CHAPTER 2

REVIEW OF LITERATURE

In today’s world the application of VDT is almost universal for both professional and recreational activities. However, tear film changes may have some effect on occupational productivity and visual comfort. Several studies have proven that 64-90% of the visual symptoms are due to VDT use. CVS is one of the major problems with VDT users and DED has been considered as a major contributor to it [17]. Tear film assessment can help in early diagnosis and focus and help in therapeutic interventions by potentially increasing treatment efficacy and safety.

The VDT use is becoming common place items now days. Large number of individual working on visual display terminal devices experience eye-related discomforts due to tear film changes. However, it is still not clear whether these symptoms are more significant in VDT users or in non-VDT users [2]. The use of VDT is on the rise to workplaces due to growing trend towards digital India. This study is determined to correlate the tear film changes in VDT and non-VDT users.

DED is considered as one of the common eye related problem in today’s life. It is one of the common sources of discomfort that influences life of individual as well as its quality. This is a problem of tear film caused by various etiologies that result in ocular discomfort, tear film instability and disturbance of vision. All these factors potentially harm the ocular surface. Instability of tear film and ocular surface inflammation are one of the contributing factors leading to this damage [7] which results in excessive evaporation of tear film, burning, stinging sensation, and irritation and in some cases potentially damaging the ocular surface.

2.1 Human Tear Film

The outermost part of the eye comprises of various parts, each of structure has its unique function. Tears coat the front surface of the eye and give lubricant and transport oxygen, carbon dioxide and supplements for the eye. Tears are delivered by various structures of the eye and comprise of three layers which are discussed beneath.
2.1.1 Layers of tear film

Tear film comprises of protein, mucins, catalyst, glycoproteins and immunoglobins, water, natural solutes, electrolytes and lipids in three unique layers [39, 40].

The lipid layers: It is the shallow/furthest layer of tear film which is primarily derived from the meibomian gland of the eyelids [41]. It comprises of an external non-polar lipid layer and an inward polar layer [42]. The meibomian glands are lavishly innervated by both sympathetic and parasympathetic neurons [43]. Glands of Moll and lash follicle organs of Zeiss also add to shape lipid layer [44]. This oily layer provides effective barrier in order to prevent excessive evaporation of tear film, it also acts as a lubricant to encourage the development of the eyelids between blinking [42, 45, 46, 47]. Defects and instability in the lipid layer can oversee tear breakup, with ensuing dry spots prompting dry eye.

The aqueous layer: Majority of the tear film is formed by this layer. Its thickness is roughly 6.5 to 7.5 μm thick and is essentially produced by main lacrimal gland and well supported by its accessory glands like glands of Krause and Wolfring. This layer also consists of electrolytes, protein compounds and metabolites. This is quantitatively the most significant layer. The important elements of aqueous layer of tear film is to supply basic supplement and oxygen to cornea and helps in cellular development. It contains lysozyme, lipocalin, lactoferrin and IgA which are in charge of antimicrobial movement. This layer also helps in clearing debris and noxious substances from the ocular surface. It also contains various growth factors critical for corneal physiology [48, 49].

The mucous layer: The innermost layer of tear film which is primarily is derived from the goblet cells of conjunctiva and the crypts of Henle present in conjunctival fornices. An accessory source of mucin is also supplied by the squamous epithelial cells of the ocular surface (cornea and conjunctiva) with a little commitment from the lacrimal gland. Mucin maintains the stability of tear film and has vital role in maintaining precorneal tear film by spreading them uniformly over the ocular surface and thus, impacts the value of TBUT [50, 51]. The most significant capacity of mucin is to lubricate, encouraging the eyelid edges and palpebral conjunctiva to slide easily more than each other amid blinking and ocular rotational developments. Mucus strings spread outside bodies with a slippery covering, shielding the cornea and conjunctiva from abrasion. It also helps in maintaining the wettability of corneal surface [50, 52].

2.1.2 Effect on tear film in DED
Tear lipids in DED- Examination of lipid parts have appeared significant decreases in triglycerides and cholesterol, and monounsaturated unsaturated fats (explicitly oleic corrosive), in patients with obstructive meibomian organ brokenness, endless blepharitis and gooky meibum [53, 54]. These adjustments in the lipid organization might be related with tear film precariousness. Polar lipids may characterize the basic association of the overlying non-polar lipids and loss of these constituents are accepted to result in diminished tear separation time and expanded watery tear evaporation [55].

Aqueous layer in DED: Lysozyme levels decline with age and in dry eye disorders. Sjogren disorder patients demonstrate a diminishing in lysozyme, lactoferrin and epidermal development factor (EGF) levels in tears [56]. Lack of tear lipocalin can prompt the development of mucous strands and cause tear film instability [57].

Mucin layer in DED: Primary source of mucin is discharged by conjunctival goblet cells [MUC5AC], the film related mucins of apical corneal and conjunctival epithelium [MUC1, MUC4 & MUC16] ensure and hydrate the ocular surface. The incendiary cytokines discharged by the conjunctival epithelium are associated with the pathogenesis of visual surface maladies, for example, keratoconjunctivitis sicca [56, 58].

2.1.3 Test for tear film

Various clinical tests have been set for assessment of tear film which are tests of severity that can be broadly categorized as either objective or subjective. Tests which are useful for clinical diagnosis based on quantitative and qualitative analysis are:

2.1.3.1 Tear Film Break Up Time (TBUT)

Instability of tear film is of the indication for the dry eye. Vision will be affected and adds damage for the homeostatic regulation of the lacrimal function unit, which leads to fluctuation of various clinical test for dry eye. Tear instability is; hence, specifically noteworthy and precise estimation of this factor could give data that mirrors a key hub of the ailment. Therefore, TBUT is mainly used to evaluate the tear film stability [59]. The stability of tear film is indicator of strong cohesive forces between these 3 layers of tear film. During evaluation process these layers are viewed using fluorescein dye under cobalt blue filter. Ideally, minimum of 3 scores is considered an average of the outcomes found are considered. This technique of tear film instability is quite popular around the world because of its easy accessibility, simplicity and affordability [60].
Some of the drawbacks pointed by few researchers are its varied normative values, lack of uniform procedure and its poor relationship with subjective symptoms [61, 62]. Even though this procedure gives a wide range of score among individuals but as per various studies TBUT of less than 10 seconds indicates instability of the tear film and a value less than 5 seconds is considered as indicator for dry eye disease. As per a study three successive measurement and an average value of $\leq 10$ seconds was considered as indicator for a of dry eye disease. Another study recommended the average of 5 readings for accurate findings and the value less than 10 seconds considered as characteristics sign for dry eye [63]. It has been observed that average TBUT in Indian populations are $13.8 \pm 4.79$ seconds which varied in the range of 8-31 seconds. Another study found out that average TBUT of Indians are $7.81 \pm 6.63$ sec with very wide range of $1.67 - 40.33$ seconds and the average TBUT in female (6.98 sec.) were less compared to male (8.90). TBUT was generally performed using sodium fluorescein as a dye [64].

Staining of ocular surface with dye are done using needle mounted tube, catheter, needle or laboratory pipette to install sodium fluorescein solution (dye) in the lower conjunctival fornix. dye. Many researchers have suggested the of fluorescein strip by slightly moistening it with saline for staining the ocular surface. In order to observe the staining pattern a 1-2 mm wide beam or diffuses beam of light is used to scan the cornea or tear film. an additional yellow barrier filter is also preferred by many researchers.

A strong and significant correlation has been established between TBUT and blink rate [65]. Some of the condition like difficulty of the visual task, mental stress, poor attention, and decreased corneal sensitivity has been found to influence blink rate which ultimately affects TBUT. It has been utilized as a proportion of tear insecurity for a considerable length of time. Most generally, it is estimated that after the application of fluorescein dye on the ocular structure, tear film stability is recorded by measuring the duration when the tear film starts to separate after a blink. In order to record the TBUT subject is instructed to blink sometimes initially after application of dye then advised keep eye open by avoiding blink till the time dry spots are seen. Values less than 10 sec are considered for diagnosis of dry eye [66].

2.1.3.2 Meibography

The oil secreting glands present at the back lamina of the eye lid as a cluster in between palpebral conjunctival and the tarsal plate are called meibomian gland. The meibomian gland is a round structure and has a length of 3-4 mm, crossing the eyelid margin
to the edge of the tarsal plate [66]. Meibomian glands are tubular-acinar structure with the acini and ducts which opens to the eye lid margin to secrete meibum [68]. These Glandular acini contains meibocytes—modified sebaceous cells which is responsible for secretion of lipid (meibum) in the pre-corneal tear film. Meibum secreted from the meibomian gland impregnates the lacrimal system to satisfy several important functions of the tear film. It provides physical and hydrophobic obstruction from the organic and environmental factors by preventing their entry to the ocular surface. It also averts dissipation of tears and in this way prevents drying of ocular surface. It also greases up the surface to counteract the irritation while at the same time provides clear ocular media. Consequently, the physiology of the tear relies upon the right working of the meibomian gland [69, 70]. According to the standard definition, Meibomian Gland Dysfunction (MGD) is "A chronic, diffuse variation from the norm of the meibomian gland, by and large depicted by terminal conduit hindrance and or qualitative/ quantitative changes in the glandular discharge" [6, 71].

An ideal dimension of meibum articulation is required for tear film stability that permits the division of MGD into two divisions: [72]

**Obstructive MGD:** Any hyposecretion or non-appearance of meibum present in the tear film that needs lipids and results in unusual evaporation of tear film leading to dry eye disease. The histopathological investigations of obstructive MGD show squamous metaplasia and keratinized tops in the ducts of the organs, review of lipids and cell trash inside the widened ducts, hypertrophy of the organs, lysis of the cell intersections of meibocyte and decay of the organs.

**Seborrheic MGD:** It is caused by the inflammatory response of ocular surface due to hyper secretion of meibum in the tear film due extrinsic irritation. The seborrheic MGD are less common and restricted studies are available. It has been also observed that adjustment to the anatomy and morphology of this type of MGD are not normal.

There are numerous target criteria to assess MGD like slit lamp biomicroscopy for the evaluation of meibomian gland (MG), TBUT, expressivity, or breaking down meibum communicated from the organs. One technique for assessing the strength of the meibomian gland is named 'Meibography' [73].

Generally, the presence of MGD has been assessed dependent on attributes of discharge from the MG, just as orifice plugging. As of now, easy to use procedures are accessible to picture the real dropout of the meibomian organs from the upper and lower tops by means of the utilization of an infrared camera [74]. Meibography has an indispensable influence on dry eye and useful for the understanding the anatomy and morphology of MG.
Contact Meibography- It is the customary system created in the late 1970s, which included the immediate utilization of a light test for the illumination of the eyelid, where pictures are taken through a specific camera [67, 75]. Contact meibography has been effective throughout the years, yet there are inconveniences. In the first place, the administrator experience is required to utilize the hardware accurately and get quality pictures. Eyelid eversion is a typical issue that takes quite a time and requires the obtaining and combination of a few pictures to shape a composite all-encompassing picture of the eyelid. Third, patients may encounter uneasiness because of the warmth, weight, splendour and sharpness of the probe [76]. Although advancement in contact meibography are good natured.

Non-contact Meibography- It is one the most recent meibographic technique of understanding the MGD [77] which utilizes infra-red filter on slit lamp and an infra-red charge-coupled device video camera to capture the picture of an eyelid. In non-contact meibography, a light probe is pointless, and it distinguishes from the contact system and found quicker, progressively patient friendly, simpler to use and has capacity to see a more surface zone of the eyelid to make an all-encompassing perspective on the eye lid for its assessment. Infrared meibography is the backbone of the imaging investigations of the meibomian gland because of its verifiable recognition and dependability to deliver fantastic pictures of the meibomian glands [67, 75, 77, 78]. It is the most utilized innovation in non-contact and contact systems where meibomian gland are viewed to archive the presence, progression, and treatment reaction in MGD [79, 80]. The meiboscore and meibograde frameworks speak to orderly ways to deal with evaluating meibomian organ morphology on infra-red meibography. There are shifting techniques to review MG dropout and bending and keeping in mind that most creators have built up their very own strategy for evaluating, some have selected to utilize other creator’s evaluating framework. MG dropout can be evaluated as follows: [81]
Grade 0: no dropout
Grade 1: dropout of less than 1/3 of total area of glands
Grade 2: dropout of more than 1/3, but less than 2/3 of total area of glands
Grade 3: dropout of more than 2/3 of total area of glands

2.1.3.3 Blink rate

Blinking of an eye is one of the essential aspects of ocular physiology as it helps in proper distribution of tear film on the ocular surface and helps in protection. It can be influenced by numerous elements, for example, Parkinson and illness and corneal sensitivity
issue, which lessen the quantity of blinks and cause over exposure of the ocular surface [82]. Moreover, patients with dynamic supernuclear paralysis have a diminished blink, maybe because of a lessening in the affectability of the corneal sensitivity brought about by the loss of the nerves of the cornea [4, 83]. Other factors, for example, gaze changes, lighting, room temperature and humidity can likewise impact the blink pattern of an eye. Eye uneasiness and visual weariness are as often as possible detailed when performing adjacent undertakings, for example, perusing, particularly when utilizing electronic gadgets. It has been proposed that dry eye amid VDT task may be due to diminished blink rate or expanded corneal surface. A few examinations have demonstrated that blink rate is diminished amid visual presentation task [84].

2.1.3.4 Ocular surface staining (Corneal and conjunctival)

DED communicated in the DEWS report emphasizes harm to the ocular surface. Ocular surface staining is done with fluorescein color under cobalt blue channel to analyze DED, survey its seriousness and as a clinical end point in clinical preliminaries for pharmaceutical impact [85]. Corneal staining during pathological situation is normally symptomatic, some might be asymptomatic, however are frequently joined by extra signs or have a trademark sodium fluorescein (NaFl) staining of the cornea. The utilization of vital dyes to distinguish abnormalities of the ocular surface has been an essential component for eye care practitioners [86]. Since its first use, much has been understood of its physical properties about its relation to ocular surface [87]. The use of ocular surface staining remains a fundamental component of ocular examination and, along these lines, the capacity to record the dimension of corneal staining is significant in clinical practice and is essential in research of dry eye. The staining is assessed by instillation of fluorescein utilizing cobalt blue and Wratten 12 (yellow) filter. Sodium fluorescein strip soaked with a drop of sterile saline and the assessment is done 1 to 4 minutes after the application and after few blinks for even distribution of dye. The ocular surface staining is performed with fluorescein dye using the cobalt blue filter to inspect DED [85]. The Brien Holden Vision Institute (formally known as CCLRU grading scale) grading system is used to grade staining pattern of ocular surface [86, 88]. The cornea is partitioned into five zones, every zone is assessed independently: the central (C), superior (S), nasal (N), inferior (I) and temporal (T) zones [89, 90]. Brien Holden Vision Institute grading system is graded as follows:

0 no staining
1. micropunctate
2. macropunctate
3. coalescent macropunctate staining
4. coalescent patch of 1 mm or greater size

2.1.3.5 Schirmer test

The procedure ordinarily utilized is the Schirmer test, considered a standout amongst the most valuable for distinguishing the most serious and deficient dry eye disease [59]. Schirmer test was first represented in 1903 by Schirmer and it is still considered as important and most widely used clinical test strategy for the evaluation of the production of aqueous layer [91]. Methods for Schirmer test was later modified in 1953 where Whatman filter paper was introduced as testing paper. Later in 1961, filter paper strips were made standard strips were standardized and were made standard for clinical use. There are two variations of the Schirmer test: Schirmer I which assess complete tear discharge (basal and reflex). Schirmer II assesses a proportion of reflex discharge after insertion of the strip. For better repeatability of Schirmer test for the estimation of basal secretion includes the utilization of topical anesthesia before inclusion of the strip. Performing Schirmer with anesthesia can give an increasingly exact picture of basal discharge. This test quantifies fluid tear production, where filter paper [35× 5 mm] is embedded at mid-route between the center and external third of the inferior eye lid. Furthermore, the length of wetted channel paper is estimated in millimeters following five minutes. The patients are coordinated to look and to blink ordinarily and the wet length are recorded following 5 minutes. Wet length of filter paper is considered, and a wetting length less than 15 mm is viewed as ideal for DED. As often as possible a topical analgesic is imparted before estimation to decrease the aggravating impacts of the strip on the conjunctiva, which may trigger reflex tearing [92, 93].

2.1.3.6 Tear Meniscus Height (TMH)

TMH helps clinician to evaluates the amount of tears present at the lower lid margin of an eye by measuring the height in millimeter. Fluorescein is instilled on to the bulbar conjunctiva and after 5 min the tear meniscus formed on the lower lid margins is Slit lamp illumination should be set in conical beam and the cobalt blue assesses to find tear volume. For this slit lamp should be set in conical beam and cobalt blue filter is used to measure and compare the tear film height. A tear meniscus height below 0.25 mm is critical for dry eye disease [94, 95].

2.1.3.7 Symptom assessment using Ocular Surface Disease Index (OSDI)
Studies and clinical observation have clearly stated that dry eye is a disease of symptoms. It implies that the diagnosis of this disease is an accurate without assessing the symptoms of the condition [96]. Ocular surface disease index (OSDI) is a 12 items questionnaire based on 3 components with various questions; visual function (6), ocular symptoms (3) and environmental trigger (3) where VDT users recalls symptoms of 1 week [13]. The OSDI is assessed on a scale of 0 to 100, with higher scores representing greater disability. Total OSDI scores are calculated as OSDI = sum of scores x 25/ number of questions answered [13]. The scores ranging 0 to 12 represents normal, 13 to 22 as mild DED, 23 to 32 represents moderate DED, and > 33 represent as severe DED [92, 97].

2.1.4 Types of tearing

Tear secretion is arranged into three kinds specifically, basal, emotional and reflex tears. Basal tears are discharged and spread consistently by the eyes. It lubricates and nourish the eyes [98].

Reflex tears: They are those which are created by pain, external stimulus or foreign bodies [99]. Hypo secretion of tear film is brought about by dry eye and hyper emission is brought about by ocular aggravation, corneal or nasal disturbances, and so forth. Although basal tears are indispensable for healthy eyes, reflex tears are secreted higher than basal tears [100].

Basal tear discharge: Basal Tears: This is the fluid continually present in the eye, which guarantees that the cornea is constantly wet and sustained. This thin layer of fluid likewise smoothenes out certain anomalies and makes an even surface of good optical quality, which is transformed during each blink. It is a term that recognize the quality and structure of [a] the defensive tear film which typically covers the outside of the eye consistently from [b] the reflex tears discharged because of eye aggravation (wind, something in the eye etc.) or those activated by emotion. When you have unending dry eye, it is helpful to comprehend that the "ordinary" tear film (basal tears) has novel characteristics to secure and support the corneal surface which reflex or enthusiastic tears can’t reproduce. Ever wonder why your eyes hurt increasingly in the wake of crying? Those tears are progressively watery. As a result, the great stuff - in the basal tears - is getting washes/weakened appropriate out of your eyes. Some dry eye patients attempt to "make" their eyes wet by invigorating reflex tears; despite the fact that these may make the eyes briefly wet, they can never truly supplant basal tears [98, 100].
The objective of the dry eye patient isn't just to make their eyes wetter however to improve the consistent tear film - that is, basal tears - to the degree conceivable, for the better security and sustenance of their corneas.

2.1.5 Tear drainage system

The nasolacrimal drainage system fills in as a course for tear secretion from the outer eye to the nasal cavity. It comprises of the puncta, canaliculi, lacrimal sac, and nasolacrimal duct. Any unsettling influence in the anatomical structures or any functional disorder of the lacrimal system may lead to dry eye due to any of the above-mentioned cause.

2.2 Dry Eye Disease (DED)

Dry eye disease (DED) is pathology of the preocular tear film that leads to the destruction of the ocular surface and correlates with the signs of visual difficulties. DED is also called keratoconjunctivitis sicca (KCS), sicca keratitis, sicca disorder, xerophthalmia, dry eye syndrome (DES), ocular surface disorder (OSD), dysfunctional tear syndrome (DTS) or dry eye. Dry Eye Workshop (DEWS) conducted in 2007 defines dry eye as “a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance and tear film instability, with potential damage to the ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface” [101].

DED is considered as the leading findings in eye care and speaks to a developing general wellbeing concern, with outcomes that remain broadly thought little of [102]. This pathology causes significant sway on visual capacity, which may influence quality of life [11, 97] and work productivity [103, 104, 105, 106]. It can affect patient’s quality of life, especially in the old population that can genuinely influence a patient's personal satisfaction [107] and past investigation shows women are more prone to report dry eye symptoms than men and it is a condition that has a multifactorial etiology, which, in most cases, is always chronic and progressive [108, 019, 110]. It is accepted to be an unsettling influence of the ocular surface. The ocular surface functional unit is consisted of various structures like ocular surface (cornea and conjunctiva), meibomian glands, lacrimal glands, lids and nerves like sensory and motor nerves to connect these structures. Thus, the main function of this unit is to maintain the integrity of the precorneal tear film and to help cornea in maintaining its transparency. This also process improves the overall quality of image [111, 112, 113].

2.2.1 Mechanism of dry eye initiation
It is a multifactorial issue including various interactive mechanisms. Lacrimal unit dysfunction can prompt DED by affecting modifications in the volume, structure, distribution. Two mechanisms have been distinguished that have been generalized throughout the world: lacrimal hyperosmolarity and the instability of the tear film. These factors activate inflammatory mediator of the tear film which results in ocular surface damage by cellular death at various layers of tear film. The apoptosis and cellular changes goblet cell, and other glands further leads to tear film instability and hyperosmolarity [6].

Lacrimal hyperosmolarity may be due to a low water flow or excessive evaporation of the tear film. The inflammation can also lead to the loss of goblet cells and reduce the production of mucin, which also leads to instability of the tear film. Instability of the tear film may arise after hyperosmolarity or may be the initial event (e.g., abnormalities of the lipid layer in the dysfunction of the meibomian gland). The instability of the tear film leads to an intense evaporation, which is added to the lacrimal hyperosmolarity [101, 114, 115] (Fig 2.1). Certain factors like xerophthalmia, topical preservatives, ocular allergy and contact lens are also triggering tear film instability.

Despite the etiology, inflammation is typically a crucial reason in propagating DED [116]. Long-lasting DED can cause pathological variations. For instance, subjects with moderate to serious DED can create alterable squamous metaplasia and punctual destructions of the epithelium of the ocular surface. DED is also the most recognized reason for filamentous keratitis (FK), a complaint represented by damaged epithelial cell filaments. The rubbing the eyelid during the blinking may cause more damage to the epithelium, irritation and disposition of the filaments; in this way, FK becomes long-lasting and is a typical consequence in severe DED [117, 118]. At some point, severe DED can cause complications, such as keratinization of the ocular surface, microbial keratitis, corneal neovascularization, ulceration, perforation and healing; and extreme vision loss.

The corneal nerves are stimulated during DED, may be due to corneal injury or loss of mucin generating friction between eye lid and eye which results in reflex tearing, excessive blink rate and ocular discomfort [71, 115]. Poor aqueous outflow is considered to be major contributing factors to hyperosmolarity of tear film. Other factors like excessive evaporation of tear film due to external factors like humidity and airflow causes evaporative DED. The major contributing factor for EDE is considered as meibomian gland dysfunction (MGD) [119]. Lipid layer is altered by esterase and lipase released by the eye lid glands and their number is increased in the case of blepharitis [114]. It may be due to normal ageing or induced by systemic drugs like anti-histamines and anti-muscarine agents. Common causes
are inflammation leads to tissue destruction which may be due to result of circulating antibodies to the M3 receptors. Low androgen level also favors inflammation [6, 7].

### 2.2.2 Etiology of DED

It incorporates diminished tear generation, extreme tear dissipation, also variation in the foundation of mucus or lipids of tear layer [120]. Tear insufficient dry eye is found more in old subjects, women, and in subjects with autoimmune illnesses in primary Sjogren’s disorder and rheumatoid arthritis due to poor formation of tear by lacrimal gland [108, 121, 122].

![Fig 2.1. Mechanism of dry eye.](image)

Sjogren's syndrome (SS) is represented by the combination of tear deficiency and dry mouth (xerostomia) [123]. All cases of SS are represented due to progressive infiltration due to lymphocytes on the lacrimal and salivary glands which causes the engineering complication of the ordinary glands and the consequent loss of function [47]. Patients with non-Sjogren disorder are related to the infection of the lacrimal glands. In dry eyes due to evaporation, the eyes dry up due to the greater dissipation of the tears, as in the case of a reduction in the anomalies of the surface of the lid and the flashing. Ecological factors, for example, dry atmosphere, air pollution, chemical burns, contact lens wear or driving, sitting
in front of the TV and using VDT may affect tear film and can lead to corneal ulcer and blindness [124, 125, 126]. Tear fluid loss due to evaporation and ocular dryness generally correlate with a sufficient lipid layer. Lipid layer deposits and delays the disappearance of the underlying aqueous layer [127]. Rosacea, blepharitis and MGD are the main reasons for evaporative dryness [128].

2.2.3 Classification of DED

DEWS has classified dry eye as Aqueous Deficient Dry Eye (ADDE) and Evaporative Dry Eye (EDE). ADDE is due to lacrimal gland failure or accessory gland failure resulting in poor or inadequate tear secretion. In ADDE, the secretion of tears is inadequate to reserve the tear film. This circumstance is classified into two subclasses that depend on the subjects who has experience Sjogren's syndrome or not. Sjogren's syndrome, the stomach disorder, affects the external secretory organs in numerous territories, in the same way in the eyes. Stimulated T cells may attack the lacrimal glands of the eyes, causing death and dysfunction of the glands. Sjogren's syndrome is divided into primary and secondary forms, depending on whether there is an evident disorder of the connective tissue of the immune system. Secondary Sjogren's syndrome is related with other autoimmune diseases such as rheumatoid arthritis [129, 130]. Non-Sjogren syndrome may be due to insufficiency of the lacrimal gland (various etiologies), obstruction of the lacrimal duct or reflex hyposcretion [131].

EDE is due to excessive evaporation of tear film from the exposed surface of an eye under normal lacrimal system. EDE is classified into intrinsic and extrinsic factors. Intrinsic factors include the lack of meibomian oil, alterations in lid dynamics, low frequency of blinking and effects of drug action or Extrinsic where it is caused by some external exposure. Extrinsic factors rise the ocular surface evaporation may be due to deficiency of vitamin A, topical preservatives, contact lens wear or ocular surface pathology, such as hypersensitivity [6, 7, 8, 129, 130]. The best-known explanation behind dry eye by evaporation is MGD. The most well-known causes are dermatoses, for example, acne rosacea or atopic dermatitis. While using the computer, the midwife's eyelid opening will be broader than normal, less blink rate while reading or working in the computer causes evaporation and dry eye symptoms [129, 130]. Vitamin A is necessary for the development of goblet cells and for the functioning of the glycocalyx. In the deficient aqueous form, Vitamin A deficiency can cause acinar lacrimal damage and insufficient tear fluid formation [129, 130]. Topical medications can cause a dangerous response on ocular surface which can be seen in diabetic patients. Similarly, Local anesthetic drop may block the sensory messages that increase the production
of flashes and tears which cause dry eyes [132]. The use of contact lenses can decrease corneal sensitivity and can lead an aqueous deficiency and increase evaporation due to reduced closing speed or incomplete closure during blinking [131] and poor wettability of the lens is added to the expanded evaporation (Fig 2.2) [130, 131].

DED has also been classified on the basis of its severity as mild (grade 1), moderate (grade 2) and severe (grade 3). Mild DED are usually asymptomatic which are influenced by environmental conditions like dryness and windy condition. Hyperosmolarity and decreased tear lysozyme is frequently seen. Moderate DED usually present various corneal pathology like epithelial erosion, punctate keratopathy and filamentary keratitis. These all signs can also be seen with shorter tear film break up time. Severe dry eye condition is seen in untreated conditions of mild or moderate DED. These conditions may lead to some serious corneal pathology like ulcer and opacity and can cause visual impairment (Fig 2.3)
2.2.4 Symptoms of DED

Symptoms of dry eye are dry, grittiness, itching of the eyes, foreign body sensation, excessive watering, red and painful eyes, photophobia [133, 134], rigid discharge and blurring of vision and symptoms may worsen in dry climates [135].
Fig 2.3. Grades of DED: DED seen in different grades/severity with various signs and symptoms. These clinical features are highly crucial in diagnosis and management of DED [128].

2.2.5 Personal impact of DED

Personal satisfaction can antagonistically be affected by untreated or undertreated dry eye [12]. Regularly, day by day exercises that require ideal visual lucidity, such as perusing, computer use, night driving, sewing, and watching TV are fundamentally hampered [136, 137]. Today, dry eye is one of the main sources of patient visits to eye care suppliers in the US. Asia may have as much as 33% of the population encountering noteworthy dry eye. 25% of patients visit ophthalmology department complains dry eye symptoms and making it a developing general medical issue and a standout amongst the most widely recognized condition found by eye care practitioners [138]. Previous investigation found that 7-10 million of Americans have paid more than $100 million in artificial tears which exclude cost visit to eye care practitioners [139].
2.2.6 Clinical diagnosis of DED

The diagnosis of dry eye requires a battery of interviews and tests to be performed. There are many subjective and objective methods to test for DED.

Dry eye questionnaire and clinical testing - These include general, ocular, medical history including contact lens history, subjective assessment of individual and their symptoms, status of meibomian gland, assessment of tear film quality, tear meniscus height, blink rate, tear film break-up time (TBUT), fluorescein staining of the cornea and conjunctiva, and the Schirmer test [61].

Questionnaires have been a basic device in the dry eye analysis for a long time, huge numbers of which have likewise been utilized as screening tools. Ocular Surface Disease Index (OSDI) is one of the commonly utilized questionnaires. The OSDI is a twelve items questions used for screening dry eye. The strength of this questionnaire is that it probes for three different sub-scale like ocular irritation, vision-related impact and triggering factors due to environmental. It categorizes DED on the basis of symptoms occurred in last one week [96]. The quality of this questionnaire is that it tests for those three unique aspects.

The clinical analysis of dry eye is affirmed by a suitable test of tear production. The procedure regularly utilized is the Schirmer test, being viewed as a standout amongst the most valuable in recognizing the severest, most tear insufficient dry eye. TBUT is utilized primarily to survey the dependability of tears [59]. The break-up time is recorded in seconds as the interim between the patient's last blink to the appearance of a dry spot in the precorneal tear film after the installation of fluorescein viewed with a cobalt blue filter [140]. TMH is a tear generation test used to evaluate the volume of tear at the lower lid margin of the eye. It has been talked about this may give knowledge into the general tear volume [95]. Corneal staining test is a fundamental to evaluate recoloring of the cornea and conjunctiva. Meibography is a visualization technique of the meibomian gland by transillumination of the eyelid. It has a vital influence for dry eye assessment [75]. Blinking of an eye spread tears in general surface and gives grease, wash away residue and microorganisms. Blinking guarantees the typical dispersion of the tear film [84]. Any irregularities to blinking may result in poor tear appropriation and hence forth cause harm to the visual surface [141].

2.2.7 Risk and prevalence of DED

Dry eye is one of the most pervasive eye disease and purposes behind looking for eye care among more elderly people. Prevalence of DED increases with ageing, study demonstrates that it ranges from 5% to 50% in the grown-up populace [132, 142]. DED
substantially affects personal satisfaction by influencing visual acuity, social and physical functioning and productivity in the workplace. The evaluation of utility shows that patients with moderate severe dryness have a quality of life like that of patients with severe angina or who undergo hospital dialysis. There is additionally huge economic burden for the patient, society related with dry eyes with related expenses assessed at roughly $55.4 billion a year in the United States [143].

DED might be instigated by a different mechanism and this way could be thought of as a gathering of assorted pathologies that lead to normal side effects of apparent visual dryness and disturbance. DED is described by irregularity of the disease with variations in the intensity of the symptoms over time and in different conditions [144]. In clinical practice it isn't unexpected to see patients with no clinical proof of dry eyes who are exceptionally symptomatic or, on the other hand, the individuals who have negligible side effects regardless of obvious harm to the ocular surface.

It is a significant general medical issue, causing expanded danger of visual contamination and vexatious side effects of visual distress, fatigue, and visual disturbance influence that meddle with essential exercises, for example, perusing, taking a shot at a computer, and driving a vehicle. Concentrates over the previous decade have recognized more established age, female sex, diminished androgen levels, exogenous estrogen use, and an irregularity in the dietary admission of basic unsaturated fats (Omega-3) as significant hazard factors for DED. Some causes and risk factor for dry eye are:

**Advancing Age** - Dry eye is a characteristic ageing process. Most of the individuals over age 65 experience a few side effects of dry eyes. It is ailment is a pervasive eye disorder that specifically influences the older populace. One of the real reasons for dry eye, MGD demonstrates expanded pervasiveness with maturing. MGD is brought about by hyper-keratinization of the ductal epithelium of meibomian gland and decreased amount and additionally nature of meibum, the holocrine item that balances out and avoids the vanishing of the tear film [98].

**Gender**: Women are more likely to create dry eyes because of hormonal changes brought about by menopause, pregnancy and the utilization of oral contraceptives. It appears there may be a reproductive hormonal influence on conjunctival goblet-cell count [101].

**Other systemic conditions**: DED is seen with increased prevalence in patients with autoimmune diseases, HIV and other communicable and non-communicable diseases.

**Environmental conditions**: Conditions, for example, wind and dry atmospheres can likewise influence tear volume by expanding tear evaporation. Failure to blink routinely, for
example, when gazing at a computer screen for significant lots of time, can likewise add to drying of the eyes [128].

Other factors: Use of contact lens for longer duration of time can lead to DED. Refractive surgeries may cause diminished tear production. Inadequate amount of tears – Tears are created by a few organs in and around the eyelids. Tear production will in general lessen with age, with different ailments, or as a reaction of specific drugs [129].

2.2.8 Management for DED

A direct treatment plan that depends on a differential diagnosis is considered the vital in achieving the main objective of the patient with a dry eye to improve the quality of life. The first-line treatment includes educating the subjects regarding early diagnosis, risk factors, treatment modalities and the prognosis of the disease.

2.2.8.1 Tear conservation techniques

Subjects with diagnosis of dry eyes may benefit from alterations in behavior and environment that cause the preservation of existing tears by reducing evaporation, such as interruptions during reading, lowering computer screens to reduce openness of the lid, use of shielding glasses with external side pieces and humidification of the surroundings [103, 145].

2.2.8.2 Eyelid hygiene/application of heat/massage

Cleansing of the eyelids is associated with warmth and eyelid massage, frequently the pillar of treatment for various types of blepharitis and MGD. The hygiene of the lid is accentuated for the management of anterior blepharitis, although hot compresses and massages are prescribed for posterior blepharitis / MGD [101, 146, 147].

2.2.8.3 Tear supplements and lubricants

Tears supplements and topical lubricants are available in a variety of options for the management of eye effects related to dry eye. Artificial tears lubricate ocular surface and expel fragments of the tear film, weaken the hyperosmolar tear film and decrease the size of relief of inflammatory mediators [146]. They are considered first-line treatment for lacrimal insufficiency and different types of dry eye due to accessibility [118]. Clinical trials were conducted to search for the feasibility of different definitions of lacrimal supplements, including comparative studies to evaluate the differential impacts on clinical feature of dry eye [148]. The use of protected tears supplements is suitable for mild tear deficiency to
relieve dry eye manifestations. In any case, considering the rupture of the tear film and the toxicity of the corneal epithelium, the authors recommend the use of artificial tears several times a day with supplements to moderate to severe DED.

2.2.8.4 Nutritional supplements

Essential fatty acids, including omega-3 and omega-6 unsaturated fats, essential be acquired through food use. The omega 3 and omega 6 unsaturated fats are necessary for the regular functioning of the metabolism of human cells. Diet with a higher percentage of omega-6 unsaturated fats may lead to dry eye. On the other hand, a diet that has a high percentage of omega-3 unsaturated fats are related to a reduced chance of developing a DED [149]. Current meta-analyzes of randomized, placebo-controlled investigations have shown that remarkable updates in TBUT and Schirmer test results correlated with daily dietary intake of unsaturated omega-3 fats [150]. Significant improvements were observed in the subjective symptoms of the individual (OSDI evaluation) and the objective evaluation of the corneal surface in a clinical evaluation of the long-term (mid-year) use of dietary supplements containing corrosive and gamma-linolenic fats. unsaturated omega-3 fats from patients with moderate contrast, severe dry eye and placebo ingestion.

2.2.8.5 Topical cyclosporine

Inflammation related to the ocular surface and the secretory parts of the lacrimal structure is accepted as a central element to cause DED. Alterations in the functioning of lacrimal gland and the lacrimal ducts can affect the amount and the nature of the lacrimal organ discharges that structure the aqueous mass of the tear film [134]. The inflammation related to the ocular surface can be caused by a chronic irritation due to environmental pressure, ocular comorbidities, physiological changes related to aging or the ocular appearance of systemic conditions. Treatment with anti-inflammatory agents is suggested given the solid connection of irritation with lacrimal insufficiency [103, 118, 151, 152]. Cyclosporin A, a peptide of a fungus, is an anti-inflammatory agent with immunosuppressive properties. The topical use of cyclosporin (0.05%) on the ocular surface has been shown to increase tear production in subjects who have reduced tear production due to inflammation related to DED. The exact mechanism of activity of topical cyclosporin is obscure; however, the agent is accepted as a T-cell immunomodulator in subjects with tear deficiency.

2.2.8.6 Topical steroid
These are an anti-inflammatory substance that helps to treat an inflammatory eye condition. Clinical evidence from several studies using various details shows that corticosteroids are powerful in reducing the inflammatory parts of dry eye disease. A statistically significant decrease in signs (conjunctival hyperemia) and symptoms of people diagnosed with dry KCS were observed in a group treated with corticosteroids compared with those treated with placebo [103]. Statistically significant changes were also observed in people with dry KCS were treated with corticosteroids. In formulations of ophthalmic corticosteroids are considered appropriate for the management of inflammation related to tear deficiency [103, 153, 154]

2.2.8.7 Topical antibiotic ointment

Infectious blepharitis is one of the subtypes of anterior blepharitis, often includes colonization and excess of microorganisms, such as Staphylococcus aureus, a negative coagulase staphylococcus species, e.g., *Staphylococcus epidermidis* and *Propionium acnes* [155]. For the management of anterior blepharitis, therapeutic preparations for economically accessible ointments of erythromycin, bacitracin or other anti-toxic agents are suggested. The details of topical antibiotics are suggested mainly to use at bedtime or twice daily for three weeks for the management of anterior blepharitis [101].

2.2.8.8 Moisture chamber eye wear

Environmental variables, for example, low humidity, drafts and ventilated conditions, can worsen the side effects of inadequate tears. The use of safety glasses offers to reduce the ecological drying while increasing periocular moisture [118, 156, 157].

2.2.8.9 Punctual Plugs and cautery occlusion

Tear preservation can be achieved by blocking the path for tear extraction and drainage. Punctual plugs are made by inserting plug. Numerous types of point plugs could be used to provide a momentary obstruction of the tear film drainage, for example with absorbable collagen and polymer caps, or to be fixed for an uncertain period using non-absorbable thermolabile polymer capsules. Permanent point occlusion, such as laser cautery, could be achieved on patients. Several studies have demonstrated the clinical viability of point occlusion in decreasing clinical signs and side effects of tear deficiency [158, 159].

2.2.8.10 Autologous serum
Naturally occurring biologic liquids, for example, serum, offer a lubricant that mirrors the structure of natural tears from multiple points of view and might be utilized as a tear supplement. The utilization of autologous serum improves the danger of antigenicity. Serum contains a significant number of the parts present in the tear film, including immunoglobulins, enzymes and growth factors [160, 161].

2.2.8.11 Contact lenses (Bandage and scleral)

Bandaged contact lens is used in eye conditions associated with aqueous deficiency. A symptomatic relief has been observed in association with the use of bandaged contact lenses to promote healing of the corneal epithelium [162]. Significant improvements in visual acuity, cornea and better corrected ocular symptoms have been observed in patients with severe dry eye due to Sjogren's syndrome [27]. Contact lens prescribed as an alternative treatment for eye conditions associated with water deficiency, such as filamentous keratitis [118]. Scleral contact lenses are special devices suitable for resting on the conjunctiva and the sclera instead of on the cornea. The material of the lens is generally of a rigid nature and is designed to be gas permeable, with the ability to contain a reservoir of liquid under the lens, along these lines that hydrate and protect the cornea from exposure and abrasion [163, 164].

2.2.8.12 Vitamin A

Vitamin A (retinoids) is associated with numerous dimensions of cell physiology. Adequate dimensions of vitamin A also required for growth and preservation of goblet cells in the conjunctiva [165]. Any deficiency of this vitamin may lead to the advancement of dry eye, which may affect mucinous layer and the acinar cells of the lacrimal system [118, 166].

2.2.8.13 Secretagogues

The rebamipide is an aggravating factor of the quinolone that was initially produced for the management of gastric ulcers. The rebamipide initiates the secretion of mucus and shown to show anti-inflammatory and cytoprotective properties and to improve wound healing. The examination of the visual properties of rebamipide to instigate the secretion of mucus and induce epithelial healing has led to the support and commercialization of the compound in Japan. In US the clinical examination on the safety and vitality of rebamipide are used in the management of dry eye [167].

2.2.8.14 Surgical procedures
Surgical options should be considered for the management of the introduction of keratopathy according to the cause and severity of the disorder. The limitation of the size of the interpalpebral fissure through tarsorrhaphy can also be considered in patients with keratopathy of severe exposure [116, 152, 168].

2.3 Computer Vision Syndrome (CVS)

The Computer and other visual display devices have turned as a piece of the regular daily existence at present. A visual display terminal is a typical thing in work environments, home, school and colleges. Its utilization has expanded effectiveness in simple access to information, creating articles and in communication. A large number of people including youngsters and understudies are utilizing VDT for drawn out hours. A VDT is generally called computer screen which is a presentation yield surface and anticipating instrument that shows content and frequently realistic pictures to the clients. As indicated by American Optometric Association, CVS is defined as a complex of eye and vision problems related to the activities which stress the near vision and which are experienced in relation to or during the use of computers [169]. Professionals like investors, accountant, bankers or any other IT professionals or group having excessive close work by mobile, laptop, or tab users are routinely influenced.

Studies in the past have indicated that more than two hours of computer uses daily can have 90% chances of computer vision syndrome [170]. In 21st century CVS is a leading one of the occupational hazards. VDT use is progressively basic in computer clients as well as in the all-inclusive community because the across the board utilization of advanced cells and other computerized devices [1, 171]. VDT use has noteworthy effect on everyday life action. VDT empower shifted exercises including perusing the web, watching video, bunch visiting, and long-range interpersonal communication when contrasted with those in the past age. Accordingly, time spent at screens has expanded and it will increment in coming years.

This expanded utilization of VDT has prompted an expansion in number of subjects griping visual manifestations identified with VDT use [2]. The symptoms are generally brief and vanish toward the finish of the working day even though a minority of workers may have dependable manifestations [3].

2.3.1 Visual mechanisms on VDT screen

Human eyes that are focusing system are not suggested for electronically delivered characters on the VDT. It reacts superbly to the pictures that have all around characterized
edges with great foundation differentiated (e.g. strong dark letters on white background). VDT letters are comprised of little spots or pixels. At middle every pixel is bright with its diminishing splendor at its external edges. The human eyes think that its exceptionally hard to concentrate on the pixel characters. Eyes focus around the plane of the screen however can't continue to focus. At that point it will relax on to a concentration behind the screen. This point is known as the resting point of accommodation (RPA). RPA is unique in relation to individual to individual, yet it is to some degree away than the typical working distance to the screen. Eye are always relaxing to RPA and stressing to refocus on to the screen continually.

Steady change of the ciliary body makes exhaustion to the eye and causes accommodative indications symptoms to CVS which further prompts sprain and strain on muscle and bone in procedure of modifying the eye and vision related problems (Fig 2.4) [5, 170].

2.3.2 Prevalence of CVS

CVS is increasing with the use of VDT. Certain studies found that 90% of the 70 million US laborer utilizing computers over three hours an everyday may encounters CVS [172]. The effect of VDT use may cause discomfort to the eyes which reduces productivity, increases work time and decreases job satisfaction ultimately resulting in reduction in work accuracy and task volume [173]. Long term use of VDT work has been correlated with high incidence of ocular surface disorder [92, 174]. Various studies have discussed blink rate is reduced during VDT uses [175]. Mean blink rate at relaxed state were found to be 22 per minute while ten and seven per minute were found during book and screen viewing respectively [84]. Tear evaporation is dependent on the palpebral fissure width and humidity of surrounding. Wider palpebral fissure increases evaporative rate leading to decreased tear stability and thus dry symptoms may further lead to CVS and affects the quality of life [176]. Thus, DED may cause CVS due to significantly decrease blink rate and corneal exposure observed during VDT use. The major management for DED consists of palliative regimes to reduce the symptoms by drugs like lubricating eye drops.

VDT use has been extended to teaching at school, recreational purposes and now it has become a routine in our day to day life [173,177]. Studies reports that >50% of VDT users complain of eye discomfort or asthenopia [177]. Therefore, through diagnosis of CVS and assessing tear film in VDT users can help the patient get rid of dry eye symptoms. Eye care professionals will probably encounter increased patients in their day to day practice. The
burden of DED has impact on visual, physical, social functioning, occupational productivity and quality of life [178].

![Pathogenesis of CVS seen in VDT users using VDT for prolonged period](image)

Fig 2.4. Pathogenesis of CVS seen in VDT users using VDT for prolonged period: During the process of CVS patient undergoes series of symptoms related to eye, vision, and musculoskeletal. It is initiated from the poor visual quality of VDT screen leading to blurring of vision and strain which makes eyes fatigue and stain. Poor blinking during VDT use further adds to the symptoms. Ergonomics of VDT use is vital for maintaining good posture in order to avoid strain on various musculoskeletal parts of the body [170].

Assessment of tear film in VDT (diagnosed with CVS) and non-VDT has not been thoroughly studied. The need is to establish an easy way to diagnose the disease progression. However, till date no such studies have shown a correlation of system which can easily identify the onset and severity of the disease. In this case, large sample size with inclusion of objective and subjective tests can give better understanding for DED in VDT users leading to CVS [92]. However, large sample size and its correlation with other tests are needed to deduce the true effects. The connection of the meiboscore with utilitarian tear film parameters proposes that patients with noticeable meibomian gland atrophy will likewise associate with an impeded meibomian gland function [73]. In any case, meibography does not appear to be adequate as a solitary test for the determination of MGD. For the future, imminent
investigations are expected to affirm these outcomes and further assess the capability of meibography in the determination of MGD in VDT and non-VDT users. Therefore, this test can likewise be useful in distinguishing unobtrusive changes in the ocular surface which could anticipate the early prognosis of DED.

2.3.3 Risk factors for CVS

Lightening of the workplace, the differentiation of the screen, the duration of the work in VDT, the distance and the angles of vision, the explicit assignment of the business, the pressure and the interest, the reflection of the screen, the quality the ergonomics of the image and the workplace played a key role in showing the side effects in VDT users [2].

2.3.4 Symptoms of CVS

Incorporates dry and aggravated eyes, fatigue eyes, blurring of the vision, redness, watering, doubling of vision, headache, sensitivity to light and glare, slow change of focus, changes in color perception, burning eyes, neck and back pain and muscle spasms. It has not yet been proven that working with the computer causes permanent eye damage, but the permanent discomfort that can occur can reduce efficiency. It may reduce job satisfaction and decrease in work accuracy and a decrease in commitment volume [173, 179].

2.3.5 Diagnosis of CVS

At first eliminate other potential reasons for inconvenience. For instance, blurring of vision may be due to uncorrected refractive error [for example, Myopia and Astigmatism] or presbyopia, binocular vision assessment. Glare may be due to cataract or corneal scarring. Take history of computer usage, workstation ergonomics and habits. These inquiries may frequently give understanding for diagnosis and management [180].

2.3.6 Treatments and prevention of CVS

Correction of refractive error is important to avoid eye strain [181]. Step by step instructions to work for extended periods of time on computer [170]. The 20-20-20 rule is highly effective for all times of VDT users which says that at every 20 minutes, take a break of 20-seconds. Eyes need to focus on points at any 20 feet from computer. Small breaks after VDT use with this rule and good amount of blinking are helpful in maintaining ocular surface healthy [182]. Some other factors that prevents the symptoms of CVS are: 1) Proper lighting in the room- Modify the room illuminance to decrease the brightness of the computer screen.
Do not face monitor at any open window to avoid reflections on the screen. Use antireflection filters to decrease the brightness of the monitor. Satisfactory brightening of room and not working in the dark [170], for example following 20 minutes of computer use, look at 20 feet away for 20 seconds. Illumination, contrast and brightness of the screen ought to be adjusted optimally before starting the work. The room illumination ought not to exceed three times the average of the screen illumination [183]; 2) The ideal computer monitor- Use the monitor without flicker [LCD / LED]. Keep monitor five to nine inches below the eye level. From your eyes keep the screen at one hand distance away. Keep the monitor away from the window. System brightness and contrast need to be adjusted according to your comfort. Font size of the text need to be increased [170]. Keep the screen at 35-40 inches where eyes can relax [184]. Screen should not be tilted excessively. Excessive tilt can distort the letters and adjust their shape, affecting the contrast. Screen ought to be perpendicular to the line of sight [172]. Comfortable setting of computer monitors on a computer screen, black text on a white background is ideal and avoids low contrast text or background color schemes [170]. Computer need to be adjusted at a viewing angle of 15 degree below the horizontal level which may decrease visual discomfort, neck and back pain [185]; 3) Sitting posture-Maintain a good posture to avoid neck and back torment; 4) Comfortable workplace- Taking small regular breaks can relax the accommodation of the eyes, thus avoiding visual fatigue [186]. Computer vision syndrome can be caused by smartphone as well. Smartphone need to be kept at farther distance. The closer you keep the phone more stress you put on your eyes. If it is necessary change the configuration to enable a larger print [170]; 5) For DED-Artificial tears drops moisten the ocular surface, contribute to the volume of tears which reduce eye fatigue and dryness. Clarity of the screen can be affected by the screen that may cause glare therefore screens should be dust-free; 6) consultation from eye care practitioner-full eye examination, assessment of binocular vision, tear film assessment correction of refractive error, presbyopia and management of binocular vision anomalies are, hence, required [170, 172, 187, 188].

2.4 Socio-economic status and its association with ocular diseases

The socioeconomic status (SES) is portrayed as the circumstance of individual, families and various aggregates with respect to the capacity to make or use items that are esteemed in our overall population [24]. SES, socioeconomic class or social class are widely used in health research [189]. SES assessment is an important aspect in community-based health research, since it is a determinant of health and nutritional status, mortality and
morbidity [20, 21]. Revised Kuppuswamy Socio-economic Scale is the most regularly utilized scale for deciding the SES. It takes into consideration of education, occupation, and income of the individual which determines the SES. It is additionally imperative for consideration when tweaking health training to the intended interest group [22].

The SES has been a powerful determinant of health in general, rich people tend to have better health than the poorest people. SES is widely recognized as one of the important factors that influence the health conditions of an individual or a family [190]. There seems to be a significant impact of SES on a multitude of diseases, including cardiovascular diseases, respiratory diseases and mental health disorders. Several studies conducted in health-related fields require an evaluation of the SES and consider it during the analysis of the data. The SES is generally measured by three variables: education, income and employment [21].

*Education:* It may be the most fundamental part of the SES, as it models upcoming job opportunities and earning potential. It additionally gives knowledge that enable better educated individuals to acquire quicker access to data and assets to advance wellbeing. Research demonstrates that youngsters from families and communities with low create scholastic aptitudes that are slower than kids in higher SES group. Marilyn Winkleby and her associates inspected in what way education, income and employment refer to risk factors for cardiovascular diseases. A hypothesis has been found education can aware against disease by prompting habits, skills and problem-solving values. In addition, education may encourage the procurement of optimistic social, mental, economic skills and resources which can provide isolation from unfavorable influences [191].

*Income:* Previous investigation showed that higher incomes may provide improve nutrition, education, housing and recreation.

*Occupation:* The occupational status is a more complex feature of person’s life. Employment affects various working life of individual or family. Study have proven that employment gives better health and uplift the standard of individual. It has been observed that unemployment and duration of un-employment adversely affects health status [192]. Low socio-economic status and lower jobs status affects individual by exposing them to occupational hazards and other psychosocial risks. They are more prone to workplace injury and exposure to toxins. They also deal with the problem like excessive workload and enjoy professionalism to the inferior level. The predictors like income, education and occupation are strongest and mysterious determinants of health. These parameters directly or indirectly are inter-linked and acts as a proxy for other determinants. People are generally divided into groups according to these predictors in low, medium or high SES.
In general, SES is considered as an indicator of the economic and social position. The variables/components traditionally used to evaluate one's social classifications are education, occupation and income; however, the additional indicators that are considered important are the employment situation, the possessions and even the presence of reading material in the home. Studies have reported that the only best indicator of a person's SES is employment.

2.4.1 SES and its effects on health

The hypothesis is that the environmental exposures like pollution, toxins and other characteristics, psychosocial exposure like stress, cognitive and emotional processes logical, social and behavioral processes like diet, smoking, alcohol and drugs modelled by SES influences the functioning of several systems of biological regulation important for health. These incorporate essential administrative frameworks, for example, neuroendocrine and sensory system. The lowest SES, surveyed by an assortment of education, income, employment status, financial stress has been connected to more "risky" biological functioning patterns, including higher levels of hormones that are presumed to be high in conditions of stress, poorer metabolism profiles and other indicators of cardiovascular disease risk. C-reactive protein, fibrinogen and other indicators of inflammatory load are found higher in lower SES (Fig 2.5). Study indicates that the experiential and behavioral corresponds of SES are probably going to impact and risk of more serious pathologies is influenced by the functioning of several physiological systems, the physiological cost of multiple systems that the SES adversity experience imparts to the lower SES body [193].

Past investigation [25] had demonstrated that patients with poor education and lack of awareness were more likely to have diabetes mellitus, hypertension, heart disease and sleep deprivation, just as a lower score for general wellbeing. A few examinations have discovered a relationship of financial status with the pervasiveness of eye disease that can conceivably prompt visual impairment. Instances of these eye diseases are trachoma, deficiency for vitamin A, and diabetic retinopathy. Low SES is now recognized as a risk factor in the advancement of numerous eye disease including age-related macular degeneration, glaucoma, diabetic retinopathy and cataract. A study discovered that low SES is related with improvement of cataract, for example, low eating regimen quality with deficient admission of cancer prevention agents and nutrients [33]. The prevalence of cataract, blindness or visual impairment has been found more in the lower class of SES of Indian territory [30].
Fig 2.5. SES and its effects on health: Most common predictor for SES influenced by environmental exposure, psychosocial stress, behavioral aspects of individual leads to biological changes in the system. The SES is directly or indirectly associated with health of an individual [193].