. A et al.,2019)

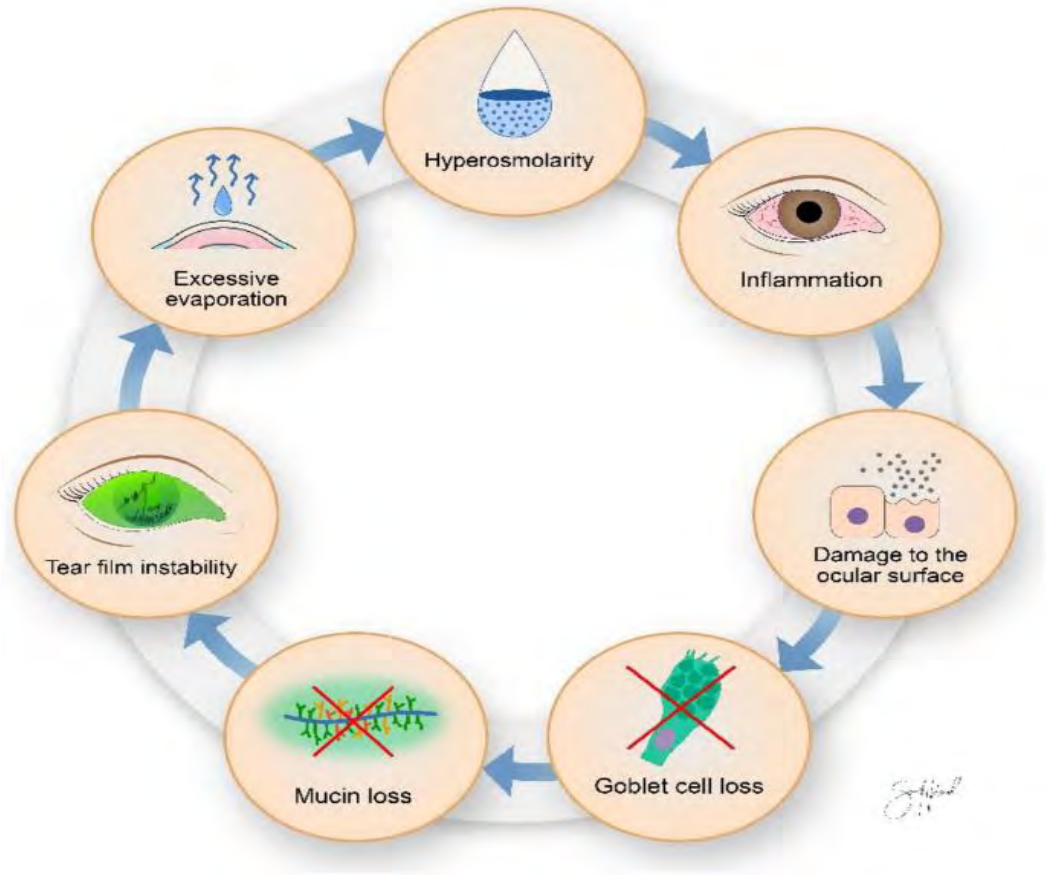


Fig 2: Mechanism of Instability of tear film

1.2 Dry eye classification

There are two main subtypes of dry eye disease – aqueous deficiency and evaporative. These may co-exist. **Aqueous deficiency** occurs because of reduced aqueous production from the lacrimal glands. It accounts for only a tenth of dry eye disease. Aqueous deficiency can be further separated into **Sjögren's syndrome-related and non-Sjögren's syndrome-related**. **Evaporative** dry eye is due to a deficient tear film lipid layer, which increases tear evaporation. It is caused by meibomian gland dysfunction, which occurs in over 85% of dry eye disease. (Schaumberg et al.,2011)

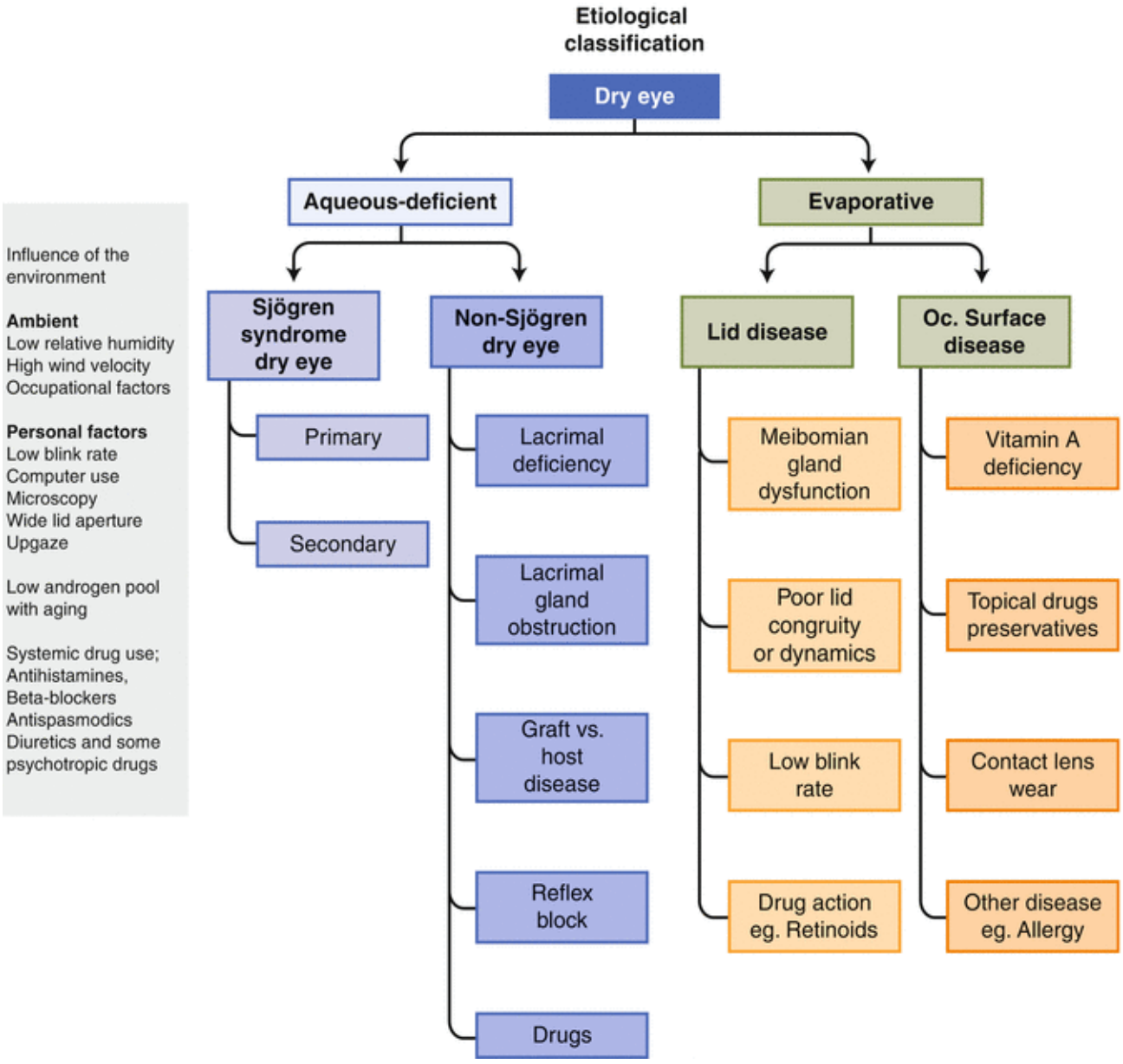


Fig 3: Classification of Dry eye

1.3 Dry eye Severity scheme

The severity grading scheme established four levels of dry eye based on ocular discomfort and visual symptoms and the presence of multiple signs, including conjunctival, corneal, lid/meibomian gland, TFBUT, and Schirmer scores. (Baudouin, C et al.,2014)

Patient-reported symptoms included requirement of tear substitute, ocular discomfort and visual disturbance. Clinical signs included conjunctival injection, conjunctival and corneal staining, corneal/tear signs (i.e., filamentary keratitis), lid/meibomian glands, tear break-up time (TBUT; fluorescein based), and Schirmer score. This system is advantageous in terms of simplicity and practicality, but requires severe symptoms AND severe signs before severe disease is diagnosed. (Sowmya, V et al.,2016)

Dry Eye Severity scale	Level 1	Level 2	Level 3	Level 4#
Discomfort, severity and frequency	Mild and/ or episodic; occurs under environmental stress	Moderate eoisodic or chronic, stress or no stress	Severe frequent or constant without stress	Severe and/or disabling and constant
Visual symptoms	None or episodic mild fatigue	Annoying and/ or activity limiting, episodic	Annoying, chronic and/ or constant, limiting activity	Constant and/ or possibly disabling
Conjunctival congestion	None to mild	None to mild	+/-	+/++
Conjunctival staining	None to mild	Variable	Moderate to marked	Marked
Corneal staining(severity/ location)	None to mild	Variable	Marked central	Severe punctate erosions
Corneal/ tear sign	None to mild	Mild debris, reduced meniscus height	Filamentary keratitis, mucus clumping, increased tear debris	Filamentary keratitis, mucus clumping, increased tear debris, ulceration
Lid/ meibomian glands	MGD variably present	MGD variably present	Frequent	Trichiasis, keratinization, symblepharon
TFBUT(Second)	Variable	≤10	≤5	Immediate
Schirmer test(mm/5min)	Variable	≤10	≤5	≤2

Fig 4: Grading scheme of dry eye severity

Various laboratory and clinical studies have been performed the past few decades and they come upon a result that the Dry Eye is an inflammatory chronic disease. It depends on various extrinsic and intrinsic factors and can be initiated by these factors. These factors promote hyperosmolar and unstable tear film. Then, in certain cases, this sort of changes in the composition of tears and the systemic factors combined lead to serious damage such

as an inflammatory cycle starts that causes neural stimulation and epithelial disease. (Pflugfelder, S. C., & de Paiva, C. S. (2017).

Advanced age, female sex and larger latitude were significant risk factors for DED by symptoms and signs, whereas only advanced age was positively associated with an increased prevalence of DED by symptoms. In 2010, the prevalence of DED by symptoms and signs were 13.55% (95% CI = 10.00-18.05) and that of DED by symptoms was 31.40% (95% CI = 23.02-41.13) in Chinese people aged 5-89 years, corresponding to a total of 170.09 million (95% CI = 125.52-226.63) and 394.13 million (95% CI = 288.99-516.30) affected individuals respectively. (Mestl, H. E., & Edwards, R. (2011).

Impact of dry eye on quality of vision

The pre-corneal tear film has an important optical function. Tear film instability and corneal surface irregularities due to epithelial desiccation, resulting in changes in optical quality, can be visualized and quantified using a range of techniques. In the majority of patients with DED, the visual acuity is normal according to standard measurements, however, instability of the tear film introduces higher-order aberrations that result in a decrease in visual quality. Patients with DED often report vision-related difficulties during daily activities, resulting in a decreased QoL and these changes are often related to depression and anxiety.

Impact of dry eye on mental health:

The effects of DED associated with Sjögren syndrome on mental health status have been widely reported, although the impact on DED more broadly has not been evaluated. Patients with Sjögren syndrome experience significant symptoms of fatigue, autonomic dysfunction, and excessive sleepiness in addition to sicca-related symptoms. The overall impact on the functional ability of individuals is considered as significant negative impact on psychological well-being. (Song, P et al.,2018)

1.1. Rationale:

Globally prevalence of DED is 5-50%. (TFOS Epidemiology report). It's a rising public health concern triggering ocular discomfort, fatigue and visual disturbance that affects the quality of life (QOL), daily activities and workplace productivity. Shift to digital gadgets in recent decades especially during COVID-19, demographical changes, environmental changes and lifestyle factors indicate that the dry eye syndrome patient population will increase significantly, and there is need of preventive and interventional strategies to meet the burden. There is limited data available on pattern of DED in Pakistan.

This study will help to find out geographical impact on prevalence pattern of DED and way forward for its preventive measures.

This will eventually help to develop interventions for managing dry eye disease in geographically diverse population, which will help to reduce the burden of disease.

1.2. Objectives:

- To access the pattern of dry eye disease among geographically diverse population of Punjab.
- To find out association of dry eye disease between sociodemographic factors.

CHAPTER II: LITERATURE REVIEW

Dry Eye Disease (DED) is defined as a multifactorial disease of the ocular surface accompanied by the loss of homeostasis, ocular surface inflammation and damage, and neurosensory abnormalities (Craig et al. 2017) . It is a major cause of ocular morbidity which usually does not directly affect vision in most cases, but does affect the quality of life markedly.

Pathophysiology

DED is divided into two main types: aqueous deficient and evaporative dry eye, the former associated with aqueous deficiency and the latter with a deficient lipid layer and meibomian gland dysfunction (Craig et al. 2017). Clinically, DED is characterised by the loss of tear volume, more rapid breakup of the tear film and increased evaporation of tears from the ocular surface (Willcox et al. 2017). A stable tear film has been viewed as a protective and lubricating fluid for the ocular surface (Korb et al. 1998). Changes to the tear film can lead to visual degradation and symptoms of fluctuating vision, loss of contrast and discomfort (Lee and Mannis 2013). DED may lead to chronic sequelae such as corneal inflammation (Rolando and Zierhut 2001). The aetiology of DED is multifactorial and includes inflammatory processes and neural feedback mechanisms (Stapleton et al. 2017). The pathogenesis of DED is complex and is not fully understood (Craig et al. 2013) and how the components of the tear film such as lipids and protein interact at the molecular level is an area of further research (Willcox et al. 2017).

Epidemiological measures of Dry Eye Disease:

Epidemiological studies describe the distribution of disease, identify factors that influence the distribution, and measure the impact and morbidity of disease in defined populations.

To evaluate the prevalence of dry eye disease globally and in sub-groups defined by: diagnostic criterion, sex, geographic location and age Bayesian approach is used to get the results. Modelling prevalence as a Beta distribution, estimates were inferred from Bayesian posterior distributions obtained by combing an uninformed prior with likelihood functions generated from all relevant studies reporting dry eye prevalence between 1997 and 2021.

Global prevalence of dry eye disease was estimated at 11.59% (standard deviation (SD) = 0.04). For symptomatic disease, the estimate was 9.12% (SD = 0.04), with women 9.5% (SD = 0.05) and men 6.8% (SD = 0.06); prevalence was lowest in North America, 4.6% (SD = 0.03) and highest in Africa, 47.9% (SD = 1.8). For signs, prevalence was 35.2% (SD = 0.3), with woman 34.7% (SD = 0.7) and men 37.6% (SD = 0.7); North America showed the lowest regional prevalence, 3.5%, (SD = 0.4) with Eastern Asia the highest, 42.8% (SD = 0.4). Using TFOS DEWS II diagnostic criteria resulted in a global prevalence of 29.5% (SD = 0.8), with women 28.1% (SD = 1.2) and men 24.9% (SD = 1.4). Prevalence was lowest during the fifth decade, increasing approximately linearly with age thereafter. A simple, flexible, yet powerful means of combining data from multiple sources to yield prevalence estimates across a range of circumstances is described, that is compatible with published guidelines for conducting meta-analysis. Estimates can be readily updated as new information emerges, or according to need. Understanding the specific characteristics of studies chosen for inclusion is critical to the validity of the outcome. Although dry eye disease is evidently common, affecting about one in 11 people world-wide, data are sparse for the young and all geographical locations except Eastern Asia. (Papas,. E. B. (2021).

A comprehensive and systematic search was performed using several databases, including PubMed, Cochrane Library, and Web of Science, in January 2021 to study the epidemiology of DED in Asia. A random-effects meta-analysis was performed on logit-transformed prevalence and incidence rates to calculate pooled prevalence and incidence estimates. Meta-regression and subgroup analyses were performed to explain the heterogeneity. Among the 6,742 articles identified, 23 were included in the analysis, with a total sample size of 1,488,935 subjects. Twenty studies reported the prevalence of DED in Asia, two studies reported the incidence, and one study reported both prevalence and incidence. The estimated pooled prevalence of DED in any population in Asia was 20.1% (95% confidence interval: 13.9–28.3%), and the incidence 16.7% (95% CI: 0–34.9%). [Ozdemir et al., Acta Ophthalmol. 2019;97(1): e91–6]

The prevalence rate of DED in males and females was 16.4% (95% CI: 10.0–25.8%) and 21.7% (95% CI: 14.7–30.8%; $p < 0.001$), respectively. In general, the prevalence increased

with age. The risk factors considered for specific populations were not significant, and the prevalence in the general population, excluding the populations considered at risk, was similar at 20.9% (95% CI: 12.8–32.1%). DED is common in Asian populations and causes a significant disease burden. Its prevalence is higher in females than that in males, and it tends to increase in severity with age. Further research on additional risk factors is needed to adequately explain the epidemiology of DED in Asia. (Cai, Y., Wei, J., Zhou, J., & Zou, W. (2022)).

The report of the Tear Film and Ocular Surface Society (TFOS) Dry Eye Workshop (DEWS) Epidemiology subcommittee summarized the available evidence on dry eye prevalence, incidence, risk factors, and impact; and reviewed instruments for the diagnosis and assessment of dry eye disease (DED) in clinical trials. The initial TFOS DEWS Epidemiology subcommittee report reviewed the major international epidemiological studies and concluded that the prevalence of DED ranged from 5 to 30% in individuals over the age of 50. Four hundred and thirty-seven studies were identified (updated 17 Sep 2015). Estimates of the prevalence of DED from 24 large international cohort studies.The subcommittee reviewed the prevalence, incidence, risk factors, natural history, morbidity and questionnaires reported in epidemiological studies of dry eye disease (DED). A meta-analysis of published prevalence data estimated the impact of age and sex. Global mapping of prevalence was undertaken. The prevalence of DED ranged from 5 to 50%. The prevalence of signs was higher and more variable than symptoms. There were limited prevalence studies in youth and in populations south of the equator. The meta-analysis confirmed that prevalence increases with age, however signs showed a greater increase per decade than symptoms. Women have a higher prevalence of DED than men, although differences become significant only with age. Risk factors were categorized as modifiable/non-modifiable, and as consistent, probable or inconclusive. Asian ethnicity was a mostly consistent risk factor. The economic burden and impact of DED on vision, quality of life, work productivity, psychological and physical impact of pain, are considerable, particularly costs due to reduced work productivity. Questionnaires used to evaluate DED vary in their utility. Future research should establish the prevalence of disease of varying severity, the incidence in different populations and potential risk factors such as youth and digital device usage. Geospatial mapping might elucidate the impact of

climate, environment and socioeconomic factors. Given the limited study of the natural history of treated and untreated DED, this remains an important area for future research. The TFOS DEWS II epidemiological report concluded that DED is more common in Asians compared to Caucasians. (StapletonL,. (2017))

A cross-sectional descriptive study was conducted among 327 undergraduate students of the IT department in the district of Dera Ghazi khan over five months from September 2021 to January 2022. DED was assessed subjectively with Ocular Surface Disease Index (OSDI). Data were analyzed using SPSS version 21. The quantitative analysis was presented as mean and standard deviation, and qualitative variables were introduced in frequency and percentages. The chi-square test (Fisher's exact test) was used to study the significance of associations between dependent and independent variables. The mean age of the participants was 20.25 ± 1.305 years (range, 17–25). The prevalence of DED among computer programmers was 47.7%. This study showed that gender ($p = 0.31$), contact lens usage ($p = 0.64$), and duration of time spent on computer display units ($p = 0.47$) were not significant determinants of DED among computer programmers. DED is prevalent among IT students, along with different symptoms. However, further studies are required to adequately measure the prevalence of DED during longer exposure time to computer screens and explore environmental risk factors. (Sarwat, S.,. (2023).

Nauman Hashmani conducted a survey on 2433 individuals with a mean age of 30.7±15.6 years to determine the distribution of Ocular Surface Disease Index (OSDI) scores in non-clinical individuals in Karachi. There is increasing recognition of dry eye disease (DED) as a significant factor influencing quality of life in seemingly normal individuals., Pakistan.OSDI questionnaires was distributed to subjects aged > 18 years with no active ocular complaint. Examiners were selected from various areas of the city to administer questionnaires to students and the general population. The OSDI score was grouped as per the following: normal (0-12 points), mild (13-22 points), moderate (23-32 points), and severe (33-100 points). The mean OSDI score was 22.4±18.7. To estimate prevalence, two OSDI score cutoffs: >13 (64.4%) and >22 points (43.6%) was used . Statistical significance was found using multivariate regression in the following variables: age ($p<0.001$), contact lens wear ($p<0.001$), ocular allergies ($p<0.001$), hypertension ($p<0.001$), diabetes

(p=0.003), and smoking (p=0.047). When graphing mean age against OSDI score, there was a large jump between the third and fourth decades; thereafter, there was a steady increase. Similarly, when plotting smoking, the score was steady until five years and then there was a sharp incline. There was a high prevalence of DED in the studied population. Additionally, many systemic and ocular factors were associated with this disease. (Hashmani, N.,. (2020)

Naveed Mansoori carried out a cross-sectional study to assess the frequency of presence of dry eyes and its associated risk factors among employees working in call centres and software houses in Karachi at Hamdard College of Medicine and Dentistry, Karachi. By convenient sampling technique, data was collected from employees aged 20 to 40 years of call centres and software houses. Demographic information was recorded on pre-designed questionnaire and Schirmer's test strips were used to measure production of tears. Descriptive analysis was done for categorical variables using SPSS version 20. Cross-tabulation of different variables was done with dryness of eyes experienced. The frequency of various eye complaints was determined and Chi square test was used to observe the association with Schirmer's test. P- value<0.05 was considered as significant. Out of 150 employees 42 (28%) were found to have dry eyes. Mean age was 27 ± 3.5 years. The majority of employees 117 (78%) were males and 77 (51.3%) were using corrective spectacles for refractive errors.

The most common eye complaints among the computer users were burning of eyes (44%), redness of eye (41.3%), dryness of nose (36%), dryness of mouth (34.7%), discharge from eye (10.7%) and foreign body sensation (10%). Statistically significant (p<0.05) relationship has been observed between presence of eye burning and positive Schirmer's test. This study indicated that 28% of the individuals had dry eye, along with other symptoms of eyes among computer users in call centres and software houses. (Mansoori, S. M. 2017)

Abdullah Ayub Faryal and Muhammad Akhtar carried out a Cross-sectional study at Department of Ophthalmology, Jinnah Hospital, to determine prevalence and risk factors of dry eye in hospital based Pakistani population in 2016. There were 300 participants

enrolled in the study with mean age 46.8 ± 8.3 years. 54.3% were female patients in the study. The prevalence of dry eye was found to be 18.7%. Patients aged more than 70 years showed significantly higher prevalence of dry eyes (p = 0.006). 18.9% hypermetropes, 16.2% myopes and 15.2% emmetropes suffered from dry eyes. Multivariate regression analysis showed that outdoor workers, people working in air conditioners, housewives, diabetics, smokers, people exposed to excessive sunlight, wind, temperature, and patients suffering from meibomian gland dysfunction were at higher risk of developing dry eye. Dry eye is associated with increasing age, female gender, outdoor occupations, smoking, diabetes, meibomian gland dysfunction and refractive errors. (Ayub, , N. H. (2017)).

Dry Eye Association with Geographical diversity:

To find out whether or not the phenomenon of geographically area in dry eye disease does indeed exist, in 2013, an international survey was developed by the authors and conducted in five European countries. We herewith report on the study with focus on the seasonality aspect of this survey and aimed at investigating whether seasonality could influence dry eye symptomatology and whether there was a relationship between the seasonal and environmental factors and the subjective sensations of OSD and dry eye. Overall, 47% of respondents stated that seasonal conditions had a high impact on their DED symptoms, with only 15% reporting that there was no seasonal impact on their symptoms. Wind was the most commonly reported weather condition to impact dry eye symptoms (for 71% of patients), followed by sunshine (60%) and heat (42%). Cold weather was also reported to aggravate dry eye sensation by 34% of patients. The two seasons most commonly associated with dry eye complaints were summer and winter (for 51% and 43% of patients, respectively). Only 8% stated that no weather conditions affected their symptoms.

This study confirms the seasonal enhancement of dry eye sensations and symptoms. Environmental characteristics such as cold and heat as well as wind were the most commonly cited triggering factors. Geographical differences do exist between the countries surveyed and the seasonal peak of complaints appears related to temperature and humidity. The main seasons of dry eye complaints in Europe were winter and summer. Such seasonal

characteristics in ocular surface disease should be kept in mind when considering diagnosis and treatment as well when investigating the ocular surface.(van Setten, , M. (2016)

Study was conducted to find Variations of dry eye disease prevalence by age, sex and geographic characteristics in China: a systematic review and meta-analysis in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines. Advanced age, female sex and larger latitude were significant risk factors for DED by symptoms and signs, whereas only advanced age was positively associated with an increased prevalence of DED by symptoms. In 2010, the prevalence of DED by symptoms and signs were 13.55% (95% CI = 10.00-18.05) and that of DED by symptoms was 31.40% (95% CI = 23.02-41.13) in Chinese people aged 5-89 years, corresponding to a total of 170.09 million (95% CI = 125.52-226.63) and 394.13 million (95% CI = 288.99-516.30) affected individuals respectively. The huge burden of DED in China calls for more public health attention and actions. Improved epidemiological studies on DED prevalence are still urgently needed. (Song, P., Xia, W., Wang,2018).

To estimate the prevalence and determine risk factors for dry eye disease (DED) in geographically diverse regions of India. A population based cross-sectional study was conducted on people aged ≥40 years in plain, hilly and coastal areas. Dry eye assessment by objective [tear film break-up time (TBUT), Schirmer I, corneal staining] and subjective [Ocular Surface Disease Index (OSDI)] parameters was performed with questionnaire-based assessment of exposure to sunlight, cigarette smoke, indoor smoke. The prevalence of DED with age, sex, occupation, location, smoking, exposure to sunlight, indoor smoke, diabetes, hypertension, was subjected to logistic regression analysis.

9,735 people (age 54.5 ± 0.1 years; range 40–99, males 45.5%) were included. The prevalence of DED was 26.2%, was higher in plains (41.3%) compared to hilly (24.0%) and coastal area (9.9%) ($p < 0.001$) and increased with age ($p < 0.001$), female gender ($p < 0.001$), smoking ($p < 0.001$), indoor smoke ($p < 0.001$), diabetes (p-0.02), hypertension (0.001), occupations with predominant outdoor activity (p-0.013) and increasing exposure to sunlight (trend). Multi-logistic regression showed a positive association with female sex (OR-1.2, CI-1.01, 1.4), exposure to indoor smoke (OR-1.3, CI-

1.1, 1.5), smoking (OR-1.2; CI-1.03, 1.3), prolonged exposure to sunlight (OR-1.8, CI-1.5, 2.2), hypertension (OR 1.3, CI-1.2, 1.4), diabetes (OR-1.2, CI-1, 1.5) and negative association with region - hilly (OR-0.5, CI-0.4, 0.6) and coastal (OR-0.2; CI-0.1, 0.2), and BMI (OR-0.8, CI-0.7, 0.9).DED is common in population ≥40 years of age. Its prevalence is affected by extrinsic (geographic location, exposure to sunlight, smoking, indoor smoke) and intrinsic (age, sex, hypertension, diabetes, BMI) factors.

While there are numerous studies from China, Japan , Korea and Singapore , there are no similar reports from Pakistan, world's fifth most populated country. Additionally, it is hypothesized that geographic location and climate can influence the occurrence of DED; however, this has not been validated by evaluating diverse environmental conditions in a single study. With the geographic and climatic variation in Pakistan, we had an opportunity to explore the effect of the same in the prevalence of DED by conducting a multi-centric study with geographic mapping approach including populations from, hilly and plain areas accounting for the effect of variations in humidity and air quality index on DED. Sunlight exposure and smoke are additional risk factors for DED for which, at present, reports are inconclusive. In the current study, geographical diversity and DED effect was assessed in addition to age, sex, education

Conceptual Framework

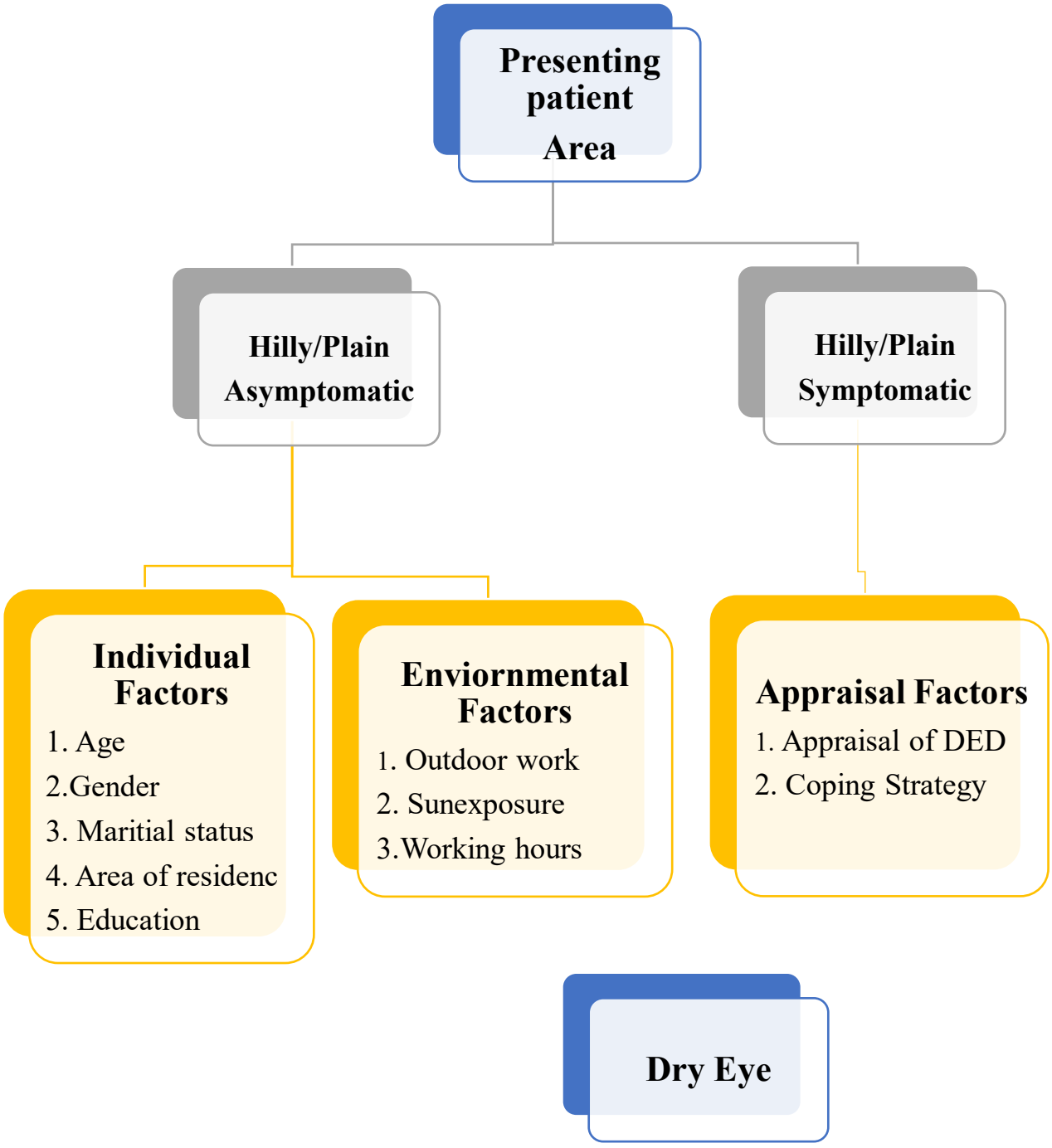


Fig 5: Conceptual Framework for Dry Eye Disease

1) OPERATIONAL DEFINITIONS:

Dry Eye Disease (Keratoconjunctivitis Sicca):

Dry eye disease (DED) is a multifactorial ocular surface disease characterized by symptoms of discomfort, irritation, and visual disturbance. DED imposes significant burdens on individuals, including impairment in social functioning, occupational functioning, and reduced quality of life. In current study pattern of DED will be assessed using Ocular Surface Disease Index (OSDI) questionnaire a validated tool. (Allergan Inc (Irvine, Calif).

Geographical diversity:

Geographical diversity is the set of physical, human and cultural elements, differentiated from each other, that converge in the same relatively small geographic space that is part of the same zone, region or country.

The term diversity refers to the difference and variety. The word diversity comes from Latin *various.* Describe the multiplicity or abundance of existing species or things. Diversity is expressed in the various physical characteristics of a region or space, such as climate, vegetation, fauna, bodies of water, existing types of relief and landscape, among others.

Ocular Surface Disease Index (OSDI):

OSDI is 12-item questionnaire assesses dry eye symptoms and the effects it has on vision-related function in the past week of the patient's life. The questionnaire has 3 subscales: ocular symptoms, vision-related function, and environmental triggers.

CHAPTER III: METHODOLOGY

3.1. Study Design:

A quantitative research approach using cross-sectional study design was used for the current study.

3.2. Study Duration:

Study period for the current research was six months from October 2022-March 2023.

3.3. Study Setting:

The study was carried out at Community eye camps in geographically diverse (plain and hilly) areas of Punjab.

3.4. Study Participants:

Patients from Community eye camp with complain of Dry Eye were included on the basis of inclusion and exclusion criteria.

3.4.1. Inclusion Criteria:

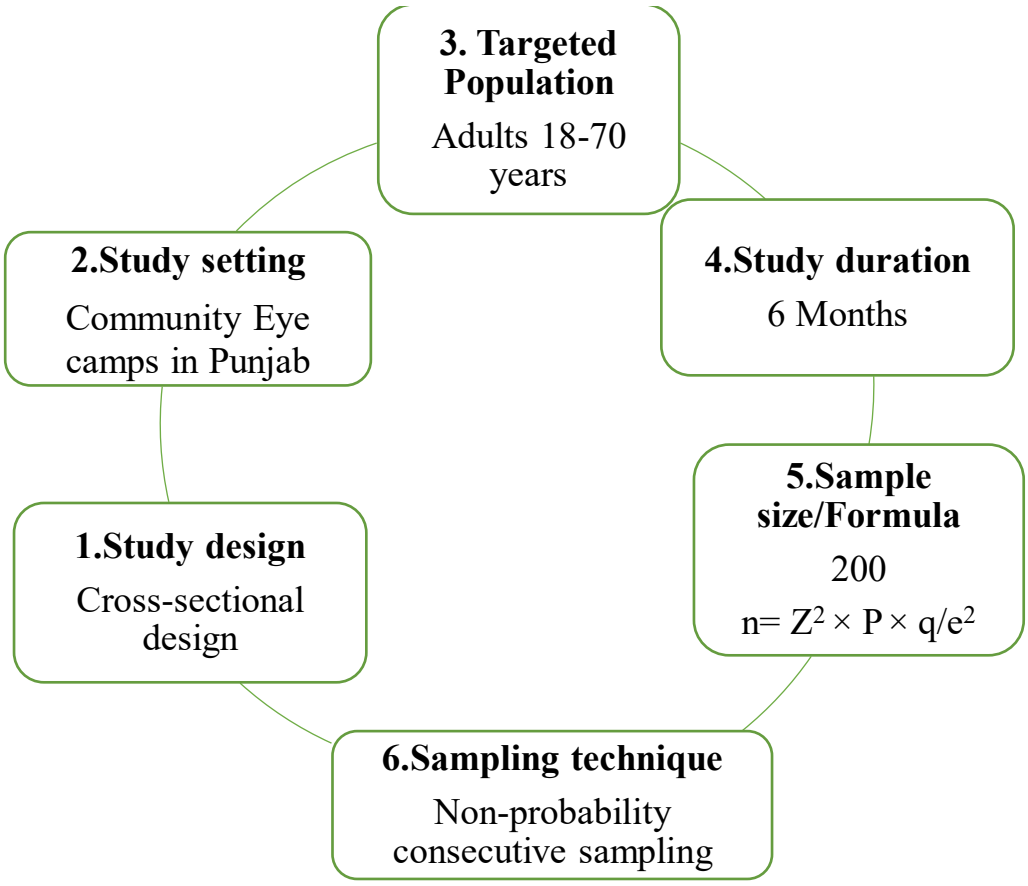
1. Patients with symptoms of dry eye disease.
2. Adult patients of age 18-70 years.
3. Both male and female patients were included.
4. Patients with history of DED

3.4.2. Exclusion Criteria:

1. Patients diagnosed with symptoms similar to those caused by DED
2. Patients diagnosed with Ocular or systemic diseases such as DM, HTN, corneal infections, allergies, pregnant women, Lactating mothers, Sjogrem syndrome, thyroid eye disease etc.
3. Patients with history of refractive surgery or other surgical procedure.
4. Patients who were not willing to participate in the study.

3.5. Sample Size Calculation:

Sample size was calculated using proportion formula for sample size calculation in Open Epi menu, Version 3.01 software. Previous prevalence of dry eye disease in Pakistan was taken as 18.7% as reported by a study conducted at a Department of Ophthalmology, Jinnah Hospital, Lahore, Pakistan in 2017 (Pak J Ophthalmol 2017, Vol. 33, No. 4). Calculated sample size was 200 with 95% confidence interval (C.I) and 5% margin of error. After adding 5% non-response rate, final sample size came out to be 200 Dysfunctional tear syndrome patients. 200 patients from Plain and 200 from hilly area.



3.6. Sampling Strategy:

Desired sample was collected using non-probability consecutive sampling strategy.

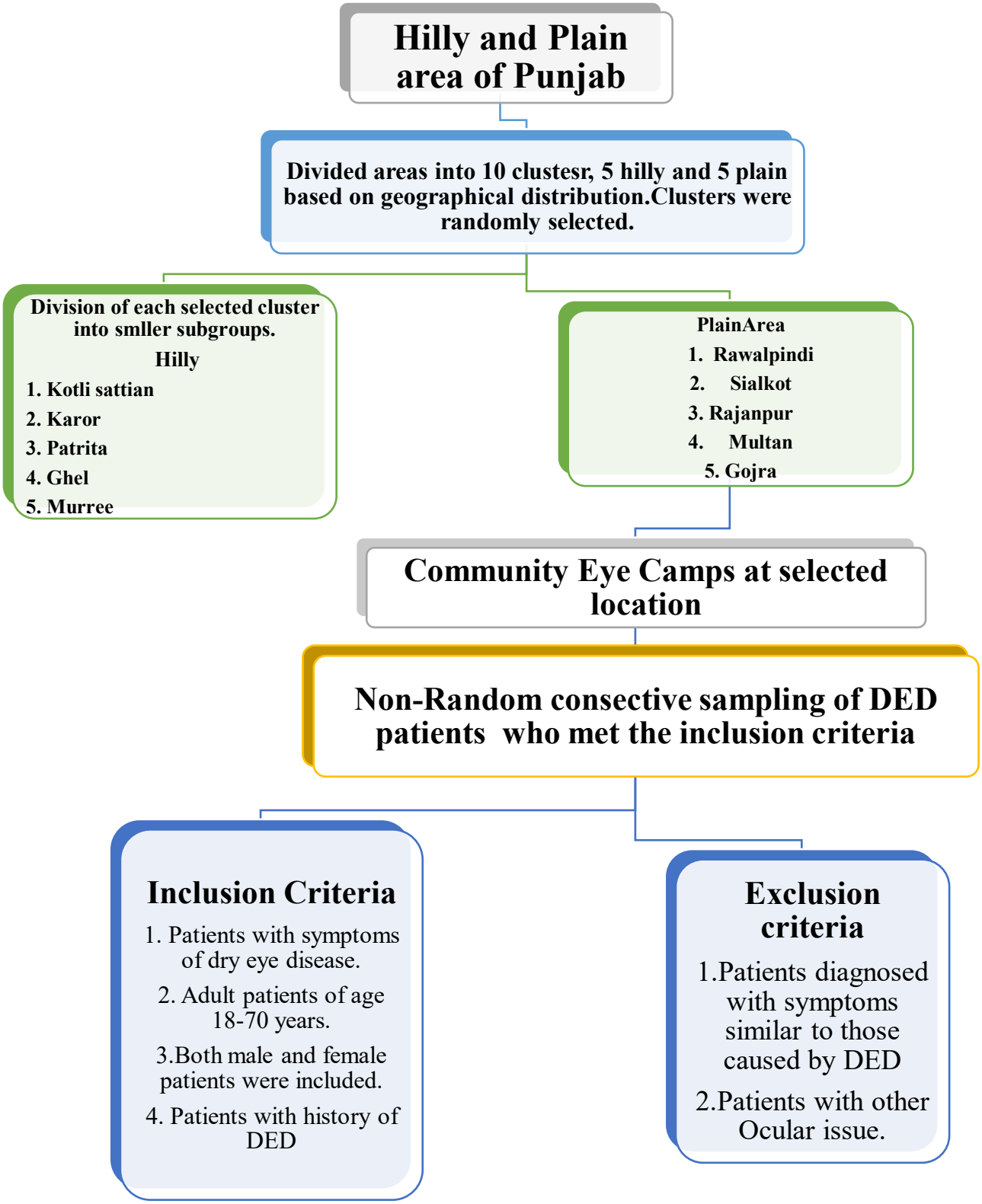


Fig 6: Non-Probability Consecutive Sampling Strategy

3.7. Data Collection Instrument:

3.7.1. Questionnaire Design:

Data was collected using an interview-based questionnaire. A Performa was developed to collect data regarding sociodemographic characters of the respondents, main symptoms of dry eye disease, gender, age and area of residence. OSDI score Questionnaire was used for measuring Dry Eye. Questionnaire is attached in Annexure-I.

3.7.2. Content of the Questionnaire:

The questionnaire contained two major sections:

1. **First part** included questions related to sociodemographic characteristics of the respondents such as age, gender etc.
2. **Second part** Ocular Surface Disease Index (OSDI)

   This 12-item questionnaire assesses dry eye symptoms and the effects it has on vision-related function in the past week of the patient's life. The questionnaire has 3 subscales: ocular symptoms, vision-related function, and environmental triggers.

   The OSDI overall and subscale scores range from **0 to 100**. Based on their OSDI scores, patients can be categorized as having a normal ocular surface **(0-12 points)** or as having mild **(13-22 points),** moderate **(23-32 points),** or severe **(33-100 points)** ocular surface disease.

Data collection tool:

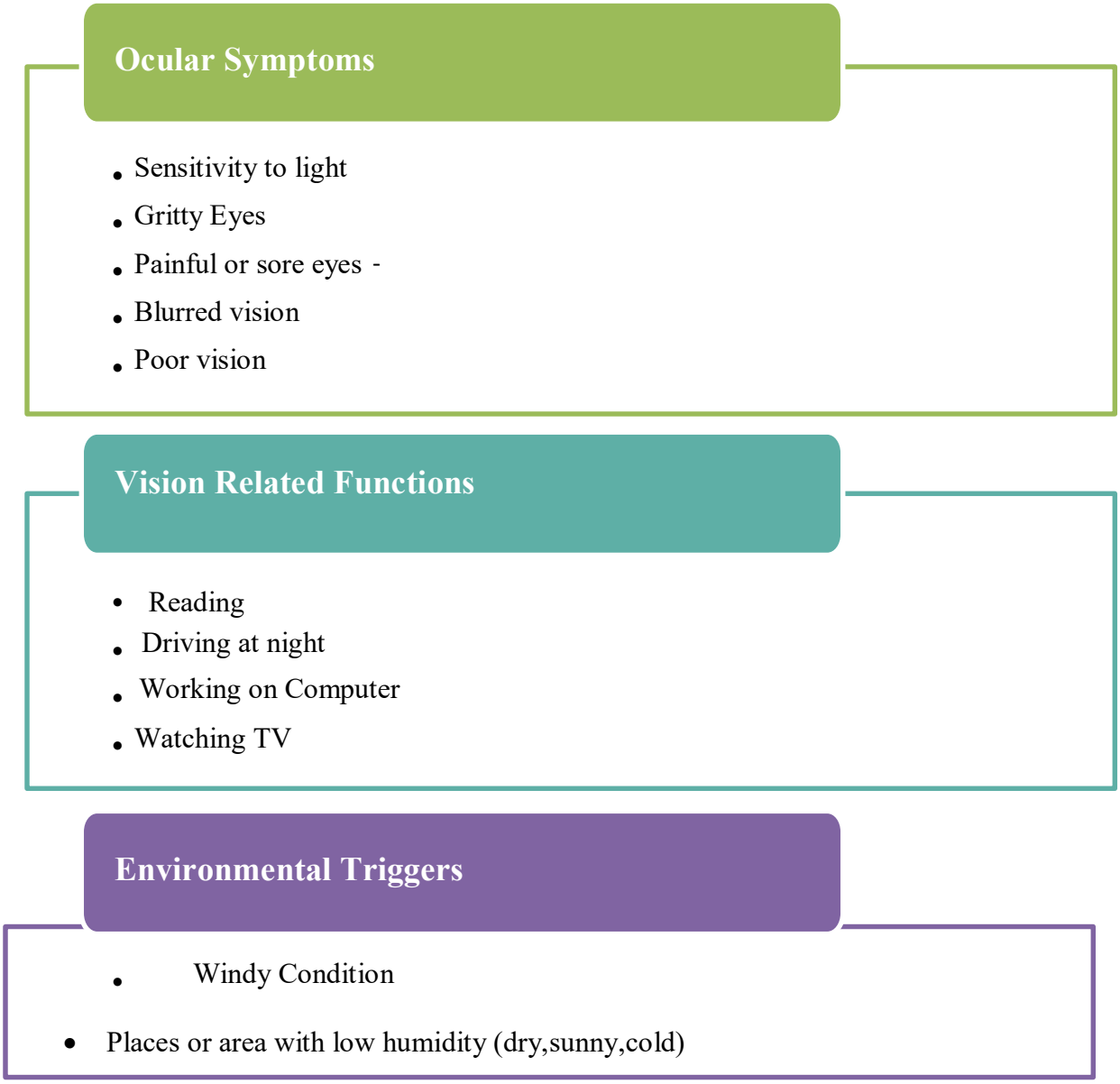


Fig 7: Data collection tool

Study Variables:

3.7.3.1. Outcome Variable:

The major construct of the questionnaire was to assess dry eye. The outcome variable was dry eye which was measured by using OSDI score. OSDI score tool is validated order to quickly assess the symptoms of ocular irritation in dry eye disease and how they affect functioning related to vision. Data was collected through a structured Performa that is constructed internationally to assess dry eye. Patients rate their responses on a 0 to 4 scale with 0 corresponding to "none of the time" and 4 corresponding to "all of the time." A final score is calculated which ranges from 0 to 100 with scores 0 to 12 representing normal, 13 to 22 representing mild dry eye disease, 23 to 32 representing moderate dry eye disease, and greater than 33 representing severe dry eye disease.

The OSDI limits itself by assessing a small number of dry eye symptoms including sensitivity to light, grittiness, and pain. The questionnaire does not assess other symptoms such as tearing and foreign body sensation.

3.7.3.2. Independent Variable:

Data on independent variables was collected through a structured Performa that is constructed after literature review. The Performa included sociodemographic variables such as gender, age, education level, marital status, place of residence etc.

3.8. Data Collection Process:

3.8.1. Pilot Testing:

Pilot testing was performed before starting the formal data collection procedure by including 10% of the actual sample size. Performa was tested for any future changes; no major changes were done after pilot testing. One question was added in demographic section which was area of residence to elucidate the geographical diversity. Data from pilot testing was not included in final analysis.

3.8.2. Data Collection:

All the patients with complain of dry eye or presenting with symptoms of dry were approached. Consent was taken orally from all patients and only those patients were selected who agreed to take part in the research process and fulfill the inclusion criteria. After taking the consent, the patients were interviewed and their responses were recorded by the researcher.

3.9. Data Analysis Procedure:

Code book was developed and data was entered in Statistical Package for Social Sciences (SPSS) version 26. After careful data entry, data was checked for any error before proceeding to the further analysis. After data cleaning, data transformation was carried out for certain variables. Data analysis was done in two phases; descriptive analysis and inferential analysis.

3.9.1 Data Transformation:

Recoding was done for the respective scale items before proceeding to the further analysis. Computed response for OSDI score was calculated for each patient by adding the individual responses in SPSS. Computed scores for all dimension were also calculated. Continuous variables were categorized in order to proceed the analysis. OSDI Scores was transformed into a categorical variable upon entering in SPSS. Dry eye disease was divided into categories; Normal ocular surface (0-12), Mild ocular surface (13-22), Moderate ocular surface (23-32) and Severe (33-100). Total score for each dry eye type was calculated and categorization was done as per the instructions of the original scales.

3.9.2. Descriptive Analysis:

Descriptive statistics were generated for sociodemographic characteristics and outcome variable. Data was summarized in the form of frequencies and percentages and presented in table form, Bar chart and Pie chart.

Inferential Analysis:

Pearson Chi Square test of Independence was used to determine the association between dry eye and socio-demographic characteristics of the respondents. P value less than 0.05 was considered statistically significant.

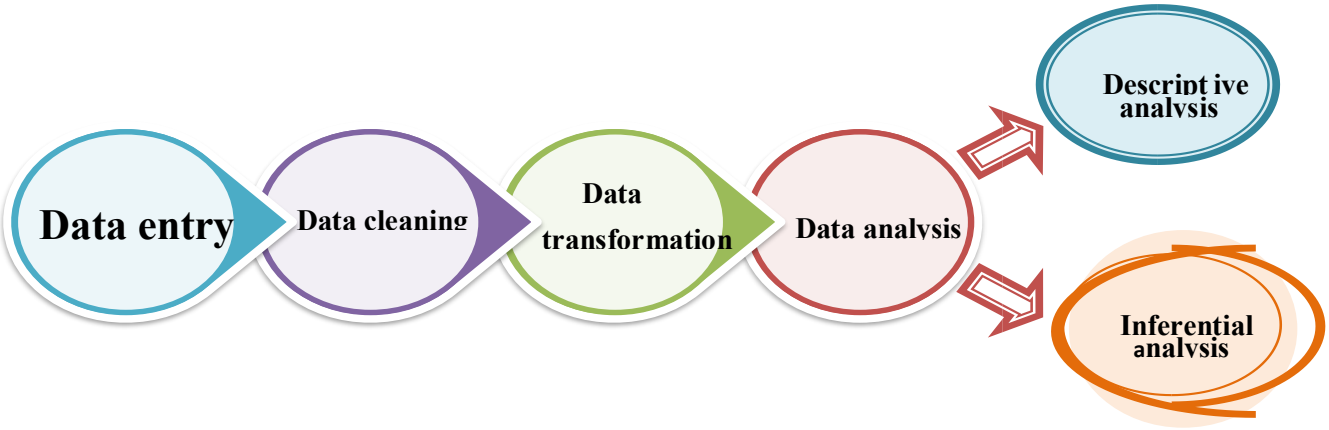


Fig 8: Data Analysis plan

3.10. Ethical Considerations:

Before starting formal data collection, approval from Institutional Review Board (IRB) of Al-Shifa School of Public Health Rawalpindi, Pakistan has been taken (Annexure-4). Permission letter from the Head of Department of Al-Shifa School of Public Health was obtained regarding access to AL-Shifa Trust Eye Hospital. Permission was taken from the head of department of Al-Shifa center for community Ophthalmology (ACCO) . Patients were explained the purpose of the research and oral consent was taken from each participant (Annexure-3). Participants were assured for the confidentiality of their data. Data collected from the respondents was kept anonymous and was not shared with anyone. Data was entered in SPSS anonymously. After data entry, hard copies of collected were kept at a safe place.

CHAPTER IV: RESULTS

For the current study, data of 400 Dry Eye patients, who were visiting community eye camp for examination was collected. A summary of descriptive and inferential analysis is given below.

4.1. Demographic Characteristics:

A total of 400 respondents were included in this study on basis of geographical diversity 200 from plain and 200 from hilly area. Majority of the respondents were females in plain geographical area (n=124, 62%) and in hilly area (n=88, 44%). Majority of the respondents were married (n=232,58%) with no previous history of ocular surgery and were 18-28 years of age (n=165,41.3%).

Table 1: Descriptive summary of Sociodemographic variables

S. No	Variable	Frequency (N)	Percentage (%)
1.	**Age**		
	18-28 years	165	41.25%
	29-38years	92	23.0%
	39-49 years	81	20.25%
	More than 50 years	62	15.5%
2.	**Gender**		
	Male	188	47%
	Female	212	53%
	Plain Area		
	Male	76	38%
	Female	124	62%

	Hilly Area		
	Male	112	56%
	Female	88	44%
3.	**Marital status**		
	Unmarried	168	42%
	Married	232	58%
	Widow/Widower	0	0%
4.	**Educational status**		
	Illiterate	80	20%
	Primary	68	17%
	Middle	52	13%
	Intermediate	150	37.5%
	Other	50	12.5%
5.	**Area of residence**		
	Plain	200	50%
	Hilly	200	50%

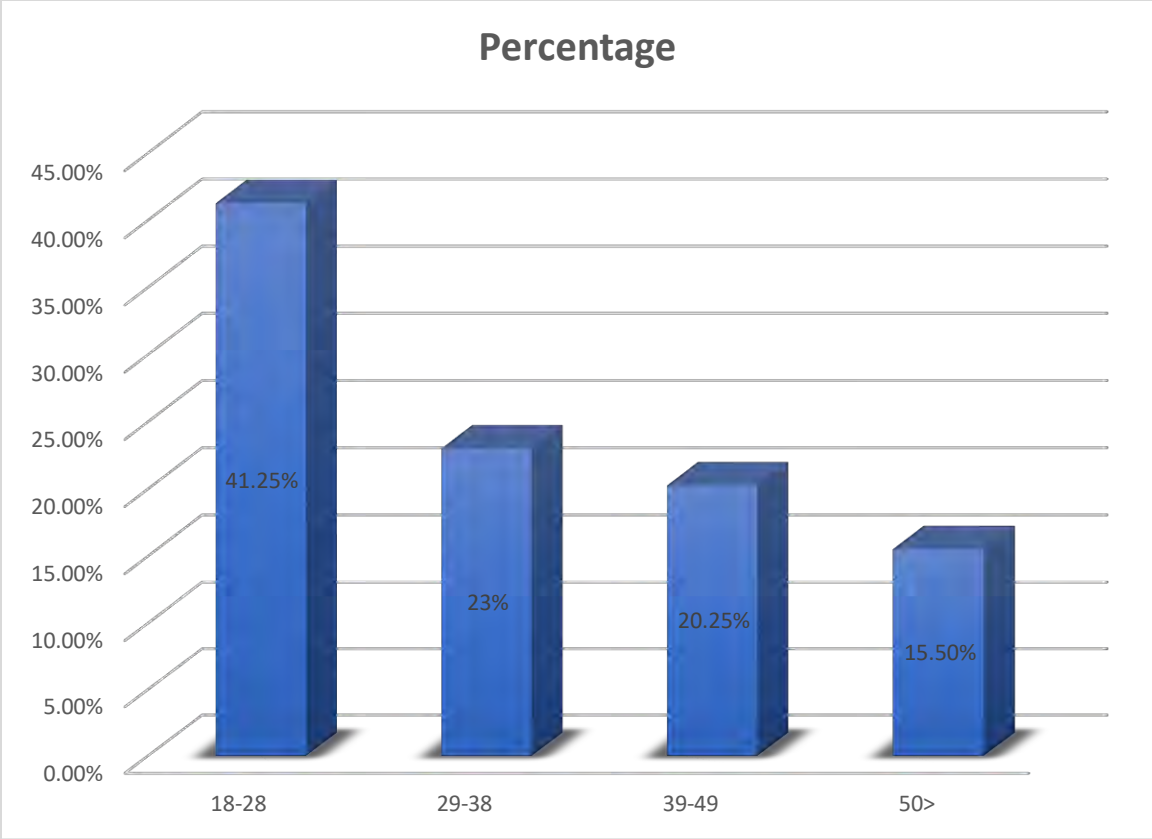


Fig 9: Percentages of age group

Current findings showed that most of the respondents presented with DED in hilly area were between age group 39-49 (n= 59, 29.50%) mostly adults whereas between 18-29 17% respondents (n=34), 29-38(n=53,26%) and 50> (n=54,27%). And in plain 18-28 (n= 131,65%) mostly young values for other age groups are 29-38 (n=39,19.5%) ,39-49(n=22,11% and 50> (n=8,4%). The age of dry eye patient is significantly different among geographically diverse area as shown in fig

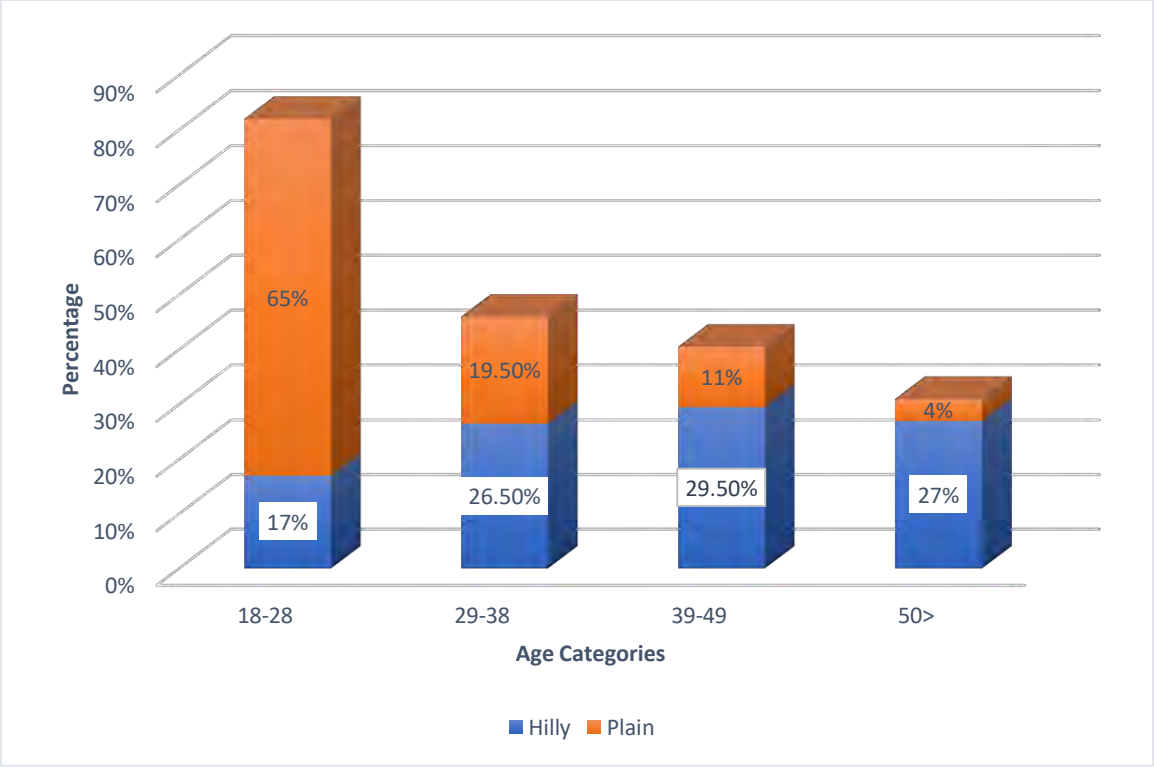


Fig 10: Percentages of age group geographically (Plain and Hilly areas)

In plain area majority of respondents suffering from dry eye disease were 18-28 years of age, whereas in hilly area age group39-49 years were greatly affected with the disease.

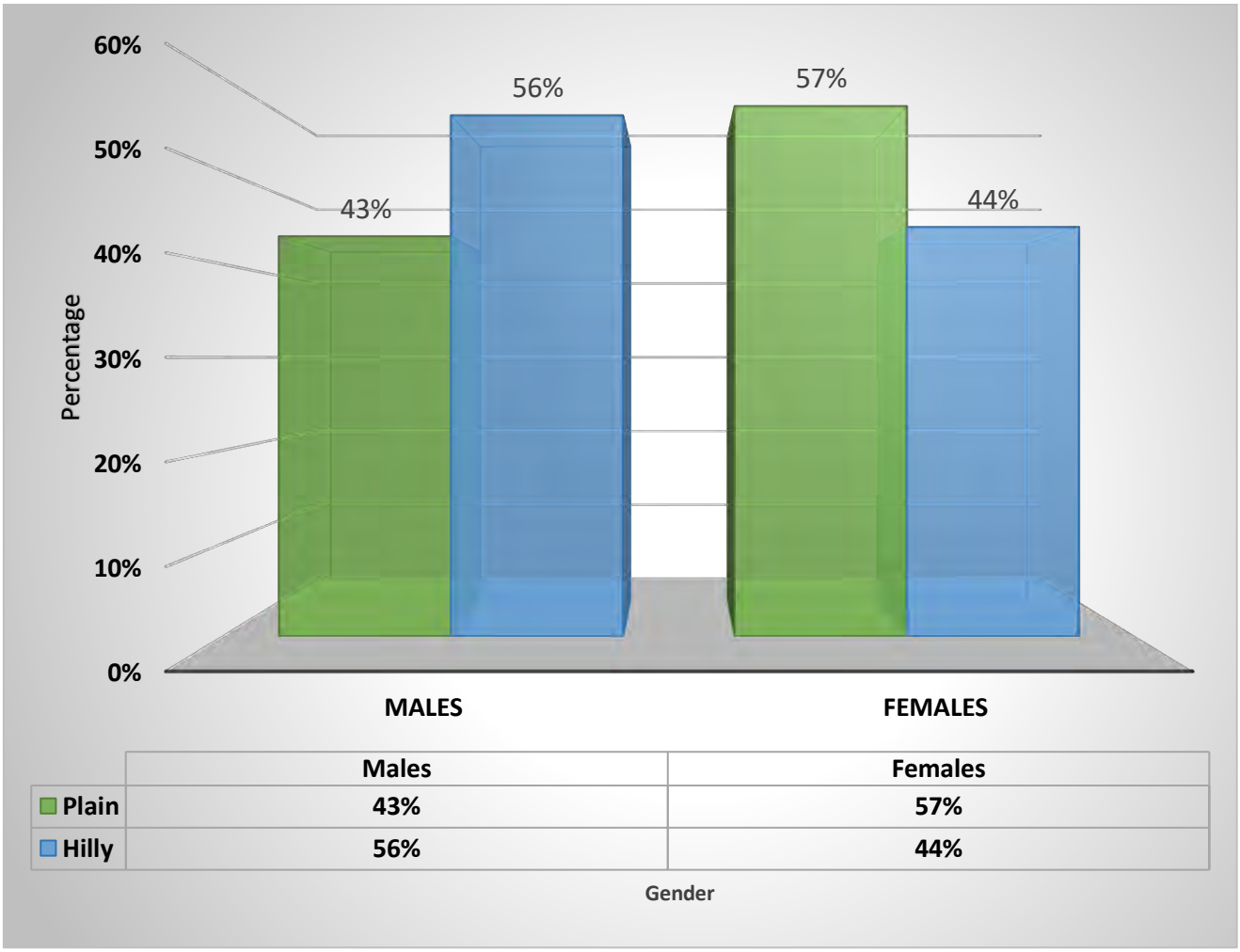


Figure 11: Gender distribution of dry eye disease among plain and hilly areas

Out of 200 respondents from plain area, majority were females 57%, males 43%, whereas in hilly area out of 200 respondents,56% were males, females were 44%.

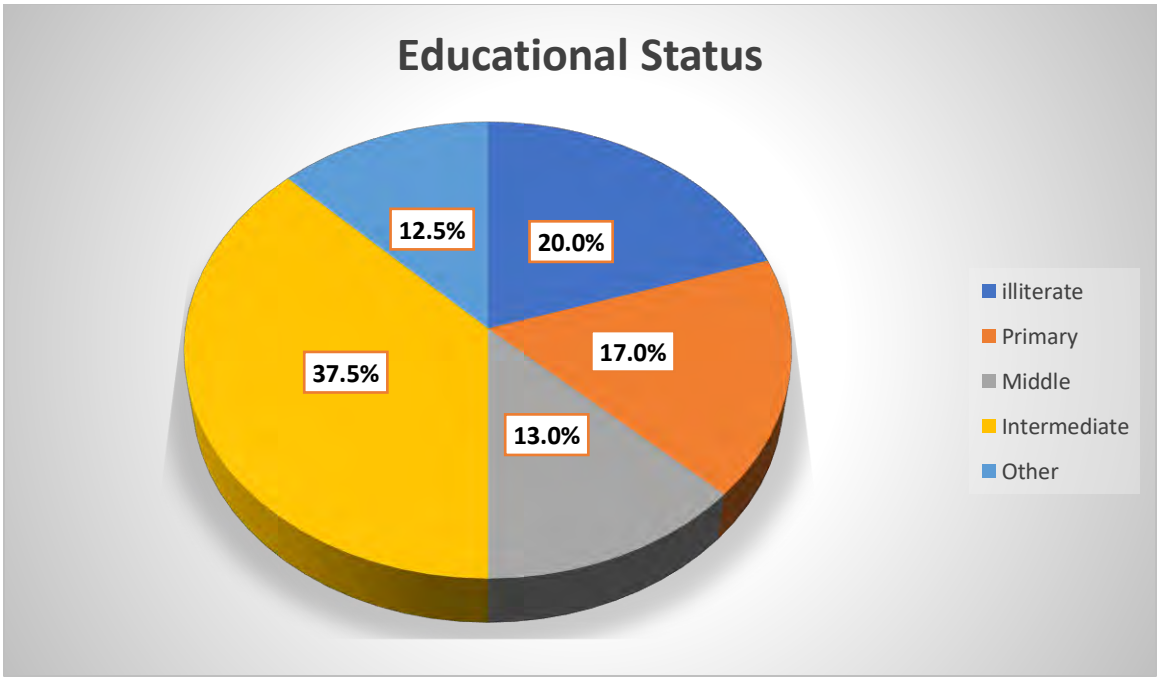


Figure 12: Percentage of Education status

Findings of the study indicates that majority of the patients under study with DED were illiterate in hilly area (n=64,32 %), whereas in plain area education level of most of the patients were intermediate (n=96,46%).

4.2. Descriptive Results for Dry Eye symptoms:

Table 2: Descriptive summary of dry eye symptoms of Hilly area participants

Have you experienced any of the following during last week:

Questions	Descriptive	None of the time	Some of the time	Half of the time	Most of the time	All the time
Eyes that are sensitive to light?	*Percentage %*	14	15	36	27	8
	Frequency	28	30	72	54	16
Eyes that feel gritty?	*Percentage %*	7	13	43	32	5
	Frequency	14	26	86	64	10
Painful or sore eyes?	*Percentage %*	19	21	29	27	4
	Frequency	38	42	58	54	8
Blurred Vision?	*Percentage %*	7	13	31	42	7
	Frequency	14	26	62	84	14
Poor Vision?	*Percentage %*	33	25	11	24	7
	Frequency	66	50	22	48	14

Table 3: Frequency and Percentage of dry eye Symptoms of plain area participants

Questions	Descriptive	None of the time	Some of the time	Half of the time	Most of the time	All of the time
Eyes that are sensitive to light?	*Percentage %*	13	18	30	30	9
	Frequency	26	36	60	60	18
Eyes that feel gritty?	*Percentage %*	31	16	26	22	5
	Frequency	62	32	52	44	10
Painful or sore eyes?	*Percentage %*	31	22	23	15	9
	Frequency	62	44	46	30	18
Blurred Vision?	*Percentage %*	26	20	32	14	8
	Frequency	52	40	64	28	16
Poor Vision?	*Percentage %*	58	19	12	6	5
	Frequency	116	38	24	12	10

Results indicate that majority of the patients have experienced light sensitivity half of the time in both plain area (n=60,30%) and in hilly area(n=72,36%), Half of the time felt gritty eyes plain (n=52,26%) in hilly area (n=86,43%) , Half of the time eyes were painful and sore in hilly area (n=58,29%) and none of the time in plain area (n=62,31%) , Blurred

vision most of the time in hilly area (n=42,54%) and half of the time in plain area (n=32,46%), poor vision is observed none of the time in both areas hilly (n=66,33%) and in plain area (n=116,58%)

Table 4: Frequency and Percentage of dry eye Symptoms of Hilly area participants

Have problem with your eyes limited you in performing any of the following during last week:

Questions	Descriptive					
		None of the time	**Some of the time**	**Half of the time**	**Most of the time**	**All of the time**
Reading?	*Percentage %*	9	10	14	48	19
	Frequency	18	20	28	96	38
Driving at night?	*Percentage %*	94	1	0	4	1
	Frequency	188	2	0	8	2
Working with computer or bank machine (ATM)?	*Percentage %*	65	15	0	13	7
	Frequency	130	30	0	26	14
Watching TV?	*Percentage %*	13	20	19	37	11
	Frequency	26	40	38	74	22

Table 5: Frequency and Percentage of dry eye Symptoms of plain area participants

Questions	Descriptive	None of the time	Some of the time	Half of the time	Most of the time	All of the time
Reading?	*Percentage %*	34	12	22	23	9
	Frequency	68	24	44	46	18
Driving at night?	*Percentage %*	63	14	0	8	11
	Frequency	126	28	0	16	8
Working with computer or bank machine (ATM)?	*Percentage %*	48	11	21	17	3
	Frequency	96	22	42	34	6
Watching TV?	*Percentage %*	42	18	24	11	5
	Frequency	84	36	48	22	10

Current findings of vision related questions showed that most of the time participants in hilly area faced difficulty while reading (n=96,48%) and none of time in plain area (n=68,34%), none of time respondents faced difficulty while driving in both hilly (n=188,94%) and plain area (n=126,63%) , working on computer respondents experienced no issue in hilly (n=130,65%) and in plain area(n=96,48%), most of the time respondents of hilly area faced difficulty watching TV (n=74,37%) and none of time respondents of plain area(n=84,42%)

Table 6: Frequency and Percentage of dry eye Symptoms of Hilly area participants

Have your eyes felt Uncomfortable in any of the following situations during the last week:

Questions	Descriptive					
		None of the time	**Some of the time**	**Half of the time**	**Most of the time**	**All of the time**
Windy conditions?	*Percentage %*	10	12	35	40	3
	Frequency	20	24	70	80	6
Place or areas with low humidity (very dry)?	*Percentage %*	2	24	47	24	3
	Frequency	4	48	94	48	6
Areas that are air conditioned?	*Percentage %*	0	53	41	5	1
	Frequency	0	106	82	10	2

Table 7: Frequency and Percentage of dry eye Symptoms of plain area participants

Questions	Descriptive	None of the time	Some of the time	Half of the time	Most of the time	All of the time
Windy conditions?	*Percentage %*	18	19	27	29	7
	Frequency	36	38	54	58	14
Place or areas with low humidity (very dry)?	*Percentage %*	37	11	20	21	11
	Frequency	74	22	40	42	22
Areas that are air conditioned?	*Percentage %*	64	14	16	2	4
	Frequency	128	28	32	4	8

Environmental triggers of this study found that most of the time patients from hilly area (n=80,40%) and plain area (n=58,29%) felt uncomfortable during windy condition. During very dry and low humid conditions half of the time participants from hilly area felt uncomfortable (n=94,47%), and none of time participants of plain area (n=74,37%). Respondents from plain area none of time felt uncomfortable in air conditioned areas (n=128,64%) whereas some of time respondents from hilly area felt uncomfortable. (n=82,41%)

4.3 Inferential Analysis:

4.3.1. Pearson Chi Square Results:

Association of Dry eye disease (OSDI score) with demographic variables was determined using Pearson Chi Square Test of Independence after confirming the assumptions of the test. Association of demographic variables was tested independently with OSDI due to geographical, environmental diversity and need for information using Chi Square test of Independence. All p-values below 0.05 were considered statistically significant. A summary of association of sociodemographic characters and OSDI score is given in table below.

Table 8: Association of OSDI score and Sociodemographic characteristics

S. No.	Variables	0-12 Normal n (%)	13-22 Mild n (%)	23-32 Moderate n (%)	33-100 Severe n(%)	Chi Square (df)	P- value
1.	**Age**						
	Hilly						
	18-28	0(0.0)	1(2.9)	4(11.4)	30(85.7)	17.365 (9)	**0.043**
	29-38	0(0.0)	0(0.0)	0(0.0)	55(100.0)		
	39-49	1(1.8)	2(3.6)	2(3.6)	50(99.9)		
	50>	0(0.0)	0(0.0)	8(14.5)	47(85.5)		
	Plain						
	18-28	16(12.2)	29(22.1)	30(22.9)	56(42.7)	16.223 (9)	**0.062**
	29-38	5(12.8)	7(17.9)	3(7.7)	24(61.5)		
	39-49	2(9.1)	0(0.0)	6(27.3)	14(63.6)		
	50>	0(0.0)	2(25.0)	0(0.0)	6(75.0)		

2.	**Marital Status**						
	Hilly						
	Single	0 (0.0)	0 (0.0)	0 (0.0)	30(100.0)	3.491 (3)	**0.322**
	Married	1(o.6)	3(1.8)	14(8.2)	152(89.4)		
	Plain						
	Single	21(15.2)	32(23.2)	27(19.6)	58(42.0)	15.117 (3)	**0.002**
	Married	2(3.2)	6(9.70	12(19.4)	42(67.7)		
4.	**Education Level**						
	Hilly						
	Illiterate	0(0.0)	0(0.0)	10(15.6)	54(84.4)	36.579 (12)	**.000**
	Primary	0(0.0)	0(0.0)	0(0.0)	32(100.0)		
	Middle	1(2.9)	3(8.8)	4(11.8)	26(76.5)		
	Intermediate	0(0.0)	0(0.0)	0(0.0)	58(100.0)		
	Other	0(0.0)	0(0.0)	0(0.0)	12(100.0)		
	Plain						
	Illiterate	0(0.0)	0(0.0)	0(0.0)	16(100.0)	40.762 (12)	**.000**
	Primary	0(0.0)	8(22.2)	4(11.1)	24(66.7)		
	Middle	2(11.1)	2(11.1)	4(22.2)	10(55.6)		
	Intermediate	19(20.7)	16(17.4)	23(25)	34(37.0)		
	Other	2(5.3)	12(31.6)	8(21.1)	16(42.1)		

Results of the Chi square analysis show that dry eye disease is significantly associated with, age in hilly area (p value=0.04) marital status in plain area (p value=0.002) and education level of both plain and hilly areas (p value=0.00).

Table 9: OSDI Score distribution among geographical areas:

S. No.	Variables	0-12 Normal n (%)	13-22 Mild n (%)	23-32 Moderate n (%)	33-100 Severe n(%)	Chi Square (df)	P-value
1.	**Geographical Area**						
	Hilly	1(0.5)	3(1.5)	14(7.0)	182(91.0)	85.681	**.000**
	Plain	23(11.5)	38(19.0)	39(19.5)	100(50.0)	(30	

Results shows that 91% of the patients indicated increased OSDI score in hilly area, implying prevalence of severe dry eye disease. In contrast half (50%) of the participant from plain area showed severe dry eye disease. Percentage of patients expressing mild and moderate dry eye disease among plain area was higher than the percentage of participants in hilly area. Overall participants from hilly area experienced sever dry eye disease while plain area participants experienced mild or moderate dry eye disease. It was seen that place of residence has statistically significant association with dry eye (p value 0.000).

Pattern of dry eye symptoms:

Overall, dry eye OSDI score differed significantly between participants of hilly and plains area ($X^2(3) = 85.7$, $p<0.001$). There was a significant association between gender and OSDI Score among both groups ($p<0.001$). In contrast, participants from both regions did not differed significantly by sensitivity of their ocular surface to sunlight ($p = 0.709$). Again, the symptoms of grittiness were significantly different among hilly and plain area

(p<0.001). Patients also experienced significant painful eyes in both regions (p= 0.001). There was a significant association between blurred vision and poor vision and geographical area (p<0.001) and (p<0.001). Difficulty in reading was also one of symptom which showed association with geographical distribution (p<0.001). Patients from both regions also experienced significant difficulty in driving (p<0.001). Low humid and windy environmental conditions such as air conditioned rooms have significantly increased OSDI score among both groups (p = <0.001).

CHAPTER V: DISCUSSION

Dry eye disease is a significant issue in clinical practice and often prompts medical attention, especially in older individuals, as it can be highly incapacitating when severe. The prevalence and associated risk factors of DED have been extensively researched, but the absence of clear and definitive diagnostic criteria prior to the TFOS DEWS II report resulted in non-standardized criteria being used in studies, which complicates direct comparisons. Hospital-based data alone is inadequate to assess the true burden of the disease and the interplay of risk factors in the population, making community-based studies necessary.

The largest population-based study on dry eye disease (DED) in Asia, which used the diagnostic criteria suggested by the TFOS DEWS II, found that the prevalence of DED in the population aged 40 years and above was 26.2%. Previous studies had shown a range of DED prevalence rates across the world, with China having the highest (30.1%) and Korea the lowest (8%). An age-wise analysis revealed that the prevalence of DED increased with age, with the prevalence being 1.8 times higher in the population aged 70 years and above than in the 40-49 years age group. Females had a higher prevalence of DED than males, but the difference became insignificant after the age of 70 years. Exposure to low humidity areas, was positively associated with DED, with higher cumulative effective sun exposure showing a stronger association with the disease.

The study confirms a higher prevalence of DED in the southeast Asian population compared to other parts of the world. Previous studies that relied on non-specific symptoms for DED diagnosis might have led to fallacious results, as they could have included symptoms caused by other ocular surface disorders. The TFOS DEWS II criteria, which take into consideration clinical signs in addition to symptoms for DED diagnosis, were used in this study, leading to more accurate results.

The study highlights the complexity of the interplay of age and gender as intrinsic factors contributing to DED. Age-related changes in the lacrimal functional unit and prolonged exposure to environmental triggers for ocular surface inflammation might be the possible

reasons for the age-related increase in DED prevalence. Furthermore, the study suggests that exposure to sunlight is a contributory factor to DED. An individualized approach was used in calculating the approximate cumulative lifetime effective exposure, which took into account the effect of protective headgear and other personal factors that influence sunlight exposure.

CONCLUSION

This study has provided reliable information on the prevalence of dry eye in Pakistan, confirming its association with increasing age, female gender, exposure to sunlight, and low humidity areas. The study also highlighted the influence of the place of residence and livelihood on the prevalence of DED, with the highest rates observed in plains compared to hills and coastal regions. Air conditioned and humidity were identified as important factors, as the highest prevalence of DED was observed in the location with lowest humidity. These findings could help improve the diagnosis, management, and prevention of dry eye disease in Pakistan and other similar regions.

RECOMMENDATION

There is lack of data regarding DED and largest population-based study on dry eye disease (DED) in Pakistan required. Further research is recommended to explore the long-term effects of Dry eye disease on population. To improve the eye health conditions and facilities in hilly areas. Community awareness programs should be introduced to make people aware of severity of diseases

4.1. Limitations:

1. The study's limitations include the lack of data on the impact of other environmental factors, such as air pollution, on DED prevalence.
2. Clinical test and detailed examination.

4.2. Strengths:

1. The study highlights the complexity of the interplay of age and gender as intrinsic factors contributing to DED
2. This study's large sample size, population-based approach, and the use of the latest diagnostic criteria for DED add strength to its findings
3. Provision of medicines

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ANNEXURE 1

Questionnaire

Please read all questions carefully and tick the most appropriate answer. You are requested to fill all information accurately so that appropriate results can be derived.

SECTION-A

Demographics

1. Gender:
   - ☐ Male
   - ☐ Female
2. Age_____ Years
3. Marital Status:
   - ☐ Single
   - ☐ Married
   - ☐ Separated
   - ☐ Widow/Widower
4. Education:
   - ☐ Illiterate
   - ☐ Primary

☐ Middle

☐ High

☐ Intermediate Other ☐

5. Area of residence:

☐ Plain

☐ Hilly

6. Family history of eye disease:

☐ Yes ☐ No

Ocular Surface Disease Index© (OSDI©)[2]

Ask your patient the following 12 questions, and circle the number in the box that best represents each answer. Then, fill in boxes A, B, C, D, and E according to the instructions beside each.

HAVE YOU EXPERIENCED ANY OF THE FOLLOWING *DURING THE LAST WEEK*:

	All of the time	Most of the time	Half of the time	Some of the time	None of the time
1. Eyes that are sensitive to light?	4	3	2	1	0
2. Eyes that feel gritty?	4	3	2	1	0
3. Painful or sore eyes?	4	3	2	1	0
4. Blurred vision?	4	3	2	1	0
5. Poor vision?	4	3	2	1	0

Subtotal score for answers 1 to 5 (A)

HAVE PROBLEMS WITH YOUR EYES LIMITED YOU IN PERFORMING ANY OF THE FOLLOWING *DURING THE LAST WEEK*:

	All of the time	Most of the time	Half of the time	Some of the time	None of the time	
6. Reading?	4	3	2	1	0	N/A
7. Driving at night?	4	3	2	1	0	N/A
8. Working with a computer or bank machine (ATM)?	4	3	2	1	0	N/A
9. Watching TV?	4	3	2	1	0	N/A

Subtotal score for answers 6 to 9 (B)

HAVE YOUR EYES FELT UNCOMFORTABLE IN ANY OF THE FOLLOWING SITUATIONS *DURING THE LAST WEEK*:

	All of the time	Most of the time	Half of the time	Some of the time	None of the time	
10. Windy conditions?	4	3	2	1	0	N/A
11. Places or areas with low humidity (very dry)?	4	3	2	1	0	N/A
12. Areas that are air conditioned?	4	3	2	1	0	N/A

Subtotal score for answers 10 to 12 (C)

ADD SUBTOTALS A, B, AND C TO OBTAIN D (D = SUM OF SCORES FOR ALL QUESTIONS ANSWERED) (D)

TOTAL NUMBER OF QUESTIONS ANSWERED (DO NOT INCLUDE QUESTIONS ANSWERED N/A) (E)

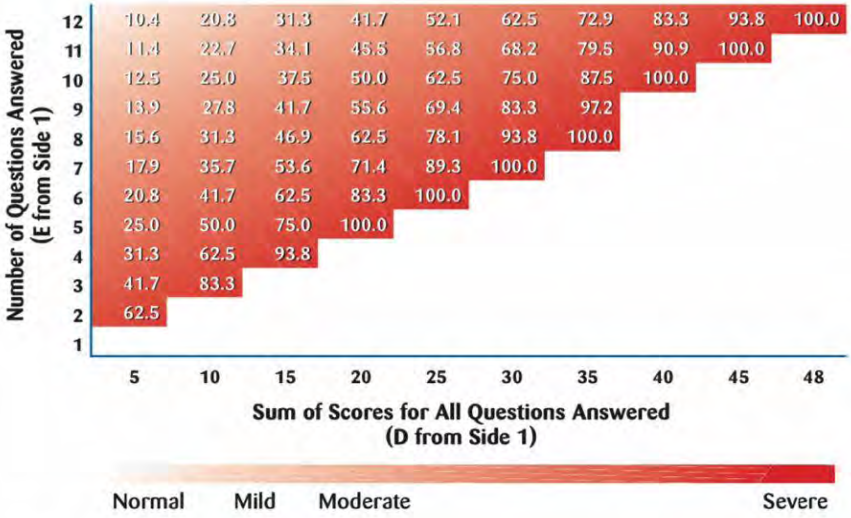
Please turn over the questionnaire to calculate the patient's final OSDI© score.

Evaluating the OSDI© Score[1]

The OSDI© is assessed on a scale of 0 to 100, with higher scores representing greater disability. The index demonstrates sensitivity and specificity in distinguishing between normal subjects and patients with dry eye disease. The OSDI© is a valid and reliable instrument for measuring dry eye disease severity (normal, mild to moderate, and severe) and effect on vision-related function.

Assessing Your Patient's Dry Eye Disease[1,2]

Use your answers D and E from Side 1 to compare the sum of scores for all questions answered (D) and the number of questions answered (E) with the chart below.*
Find where your patient's score would fall. Match the corresponding shade of red to the key below to determine whether your patient's score indicates normal, mild, moderate, or severe dry eye disease.



*Values to determine dry eye disease severity calculated using the OSDI© formula:

$$\text{OSDI©} = \frac{(\text{sum of scores}) \times 25}{(\#\text{ of questions answered})}$$

Patient's Name: _____ **Date:** _____

How long has the patient experienced dry eye? _____

Eye Care Professional's Comments: _____

Reference: 1. Schiffman RM, Christianson MD, Jacobsen G, Hirsch JD, Reis BL. Reliability and validity of the Ocular Surface Disease Index. *Arch Ophthalmol.* 2000;118:615-621. **2.** Data on file, Allergan, Inc.

ALLERGAN INSPIRE

 Re-order: 4941843

Tear and place in patient's chart for follow-up care on next visit.

ANNEXURE 3

Informed Consent Form

I am Ambreen Akhtar, student of MSPH- Final Semester, Alshifa School of Public Health, Alshifa Eye Hospital, Rawalpindi. I am doing research on Pattern of dry eye disease in geographically diverse adult population of Punjab.

PURPOSE OF THE RESEARCH

The purpose of this study is to assess the pattern of dry eye disease among geographically diverse adult population of Punjab.

PARTICIPATION

I do not anticipate that taking this study will contain any risk or inconvenience to you. Your participation is strictly voluntary and you may withdraw your participation at any time without penalty. I request you to answer the questions as honestly as possible. It will take no longer than 20 minutes to complete a questionnaire. All information collected will be used only for research purpose and will be kept highly confidential. Your identity and your responses will not be identifiable; all data will be stored anonymously. As this is solely a student project no incentive will be provided. Once study is completed, I would be happy to share the results with you if you desire.

Thank you for agreeing to participate in this study. Your feedback is important.

Consent

I have read and understand the information sheet and agree to take part in the study.

Signature_____ **Date**_____

ANNEXURE 4

IRB Letter

AL-SHIFA SCHOOL OF PUBLIC HEALTH
PAKISTAN INSTITUTE OF OPHTHALMOLOGY
AL-SHIFA TRUST, RAWALPINDI

MSPH-IRB/14-02
27th Sep, 2022

TO WHOM IT MAY CONCERN

This is to certify that **Ambreen Akhtar** D/O **Muhammad Ilyas** is a student of Master of Science in Public Health (MSPH) final semester at Al-Shifa School of Public Health, PIO, Al-Shifa Trust Rawalpindi. He/she has to conduct a research project as part of curriculum & compulsory requirement for the award of degree by the Quaid-i-Azam University, Islamabad. His/her research topic which has already been approved by the Institutional Review Board (IRB) is **"Parrent of dry eye disease in geographically diverse adult population of Punjab".**

Please provide his/her necessary help and support in completion of the research project. Thank you.

Sincerely,

Dr. Ayesha Babar Kawish
Head
Al-Shifa School of Public Health, PIO
Al-Shifa Trust, Rawalpindi

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