Alneelain University

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Treatment of Dry Eye: comparing the use of Tears Naturale Eye Drop, Omega 3, Physical Treatment and Exercises

Project submitted in partial fulfillment for M.Sc. degree in Optometry & Visual Sciences

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2014

Abstract

This study was designed to assess the benefit of the treatment of the dry eye by the use of tears naturale e.d, omega 3, and physical treatment and exercises.

The study was done in (Khartoum capital – Sudan) in Banan Information Technologies Co., Humanitarian Aid Commission, Sudanese Airway Co. (H.Q), and National Telecom Corporation Tower, and in (Al Sulaymaniyah city – Iraq) in Agricultural Faculty of Al Sulaymaniyah University.

The study was done at June and July 2013 (Khartoum) and at September and October 2013 (Al Sulaymaniyah).

The study involved 90 subjects; 46 Sudanese and 44 Iraqis. There were 29 males and 61 females their ages ranged between 20 years and 43 years with a mean of 27.30 ± 6.63. Those subjects were divided into three equal groups; 30 subjects were treated with tears naturale e.d, 30 subjects were treated with omega 3, and 30 by physical treatment and exercises.

Subject's history had been taken, their outer and inner eyes were examined by ophthalmoscope, Schirmer test was done before and after treatment to assess the tear film, and questionnaire was done to evaluate the case.

The subjects' results were statistically analyzed by SPSS program. The study revealed the following results:

The Schirmer test score for all subjects before treatment ranged between 2 mm and 14 mm with a mean of 7.57 mm ± 3.66. While the results after treatment were:

The Schirmer score of the subjects who were treated with tears naturale was with a mean of 17.1 mm ± 6.48. 73.3% of subjects were within the normal, and 90% were symptoms free.

The Schirmer score of the subjects who were treated by physical treatment and exercises was with a mean of 15.93 mm ± 6.83. 63.3% of subjects were within the normal limits, and 50% were symptoms free.

The Schirmer score of the subjects who were treated with omega 3 was with a mean of 10 mm ± 4. 20% of subjects were within the normal limits, and 73.3% still complained of dry eye symptoms.

For all subjects; the schirmer score ranged between 3 mm and 32 mm with a mean of 14.34 ± 6.62. 52.22% of subjects were within the normal limits, and 55.55% were symptoms free.

Key words: Schirmer test, dry eye symptoms.

جامعة النيلين

كلية الدراسات العليا

علاج جفاف العين: مقارنة بإستخدام قطرة الدموع الطبيعية للعين، أوميغا 3،

و العلاج الطبيعي و التمارين

أسماء جمال عبد الواحد محمود

د. نهى محمد فتح الرحمن محجوب

2014

الخُلاصة

أعدّت هذه الدراسة لتقييم منافع علاج جفاف العين بواسطة استخدام قطرة الدموع الطبيعية (Tears Naturale e.d) للعين، أوميغا 3، و العلاج الطبيعي و التمارين.

تمّ عمل الدراسة في (مدينة الخرطوم – السودان) في شركة بنان لتقنية المعلومات، مفوضية العون الإنساني، شركة الخطوط الجوية السودانية (الرئاسة)، و برج الهيئة القومية للإتصالات، و في (مدينة السليمانية – العراق) في كلية الزراعة جامعة السليمانية.

أجريت هذه الدراسة في يونيو/ حزيران ويوليو/ تموز 2013 (الخرطوم)، و سبتمبر/ أيلول وأكتوبر/ تشرين الأول 2013 (السليمانية) .

تضمنت الدراسة 90 شخصاً؛ 46 سودانيّاً و 44 عراقيّاً. 29 شخصاً منهم ذكور و 61 إناث تراوحت أعمارهم بين 20 عاماً و 43 عاماً و كان متوسط أعمارهم 27.30 ± 6.63 عاماً. تمّ تقسيم هؤلاء الأشخاص إلى ثلاث مجموعاتٍ متساوية؛ 30 شخصاً عولجوا بواسطة قطرة الدموع الطبيعية للعين، 30 شخصاً عولجوا بواسطة أوميغا 3، و 30 شخصاً تمّ علاجهم بواسطة التمارين و العلاج الطبيعي .

تم أخذ التاريخ الشخصيّ للمريض، و عمل فحص لداخل العين و خارجها بواسطة منظار العين، و أستخدم اختبار شيرمر(Schirmer) لفحص طبقة الدموع قبل و بعد العلاج، ثم تمّ عمل الاستبيان لتقييم الحالة.

حُللت نتائج البحث بشكل إحصائي بواسطة برنامج SPSS. و توصلت الدراسة للنتائج التالية:

تراوحت نتيجة إختبار شيرمر لجميع الأشخاص قبل العلاج بين 2 ملم و 14 ملم بوسطٍ حسابي 7.57 ملم ± 3.66. و كانت النتيجة بعد العلاج كالتالي:

بعد استخدام قطرة الدموع الطبيعية للعين؛ سجل اختبار شيرمر وسطاً حسابياً 17.1 ملم ± 6.48. 73.3% من العينات كانوا ضمن الحدود الطبيعية و 90% منهم لم يعد لديه شكوى.

بعد التمارين و العلاج الطبيعي؛ سجل اختبار شيرمر وسطاً حسابياً 15.93 ملم ± 6.83. 63.3% من العينات أصبح ضمن الحدود الطبيعية و 50% منهم لم يعد لديه شكوى.

بعد استخدام أوميغا 3؛ سجل اختبار شيرمر وسطاً حسابياً 10 ملم ± 4. 20% من العينات كان ضمن الحدود الطبيعية و 73.3% لا زال لديه شكوى.

كانت نتيجة إختبار شيرمر لجميع العينات تتراوح بين 3 ملم و 32 ملم مع وسط حسابي 14.34 ملم ± 6.62. 52.22% من العينات أصبحوا ضمن الحدود الطبيعية ، و 55.55% منهم لم يعد يشكو من الأعراض.

الكلمات المفتاحية: إختبار شيرمر، أعراض جفاف العين.

Dedication

To the first teacher, teacher of teachers, master of all creatures. .
my PROPHET (peace be upon him)

To the great who grabs my hands and makes his life my ladder and guide to success. . my dearest FATHER

To the fountain of patience and hope, and the first lady in my heart. .
my sweetest MOTHER

To the taste of my life, and companions of my way. .
my BROTHERS and SISTER

To who complain and in pain. .
ask Allah to heal him

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Thanks to anyone who help me in this study whatever it was; asking Allah to make that in their balance of good deeds.

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Common abbreviation

DES ≡ Dry Eye Syndrome.

KCS ≡ Keratoconjunctivitis Sicca.

TBUT ≡ Tear Break Up Time.

PLD ≡ Primary Lacrimal Deficiency.

MGD ≡ Meibomian Gland Dysfunction.

CVS ≡ Computer Vision Syndrome.

LCD ≡ Liquid Crystal Display.

CRT ≡ Cathode Ray Tube.

EPA ≡ Eicosapentaenoic Acid.

DHA ≡ Docosahexaenoic Acid.

Chapter One

INTRODUCTION

Chapter One

1. Introduction

Dry eye is a condition in which there are insufficient tears to lubricate and nourish the eye due to either not enough production of tears or poor quality of tears causing several symptoms. Treatments for dry eyes aim to restore or maintain the normal amount of tears in the eye to minimize dryness and related discomfort and to maintain eye health (AOA 2013). This achieved either by:

a. Medical and Medications treatment by adding tears to compensate the normal tears or conserving tears (Artificial tears).
b. Physical treatment to stimulate tears glands (Hot compress), increase the spread of the tears across the front surface of the eye (Eye exercises), or increase the water contents of the tears by increasing body hydration.
c. Nutritional Supplements and healthy food to increase tears production (Omega3) (AOA 2013).

The study was done in (Khartoum capital – Sudan) and in (Al Sulaymaniyah city – Iraq).

1.1 Aim of the study

The study aimed to assess the benefits of the three methods of the dry eye treatments; Tears Naturale, Omega 3, and physical treatment and exercises. This can be achieved through the following:

a. Examination of the outer and inner eye of the subject by direct ophthalmoscope.
b. Assess the tears film by Schirmer strips.
c. Give a questionnaire paper to the subject.
d. Prescribe the treatment to the patient for a month.
e. After this month, re-examine the patients by schirmer strips.
f. Record and compare between the results to determine the most effective treatment.

The sections below give a brief idea of the skeleton of the study regarding that the topics will be covered in the subsequent chapters.

1.2 Literature review

In chapter two the normal lacrimal system, the normal composition, functions, physical properties, dynamics, and evaluation of the tear film were mentioned. Also dry eye's definition, mechanisms, classification and causes, severity, treatment, and computer vision syndrome altogether with previous studies are represented.

1.3 Subjects and methods

This chapter provides coverage to subjects' population, criteria for admission and place of study. The details of subjects screening, procedures of examinations and measurements are illustrated too.

1.4 Results

The data which are collected as tables and figures in chapter three will be displayed and analyzed in chapter four.

1.5 Discussion

The obtained results in chapter four will be discussed in chapter five.

1.6 Conclusions and recommendations

The main findings of this study will be concluded in chapter six in addition to the recommendations and suggestions for further studies. Then the references and appendices will be shown.

Chapter Two

LITERRATURE REVIEW

Chapter Two

2. Literature Review

2.1 The lacrimal system

The lacrimal system consists of two sections:

a. Structures that secrete tear fluid; the tears are produced by the lacrimal gland which is about the size of a walnut (Lang and Wagner 2007), and the accessory lacrimal tissue which lies in the different structures of the eye lid and conjunctiva, and distributed over the eye surface by the blinking action of the lids (Langston and Colby 2008). They contribute to the formation of the middle aqueous layer of the precorneal tear film are known as the secretory system (Edward and Bedrossion 2007).
b. Structures that facilitate tear drainage; with each blink acting as a lacrimal pump, the tear is moved nasally, where it enters the puncta and flows through the canaliculus, lacrimal sac, and the nasolacrimal duct (NLD) into the nose. They are known as the excretory system (Leitman 2007).

2.1.1 The secretory system

The lacrimal glands are exocrine glands. They are divided into two groups: the main lacrimal gland and the accessory lacrimal glands (Edward and Bedrossion 2007). The main lacrimal gland located laterally above the eye, measures approximately 20 mm long, 12 mm wide, and 5 mm thick consists of two portions; the almond-shaped orbital portion, located in the lacrimal fossa in the anterior upper temporal segment of the orbit, and the smaller palpebral portion is located just above the temporal segment of the superior conjunctival fornix (Eva and Whitcher, 2007).

The accessory lacrimal exocrine glands of Wolfring and Krause structurally resemble the main lacrimal gland but on a lesser scale. The glands of Wolfring which are larger in size than the glands of Krause; can be found along the upper border of the superior and lower tarsus, while Krause are located in the superior and inferior conjunctival fornix. Those structures works to produce tears that are needed to wet

the front of the eye and flush debris from the ocular surface (Edward and Bedrossian 2007).

There are two types of secretion; basal secretion occurs normally without any stimulation and reflex tear secretion produced in response to a corneal or conjunctival irritant and also depends on psychological factors. The accessory lacrimal glands are basal secretors because they do not possess direct secretory motor fibers. The other basal secretors are the sebaceous glands (meibomian and Zeis) and the mucous glands (goblet cells). And the reflex secretors are the main lacrimal glands (Edward and Bedrossian 2007).

2.1.2 The excretory system

The lacrimal secretions are distributed over the surface of the eye by gravity, capillary action, and the eyelids (Rubin 2008). Tears secreted from the lacrimal gland in the superolateral region of the conjunctiva, spread over the surface of the globe to collect in the lacrimal lake at the medial aspect of the conjunctival fornix by lacrimal pump mechanism. They then pass by capillary attraction into the lacrimal puncta (0.3 mm in diameter) which open into vertically orientated ampullae (2 mm long) and the lacrimal canaliculi (8 mm long), about 70% of tear drainage is via the lower canaliculus and the remaining through the upper canaliculus. Aided by the lacrimal pump mechanism and gravity, fluid then passes into the common canaliculus (4 mm long) and the lacrimal sac (10 – 12 mm long). Fluid continues downward into the nasolacrimal duct (12 – 18 mm long), emptying into the inferior meatus of the nose under the inferior turbinate bone (Edward and Bedrossian 2007) (Kanski and Bowling 2011).

The lacrimal pump has a passive (filling) phase with the eyelids open, and an active (pumping) phase upon eyelid closure and contraction (Edward and Bedrossian 2007).

2.2 The tear film

2.2.1 Function of the tear film

Tears are continually replenished from the inferior tear meniscus by blinking giving primary functions to the ocular surface (Foster and Lee 2013):

a. An optical function by maintaining an optically uniform corneal surface by smoothing the irregular corneal epithelium,
b. A mechanical function by facilitating the blinking and movement of the eye ball by lubricating the cornea, conjunctiva, and eyelids.
c. A corneal nutritional function since the cornea is an avascular structure, by transporting oxygen and a limited number of other nutrients to the cornea.
d. An antibacterial function via specific and nonspecific antibacterial substances.
e. A protection functions by providing white blood cells with access to the cornea and conjunctiva in case of injuries, protect the ocular surface from free-radical insults with antioxidants and from external environment by responding dynamically to a wide range of external conditions and potentially damaging situations such as bright light, cold, and infections.
f. A cleaning function by removing foreign materials, debris and noxious irritants from the ocular surface (Garg 2010) (Uchino and Tsubota 2010).

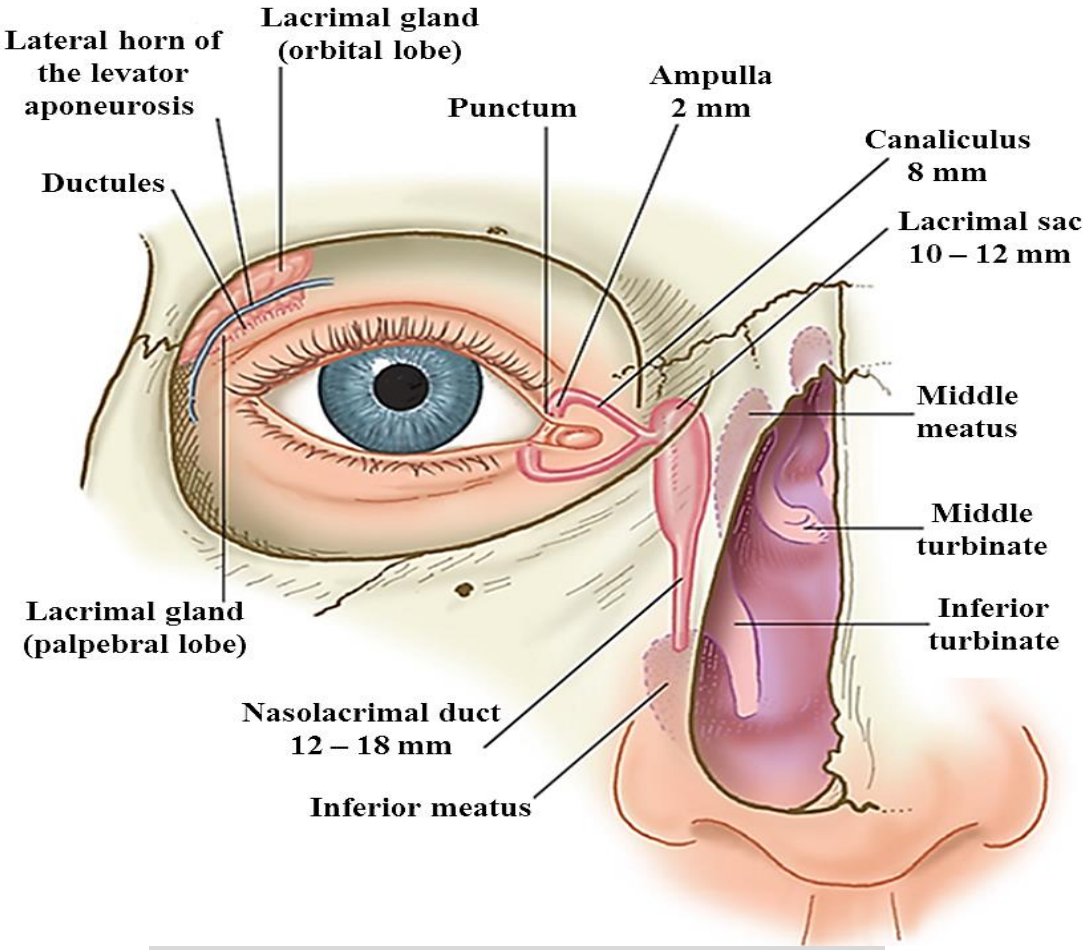


Fig. 2.1 The lacrimal drainage system (Lin 2013)

Those achieved by normal spread of tear film over the ocular surface through a neuronally-controlled blinking mechanism and ocular movements (Kanski and Bowling 2011). And for normal resurfacing of the tear film; those factors are required: normal blink reflex, normal lid anatomy, a normal corneal epithelium, contact between the external ocular surface and the eyelids, and of course, a normal tear film structure is essential (Gault 2007).

2.2.2 Normal structure of the tear film

The ocular surface requires a dynamic yet stable tear film to meet the environmental, immunologic, and optical challenges presented to it. For decades, a discrete three-layer model was accepted, consisting of an anterior lipid layer to provide protection from evaporation; an aqueous component that provided the largest part of tear film volume; and a mucin layer that provided protection and lubrication of the corneal and conjunctival epithelium (Lang and Wagner 2007).

2.2.2.1 The superficial lipid layer

The outer oily layer (approximately 0.1 μm thick) is a product of the meibomian glands, the eyelid sebaceous glands (Zeiss and Moll) and sweat glands of the margin of the eyelid (Lang and Wagner 2007). Meibomian glands are a series of fat (lipid) producing glands found at the rim of the upper and lower eyelids within the tarsal plates (Millar, Mudgil, and Khanal 2011), Zeiss glands associated with the lash follicles and Moll glands found at the lid margin (Wojno 2011).

This layer composed of an inner thin polar phase containing phospholipids adjacent to the aqueous-mucin phase and free fatty acids, and thicker outer non-polar phase containing waxes, cholesterol esters, triglycerides and free fatty acids responsible for retarding evaporation (Kanski and Bowling 2011) (Peters and Colby 2007).

The primary function of this layer is to stabilize the tear film. With its hydrophobic properties, it prevents rapid evaporation (Lang and Wagner 2007) and forms the initial barrier between the ocular surface and the environment (Craig, Tomlinson, and McCann 2011). The lipid layer is also acting as a barrier against foreign particles (Peters and Colby 2007), provides an optically smooth refracting surface (Foster and lee 2013), and form a water-tight seal when the lids are closed (Whitcher 2007).

2.2.2.2 The middle aqueous layer

The middle watery layer (approximately 8 μm thick) is secreted by main lacrimal glands which produce about 95% of the aqueous component of tears and the accessory lacrimal glands of Krause and Wolfring produce the remainder (Kanski and Bowling 2011).

This layer has four main functions:

a. Most importantly it supplies atmospheric oxygen to the corneal epithelium.
b. It has antibacterial substances like lactoferrin and lysozyme. Therefore, dry eye patients are more susceptible to infection than a normal eye.
c. It provides smooth optical surface by removing any minute irregularities of the cornea.
d. It washes away debris from the cornea and conjunctiva (Garg 2010).

This layer contains: water (98.2%) and the residual (1.8%) are electrolytes, proteins, peptide growth factors, antioxidants, amino acids, glucose, urea, and hormones (Garg 2010).

Electrolytes are secreted by the epithelial cells of the ocular surface. They present in the tear film include positively charged electrolytes (cations) sodium, potassium, magnesium, calcium, while chloride, bicarbonate, and phosphate are the negative ions (anions). The electrolytes are responsible for the osmolarity of tears, acting as a buffer to maintain a constant pH and contribute to maintaining epithelial integrity and membrane permeability of the ocular surface. An increase in the electrolyte concentration, described as hyperosmolarity, can cause damage to the ocular surface (Garg 2010) (Peters and Colby 2007).

Proteins found in human tears are species-specific. More than 60 proteins have been identified in human tears including albumin, immunoglobulins, metal-carrying proteins, complement, histamine, plasminogen activator, prostaglandins, proteases, and antimicrobials. They form the first line of defense against an external infection and seen to be more effective than systemically produced antibodies. The primary defense system of the ocular surface is composed of the nonspecific immunity conferred by albumin, lysozyme, lactoferrin, β-lysin, complement, and the specific

immunity of antibodies, such as secretory immunoglobulin. The primary function of the whole types of protein; is to protect the eye against infections and inflammatory diseases (Peters and Colby 2007) (Garg 2010).

Antioxidants, such as Vitamin C, tyrosine, and glutathione scavenge free radicals to help minimize cellular oxidative damage (Craig and etal 2011).

Glucose found in the tear in low concentration which is important for corneal nutrition (Garg 2010).

Peptide growth factors and vitamin A act to regulate epithelial proliferation, motility, and differentiation. Peptide growth factors are also involved in corneal wound healing and immune modulation. The other components found in the tears with very low concentration (Peters and Colby 2007) (Garg 2010) (Craig and etal 2011).

2.2.2.3 The inner mucous layer

The deep mucin layer (approximately 0.8 μm thick) is secreted by columnar epithelial cells of conjunctiva known as goblet cells and glands of Manz (corneal limbus glands). It converts the hydrophobic corneal surface into hydrophilic one (Khurana 2007), which also helps to stabilize the tear film. This layer prevents the watery layer from forming beads on the cornea, ensures that the watery layer moistens the entire surface of the cornea and conjunctiva (Lang and Wagner 2007), absorb various organic compounds found in tears, and contribute to resistance of the eye to infection by providing protection against microorganism (Dartt 2011).

Ocular mucus is composed of mucin, immunoglobulins, urea, salts, glucose, and enzymes. Mucins are high molecular weight glycoproteins (Peters and Colby 2007).

The corneal surface is covered with fine microvilli interact with the mucus to provide some support for the tear film (Garg 2010).

A more recently proposed model consists of a mucin/aqueous glycocalyx gel that comprise most of the tear film volume with an external protective lipid layer to resist evaporative forces (Foster and lee 2013).

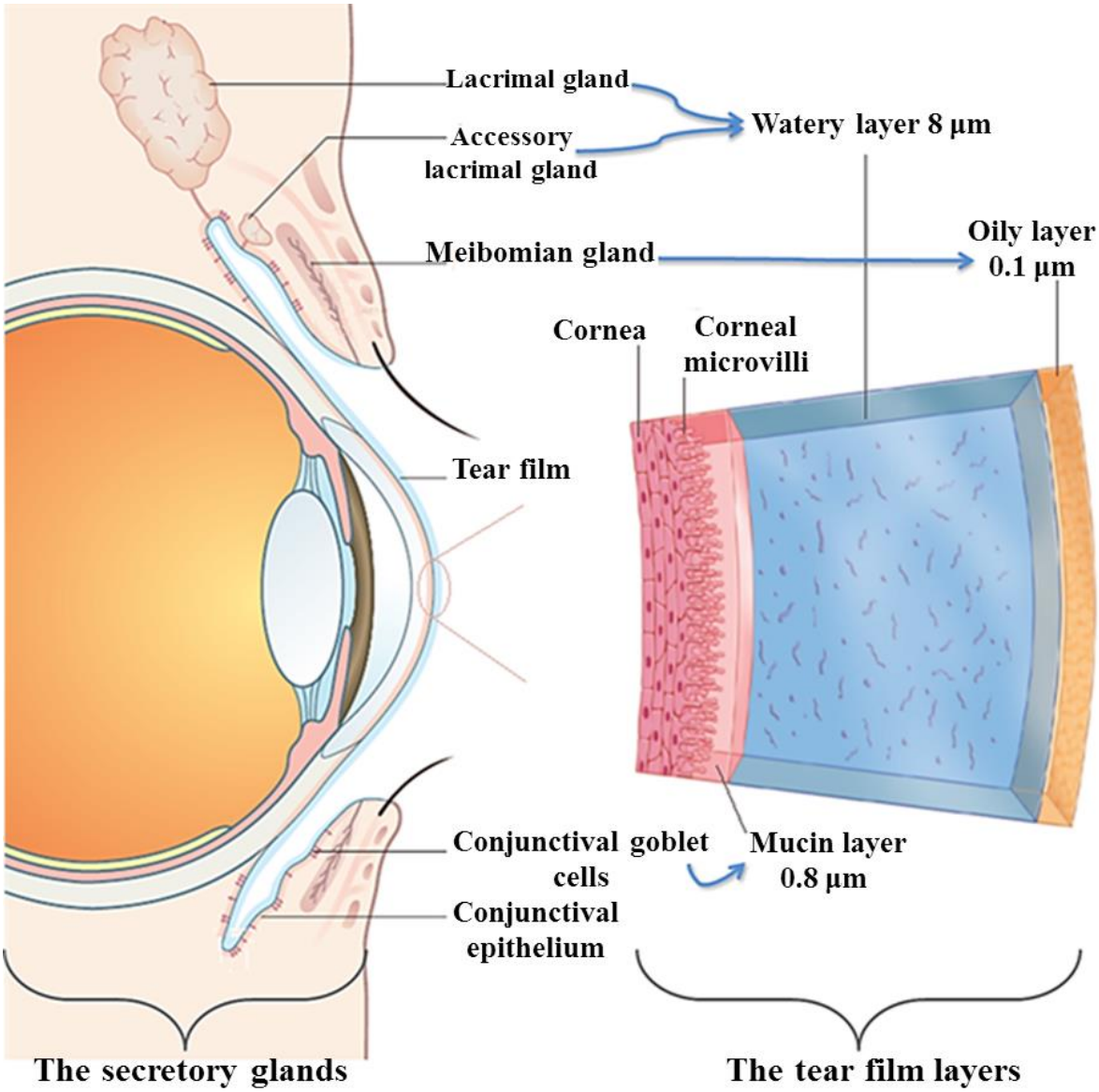


Fig. 2.2 The tear film layers and their secretory glands (Macsai and Mojica 2013)

2.2.3 Physical properties

The precorneal tear film is a thin film of fluid, which covers the exposed ocular surface. Essential for the health and normal function of the eye and visual system, any abnormality in quantity or quality of the tear film can lead to signs and symptoms of dry eye disease and ultimately to a loss of vision (Craig and etal 2011).

Tears form a thin layer approximately 7 – 10 µm thick that covers the corneal and conjunctival epithelium in normal subjects (Whitcher 2007) may reach to 40 µm as shown recently by confocal microscope. The tear film is thickest after a blink

measuring about 9 μm then decreased gradually to reach to its minimal thickness 4 μm after 30 seconds (Khurana and Khurana 2008). The tear film is significantly thinner in dry eye patients with measured values as low as 2.0 μm ± 1.5 μm (Foster and Lee 2013), it provides the interface between these epithelia and the external environment (Dartt 2011). Tear production is approximately 1.2 μl per minute (Foster and Lee 2013), with a total volume of estimated to be 7 ± 2 μL in each eye in waking (Whitcher 2007) and a turnover rate of 16% per minute (Foster and Lee 2013). This volume is highest in youth and then begins to decline with age to reach a value of 10 % the youthful value by the age of 70 years leading to signs and symptoms of dryness (Khurana and Khurana 2008). During sleep, tear production is minimal in the normal eye (Craig and etal 2011).

The tear film is essential for the health and protection of the ocular surface and for clear vision as the tear film is the first refractive surface of the eye (Dartt 2011). With 1.357 refractive index, it provides a smooth refracting surface over the microvilli of the corneal epithelium. The air–fluid interface of the tear film is a powerful lens that supplies two thirds of the refracting power of the eye (Foster and Lee 2013).

The tear film tempreture is 35° C at the limbus to low of 30° C at the center of the cornea with oxygen tension (pO_2) varies from 40 – 160 mm Hg (Khurana and Khurana 2008).

The pH of tears is about 7.4. A more acidic pH of about 7.25 is found following prolonged lid closure possibly due to carbon dioxide produced by the cornea and trapped in the tear pool under the eyelids (Garg 2010).

Adequate production, retention, distribution, and balanced elimination of tears are necessary for ocular surface health and normal function. Any imbalance of these components can lead to the condition of dry eye. They all balanced by tears Osmolarity (Carig and etal 2011). The Tears osmatic pressure which caused by the presence of electrolytes is about 305 mOsm/ kg. A decrease to an average 285 mOsm/kg has been reported following prolonged lid closure which accounts for the reduced evaporation. When the aqueous component of tears decreases, the tears become markedly hypertonic and corneal dehydration results (Garg 2010). Elevated osmolarity (Hyperosmolarity) causes significant corneal epithelial stress that may

result in increased levels of inflammatory mediators and may be the single best marker for dry eye disease (Foster and Lee 2013).

2.2.4 Formation of tear film

During the closure of the eyelids the superficial lipid layer of the tear film is compressed by the eyelid edges. The aqueous tear layer remains uniform under the lids and acts as a lubricant between the eyelids and the globe. In a complete blink phenomenon, the two tear menisci join and most of their bulk is held at their junction to fill the slight bridge formed by the meeting eyelids and at the canthus (Garg 2010). Meibum oily cell is released on to the ocular surface in small amounts with each blink forming a casual reservoir with about 30 times more lipid than needed for each blink. With the up-phase of each blink the upper lid draws oil from the lid reservoir and spreads it over the anterior tear film surface. With the down phase the lipid film is returned to the marginal reservoir as the lid closes (Dartt 2010). The conjunctival mucus spread on to the cornea by the action of the lids (Khurana and Khurana 2008).

Generally there is balance between the secretion and excretion of tears and the rate of tear drainage increases with increased tear volume (Garg 2010).

2.2.5 Tear film stability, distribution, and blinking

The distribution of tear fluid on the ocular surface is highly dependent on the blink. A blink initiates a cycle of secretion, dispersal, evaporation, and drainage of tears (Griepentrog and Lucarelli 2010). Lid closure during a blink progresses from the temporal to the nasal side of the eye spreading tears across the ocular surface and facilitating tear drainage through the lacrimal puncta (Craig and etal 2011).With each blink, the tear film is continuously spread over the ocular surface, maintaining optical visual clarity of the cornea (Biber 2013). The normal blink rate in the human eyes is 16 - 20 per minute (Garg 2010) but in detailed reading tasks, requiring concentration, the blink rate drops to about a half (Craig and etal 2011) leading to increasing evaporative loss (Biber 2013). Improved regularity of complete blinks may contribute to reduce tear thinning and evaporation rates by improving mucin, lipid, and aqueous distribution and accordingly; tears stability (McMonnies 2010).

The thin tear film is stable and so not likely to break especially in the presence of hydrophilic mucins, except by mechanisms that draw fluid out of the tear film such as evaporation (Wang and Chauhan 2010).

The Superficial epithelial cells of the cornea have surface microvilli increase the cell surface area and improve oxygen and nutrient uptake from the tear film to the cornea. Those microvilli interact with glycocalyx particles, which attach to the mucins in the tear film and improve tear film stability. Loss of glycocalyx particles causes tear film instability and ocular surface disease (Hamrah and Sahin 2013). Unstable tear film, occurs when the mucous layer ruptured, allowing the aqueous to come in contact with exposed epithelium (Jeng 2013).

2.2.6 Tear film break up

There are many mechanisms of tear breakup; it may depend strongly on the initial tear film thickness, the aqueous film rupture once the mucous layer has been broken. When the hydrophilic mucin layer is sufficiently contaminated by lipid from the top, the mucin becomes hydrophobic and the tear film ruptures (Wang and Chauhan 2010).

Deficient lipid layer may also cause break up problems due to increase of evaporation (McMonnies 2010).

It is clearly that the quality and quantity of tears are the most important variables that have an impact on tear film disruption and breakup (Wang and Chauhan 2010).

2.2.7 Tear film evaporation

Evaporation of the tear film depends on the amount of time the tear film is exposed between blinks and temperature, humidity, and wind speed (Dartt 2010).

In the normal tear film between 10 and 25% of the total tears secreted are lost by evaporation. Evaporation rate is low because of the protective oily surface (Garg 2010).

Generally the approximate evaporation rate is 0.14 µL/min (Peters and Colby 2007), or 3 µl/hr cm^2 in normal eye (Dawson, Ubels, and Edelhauser 2010).

2.2.8 Tear film evaluation

2.2.8.1 Schirmer tears testing

Quantification of tear production in the office setting is routinely done with Schirmer test strip. White Whatman filter paper in (35x5 mm) strips is folded 5 mm from one end which is placed into the inferior fornix at the junction of the medial two thirds and the other lateral one-third of the lower eyelid. In semi-darkened room, the patient asked to blink normally for 5 minutes. The amount of wetting is recorded in millimeters (Kominek, DellaRocca, and Rosenbaum 2007).

Schirmer 1 test which the most popular measures both basal and reflex tear production (Jeng 2013). Normal values of the test without anesthesia are more than 15 mm, values of 5-10 mm are suggestive of moderate to mild dryness and less than 5 mm is severe (Khurana 2007). When topical anesthetic is applied before performing the filter; less than 5 mm is diagnostic of aqueous tear deficiency and 5 to 10 mm is involved (Peters and Colby 2007), (In the normal nonanesthetized eye, 15 mm of wetting is expected in a patient younger than 40 years of age, and at least 10 mm of wetting is expected in a patient older than 40 years. If anesthetic is placed onto the eye, the basal secretion is expected to be 10 mm of wetting in a normal patient younger than 40 years and at least 5 mm in a patient older than 40years (Hurwitz 2008)). Schirmer 1 test results for normal individuals have been reported to reach up to 33.1 mm (Jeng 2013).

The Schirmer 2 test measures reflex tear secretion in response to nasal stimulation. The Whatman paper is placed in the lower eyelid in the same manner as the Schirmer I test, followed by stimulation of the nasal mucosa with a cotton-tipped applicator. Wetting of less than 15 mm after 5 minutes is associated with a defect in reflex secretion. This test is uncomfortable for the patient because of the vigorous stimulation of the nasal mucosa (Peters and Colby 2007).

2.2.8.2 Tear break-up time (TBUT)

This test evaluates the stability of the tear film (Lang and Wagner, 2007); it indicates the function of the mucin layer or perhaps a reflex hyper secretion of an aqueous component of the tears (Kominek and etal 2007).

TBUT is the interval between a complete blink and appearance of first randomly distributed dry spot on the cornea. It is noted after instilling a drop of fluorescein and examining in a cobalt-blue light of a slit-lamp. Its normal values range from 15 to 35 seconds. Values less than 10 seconds imply an unstable tear film (Khurana 2007).

2.2.8.3 Bengal rose staining

The instillation of dyes is a common method to detect ocular surface epithelial pathology associated with dry eyes (Sridhar 2009).

Rose Bengal dyes dead epithelial cells and mucin (Lang and Wagner 2007). Rose bengal staining is considered more sensitive and more specific in detecting patients with dry eyes than either reduced tear break-up time or a Schirmer's test (Sridhar 2009). It is very useful in detecting even mild cases of keratoconjunctivitis sicca (KCS). The only disadvantage with Rose Bengal staining is that it may cause ocular irritation especially in eyes with severe KCS. In order to reduce that amount of irritation only a small drop should be instilled into the eye (Garg 2010).

The test is similar to a break-up time test. One drop of bengal rose is placed in the eye and the patient blinks several times for 1 min. Interpalpebral staining with bengal rose areas are then found in the dry eye (Kominek and etal 2007).

2.2.8.4 Lipid layer evaluation

The currently available examinations are Interferometry and Meibometry (Peters and Colby 2007).

Interferometry is used to determine lipid layer thickness and fluidity by observing interference patterns generated by light reflected from the surface of the lipid layer and from the interface between the lipid and aqueous layer of the tear film. Studies have shown greater tear film stability with a thicker lipid layer (Peters and Colby 2007).

Meibometry assesses the baseline level of meibomian lipids by using a laser device (Peters and Colby 2007).

2.3 Dry eyes

Dry eye syndrome DES (also called dysfunctional tear syndrome or keratoconjunctivitis sicca KCS) is a common, multifactorial disease. It is a disorder of the tear film and the ocular surface that occurs due to either deficient production of aqueous tears or excessive evaporation of tears or a combination of the two that causes damage to the interpalpebral ocular surface associated with symptoms of ocular discomfort and/or visual disturbance. Dry eye is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface (Goyal, Barsam, and Tuft 2009) (Lemp 2007).

2.3.1 Symptoms and clinical findings

Dry eye results in a broad spectrum of symptoms with varying degrees of severity. The most common result of these symptoms is due to epithelial problems leading to foreign body sensation, fluctuation in visual quality, decreased contrast, photophobia and other Complaints (Foster and Lee 2013).

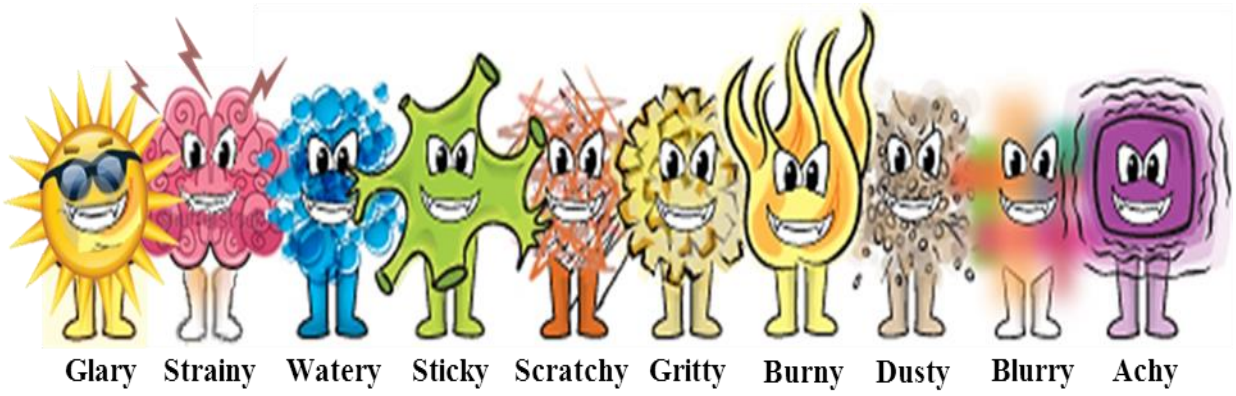


Fig. 2.3 The complaints of dry eye's patient (what is dry eye 2014)

Usually bilateral and chronic, patients with dry eyes complain most frequently of a scratchy or sandy (foreign body) sensation, burning, dryness, and photophobia. Other common symptoms are itching, redness, ocular pain, difficulty in moving the lids, mildly to moderately decreased vision, sometimes excess tearing. The eye often exacerbated by smoke, wind, heat, low humidity, cold, central heating, air conditioning, or prolonged use of the eye (commonly when working on a computer),

(Ehlers and Shah 2008) (Whitcher 2007). Symptoms from aqueous tear deficiency tend to be worse at the end of the day while those from increase evaporative tend to be worse at the beginning of the day (Goyal and etal 2009).

Signs of dry eye include a decreased tear meniscus (The normal meniscus should be at least 1 mm in height and have a convex shape), debris in the tear film, conjunctival injection, the bulbar conjunctiva loses its normal luster and may be thickened, edematous, and hyperemic and superficial punctate keratitis and conjunctivitis. Abnormal fluorescein or rose bengal staining of the corneal and conjunctival epithelium in the exposed interpalpebral fissure (at 3 and 9 o'clock) of the lower third of the cornea is often present, decreased tear breakup time less than 10 sec., less than 10 mm of Schirmer strips wetting without anesthesia or less than 5 mm with anesthesia. (Ehlers and Shah 2008) (Whitcher 2007) (Gault 2007).

2.3.2 The causative mechanisms of dry eye

There are certain core mechanisms which envisaged at the center of the dry eye process that can initiate, amplify, and potentially change the character of dry eye over time. These are tear hyperosmolarity and tear film instability (Craig and etal 2011).

2.3.2.1 Tear hyperosmolarity

Hyperosmolarity; which is an increase in the solute concentration, is thus an important biomarker for dry eye disease. Tear hyperosmolarity has been found to be the primary cause of discomfort, ocular surface damage, and inflammation in dry eye. It has been demonstrated to decrease a 17 % in the density of goblet cells in humans (Craig and etal 2011).

Tear hyperosmolarity arises as a result of water evaporation from the exposed ocular surface, in situations of a low aqueous tear flow, or as a result of excessive evaporation, or a combination of these events (Lemp 2007).

Hyperosmolarity stimulates a cascade of inflammatory events in the epithelial surface cells, these inflammatory events lead to apoptotic death of surface epithelial cells, including goblet cells (Lemp 2007) causing changes in mucin production and a loss of lubrication between the lid and the ocular surface (Lemp 2013) leading to tear film

instability. This instability exacerbates ocular surface hyperosmolarity and completes the vicious circle (Lemp 2007).

2.3.2.2 Tear film instability

A tear breakup time of greater than 10 sec. is considered normal while values less than 5 sec. are suggestive of dry eye. The BUT value is still currently regarded as an index of tear film instability (Lemp 2007).

In some forms of dry eye, tear film instability may be the initiating event, unrelated to prior tear hyperosmolarity (Lemp 2007).

Disturbances in the mucin cover of the cornea are responsible for rapid break-up as in xerophthalmia, allergic eye disease and Contact lens wearing (Lemp 2007).

2.3.3 Classification

From this definition, there are two clear categories of DES as proposed by the National Eye Institute, one related to insufficient production and the other to increased evaporation of tears, and there are several subgroups in each of the two categories (Meyer 2010).

2.3.3.1 Aqueous tear deficient dry eye

Aqueous tear-deficient dry eye implies that dry eye is due to a failure of lacrimal tear secretion. In any form of dry eye due to lacrimal acinar destruction or dysfunction, dryness results from reduced lacrimal tear secretion and volume. This cause tears hyperosmolarity, because, although the water evaporates from the ocular surface at normal rates, it is from a reduced aqueous tear pool (Lemp 2007). Tear-deficient dry eye is subdivided into two categories: Sjögren syndrome tear deficiency and non-Sjögren tear deficiency depending upon whether there are associated systemic signs and symptoms (Peters and Colby 2007).

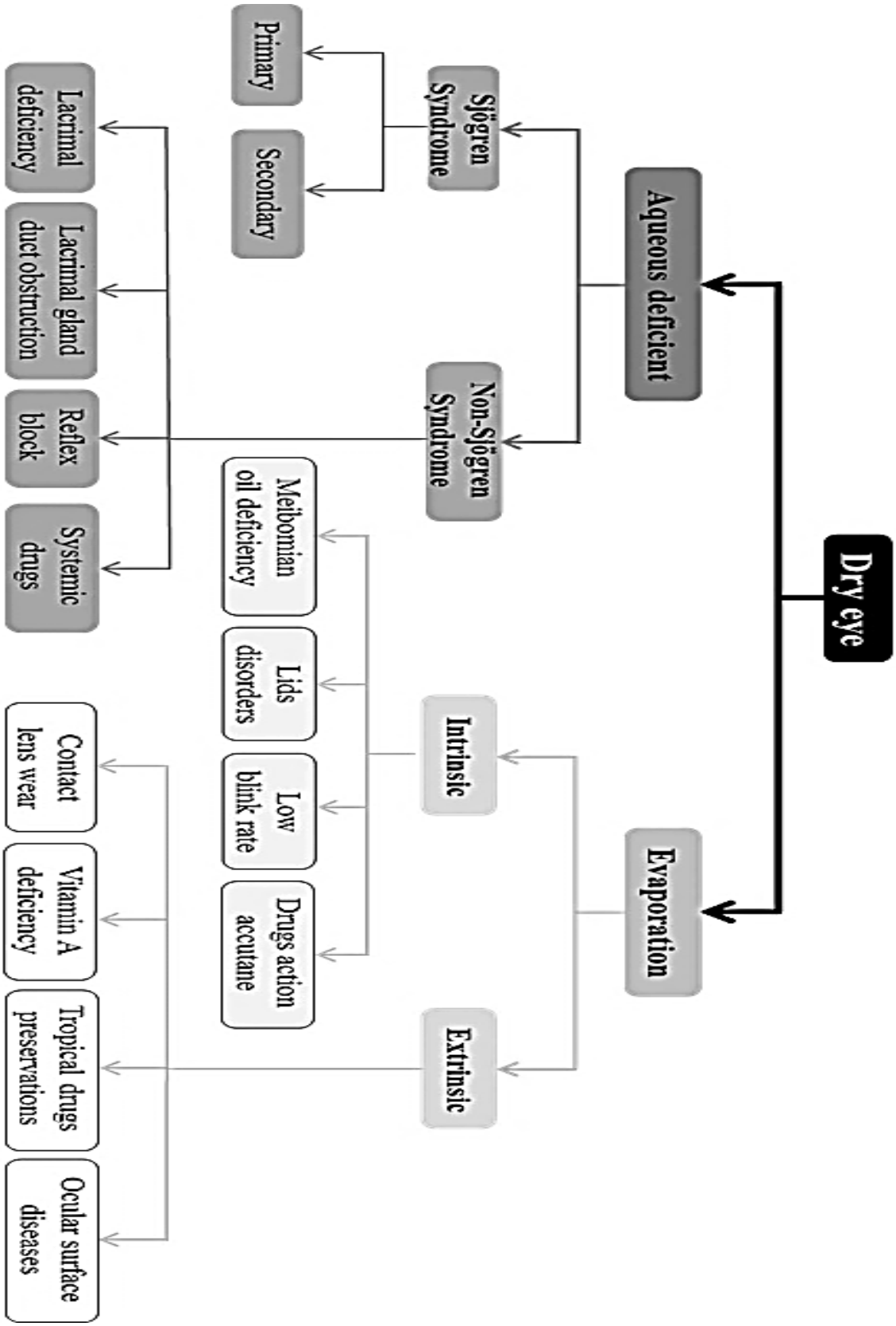


Fig. 2.4 Major etiological causes of dry eye according to International Dry Eye Work Shop (DEWS) (Lemp 2007)

2.3.3.1.1 Sjögren syndrome

Sjögren syndrome is an autoimmune exocrinopathy that is characterized by chronic inflammatory lymphocytic infiltration and immune-mediated destruction of the lacrimal and salivary glands causing dry eyes and mouth (Peters and Colby 2007). The condition is classified as primary when it exists in isolation, and secondary when associated with other diseases such as rheumatoid arthritis, systemic sclerosis, mixed connective tissue disease, primary biliary cirrhosis, chronic active hepatitis and myasthenia gravis (Kanski and Bowling 2011).

The ocular dryness in Sjögren Syndrome is due to lacrimal hypo secretion and the accompanying characteristic inflammatory changes in the lacrimal gland, together with the presence of inflammatory mediators in the tears and within the conjunctiva (Lemp 2007).

2.3.3.1.2 Non-sjögren syndrome

In the absence of an autoimmune disease, ocular symptoms of dry eye with evidence of lacrimal dysfunction may be diagnosed as non- Sjögren dry eye. Non- Sjögren tear deficiencies include different forms (Peters and Colby 2007).

2.3.3.1.2.1 Primary lacrimal deficiency

The most common form of Non-Sjögren dry eye is primary lacrimal deficiency (PLD), although the etiology of this disorder is unknown but it had been reported that the lacrimal gland dysfunction may be a result of age-related changes in the lacrimal gland including lobular and diffuse fibrosis and atrophy, as well as periductal fibrosis. PLD also, may occur due to hormonal fluctuations as a result of a decline in serum androgen levels experienced with menopause, pregnancy, lactation, or the use of estrogen-containing oral contraceptives in women. Congenital alacrima which is a type of PLD is an uncommon condition in children resulting from the absence or hypoplasia of the lacrimal gland, or abnormalities of the innervation of the lacrimal gland. The most common condition associated with alacrima is the Riley-Day syndrome, in which decreased tear production may be caused by abnormal parasympathetic innervation of the lacrimal gland. Patients with this condition produce a reduced amount of tears when crying, reflex lacrimation is absent, and

corneal sensation is decreased. These symptoms make the patients more prone to corneal ulceration and perforation (Peters and Colby 2007).

2.3.3.1.2.2 Secondary lacrimal deficiency

Secondary lacrimal deficiency may be caused by numerous conditions, including lacrimal gland infiltration by sarcoid granulomata, lymphomas, and neurofibromas; lacrimal gland inflammation associated with viral infections such as human immunodeficiency virus type 1 (HIV-1) and hepatits C, vitamin A deficiency through xerophthalmia, a mucin deficiency, and a protein deficiency, lacrimal gland ablation, sensory denervation, refractive surgery, and seventh-nerve palsy affecting the greater superficial petrosal nerve or the nervus intermedius damages caused by interference with the secretomotor fibers of the lacrimal gland (Peters and Colby 2007).

Aqueous deficiency also occurs when the secretory ducts and orifices of the orbital and accessory lacrimal glands are scarred as a result of cicatrizing conjunctival diseases. The most common cicatrizing diseases are: trachoma, ocular cicatricial pemphigoid, erythema multiforme, and Stevens-Johnson symdrome, and chemical and thermal burns (Peters and Colby 2007).

Systemic medications can also increase the risk of developing dry eye in patients with marginal tear production such as antihistamines and anticholinergics (Peters and Colby 2007). Loss of reflex tearing due to decreased surface innervations; contact lens wear (wearers of hard and extended wearing of contact lenses), herpetic disease, diabetic neuropathy, topical/systemic anaesthesia, fifth cranial nerve disease, post-excimer laser refractive surgery (Goyal and etal 2009).

2.3.3.2 Evaporative dry eye

Evaporative dry eye is due to excessive water loss from the exposed ocular surface in the presence of normal lacrimal secretory function. Its causes have been described as intrinsic, where they are due to intrinsic disease affecting lid structures or dynamics, or extrinsic, where ocular surface disease occurs due to some extrinsic exposure (Lemp 2007).

A study has shown that the tear evaporation rate is positively correlated with tear osmolarity and inversely related to tear stability. Hyperosmolarity damages the ocular surface directly and indirectly by triggering inflammation (Peters and Colby 2007).

2.3.3.2.1 Intrinsic causes

2.3.3.2.1.1 Meibomian gland dysfunction

Meibomian gland dysfunction MGD, or posterior blepharitis, is a condition of meibomian gland obstruction and is the most common cause of evaporative dry eye (Lemp 2007); it leads to both decreased secretion and abnormal composition of the tear film lipid layer. The abnormal composition leads to meibomian gland blockage and reduced effectiveness in the tear film. The resulting ocular surface and eyelid inflammation perpetuates a cycle of inflammation, scarring, hyperkeratosis, stenosis, and further MGD. (Tu and Rheinstorm 2008). MGD can be primary or secondary, simple or cicatricial. In simple MGD, the gland orifices remain located in the skin of the lid, anterior to the mucocutaneous junction while in cicatricial MGD, the duct orifices are drawn posteriorly onto the lid and tarsal mucosa and, hence, are unable to deliver oil to the surface of the tear film (Lemp 2007).

Obstruction of the meibomian ducts causes accumulation of meibomian gland secretions, known as meibum which can lead to inflammation of the gland and bacterial colonization. The colonizing bacteria have Lipases that break the non-polar wax and sterol esters into triglycerides and free fatty acids (polar lipids), thus altering the normal composition of the meibum. The polar lipids diffuse more easily through the aqueous layer and contaminate the mucin layer, making it hydrophobic. This causes the tear film to become unstable, and the surface of the eye becomes unwettable (Perry and Donnenfeld 2010). An association is also seen with dermatologic conditions such as seborrheic dermatitis and acne rosacea, a disorder resulting in vascular dilatation, telangiectasias, and plugging of sebaceous glands of both facial and eyelid skin (Tu and Rheinstorm 2008).

Blepharitis which is an acute or chronic inflammatory process involving the eyelids aggravates dry eye syndrome by acting as a source of antigenic and proinflammatory substances, and adversely influencing lipid production. Conjunctival impression

cytology demonstrates epithelial impairment, rupture of intercellular junctions, loss of goblet cells, and deficient mucin secretion in patients with blepharitis (Peters and Colby 2007).

Blepharitis and meibomianitis are two of the most common forms of ocular surface dysfunction. Their sequelae may lead to breakdown of the ocular surface including dry eye symptoms which are usually worse in the morning than in the evening. Both are chronic diseases which often require long term therapy. A comprehensive approach in conjunction with a dermatologist may be necessary (Perry and Donnenfeld 2010).

2.3.3.2.1.2 Disorders of lid aperture and lid/globe congruity or dynamic

The width of the lid aperture determines the size of the ocular surface area that is exposed and subject to evaporation as in endocrine exophthalmos. Patients with proptosis of any cause and high myopia will experience greater rates of evaporation from the ocular surface, which may result in surface drying. Poor lid/globe congruity affects tear film resurfacing between blinks (Peters and Colby 2007) (Lemp 2007). Proptosis due to thyroid eye disease, craniosynostosis, and orbital masses increase the area of exposure, resulting in worsening dry eye. Lagophthalmos, especially nocturnal, or incomplete closure after blepharoplasty are other causes of intrinsic evaporative dry eye (Biber 2013).

2.3.3.2.1.3 Low blink rate

Neuronally controlled lid blinking mechanically spreads the tear film over the ocular surface while also removing and draining old tears via the nasolacrimal ducts into the nose. Thus, disorders that affect the frequency of blinking will not only influence the integrity of the tear film but will also affect the removal of tears from the ocular surface. Delayed tear clearance caused by decreased blinking may promote ocular surface inflammation by prolonging exposure to noxious substances present in the tears. In addition, decreased blinking will increase the rate of evaporation from the eye by prolonging interblink periods and may decrease lipid layer thickness by reducing meibomian oil secretion (Peters and Colby 2007). This may occur as a physiological phenomenon during performance of certain tasks of concentration, as,

working at video terminals or microscopes, or it may be a feature of an extrapyramidal disorder, such as Parkinson disease (Lemp 2007).

2.3.3.2.2 Extrinsic causes

2.3.3.2.2.1 Ocular surface disorders

Disease of the exposed ocular surface may lead to imperfect surface wetting, early tear film breakup, tear hyperosmolarity, and dry eye. Causes include vitamin A deficiency and the effects of chronically applied topical anesthetics and preservatives (Mindel 2007).

2.3.3.2.2.1.1 Vitamin A deficiency

Vitamin A is a fat-soluble alcohol important for corneal and retinal function. Humans ingest preformed vitamin A or its precursors, carotenoids (Mindel 2007). It is particularly important because it helps make the white blood cells called lymphocytes in the immune system; it's one of antioxidants (Allman 2010), so; it is required for normal immunity, maintenance of mucosal surfaces, growth, reproduction, vision, and hematopoiesis (Semba 2007).

Vitamin A Deficiency disorders consist of a syndrome that includes night blindness, pathological changes of the conjunctiva, cornea, and retina, and blindness, immune suppression and increased inflammation, increased morbidity and mortality from some infectious diseases, growth failure, and anemia (Semba 2007).Vitamin A Deficiency results in keratinization of the superficial epithelial cells of the eye and Xerophthalmia (Lang and Wagner 2007). Without vitamin A, the goblet cells diminish in number and activity, limiting the secretion of mucus (Rolfes, Pinna, and Whitney 2009), Degeneration of the goblet cells causes the surface of the conjunctiva to lose its luster .The keratinized epithelial cells die and are swept into the palpebral fissure by blinking, where they accumulate and create characteristic white Bitot's spots (Lang and Wagner 2007) which is a localized keratinization, squamous metaplasia of the bulbar conjunctiva, and shows a thickened, bubbly appearance to the involved area and xerosis bacteria are found in great numbers on the lesion (Yanoff and Sassani 2009) (Semba 2007).

Due to bilateral conjunctival and corneal dryness; vitamin A deficiency characterized by decreased tear breakup time. The deficiency also causes yellow or white peripheral retinal dots representing focal retinal pigment epithelium (RPE) defects (Xerophthalmia fundus and Retinitis Pigmentosa).

So, briefly; the patients with vitamin A deficiency; complains of night blindness (earliest and most common manifestation), dry eyes, ocular pain, and severe vision loss later (Shah and Ehlers 2008) may lead to blindness within a few years without vitamin A substitution (Lang and Wagner 2007), with ocular signs; classified in order of severity from night blindness (XN) to corneal ulceration and keratomalacia that involves one-third of the cornea or greater (X3B). A corneal scar (XS) is not a sign of active vitamin A deficiency. Xerophthalmic fundus (XS) is usually considered to be a rare condition (Semba 2007).

2.3.3.2.2.1.2 Topical drugs and preservatives

Many components of eye drop formulations can induce a toxic response from the ocular surface. Of these, the most common offenders are preservatives, which cause surface epithelial cell damage and punctuate epithelial keratitis, which interferes with surface wettability. Therefore, frequent applications of preserved artificial tear preparations should be avoided. Topical anesthesia causes drying in two ways. It reduces lacrimal secretion by reducing sensory drive to the lacrimal gland and also reduces the blink rate. Chronic use of topical anesthetics can cause a neurotrophic keratitis leading to corneal perforation (Lemp 2007). Topical eye drops such as those used in glaucoma can cause or worsen dry eye. Aminoglycoside antibiotics, b-blockers, and pilocarpine are common offenders. Systemic medications that can decrease tear production include antimuscarinics (Scopolamine, Detrol), antihistamines, lithium, diuretics, estrogens (including birth control pills), antihypertensives (β-blockers, α-agonists), antidepressants, chemotherapy agents, antipsychotics, marijuana, and morphine (Gault 2007). Glaucoma patients treated for years with preservative-containing drops are at risk for evaporative dry eye (Biber 2013).

2.3.3.2.2.2 Contact lens wear

Contact lens wear disrupts the stability of the tear film leading to increased evaporation from the ocular surface. Sensory loss as a result of prolonged contact lens wear may also decrease lacrimal secretion by interfering with the afferent reflex arc (Peters and Colby 2007).

Compared with the normal tear film, the pre-lens tear film is thinner, less stable, and exhibits higher evaporation related to a thinner lipid layer. All contact lenses inhibit normal tear exchange by trapping debris, toxins, antigens, and microorganisms beneath the lens and interfering with the normal resurfacing action of blinking (Carnt, Wu, and Stapleton 2011).

The rate of tear exchange varies with lens type, material and wearer characteristics. For example, rigid gas permeable (RGP) contact lenses allow more rapid tear exchange than hydrogel or silicone hydrogel lenses and are associated with a lower rate of inflammatory complications compared to soft lens wear (Carnt and etal 2011), but, Prolong wearing of rigid contact lenses cause Inferior/palpebral punctate stain plus hyperemia due to incomplete blink and drying epithelial punctate staining of the peripheral cornea 3 and 9 o'clock, with or without superficial vascularized scars and interpalpebral hyperemia (Beyer and Langston 2008).

2.3.3.2.2.3 Refractive surgery

Injuries to the ocular surface occur in the reshaping of the anterior corneal surface by excimer laser photorefractive keratectomy (PRK), laser in situ keratomileusis (LASIK) or laser subepithelial keratomileusis (LASEK).During flap creation and laser ablation; corneal nerves are transected, resulting in decreased corneal sensitivity and a transient neurotrophic cornea. As a result, it derails the reflex arc of lubrication, results in decreased tear secretion, decreased mucin production, decreased blink rate, altered tear-film stability caused by changes in corneal curvature, and loss of trophic effects on surface cells, leading to dry eyes (Nassaralla, and Nassaralla 2010).

Dry eyes are a common complaint after refractive surgery, with an incidence ranging from 3% to 60%. Over the course of weeks to months to years, the nerves regenerate, and tear dynamics can return to normal (Nassaralla, and Nassaralla 2010).

2.3.3.2.2.4 Allergic conjunctivitis

Allergic conjunctivitis takes several forms, which include seasonal allergic conjunctivitis, vernal keratoconjunctivitis, and atopic keratoconjunctivitis. They cause stimulation of goblet cell secretion and loss of surface membrane mucins. Surface epithelial cell death occurs, affecting conjunctival and corneal epithelium (punctate keratoconjunctivitis). Surface damage and the release of inflammatory mediators leads to allergic symptoms and to reflex stimulation of the normal lacrimal gland (Lemp 2007).

Surface irregularities on the cornea (punctate epithelial keratitis and shield ulcer) and conjunctiva can lead to tear film instability and, hence, to a local drying component to the allergic eye disease. In chronic disease, there may be meibomian gland dysfunction, which could exacerbate surface drying by interfering with the tear film lipid layer (Lemp 2007).

2.3.3.2.2.5 Environmental factors

There are environmental factors that could dehydrate the eyes and tear film, may include indoor conditions such as forced-air heating and cooling. Indoor chemicals such as cleaning fluids also are dehydrating to the eyes. However, fresh air from the outdoors (unless heavily polluted), is usually far healthier for eyes, skin, breathing passages and lungs. Hot, dry, and windy weather, heaters and air conditioners, and high altitudes increase the evaporation of tears (Kleyne 2012).

Car, truck passenger compartments and airliner cabins are extremely dehydrating to eyes due to low humidity (Kleyne 2012).

Lifestyle choices and personal habits that could contribute to eye dehydration include wearing contact lenses, prolonged computer use, participation in extreme sports (with lots of perspiration and exposure to heat and sun), caffeine and alcohol consumption, not drinking enough water, too much time spent indoors, cigarette smoking, medications, etc (Kleyne 2012).

Exposure to smoke, dust, wind, extreme heat and cold and other outdoor conditions could also contribute to eye dehydration (Kleyne 2012).

As temperature increases, delivery to eyelid margin increases, refractive index decreases, lipid becomes more disordered, and lipid motion increases. In the other side; drop in temperatures make the oil to become too thick and stiff to spread onto the eye surface. The meibum normally has a melting point between 19 and 39°C (Foulks and Borchman 2010).

2.3.3.3 Classification of dry eye on the basis of severity according to international dry eye work shop (DEWS)

2.3.3.3.1 Mild dry dye

Occurs under environmental stress, the patient not complain/or may complain of mild symptoms. The schiermer filter record more than10 mm in 5 min (Lemp 2007).

2.3.3.3.2 Moderate dry eye

Patient now is annoying, with mild debris and reduction in the tear meniscus, mild conjunctival injection and the schiermer score ≤ 10 (Lemp 2007).

2.3.3.3.3 Severe dry eye

The patient complains of chronic symptoms, there is moderate to marked conjunctival injection and staining, filamentary keratitis, mucus clumping, increase in tear debris, and schiermer score ≤ 5 (Lemp 2007).

2.3.3.4 Dry eye and computer vision syndrome

Computer vision syndrome (CVS) is a condition affecting people working on the computer monitor. Considering the undisputable invasion of technology into our lives, this is a problem to reckon with (Garg 2010). It describes a group of eye and vision-related problems that result from prolonged computer use. The level of discomfort appears to increase with the amount of computer use with variable symptoms but mostly include eyestrain, headaches, blurred vision (distance or near), dry and irritated eyes, slow refocusing, neck and backache, light sensitivity, double vision, and color distortion according to American Optometric Association (AOA 2013).

Working at a computer requires that the eyes continuously focus, move back and forth, and align with what you are seeing. You may have to look down at papers and then back up to type, and the eyes have to accommodate to changing images on the screen in order to create a clear picture for the brain to interpret. All of these functions require a lot of effort from eye muscles. Working on a computer is more challenging to your eyes than reading a book or piece of paper (Nazario 2012), the prints on a computer monitor, unlike in paper in made up of pixels which are small dots. Their edges are fuzzy giving rise to poor contrast and indistinct margins. The eye has to constantly refocus to keep the images sharp which leads to strain of the eye muscles, also, letters on computer monitors may be of variable light intensify thereby adding to the poor contrast levels (Garg 2010).

There's no evidence that computer vision syndrome causes any long-term damage to the eyes, for example; cataracts. However, regular computer use can be the source of significant eyestrain and discomfort (Nazario 2012) due to poor lighting, glare on the computer screen, improper viewing distances, poor seating posture, uncorrected vision problems, and / or a combination of these factors. Many of the visual symptoms experienced by computer users are only temporary and will decline after stopping computer work. However, some individuals may experience continued reduced visual abilities, such as blurred distance vision, even after stopping work at a computer. If nothing is done to address the cause of the problem, the symptoms will continue to recur and perhaps worsen with future computer use (AOA 2013).

The most common symptoms are:

a. Dry and Irritated eyes; caused by decreased blinking reflex while working long hours focusing on computer screens. The normal blink rate in the human eyes is 16-20 per minute. Studies have shown the blink rate to decrease to as low as 6-8 blinks/minute for persons working on the computer screen, and so; leads to dry eyes (Garg 2010). Possible explanations for the decreased blink rate include concentration on the task or a relatively limited range of eye movements. Although both book reading and computer work result in significantly decreased blink rates, a difference between them is that computer work usually requires a higher gaze angle, resulting in an increased rate of tear evaporation. It is also likely that the higher gaze angle results in a greater percentage of blinks that are incomplete (AOA 2013) (Anshel 2005).

b. Eyestrain (asthenopia); can be caused from some underlying conditions such as near focusing effort required for such long hours puts strain on ciliary muscles of the eye, different vision in each eye, astigmatism, hyperopia, myopia, excess light, voluntary focusing, eye coordination difficulties, and more. This need to eye examination performed to determine the exact source of the complaint (AOA 2013) (Anshel 2005).
c. Blurred Vision; can result from refractive error (e.g., hyperopia, myopia, and astigmatism), improper prescription lenses, presbyopia, or other focusing disorders. Blurred images can also arise from a dirty screen, poor viewing angle, reflected glare, or a poor quality or defective monitor. As the computer worker views the task for an extended period of time, this lag of accommodation increases, often leading to a subjective symptom of blur. The eyes must then expend more effort to pull the focusing point back to the screen causing pseudo myopia (AOA 2013) (Anshel 2005).
d. Headache; Headaches are another of those asthenopic symptoms and are one of the primary reasons people seek an eye examination. Visual headaches most often occur toward the front or sides of the head occur most often toward the middle or end of the day; do not appear upon awakening. Computer workers most likely get tension-type headaches. These can be precipitated by many forms of stress, including anxiety and depression; numerous eye conditions, including astigmatism and hyperopia; improper workplace conditions, including glare, poor lighting, and improper workstation setup (AOA 2013) (Anshel 2005).
e. Neck and Back Ache; doing computer work for three hours contributed not only to eye muscle fatigue but also muscle pain in the head, neck and upper back regions. The computer workers generally adapt their posture to ease the strain on the visual system which causes excessive postural accommodations that lead to the symptoms of neck and back discomfort (AOA 2013) (Anshel 2005).
f. Light sensitivity; discomfort glare is the commonest light sensitivity problem in the work place. It largely caused by large disparities in brightness in the field of view. Poor room light with very bright screen also cause glare (Anshel 2005).
g. Double Vision; looking at objects closer than one's resting point (average 100 cm) for long period causes strain on the muscles controlling the vergence causing misalign, and thus, diplopia (Anshel 2005).

h. After-Images and Color Distortion; when the three types of cones in the retina that mediate colors (red, blue, and green) exposed to a particular color for an extended period of time, they become bleached to that color. Since those cones are temporarily nonfunctional, the other neighboring cones become more effective and they produce a color that is complementary to the original bleaching color causing non-permanent color distortion (Anshel 2005).

Those symptoms may differ from user of liquid-crystal display (LCD) screen and the old cathode ray tube (CRT) screen. LCD exhibits no distortion or flicker by adding enough pixels to fill the screen without distorting the image, which is more comfortable to the eyes (Berkwits 2005). But the LCD causes glare more than CRT because it is much brighter with high contrast than CRT screen (Anshel 2005).

2.3.3.5 Dry eye treatment

Significant advances have been made in treating the many facets of dry eye, but it remains a disorder of long-term maintenance rather than permanent cure. Current therapy focuses on restoring a normal ocular surface through tear supplementation as well as inhibition of aberrant inflammation seen in chronic dry eye syndrome, and since the tear film is a highly integrated unit, addressing each component is central to the successful treatment of DES (Tu and Rheinstrom 2008). Lid hygiene to stabilize the tear film is indicated at all levels (Langston and Colby 2008).

Dry eye can be treated and relieved as long as the corneal and conjunctival epithelial not changed or their changes are reversible (Whitcher 2007), otherwise the management is to control the symptoms and prevent the surface damage (Kanski and Bowling 2011).

The choice of treatment depends on the severity of the disease (Kanski and Bowling 2011) and aetiology. Underlying disease such as blepharitis must be adequately treated (Goyal and etal 2009).

The treatment and management involves one or more of the following measures alone or in combination:

2.3.3.5.1 Artificial tear (AT) replacement

As the first line of treatment, artificial tears increase available tears and, through dilution, reduce tear hyperosmolarity (Tu and Rheinstrom 2008); it is useful for all severity of dryness (Langston and Colby 2008).

Artificial tears remain the mainstay in the treatment of dry eye (Khurana 2007). Commercial artificial tears differ in electrolyte composition, thickening agents (methylcellulose, hydroxypropyl methylcellulose, and polyvinyl alcohol), physiologic buffering, tonicity, and preservative system. Individual patient preferences involve such disparate concerns as cost, comfort, visual blurring, and ease of use, but clearly, toxically preserved tears in moderate or severe dry eye are poorly tolerated and harmful. For patients with significant dry eye, single-dose, non-preserved tear preparations are the mainstay of therapy with bottled tear products a reasonable alternative when preserved with relatively nontoxic compounds. Artificial tear ointments are effective for longer-lasting control of symptoms especially during sleep (Tu and Rheinstrom 2008); they blur vision at daytime, but may be necessary during the day if exposure is a significant problem, as in Bell's palsy (Gault 2007). Ointments containing petrolatum mineral oil (Kanski and Bowling 2011). Side effects of artificial tear substitutes may include redness, stinging and ocular irritation, as well as allergy to one of the ingredients (Macsai and Mojica 2013).

Tears Naturale is one of the most common artificial tears used in Sudan and Iraq. This eye drop is a clear, colorless physiological tear product that exerts a physical, not a pharmacologic action, and it contains the ionic components of the human tear: calcium, magnesium, sodium, potassium, zinc, bicarbonate, chloride ions and purified water (Alcon 2010). It contains two active water-soluble polymers; hypromellose and dextran 70, which are known as eye lubricants (Tears Naturale 2010) (Alcon 2010).

Hypromellose is a synthetic polymer that forms a film on the surface of the eye (cornea). It produces a transparent, lubricating and moistening film on the surface of the eye. Dextran also helps to lubricant the eye (Tears Naturale 2010).

This medicine should not be used if the patient is allergic to any of its ingredients, it may cause irritation of the eye and the patient should stop using it. There are no known harmful effects when this medicine is used by pregnant or breastfeeding mothers (Tears Naturale 2010).

This eye drop used for the symptomatic treatment of moderate to severe dry eye, including keratoconjunctivitis sicca for both adults and children by instill 1 or 2 drops into the conjunctival sac of the affected eye(s) as needed, up to once every 1-2 hours or as prescribed by the physician (Alcon 2010).

The patient must not use this medication while wearing contact lenses. Eye medication may contain a preservative that can discolor soft contact lenses. He must wait at least 15 minutes after using this medication before putting the contact lenses in. If the patient use more than one drop in the same eye, he must wait about 5 minutes before putting in the next drop (Drugs A-Z team 2011)..

2.3.3.5.2 Anti-inflammatory agents

Low dose topical steroids are effective supplementary treatment for acute exacerbations (Kanski and Bowling 2011). Topical steroids should be started in patients with moderate Dryness (Langston and Colby 2008).

Topical cyclosporine (0.05%, 0.1%) is effective for patients with chronic dry eye and decreased tears secondary to ocular inflammation (Shah and Ehlers 2008). It may be used instead of steroids inhibits epithelial apoptosis and T-cell mediated inflammation of the lacrimal tissue (Khurana 2007) (Langston and Colby 2008) resulting in an increase in the number of goblet cells and reversal of squamous metaplasia of the conjunctiva (Kanski and Bowling 2011). Cyclosporine often burns with application for the first several weeks and takes 1 to 3 months for significant clinical improvement (Shah and Ehlers 2008).

Doxy- or minocycline (Tetracyclines) helps patients with dry eyes from any cause are more likely to have concurrent infections as chronic blepharitis which is common and should be treated with hygiene and topical antibiotics and acne rosacea (Whitcher 2007). Dosing for many months is the most effective. Exam reveals decreased severity of ocular surface disease, and increased tear film stability (Langston and

Colby, 2008) by improve meibomian gland function after several weeks (Tu and Rheinstrom 2008).

2.3.3.5.3 Mucolytic agents

Such as 5 percent acetylcystine drops may be useful in patients with corneal filaments and mucous plaques. It may cause irritation following instillation (Kanski and Bowling 2011). This agent helps by dispersing the mucus threads and decreasing tear viscosity (Khurana 2007).

2.3.3.5.4 Punctal occlusion

The principle behind punctal occlusion is to increase the aqueous component of the tear film by blocking tear outflow and retention of both natural and artificial tears on the ocular surface (Rootman, Ku, and Yeung 2013). It is of greatest value in patients with moderate to severe DES who have not responded to frequent use of topical treatment (Kanski and Bowling 2011). This can be achieved by insertion of temporary collagen (1 – 2 weeks) or reversible prolong silicone (2 – 6 months) punctal plugs to retain lacrimal secretions. Permanent closure of the puncta and canaliculi can be done by thermal, electrocautery, or laser treatment, it should be undertaken only in patients with severe dry eye and all four puncta should not be occluded at the same time (Kanski and Bowling 2011) (Whitcher 2007).

2.3.3.5.5 Contact lenses

New high-Dk, high-water-content contact lenses and new polymer lenses, accompanied by proper tear supplementation and hygiene, are effective in treating dry eye syndrome patients with poor corneal wetting (Tu and Rheinstrom 2008).

Low water content HEMA lenses may be successfully fitted to moderately dry eyes. Silicone rubber lenses that contain no water and readily transmit oxygen are effective in protecting the cornea in extreme tear film deficiency, although deposition of debris on the surface of the lens can blur vision and be problematic. Occlusive gas permeable scleral contact lenses provide a reservoir of saline over the cornea which can be worn on an extremely dry eye with exposure (Kanski and Bowling 2011).

2.3.3.5.6 Nutrition

Healthy eating is beneficial to prevent diseases, dryness, and even battling fatigue. Proper hydration of the body and regular daily intake of important nutrients can help to prevent or even alleviate over time many of the symptoms of dry eyes. In general, people who eat a healthful diet of primarily fresh fruits and vegetables, whole grains and moderate amounts of fish show a decreased risk of all eye problems (Hearn 2011). When fatigue is caused by a lack of sleep or long activities, of course, no nutrient or combination of nutrients can replace a good rest and sleep specially at night (Rolfes and etal 2009).

Because most people today suffer from chronic dehydration; pure water is the most essential nutrient for the human body and eye to prevent dryness (Hearn 2011).

Fatty acids are responsible for producing both the watery and the oily aqueous layers of the tear film. The best food sources of essential fatty acids are fish oil, cold-water fish and Flax Seed. People experiencing dry eye have seen an increase in tear production within ten days after increasing essential fatty acids plus vitamins B6 and C (Hearn 2011).

Dry eye can also be caused by free radical damage (oxidative stress) in the body caused by aging, poor diet, lack of exercise, and unhealthy lifestyle factors such as smoking, excess alcohol, medications and chronic stress. Healthful foods rich in antioxidants may help slow down the process of oxidation (Hearn 2011) such as the dark leafy green plants and barriers (Weiss 2012).

All minerals are important for eye health, but Potassium and zinc are especially beneficial. Zinc is a factor in the metabolic function of several enzymes in the vascular coating of the eye. Good sources of zinc include fish, liver, mushrooms, sunflower seeds and whole grains. Potassium which plays an essential role in the osmotic regulation of the extracellular and intracellular spaces is usually very low in patients with dry eye, the best food sources of potassium include almonds, bananas, raisins, dates, figs and avocados (Weiss 2012).

Vitamin A is essential for maintaining the health of epithelial cells throughout the body. Topical and systemic drugs of vitamin A can be used (Macsai and Mojica

2013), or through a good nutrition as liver, eggs, milk and its products, yellow fruits and vegetables such as orange and carrots, and dark green leafy vegetables such as spinach (Allman 2010).

2.3.3.5.7 Omega 3

Omega 3 is a polyunsaturated fatty acid, which means; it is an organic acid. It can found in its major sources; vegetable oils (canola, soybean, sun flower seeds, and flaxseed), Walnuts, fatty fish are among the best sources of it (mackerel, salmon, and sardines) (Rolfes and etal 2009).

Omega 3 fats play a key role in preventing many illnesses and conditions; inflammation (Some omega 3 fatty acids compete with arachidonic acid and inhibit the production of the most powerful inflammatory mediators), stroke and heart disease, allergies, cancer, alzheimer's disease, headache, blood clots, irregular heartbeats, it is lower blood pressure especially in people with hypertension or atherosclerosis, provide relief for people with rheumatoid arthritis or asthma, and protect from macular degeneration (Tribole 2007) (Rolfes and etal 2009). A side effect of high doses of omega 3 fatty acids has not been established. However, some studies have shown a possible increased risk of bleeding and hemorrhagic stroke following supplementation with high-dose omega 3 (Macsai and Mojica 2013).

Omega 3 fatty acids are also available in capsules of fish oil supplements (Rolfes and etal 2009). They are normally supplied in transparent or semi-transparent gelatin capsules which are swallowed with water, but patient should use it consistently for several weeks before he start to notice any benefit. Some reports indicate that some people notice the benefits quite quickly (Omega 3 and EPA 2013).

Omega 3 fats are critical for vision throughout the life cycle, from eyesight development in the womb to prevention of vision problems in the twilight years. This role has many implications for vision disorders and learning. On the other side, breastfed infants of mothers who took omega supplements during lactation had better eye-hand coordination and visual acuity at two and a half years than did breastfed infants of mothers without supplementation (Tribole 2007).

In the ocular health; Omega 3 fats slows the decline of vision loss in retinitis pigmentosa, decrease the risk of age-related macular degeneration, and lowers the risk of cataract development and dry eye syndrome (Tribole 2007).

Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are the omega 3 fatty acids; they are essential for normal growth and development, especially in the eyes and brain (Rolfes and etal 2009). The daily needs is at least 220 milligrams for each of EPA and DHA and 300 milligrams for pregnant or breastfeeding (Tribole 2007).

Omega 3 fish oils combat dry eye by decreasing inflammation in skin thus reducing blepharitis and rosacea as well as the viscosity of meibomian gland secretions (Langston and Colby 2008), and increasing tear production by stimulating tear secretion (AOA, 2013). Additionally, improvements in overall ocular surface disease index score, tear break-up time (TBUT), and meibum score were noted (Macsai and Mojica 2013).

2.3.3.5.8 Conservation of existing tears

Patients should also be counseled to avoid conditions with low humidity such as central air heating, to prevent air from blowing into their eyes as from an air conditioner vent at home or in the car, and to use a humidifier while sleeping and at work if possible. Lubrication may need to be increased while flying, as airplane cabins have very low humidity, and while reading or studying, as the blink reflex is decreased (Gault 2007).

The evaporation can be reduced by decreasing room temperature, use of moist chambers and protective glasses (Khurana 2007). Correction of eyelid abnormalities that increase exposure of the ocular surface, such as lower lid ptosis and lagophthalmos, can stabilize a decompensated ocular surface (Tu and Rheinstrom 2008).

2.3.3.5.8.1 Physical treatment and exercises

Blinking is a crucial part of keeping the right amount of moisture in the eye surface, especially during cold, dry weather. It coats the eye with a fresh layer of tears while

also cleaning the surface and moisturizing it. It is an almost subconscious action that means a lot to a dry eye patient (All about dry eye 2012).

Looking out of the window into a distance object or the sky to provides rest to the ciliary muscles (Garg 2010) and rolling the eyes clockwise one full round, then counter-clockwise another full round. Palming works also helpful to relax the eyes and mind. It is inspired by Yoga Eye Exercises and the patient can do this anywhere by rubbing the palms against each other until the patient feel them warm up , then turning the palms facing upwards and placing them over the eyes for about a minute (All about dry eye 2012).

These exercises will help the patient to relax his eyesight and muscles, clear tear ducts and prevent further vision deterioration (All about dry eye 2012).

Warm compresses may be applied over the eyelids as a treatment for meibomian gland dysfunction. They work by loosening up hardened oil that clogs the oil glands in the eyelids. For many people with chronic meibomian gland dysfunction, heat treatment is an effective maintenance treatment (Bailey 2013). Increasing the eyelid temperature from 33° to 37° C increases the lipid values on the lid margin by close to 25% (Millar and etal 2011).

Drinking more water helps too. Mild dehydration often makes dry eye problems worse. This is especially true during hot, dry and windy weather. Simply drinking more water sometimes reduces the symptoms of dry eye syndrome (Bailey 2013).

2.3.3.5.8.2 Relief of computer vision syndrome

a. Blinking the eyes every now and then to help replenish the tear film.
b. Maintain a distance of 20 - 26 inches from the computer monitor.
c. Computer monitor should be placed 10 - 15 degrees below eye level on straight gaze.
d. Use of antiglare screen.
e. Glare free room lighting.
f. Position computer to avoid falling of direct sunlight and therefore minimize glare.
g. Computer monitor may be placed horizontally on the table which will help the subject to read with his presbyopic correction (Garg 2010).

h. Take a break every 20 minutes and look outside your window or at a 20 feet distant object for 20 seconds.
i. Match the computer screen to the brightness of the environment.
j. Adjust your workstation and chair to the correct height. Purchase ergonomic furniture to ensure adequate distance from the screen, and good posture.
k. Use glasses with an anti-reflective coating.
l. Keep the pixel size as low as possible and flicker rate as high as possible on your computer.
m. Avoid sitting directly under the fan or near the air conditioner to prevent eyes from becoming dry (Priya 2009).
n. The use of over-the counter artificial tear solutions can reduce the effects of dry eye in CVS.
o. Decreased focusing capability is mitigated by wearing small plus powered over-the-counter glasses (+ 1 to + 1.50). It helps such patients regain their ability to focus on near objects (Garg 2010).

2.4 Previous studies

Göbbels M, Spitznas M. in 1992 study the influence of artificial tears on corneal epithelial permeability of dry eyes. Furthermore, the effect of benzalkonium chloride, used as a preservative of artificial tears, on corneal epithelial permeability is investigated. After 6 weeks of treatment with artificial tears containing preservative (20 patients) and (20 patients) used artificial tears without preservative; they found that epithelial permeability of patients treated with unpreserved artificial tears decreased significantly, whereas patients who had been treated with preserved artificial tears showed an increase in epithelial permeability.

Schaumberg D.A, Buring J.E, Sullivan D.A, and Dana R. in 2001 determined the relationship of hormone replacement therapy HRT and dry eye syndrome. They found that women who use HRT, particularly estrogen alone, are at increased risk of dry eye syndrome. Physicians caring for women who are taking or considering HRT should be apprised of this potential complication.

Aragona P, Papa V, Micali A, Santocono M, and Milazzo G. in 2002 demonstrated an improvement of conjunctival epithelial cell abnormalities of the ocular surface

during long term treatment. Their samples were 86 patients with medium to severe dry eye. Patients were treated with either preservative-free sodium hyaluronate or saline for 3 months at a dose of one drop 4 – 8 times a day. After 3 months of treatment; they found that sodium hyaluronate may effectively improve ocular surface damage associated with dry eye syndrome.

Micó R. M, Cáliz A, and Alió J.L. on February 2003 study the effect of artificial tear instillation on ocular aberrations in dry-eye patients. They found that optical aberrations showed a statistically significant reduction after artificial tear instillation. Total aberrations decreased on average by a factor of 2 to 3 times immediately after 10 minutes of instillation.

Pflugfelder S.C. on October 2003 did a study to present evidence establishing the relationship between inflammation and dry eye and supporting the use of anti-inflammatory therapy for dry eye. He found that ocular surface and lacrimal gland inflammation has been identified in dry eye that plays a role in the pathogenesis of KCS. Anti-inflammatory therapy has efficacy for treating KCS. Cyclosporin A is the first Food and Drug Administration approved therapy for this indication. It improved signs and symptoms of KCS, decreased artificial tear use, and it is safe for long-term use.

Trivedi K.A, Dana M. R, Gilbard J.P, Buring J.E. and Schaumberg D.A. in 2003 determined the association between dietary intake of omega 3 fatty acids and risk of dry eye syndrome in women. A total of 32,470 female health professionals aged between 45 and 84 years who provided information on diet and DES were chosen to take omega 3. They used odds ratios and 95% confidence intervals to describe the relationships of omega 3 fatty acid intake and DES. The results suggest that women with a higher dietary intake of omega 3 fatty acids are at decreased risk of developing DES. This was the first study that has evaluated this relationship.

Izquierdo J.C, García M, Buxó C, and Izquierdo N.J. in 2004 used questionnaire to identify the risk factors leading to the CVS in the workplace. They found that the most important factor leading to the syndrome is the angle of gaze at the computer monitor. Pain in computer users is diminished when gazing downwards at angles of 14 degrees or more.

Blehm C, Vishnu S, Khattak A, Mitra S, and Yee R.W. in 2005 did a research to describe both the characteristics and treatment of CVS. Computer vision syndrome symptoms may be the cause of ocular (ocular-surface abnormalities or accommodative spasms) and/or extra-ocular etiologies. However, the major contributor to computer vision syndrome symptoms by far appears to be dry eye. The proper treatment was a combining ocular therapy with adjustment of the workstation. Proper lighting, anti-glare filters, ergonomic positioning of computer monitor and regular work breaks may help improve visual comfort. Lubricating eye drops and special computer glasses help relieve ocular surface–related symptoms.

Johnson M.E, Murphy P.J, and Boulton M. on January 2006 study the effectiveness of sodium hyaluronate eye drops in the treatment of dry eye. 13 subjects with moderate dryness were measured by break-up time and subjects' symptom intensity after installing of different concentrations of saline in their both eyes. Both symptoms and TBUT improved with all treatments.

Telles S, Naveen K.V, Dash M, Deginal R. and Manjunath N.K. in 2006 study the effect of YOGA on self-rated visual discomfort in computer users. 291 professional computer users were randomly assigned to two groups, yoga (YG, n = 146) and wait list control (WL, n = 145). Both groups were assessed at baseline and after sixty days for self-rated visual discomfort using a standard questionnaire. During these 60 days the YG group practiced an hour of yoga program and exercises daily for five days in a week and the WL group did their usual recreational activities also for an hour daily for the same duration. At 60 days there were 62 in the YG group and 55 in the WL group. The results suggest that the yoga practice appeared to reduce visual discomfort, while the group who had no yoga intervention (WL) showed an increase in discomfort at the end of sixty days.

Kangari H, Eftekhari M.H, Sardari S, Hashemi H, Salamzadeh J, Broumand M, and Khabazkhoob M in 2013 did a study to assess the effect of oral omega 3 fatty acids on tear break-up time (TBUT), Schirmer's score, and ocular surface disease index (OSDI) through a double-blind clinical trial. They choose Sixty-four patients with dry eye symptoms between the ages of 45 and 90 years were randomized into 2 groups: 33 persons in the treatment group and 31 persons in the placebo group. The treatment group received 2 capsules of omega 3 daily for 30 days, and the placebo

group received 2 medium-chain triglyceride oil capsules daily for 1 month. After this month there were an increase in TBUT, decrease in OSDI, and increase in the Schirmer's score. This study demonstrated that oral consumption of omega 3 fatty acids was associated with a decrease in the rate of tear evaporation, an improvement in dry eye symptoms, and an increase in tear secretion and the results were significantly better in the treatment group than in the placebo group.

Chapter Three

SUBJECTS AND METHODS

Chapter Three

3. Subjects and Methods

3.1 Place used

The study was done in (Khartoum capital – Sudan) in Banan Information Technologies Co., Humanitarian Aid Commission, Sudanese Airway Co. (H.Q), and National Telecom Corporation Tower and in (Al Sulaymaniyah city – Iraq) in Agricultural Faculty of Al Sulaymaniyah University. The study was done at a period; June and July in Khartoum, and September and October in Al Sulaymaniyah.

3.2 Study environment

Khartoum temperature was 34 °C with humidity 23.50 %. Al Sulaymaniyah was 24.5 ° C with 25.50 % humidity. Air conditionings were used in the offices of Khartoum, and fans in the offices of Al Sulaymaniyah.

3.3 Subjects selection

3.3.1 Criteria of selection

For the subject to be included in this study he should be:

a- Complaining of eye dryness due to prolong using of computer.
b- No ocular or systemic problems and disorders.
c- No refractive surgery.
d- Schirmer score less than 15 mm.
e- Age between 20 and 45 years.
f- The female subject must not be pregnant or breastfeeding.
g- Agreement and co-operation are highly required.

3.3.2 Subjects' population

Over 400 subjects were screened for selection, 358 agreed to participate in the study, 278 were Sudanese and 80 were Iraqis. Anyone who was found to be complaining of dry eye symptoms was tested by ophthalmoscope. Subjects with normal

ophthalmoscopy were examined by Schirmer strips. Subjects whose Schirmer score was found to be less than 15 mm were selected for the study.

3.4 The research protocol

The study to be done;

a- First permission was taken from the Ministry of Health to use the drugs.
b- Permission was taken from the leader of the foundations at which the study performed.
c- Verbal consent was taken from the subject for screening, ophthalmoscopy and Schirmer examination (The subject was asked to participate in this study, if the subject agreed; he asked if the Schirmer strips can be used to measure the tear film).
d- Finally; subject's formal consent was taken for treatment.

3.5 Subject history

The subject's identification was taken, also the ocular symptoms and general health were taken to determine if he can be selected for further examination.

3.6 Ophthalmoscopy

Outer and inner eyes were examined by direct ophthalmoscope. The subject was seated comfortably and his eye was examined from 40 to 66 cm to look for the ocular media. High plus lens + 15 D was used to examine the anterior segment of the eye from a distance of around 5 cm or so, then the power of the ophthalmoscope and the distance from the subject were gradually reduced for observation of crystalline lens and vitreous body until becoming close to the subject's eye to observe the ocular fundus. Both eyes right and left were examined (Rishi and Sharma 2009).

3.7 Schirmer test before the treatment

Schirmer Tear Strips manufactured by Contracare Ophthalmics and Diagnostics in India were used in this study to assess the tears quantity before and after treatment.

500 schirmer strips were bought and used in this study.

35 x 5 mm whatman was used and placed at the junction of medial 2/3 and lateral 1/3 of the lower lid in the fornix of the subject's eye as shown in (Fig. 3.2). The patient is asked to look forward and blink normally for 5 minutes and after that the strip was removed and the length of moisture part was recorded in millimeters. This test was done for both eyes, and before the treatment and after a month of using treatment (Sridhar 2009).

Fig. 3.1 Schirmer Tear Strips used in the study (Tear strips 2013)

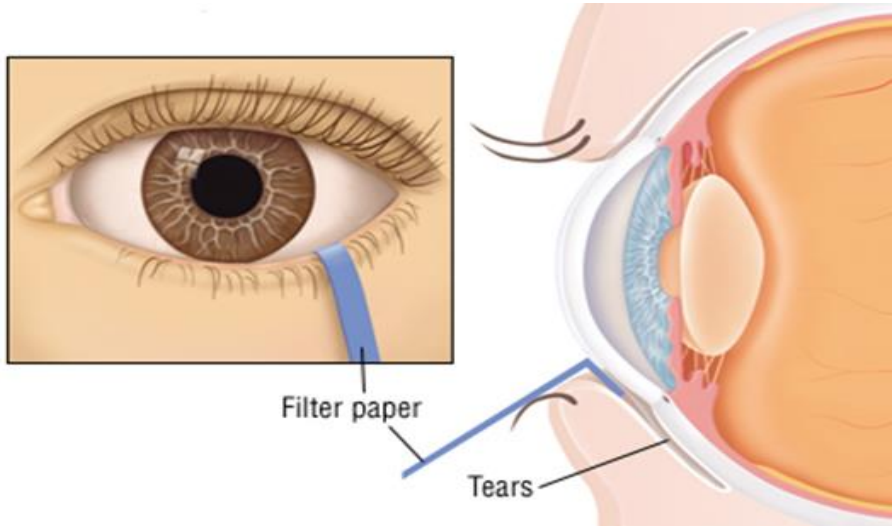


Fig. 3.2 Schirmer 1 test (Dry eye syndrome 2013)

3.8 Questionnaire papers

Questionnaire papers were in two languages; one in Arabic language used in Khartoum, and the other in Kurdish language used in Al Sulaymaniyah. It was given to the subject after Schirmer test and before the prescription of the treatment. The paper first contains patient identification, then the questions; duration of using computers, types of screens, patient complaints, time of complaining, patient procedures to relief the complaining, patient nutrition, contact lens wearing, smoking, and finally; patient's written consent (see appendix 1 and 2).

3.9 The treatment

The subjects were distributed equally into three groups to be treated by one of following:

3.9.1 Tears naturale E.D 15 ml

Tears Naturale 15 ml eye drop manufactured by Alcon prescribed for the subject to instill 1 or 2 drops into the conjunctival sac as needed, up to once every 1-2 hours or according to the subject's dryness for a month (Alcon 2010). Tears Naturale price was sensible for all the subjects.

Fig. 3.3 Tears Naturale E.D 15 ml (Alcon 2010)

3.9.2 Omega 3 soft gel

Omega 3 Norwegian cod liver oil's soft gel manufactured by Vitane's Nature; 1 soft gel daily for a month at any time per the day. Each soft gel about 1000 mg and contains 110 mg of Eicosapentaenoic acid (EPA) and 100 mg Docosahexaenoic acid (DHA) according to Vitane's pharm 2013. The price was as twice as tears naturale price, three subjects could not buy it, so the drug brought to them.

Fig. 3.4 Omega 3 Soft-gel (Vitane's pharm 2013)

3.9.3 Physical treatment and exercises

The subject asked to increase the drinking of water, decrease the glare in the working room, do palming, blinking and clockwise exercises as mentioned in section 2.3.3.5.8.1, and using a warm cup of tea or coffee as a warm compress on the eyes when finish the drink. These steps should be done as much as possible per day, and the warm cup whenever the subject drinks hot drinks for a month (All about dry eye 2012) (Hearn 2011).

Physical treatment and exercises good for patient who has drugs phobia, does not cause side effects, the patient can apply it at any place in any time, and it is priceless.

Fig. 3.5 Physical Treatment and Exercises
(1) Blinking (2) clockwise (3) Palming exercises, (4) Drinking water
(5) Warm cup compress (All about dry eye 2012).

3.9.4 After treatment

The Schirmer strips were redone for the subjects to record the results after the month of treatment, by the same procedure which was mentioned in section 3.7.

The subjects were asked about the difference in symptoms after treatment verbally.

Chapter Four

RESULTS

Chapter Four

4. Results

The results of the study were represented in tables form through frequencies and percentages distributions.

The SPSS (Statistical Package for Social Sciences) program was used for data analysis. Percentages, means, and standard deviations were used for data analysis and statistical applications. T-test was used to compare between the results.

4.1 Study population and environment

Table 4.1.1 The study environment

	Sudan (SD)	**Iraq (IQ)**
Months	June, July	September, October
Temperature	34 °C	24.5 °C
Humidity	23.5%	25.5%

Table 4.1.2 Frequency and percentages of the screened subjects who fulfilled the criteria

Nationality	**Sudan (SD)**		**Iraq (IQ)**		**SD and IQ**	
	Freq.	%	Freq.	%	Freq.	%
Screened	281	-	119	-	400	-
Agreed	278	98.9	80	67.2	358	89.5
Not agreed	3	1.1	39	32.8	42	10.5
Fulfilled criteria	97	34.8	47	58.7	144	40.2
Full cooperation	46	47.4	44	93.6	90	62.5

89.5% of subjects agreed to participate in the study, 40.2% of them fulfilled the criteria the criteria and 62.5% cooperated completely and finish the treatment to the end.

4.2 Schirmer scores before treatment

Table 4.2 Frequency and percentages distributions of subjects' Schirmer score before treatment according to Dry Eye Work Shop (DEWS)

	Sudan (SD)		Iraq (IQ)		SD and IQ	
	Freq.	%	Freq.	%	Freq.	%
Mild dryness	2	4.3	15	34.1	17	18.9
Moderate dryness	23	50.0	19	43.2	42	46.7
Severe dryness	21	45.7	10	22.7	31	34.4
Total	46	100	44	100	90	100
Mean	6.17		9.02		7.57	
Standard Deviations	± 2.99		± 3.77		± 3.66	

18.9% of subjects complained of mild dry eye, 46.7% complained of moderate dry eye, and 34.4% complained of severe dry eye.

*Mild dryness ≡ Schiermer score >10 *Moderate dryness ≡ Schiermer score ≤ 10

*Severe dryness ≡ Schiermer score ≤ 5

4.3 Questionnaire results

4.3.1 Nationality and gender

Table 4.3.1 Frequency and percentages distributions of subjects' gender and nationality

	Male		Female		Total	
	Freq.	%	Freq.	%	Freq.	%
Sudan (SD)	19	41.3	27	58.7	46	51.1
Iraq (IQ)	10	22.7	34	77.3	44	48.9
SD and IQ	29	32.2	61	67.8	90	100

51.1% of subjects were Sudanese and 48.9% Iraqis, 32.2% were males and 67.8% were females.

4.3.2 Ages of the subjects

Table 4.3.2 Frequency and percentages distributions, means and standard deviations of subject's ages in both Sudan and Iraq

	Freq.	%
20 – 30	67	74.4
30 – 40	13	14.4
40 – 50	10	11.2
Total	90	100
Mean	27.30	
Standard Deviations	± 6.63	

The range of subject's ages was between (20 – 43) years with a mean 27.30 ± 6.63. 74.4% of subjects were less than 30 years.

4.3.3 Screen types and duration of using them

Table 4.3.3.1 Frequency and percentages distributions of screen types

	Sudan (SD)		Iraq (IQ)		SD and IQ	
	Freq.	%	Freq.	%	Freq.	%
CRT	14	30.4	4	9.1	18	20.0
CRT with antiglare screen	2	4.3	0	0.0	2	2.2
LCD	30	65.2	40	90.9	70	77.8
Total	46	100	44	100	90	100

77.8% of subjects used LCD screen and 22.2% used the CRT screen.

*CRT ≡ Cathode Ray Tube *LCD ≡ Liquid Crystal Display

Table 4.3.3.2 Frequency and percentages distributions of hours of using screens

	SD		IQ		SD and IQ	
	Freq.	%	Freq.	%	Freq.	%
4 – 6 hrs.	15	32.6	16	36.3	31	34.4
7 – 9 hrs.	21	45.6	23	52.2	44	48.9
10 – 12 hrs.	10	21.7	5	11.3	15	16.7
Total	46	100	44	100	90	100
Mean	7.67		7.25		7.47	
Standard Deviations	± 2.21		± 1.95		± 2.09	

4.3.4 Subjects symptoms

Table 4.3.4.1 Frequency and percentages distributions of subjects' symptoms

	SD				IQ			
	Always		Sometimes		Always		Sometimes	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Headache and eye strain	9	19.6	37	80.4	17	38.6	26	59.1
Blur and double vision	9	19.6	20	43.5	5	11.4	24	54.5
Photophobia	7	15.2	29	63.0	10	22.7	31	70.5
Fatigue and sleepy	4	8.7	33	71.7	4	9.1	16	36.4
Foreign body sensation	8	17.4	19	41.3	8	18	24	54.5
Watery eye	4	8.7	22	47.8	3	6.8	29	65.9
Burning eye	10	21.7	23	50.0	3	6.8	37	84.1
Itchy eye	4	8.7	34	73.9	6	13.6	31	70.5
Dryness feelings	4	8.7	32	69.6	1	2.0	30	68.0
Redness and congestion	6	13.0	25	54.3	4	9.1	28	63.6

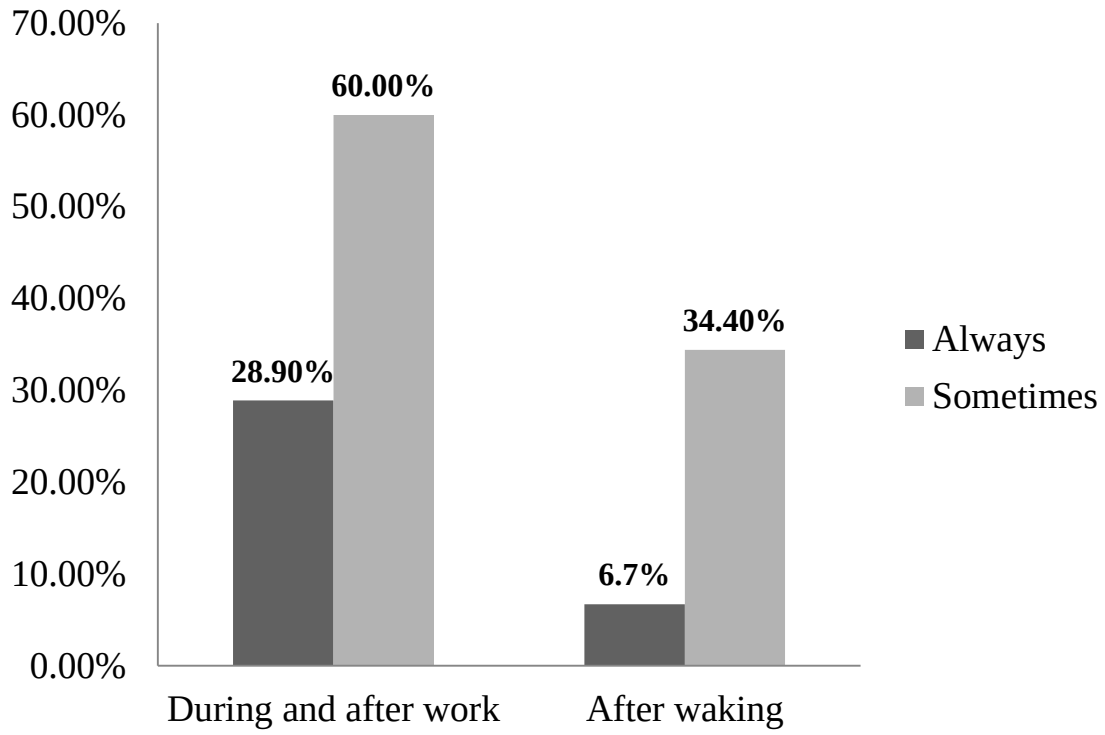
Table 4.3.4.2 Frequency and percentages distributions of subjects' symptoms in Sudan and Iraq

	SD and IQ			
	Always		Sometimes	
	Freq.	%	Freq.	%
Headache and eye strain	26	28.9	63	70.0
Blur and double vision	14	15.5	44	48.9
Photophobia	17	18.9	60	66.7
Fatigue and sleepy	12	13.3	49	54.4
Foreign body sensation	12	13.3	43	47.8
Watery eye	7	7.8	51	56.7
Burning eye	13	14.4	60	66.7
Itchy eye	10	11.1	65	72.2
Dryness feelings	5	5.5	62	68.9
Redness and congestion	10	11.1	53	58.9

Table 4.3.4.3 Frequency and percentages distributions of symptoms time

	SD				IQ			
	Always		Sometimes		Always		Sometimes	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
During and after work	14	30.4	28	60.9	12	27.2	26	59.1
After waking	5	10.9	13	28.3	1	2.0	18	40.9

Figure 4.3.4.3 Frequency and percentages distributions of symptoms time in Sudan and Iraq

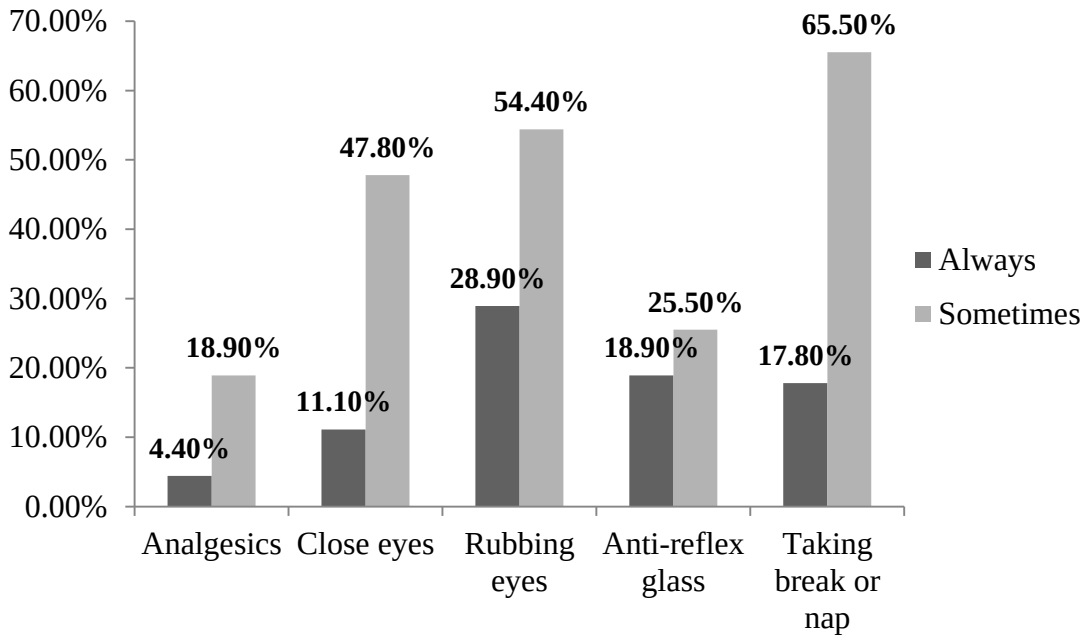


88.9% of subjects complained from symptoms during and after working, and 41.1% complained after wake.

Table 4.3.4.4 Frequency and percentages distributions of the subjects' procedures to relief symptoms

	SD				IQ			
	Always		Sometimes		Always		Sometimes	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Analgesics	3	6.5	11	23.9	1	2.0	6	13.6
Close eyes or look to roof	4	8.7	19	41.3	6	13.6	24	54.5
Rubbing eyes	11	23.9	25	54.3	15	34.1	24	54.5
Anti-reflex glasses	14	30.4	16	34.8	3	6.8	7	15.9
Taking break or nap	6	13.0	29	63.0	10	22.7	30	68.2

Figure 4.3.4.4 Frequency and percentages distributions of subjects' procedures to relief symptoms in Sudan and Iraq



4.3.5 Subjects nutrition

Table 4.3.5 Frequency and percentages distributions of the subjects' meals

	SD				IQ			
	Always		Sometimes		Always		Sometimes	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Have Meals regularly	15	32.6	22	47.8	28	63.6	13	29.5
Have Breakfast	34	73.9	10	21.7	32	72.7	12	27.3

93.1% of Iraqis have their meals regularly and 100% have their breakfast. 80.4% of Sudanese have their meals regularly and 95.6% have their breakfast.

4.3.6 Smoking

Table 4.3.6 Frequency and percentages distributions of smokers

	SD				IQ			
	Always		Sometimes		Always		Sometimes	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Smokers	1	2.2	0.0	0.0	0	0.0	0.0	0.0
negative smoking	5	10.9	11	23.9	13	29.5	21	47.7

There was just one smoker. There were 34.8 % of Sudanese subjects complained of negative smoking and 77.2% Iraqis.

4.4 Treatment results

4.4.1 Treatment groups

Table 4.4.1 Frequency distributions of the subjects according to treatment

	SD	IQ	SD and IQ
Tears Naturale E.D	13	17	30
Omega 3 Softgel	22	8	30
Physical Exercises	11	19	30
Total	46	44	90

The subjects were distributed equally into three groups (30 subjects in each group) to be treated either by Tears Naturale E.D, Omega 3, or physical treatment and exercises.

4.4.2 Schirmer score after treatment

Table 4.4.2.1 Frequency distributions, mean and standard deviation of Schirmer score results after tears naturale e.d treatment

	SD		IQ		SD and IQ	
	Freq.	%	Freq.	%	Freq.	%
Normal	11	84.6	11	64.7	22	73.3
Abnormal	2	15.4	6	35.3	8	26.7
Total	13	100	17	100	30	100
Mean	16.23		17.76		17.10	
Standard division	± 4.94		± 7.54		± 6.48	

The mean of Schirmer score after treatment by tears naturale e.d in Sudan is 16.23 ± 4.94, 17.76 ± 7.54 in Iraq, and 17.10 ± 6.48 in both (See Schirmer scores in millimeters appendix 4).

Table 4.4.2.2 Frequency distributions, mean and standard deviation of Schirmer score results after omega 3 treatment

	SD		IQ		SD and IQ	
	Freq.	%	Freq.	%	Freq.	%
Normal	2	9.1	4	50.0	6	20.0
Abnormal	20	90.9	4	50.0	24	80.0
Total	22	100	8	100	30	100
Mean	8.86		13.13		10.0	
Standard division	± 3.31		± 4.26		± 4.00	

The mean of Schirmer score after treatment by Omega 3 in Sudan is 8.86 ± 3.31, 13.13 ± 4.26 in Iraq, and 10.0 ± 4.00 in both (See Schirmer scores in millimeters appendix 5).

Table 4.4.2.3 Frequency distributions, mean and standard deviation of Schirmer score results after physical treatment and exercises

	SD		IQ		SD and IQ	
	Freq.	%	Freq.	%	Freq.	%
Normal	4	36.4	15	78.9	19	63.3
Abnormal	7	63.6	4	21.1	11	36.7
Total	11	100	19	100	30	100
Mean	11.45		18.53		15.93	
Standard division	± 7.38		± 5.05		± 6.83	

The mean of Schirmer score after treatment by physical treatment and exercises in Sudan is 11.45 ± 7.38, 18.53 ± 5.05 in Iraq, and 15.93 ± 6.83 in both (See Schirmer scores in millimeters appendix 6).

Figure 4.4.2.1 Mean of the Schirmer score before and after treatment in Sudan

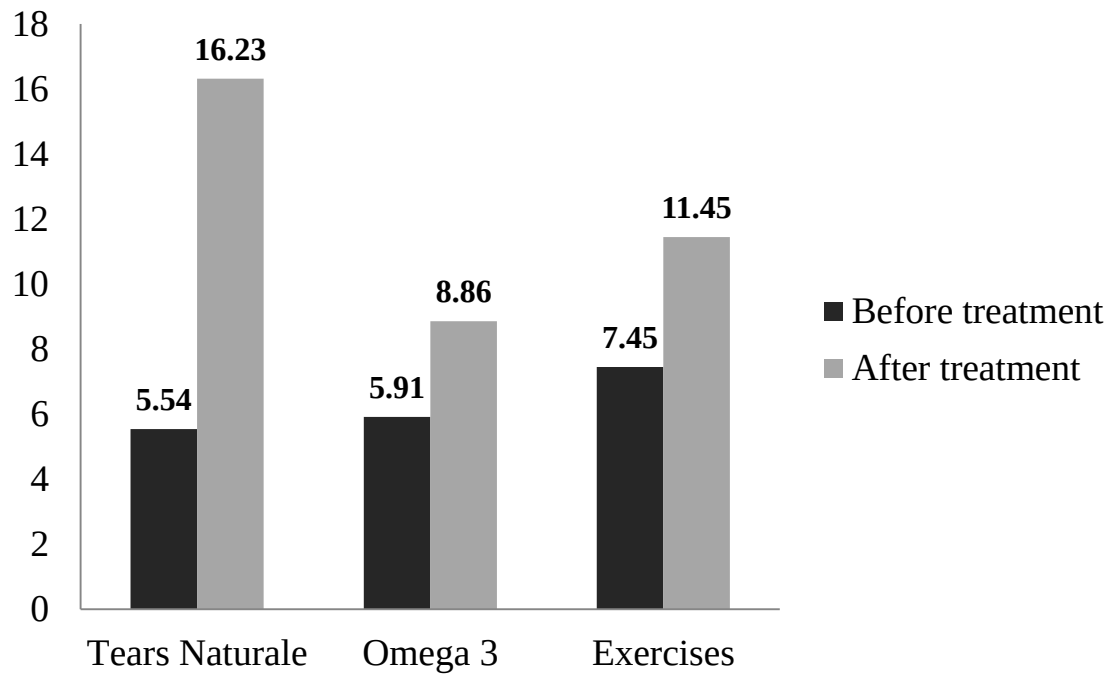


Figure 4.4.2.2 Mean of the Schirmer score before and after treatment in Iraq

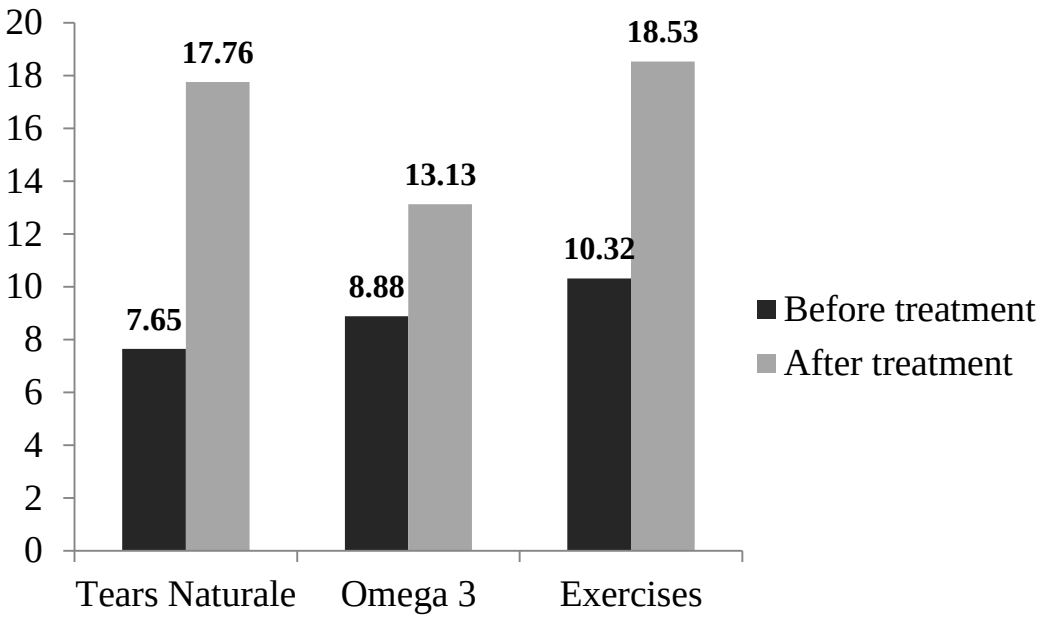
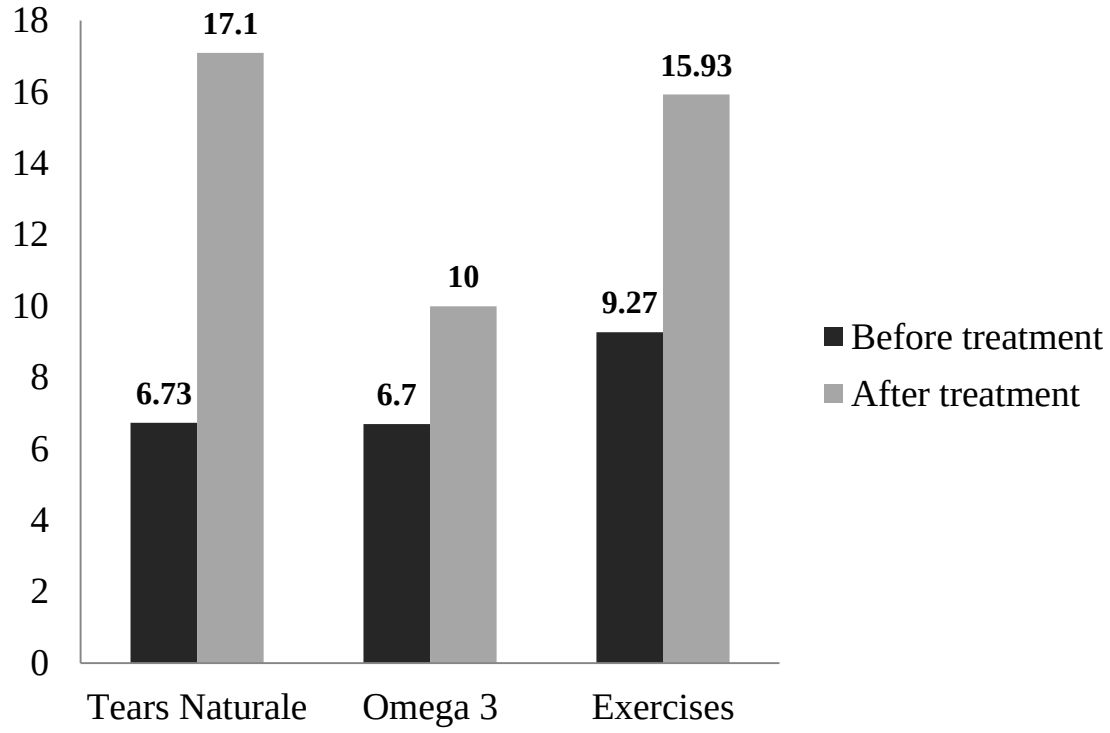


Figure 4.4.2.3 Mean of the Schirmer score before and after treatment in Sudan and Iraq



4.4.3 Symptoms relief after treatment

Table 4.4.3.1 Frequency and percentages distributions of subjects' symptoms after tears naturale

	Free		No	
	Freq.	%	Freq.	%
Headache and eye strain	7	23.3	23	76.7
Double vision and blur	20	66.7	10	33.3
Dryness symptoms	27	90.0	3	10.0
Photophobia	27	90.0	3	10.0

Table 4.4.3.2 Frequency and percentages distributions of subjects' symptoms after omega 3

	Free		No	
	Freq.	%	Freq.	%
Headache and eye strain	14	46.7	16	53.3
Double vision and blur	8	26.7	22	73.3
Dryness symptoms	8	26.7	22	73.3
Photophobia	8	26.7	22	73.3

Table 4.4.3.3 Frequency and percentages distributions of subjects' symptoms after physical treatment and exercises

	Free		No	
	Freq.	%	Freq.	%
Headache and eye strain	21	70.0	9	30.0
Double vision and blur	15	50.0	15	50.0
Dryness symptoms	15	50.0	15	50.0
Photophobia	15	50.0	15	50.0

Chapter Five

Discussion

Chapter Five

5. Discussion

The study was designed to assess the benefits of the treatment of the dry eye by using tears naturale e.d, Omega 3, and physical treatment and exercises.

Four hundred subjects were screened for selection, 358 subjects (89.5%) agreed to participate in the study, 144 subjects (40.2%) were found to be suitable to fulfill the criteria of admission, and 90 subjects (62.5%) finished the treatment to the end.

5.1 Study environment

The study was done in (Khartoum capital – Sudan) and (Al Sulaymaniyah city – Iraq) at a period from June to July in Khartoum, and September to October in Al Sulaymaniyah. The study was done just before the rain season in the two cities given same humidity in Sudan (23.5%) and Iraq (25.5%),

The temperature in Sudan was 34 °C and 24.5 °C in Iraq. The 10 °C difference in the temperature was with no significant value because the Sudanese subjects used air conditioner and Iraqis used fans given approximately same temperatures.

5.2 Study population

The study included 90 subjects; 46 Sudanese (51.1%) and 44 Iraqis (48.9%). Their ages ranged from 20 – 43 years old with a mean 27.30 ± 6.63 as shown in table 4.3.2. 74.44% of those subjects were less than 30 years old.

5.3 Gender

The females in this study were 67.78% (30% Sudanese and 37.78% Iraqis) of the subjects as seen in table 4.3.1 and the males were 32.22% (21.11% Sudanese and 11.11% Iraqis). This agrees with what mentioned by Peters and Colby 2007 in section 2.3.3.1.2.1who stated that the females are at risk of dryness more than males because of hormonic changes.

5.4 Questionnaire findings

Referring to table 4.3.4.1 and table 4.3.4.2; the subjects were found complaining of headache and other symptoms of dry eye. These symptoms may be due to long duration of using computers from 4 to 12 hours daily with a mean of 7.47 ± 2.09 and 65.6% used the computers more than 6 hours daily. According to American Optometric Association 2013 in section 2.3.3.4; the headache and other symptoms appear to increase with the computer use.

The increase of dry eye symptoms in Iraqis more than Sudanese as shown in table 4.3.4.1 may be due to increase of negative smoking among Iraqis (77.2%) more than Sudanese (38.8%). This agreed with Kleyne 2012 who mentioned that exposure to smoke and dust increase dryness symptoms and contribute to eye dehydration.

Among Iraqis; 90.9% used LCDs comparing to 65.2% of Sudanese. According to Anshel 2005 in section 2.3.3.4 those screens cause glare more than CRTs. This may be the cause of increase in photophobia among Iraqis (93.2%) more than Sudanese (78.2%). Other cause of photophobia was unprotecting eyes that only 30.4 of Sudanese subjects always used anti- reflection glasses to protect their eyes compared to 6.8% of Iraqis. Anti-reflection glasses did not spread in Iraq as in Sudan.

Among Sudanese; 32.6% always have their meals regularly compare to 63.6% Iraqis. 73.9% of Sudanese and 72.7% of Iraqis always have their breakfast as shown in table 4.3.5. Iraqis have their breakfast between 7 and 8 o'clock am early in the morning while Sudanese did not have their breakfast until noon. This may be a leading cause in Sudanese patient to become more fatigue (80.4%) in their work more than Iraqis (45.5%) because nutrition do a role in that according to Hearn 2011 in section 2.3.3.5.6. Other cause of fatigue and sleepiness; 22.7% of Iraqis always take a break or a nap, and 68.2% sometimes (most of them take a nap) compare to 13% of Sudanese patients always take a break or a nap, and 63% sometimes (most of them just take a break). Break and rest relief the fatigue and sleepiness but not as taking a nap, this mentioned by Rolfes, Pinna, and Whitney 2009 in section 2.3.3.5.6.

The other symptoms as seen in table 4.3.4.1 were almost same among Sudanese and Iraqis.

Rubbing eyes and taking a break or a nap were the most frequent procedure among subjects to relief their symptoms (83.3%), as seen in table and figure 4.3.4.4. Rubbing eyes is an effective procedure relief the pain by stimulating the meibomian glands to spread the oil over the ocular surface as shown in section 2.3.3.5.8.1 by Bailey 2013.

Figure 4.3.4.3 shows that 88.9% of the subjects were complaining of the symptoms during and after work directly, which is a normal result of long contact with the monitors. 39.2% complained from symptoms after waking, this may be due to reduction in the tear film oils according to Goyal, Barsam, and Tuft 2009 in section 2.3.1, and other non-visual problems as general fatigue due to long using of monitors as seen in section 2.3.3.4 by American Optometric Association 2013 and Anshel 2005.

5.5 Treatment findings

According to table 4.2; the Schirmer score before treatment had a mean of 6.17 ± 2.99 in Sudan, 9.02 ± 3.77 in Iraq, and 7.57 ± 3.66 in both.18.9% of subjects complained of mild dry eye, 46.7% complained of moderate dry eye, and 34.4% complained of severe dry eye.

Table 4.4.2.1 shows that 84.6% of tears naturale subjects in Sudan were within normal range of Schirmer score with a mean of 16.23 ± 4.94. In Iraq 64.7% gave normal results with a mean of 17.76 ± 7.54.

In both Sudan and Iraq 73.3% of subjects were within normal range with a mean of 17.10 ± 6.48 and 90% of subjects were free of dryness symptoms and photophobia as shown in table 4.4.3.1. The water-soluble polymers lubricants the outer surface of the eye and help to relief even the moderate and severe symptoms of dryness as mentioned by Tears Naturale 2010 and Alcon 2010 in section 2.3.3.5.1.

Table 4.4.2.2 shows that 20% (6.7% Sudanese and 13.3% Iraqis) of subjects who were treated by omega 3 showed a normal score of Schirmer test with a mean of 10.0 ± 4.00. The results still less than normal limits and 73.7% of them still complained of dry eye symptoms. This may be due to short duration of treatment, according to Omega 3 and EPA 2013 in section 2.3.3.5.7 the subject should use it constantly for

several weeks before he start to notice any benefit, or the dosage was not enough according to Tribole 2007 in same section 2.3.3.5.7.

The Schirmer score of Sudanese was with a mean of 8.86 ± 3.31and Iraqis results with a mean of 13.13 ± 4.26. This difference results may be due to the difference in nutrition between the two countries. Iraqis used a lot of nuts and sunflower seeds in their nutrition as mentioned by Rolfes, Pinna and Whitney 2009 in section 2.3.3.5.7 who stated that nuts and sunflower seeds are major sources of omega 3.

Table 4.4.2.3 shows that 36.4% of physical treatment and exercises subjects in Sudan gave normal results of Schirmer score with a mean of 11.45 ± 7.38. This result is less than normal and this could be due to using of the air conditioner which dehydrate the eyes and tear film and increase the evaporation of tears more than fans as mentioned by Kleyne 2012 in section 2.3.3.2.2.5. In Iraq 78.9% gave normal results with mean 18.53 ± 5.05. The result is normal and better than in Sudan which could be due to cooperation of Iraqis subjects because of their fear from medicines as mentioned in appendix 3, and they just used fans in the offices.

In both Sudan and Iraq 63.3% of subjects were within normal score with a mean of 15.93 ± 6.83 and 50% of subjects stopped complained of vision problems, dryness symptoms and photophobia, and the other 50% still complained because even mild dehydration increase dry eye problems especially during hot and dry weather according to Bailey 2013 in section 2.3.3.5.8.1. 70% of the subjects stopped complaining of headache and eye strain and this mentioned by Garg 2010 and All About Dry Eye 2012 in same section when they explained how these exercises will help the patient to relax his eyesight and mind, provides rest to the ciliary muscles, and loosening up the oil over the ocular surface. But, so that; 50% of subjects still complain of dry eye symptoms.

Chapter Six

CONCLUSIONS AND RECOMMENDATIONS

Chapter Six

6. Conclusions and Recommendations

Subject's history had been taken, outer and inner eye examination was performed, Schirmer test before and after treatment was applied, and questionnaire were done. The findings were concluded in this chapter.

6.1 Conclusions

The subjects were 90 included 51.1% Sudanese and 48.9% Iraqis. There were 32.2% males and 67.8% females, their ages were ranged between 20 and 43 with mean 27.30 ± 6.63 and 74.4% of them were under 30 years.

The subjects subdivided equally into three groups for treatment; 30 subjects treated with Tears Naturale E.D, 30 subjects with Omega 3, and 30 subjects with physical treatment and exercises.

6.1.1 Questionnaire conclusions

77.8% of subjects used LCD screen. 48.9% of subjects used it from 7 – 9 hours.

All subjects complained from headache and eye strain and 85.6% of photophobia.

88.9% of subjects were complained from symptoms during and after working and rubbing the eyes was the most frequent procedure among subjects (84.3%) to relief the symptoms.

6.1.2 Treatment conclusions

The Schirmer test score for all subjects before treatment was ranged between 2 mm and 14 mm with a mean of 7.57 mm ± 3.66.

After treatment the Schirmer score of tears naturale was with a mean of 17.1 mm ± 6.48. 73.3% of subjects were within normal limits (Schirmer score >15 mm), and 90% were symptoms free.

The Schirmer score of physical treatment and exercises was with a mean of 15.93 mm ± 6.83. 63.3% of subjects were within normal limits, and 50% were symptoms free.

The Schirmer score of omega 3 was with a mean of 10 mm ± 4. only 20% of subjects were within normal limits, and 73.3% of them still complained of dry eye symptoms.

6.2 Difficulties and limitations of the study

6.2.1 Difficulties

In spite of carefully planned talks and meetings with different foundations and lectures given to the members to explain the aim of study; some foundations disagreed to participate in the study, and some were uncooperative. Other difficulties were:

a- Not all the subjects agreed to participate in his study.
b- In Sudan the tears naturale drops became unavailable in last period, many of subjects could not use it.
c- Most subjects of physical treatment and exercises in Sudan were not cooperative.
d- In Iraq, people did not agree to participate in this study because of their fear from drugs.
e- Schirmer strips were not available, and it was difficult to find.

6.2.2 Limitations

a- The study population was small.
b- Short duration of the study.

6.3 Recommendations

Prolong using of monitors and visual displays and lifestyle was found to be an important reason of eye dryness. The recommendations could be as follows:

a- Increasing the public awareness about the risks of eye dryness.
b- Increase the awareness about the benefits of scientific researches in the society.
c- Increase the educations about natural and home remedies.

d- Increase the education about the significance of physical exercises to human body and the eye, and well-balanced regular nutrition.

e- The office environment should be designed with ergonomic design principles, good lighting and posture to decrease the computer vision syndrome and dry eye.

f- Prevent smoking in general places and offices.

g- Regular eye examination for employee particularly for computer users.

6.4 Further studies

a- Other procedures such as corneal topography and interferometry should be used to evaluate the tear film after using the previous treatments.

b- Longitudinal study to measure the effect of those types of treatment on the tear film after using them for long duration with enough dosage and measure the changes in the tear film regularly many times during the study.

c- Combining two types or more of dry eye treatments and study the benefits.

d- Measuring the phoria of the subjects to differentiate from dry eye symptoms.

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Appendices

Appendix (1) Arabic questionnaire used in Khartoum

جامعة النيلين

كلية الدراسات العليا

كلية علوم البصريات

ورقة استبيان

تاريخ اليوم: / /٢٠١٣

الاسم:..... **تاريخ الميلاد: / / م**

الجنس:..... **الوظيفة:**..... **اسم الشركة:**.....

عنوان الشركة:..... **تلفون:**.....

*** هذه المعلومات تبقى سريّة و لا تُستخدم إلا لغرض البحث العلمي**

*** الرجاء الاجابة عن جميع الأسئلة و بإجابة واحدة فقط**

١- كم عدد الساعات التي تقضيها أمام جهازك الرقمي في اليوم؟

أ/ ٤ ــ ٦ ساعات ب/ ٧ ــ ٩ ساعات ج/ ١٠ ــ ١٢ ساعة

٢- ما نوع الشاشة التي تستخدمها؟

أ/ إل سي دي ب/ شاشة عادية ج/ شاشة عادية عليها شاشة واقية من التوهج

٣- هل تصاب بالصداع و ارهاق العينين أثناء العمل؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٤- هل تعاني من رؤية مشوشة أو ازدواج في الرؤية؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٥- هل تعاني من حساسية أو انزعاج تجاه الضوء؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٦- هل تُحس بالإعياء و الإرهاق و النعاس أثناء العمل؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٧- هل تشكو من وخز أو احساس بجسم غريب في العينين؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٨- هل تدمع عينيك باستمرار و بكثرة؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٩- هل تعاني من حُرقة في العينين؟

أ/ دائماً ب/ أحياناً ج/ أبداً

١٠- هل تشعر بحكة في العينين باستمرار؟

أ/ دائماً ب/ أحياناً ج/ أبداً

١١- هل تحس بجفاف في العينين؟

أ/ دائماً ب/ أحياناً ج/ أبداً

١٢- هل تعاني من هيجان و احمرار العينين؟

أ/ دائماً ب/ أحياناً ج/ أبداً

١٣- هل تشكو من أيّ أعراض أخرى؟

أ/ نعم ب/ لا

اذا كانت الاجابة نعم؛ أذكرها .....

١٤- هل تشعر بهذه الأعراض أثناء العمل و بعد الانتهاء من العمل مباشرة؟

أ/ دائماً ب/ أحياناً ج/ أبداً

١٥- هل تشعر بهذه الاعراض بعد الاستيقاظ من النوم؟

أ/ دائماً ب/ أحياناً ج/ أبداً

مالذي تفعله عادة للتخلص من هذه الأعراض؟

١٦- أتناول حبوب مسكنة ؟

أ/ دائماً ب/ أحياناً ج/ أبداً

١٧- أغلق عينيّ أو أنظر للسقف؟

أ/ دائماً ب/ أحياناً ج/ أبداً

١٨- أفرك عينيّ؟

أ/ دائماً ب/ أحياناً ج/ أبداً

١٩- أستخدم نظارات مانعة للإنعكاس؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٢٠- آخذ استراحة أو غفوة؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٢١- أخرى ؛ أذكرها .....

٢٢- هل تتناول وجباتك الغذائية بانتظام

أ/ دائماً ب/ أحياناً ج/ أبداً

٢٣- هل تتناول وجبة الافطار

أ/ دائماً ب/ أحياناً ج/ أبداً

٢٤- هل ترتدي عدسات لاصقة

أ/ نعم ب/ لا

إذا كانت الاجابة نعم؛ ما نوع العدسة؟ و لكم من المدة ارتديتها؟ .....

٢٥- هل أنت مدخن

أ/ نعم ب/ لا

إذا كانت الاجابة نعم ؛ ما طول المدة؟ .....

٢٦- هل تعاني من التدخين السلبي؟

أ/ دائماً ب/ أحياناً ج/ أبداً

٢٧- هل لديك أيّة ملاحظات أخرى؟

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أنا .....**أوافق على المشاركة في هذا البحث**

التوقيع .....

شكراً لمشاركتك في الاستبيان

Asmaa Jamal

Appendix (2) Kurdish questionnaire used in Al Sulaymaniyah

وةرةقةى داپرسي

رؤژ: / /٢٠١٣

ناو:..... رؤژى لةدايك بون: / /

رةگةز:..... ئيش:..... ناوى شةريكة:.....

ناونيشانى شةريكة:..... تة لة فؤن:.....

*** ئةم زانيارياندة بة نهينى دةمينيتةوةوتةنها بوتويزينةوة بةكاردێت**

*** تكاية وةلامى هةموو پرسيارةكان بدةنةوة وة تةنها يةك وةلام هةلبژيرن:**

١- چةند سةعات لةبةردةم جيهازة رةقةمييةكان روزانة بةسةر دةبةيت؟

أ/٤-٦سةعات ب/٧-٩سةعات ج/١٠-١٢سةعات

٢- چى جورة شاشةيةك بةكاردةهێنيت؟

أ/L C D ب/شاشةى عادى ج/شاشةى عادى كةشاشةى پاريزةرى پێ وةية

٣- ئايا هةست بةسةر ئيشةو ماندووبوونى چاو دةكةى لةكاتى ئيش كردندا؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٤- ئايا لة كاتى سةير كردني شاشة بةرجاوت ليل دةبى يان يان توشى دووان بينين بووييت؟(واتة يةك شت بة دوان ببينى)

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٥- ئايا هةست بة حةساسيةت يان بيزارى بة تيشكى روونـاكى ئةكةيت؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٦- ئايا هةست بة هيلاكى وماندوو بون و چاو ئيشة دةكةيت لةكاتى ئيشدا؟

أ/هةموو كات ب/ ناو بةناو ج/ هيچ كات

٧- ئايا هةست بة چاو كزانةوة يان يا هةست بةوة دةكةى كة شتيك لةناو چاوتاية؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٨- ئايا چاوت بةبةردةوامى فرميسك دةكات بةزۆرى؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٩- ئايا هةست بة سوتانةوة لة چاوتدا دةكةى؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

١٠- ئايا هةست بة خوران دةكةيت لةچاوتدا؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

١١- ئايا هةست بة وشك بونةوة دةكةى لة چاوتدا؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

١٢- ئايا هةست بة روشان و سوربوونةوة دةكةيت ؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

١٣- هيچ كيشةيةكى ديكةت نية؟

أ/بةلى ب/ نةخير

ئةكةر وةلام بةلى بوو؛چى يةى ؟.....

١٤- ئايا ئةم نيشانانة روودةدات لةكاتى ئيش و دواى ئيش راستةو خو؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

١٥- ئايا ئةم هةستة دواى هةستان لة خةو روو دةدات؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

عادةتةن چى دةكةى بو رزگار بوون لةم حالةتة؟

١٦- خواردنى حبى ئازار بر؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

١٧- چاو دادةخةى يان چاوبةرز دةكةيتةوة سةيرى سةرةوة دةكةى؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

١٨- چاوت دةپرويّنيت؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

١٩- بةكارهينانى چاويلكةى دژبةروناكى؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٢٠- ئيسراحةت وةردةگرى؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٢١- شتى تر ؛ شةرحى بكة؟.....

٢٢- ئايا ژةمى خوراكى تةواوت هةية بة رێكوپێكى؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٢٣- ئايا ژةمى بةيانى دةخويت بةبةردةوامى؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٢٤- ئايا عةدةسة بةكار دةهينى؟

أ/بةلى ب/نةخير

ئةگةر وةلامةكةت بةلي ية ؛ چى جورة عةدةسةيةك بةكار دةهينى؟چةند جار لة رۆژيكدا؟.....

٢٥- ئايا جـگةرة دةخويت؟

أ/بةلى ب/نةخير

ئةگةر وةلامةكةت بةلى ية ؟ماوةى چةندة دةيخويت؟وه چه ند جگه ره ده خۆيت؟.....

٢٦- ئايا كةسى جـگةرة خور لةنزيك تۆ وة هةية؟(لة شوينى كار ،مال،دةرةوة)؟

أ/هةموو كات ب/ناو بةناو ج/هيچ كات

٢٧- ئايا هيچ تيبنى يةكى ترت هةية؟

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.....

.....

من.....**رازيم بةبةژدارى كردن لةم توێژينةوةدا واژۆ**.....

سوباس بو بةژدارى كردنت لة تويژينةوةدا

Asmaa Jamal

Appendix (3) NIRIJ: Network of Iraqi Reporters for Investigative Journalism reports

شبكة نيريج: حقنة اربيل القاتلة تفتك بعيون ٣٠ شخصاً والحكومة تحمي المتورطين بالمعلومات

تحقيق موفق محمد - أربيل

الخميس ٢١ نوفمبر ٢٠١٣

فقد ثلاثون مريضاً بصرهم إثر تلقيهم جرعة علاجية عن طريق الخطا في مستشفى رزكاري العام في مدينة اربيل كبرى مدن إقليم كردستان العراق، حسبما أعلن وزير صحة الإقليم مساء الاربعاء.

وقال ريكوت حمه رشيد وزير الصحة في مؤتمر صحافي إن ثلاثين مريضاً أصيبوا بفقدان البصر بسبب تلقيهم جرعة عن طريق حقنة في مستشفى رزكاري بمدينة اربيل، العقار الطبي يحمل الاسم التجاري التركي (بيفاسيزوماب).

أصيب الثلاثون بالعمى حين تلقوا في إحدى صالات مستشفى رزكاري الحكومي في أربيل جرعة في العين من عقار أفاستين الذي اشترته وزارة الصحة الكردستانية من مهرب تركي مسببة لهم ألماً و نزيفاً شديدين في العين ، في حين تم اقتلاع عين ثمانية منهم بعد ارسالهم للعلاج في ألمانيا لمنع انتقال العدوى البكتيرية لباقي أجسادهم.

لا أحد يدري من المسؤول أو ما السبب فيما حدث فقد تكون بسبب تلوث الحقنة بالبكتريا او سوء التخزين او سوء النوعية، فيما تزداد مخاوف مواطني كردستان يوما بعد يوم، من ان يؤدي تراجع الواقع الصحي الكردستاني واستمرار ملف تهريب الادوية الفاسدة الى تعريض حياتهم لخطر الموت او التشوه والعوق داخل صالات المستشفيات الحكومية نفسها.

Appendix (4) Schirmer scores before and after treatment by tears naturale e.d

N.	Nationality	Before Treatment	After Treatment
1	Sudanese	7	11
2	Sudanese	10	15
3	Sudanese	9	23
4	Sudanese	4	15
5	Sudanese	4	16
6	Sudanese	5	21
7	Sudanese	2	18
8	Sudanese	6	16
9	Sudanese	8	16
10	Sudanese	5	7
11	Sudanese	4	11
12	Sudanese	6	17
13	Sudanese	2	25
14	Iraqis	6	17
15	Iraqis	4	10
16	Iraqis	4	17
17	Iraqis	6	16
18	Iraqis	14	15
19	Iraqis	14	32
20	Iraqis	2	13
21	Iraqis	3	14
22	Iraqis	5	17
23	Iraqis	13	28
24	Iraqis	5	17
25	Iraqis	14	27
26	Iraqis	7	6
27	Iraqis	3	14
28	Iraqis	8	7
29	Iraqis	12	27
30	Iraqis	10	25

Appendix (5) Schirmer score before and after treatment by Omega 3 softgel

N.	Nationality	Before Treatment	After Treatment
1	Sudanese	13	15
2	Sudanese	8	10
3	Sudanese	8	11
4	Sudanese	6	10
5	Sudanese	8	6
6	Sudanese	5	10
7	Sudanese	3	8
8	Sudanese	2	10
9	Sudanese	3	8
10	Sudanese	14	18
11	Sudanese	7	7
12	Sudanese	5	8
13	Sudanese	3	7
14	Sudanese	7	10
15	Sudanese	3	7
16	Sudanese	8	12
17	Sudanese	2	10
18	Sudanese	6	6
19	Sudanese	4	8
20	Sudanese	5	3
21	Sudanese	8	6
22	Sudanese	2	5
23	Iraqis	7	15
24	Iraqis	6	10
25	Iraqis	10	15
26	Iraqis	10	20
27	Iraqis	14	9
28	Iraqis	14	8
29	Iraqis	7	11
30	Iraqis	3	17

Appendix (6) Schirmer score before and after treatment by physical treatment and exercises

N.	Nationality	Before Treatment	After Treatment
1	Sudanese	8	8
2	Sudanese	10	15
3	Sudanese	9	4
4	Sudanese	2	12
5	Sudanese	9	19
6	Sudanese	10	4
7	Sudanese	8	21
8	Sudanese	4	6
9	Sudanese	10	24
10	Sudanese	4	3
11	Sudanese	8	10
12	Iraqis	10	19
13	Iraqis	9	12
14	Iraqis	4	18
15	Iraqis	14	32
16	Iraqis	10	16
17	Iraqis	10	27
18	Iraqis	10	14
19	Iraqis	4	18
20	Iraqis	9	15
21	Iraqis	11	20
22	Iraqis	13	17
23	Iraqis	13	18
24	Iraqis	10	13
25	Iraqis	9	12
26	Iraqis	11	18
27	Iraqis	12	19
28	Iraqis	9	19
29	Iraqis	14	20
30	Iraqis	14	25

Appendix (7) Gender and ages

N.	Gender	Ages	N.	Gender	Ages	N.	Gender	Ages
1	Female	23	31	Male	39	61	Female	34
2	Female	23	32	Male	21	62	Female	33
3	Female	22	33	Male	25	63	Female	21
4	Female	21	34	Male	26	64	Female	28
5	Female	25	35	Male	43	65	Female	30
6	Female	21	36	Male	42	66	Female	20
7	Female	22	37	Male	26	67	Female	23
8	Female	22	38	Male	24	68	Female	22
9	Female	40	39	Male	38	69	Female	28
10	Female	21	40	Male	41	70	Female	24
11	Female	40	41	Male	20	71	Female	24
12	Female	41	42	Male	21	72	Female	25
13	Female	26	43	Male	21	73	Female	25
14	Female	29	44	Male	26	74	Female	28
15	Female	23	45	Male	29	75	Female	22
16	Female	42	46	Male	38	76	Female	23
17	Female	24	47	Female	21	77	Female	22
18	Female	21	48	Female	21	78	Female	22
19	Female	36	49	Female	31	79	Female	29
20	Female	23	50	Female	29	80	Female	25
21	Female	29	51	Female	21	81	Male	26
22	Female	38	52	Female	21	82	Male	39
23	Female	26	53	Female	24	83	Male	27
24	Female	23	54	Female	25	84	Male	40
25	Female	41	55	Female	22	85	Male	40
26	Female	25	56	Female	22	86	Male	31
27	Female	23	57	Female	22	87	Male	21
28	Male	28	58	Female	22	88	Male	26
29	Male	29	59	Female	23	89	Male	30
30	Male	27	60	Female	23	90	Male	30

Appendix (8) Screen types and hours

N.	Screen types	Hours	N.	Screen types	Hours	N.	Screen types	Hours
1	LCD	10 - 12	31	CRT	4 - 6	61	LCD	4 - 6
2	LCD	10 - 12	32	CRT	10 - 12	62	LCD	4 - 6
3	LCD	10 - 12	33	CRT	7 - 9	63	LCD	7 - 9
4	LCD	4 - 6	34	LCD	4 - 6	64	LCD	7 - 9
5	LCD	4 - 6	35	LCD	7 - 9	65	LCD	7 - 9
6	LCD	7 - 9	36	LCD	4 - 6	66	LCD	7 - 9
7	CRT with anti-glare screen	4 - 6	37	CRT	7 - 9	67	LCD	4 - 6
8	CRT	4 - 6	38	LCD	7 - 9	68	LCD	4 - 6
9	LCD	4 - 6	39	LCD	10 - 12	69	LCD	7 - 9
10	LCD	7 - 9	40	LCD	7 - 9	70	LCD	7 - 9
11	LCD	7 - 9	41	CRT	7 - 9	71	CRT	4 - 6
12	LCD	10 - 12	42	LCD	7 - 9	72	LCD	7 - 9
13	CRT	7 - 9	43	LCD	4 - 6	73	LCD	7 - 9
14	CRT	7 - 9	44	LCD	4 - 6	74	LCD	7 - 9
15	CRT	4 - 6	45	CRT	10 - 12	75	LCD	10 - 12
16	LCD	7 - 9	46	LCD	10 - 12	76	LCD	10 - 12
17	LCD	7 - 9	47	LCD	7 - 9	77	LCD	7 - 9
18	CRT	4 - 6	48	LCD	4 - 6	78	LCD	7 - 9
19	LCD	7 - 9	49	LCD	4 - 6	79	LCD	7 - 9
20	CRT	7 - 9	50	LCD	7 - 9	80	LCD	7 - 9
21	LCD	7 - 9	51	LCD	7 - 9	81	LCD	4 - 6
22	LCD	4 - 6	52	LCD	4 - 6	82	LCD	7 - 9
23	CRT with anti-glare screen	7 - 9	53	LCD	10 - 12	83	LCD	4 - 6
24	CRT	7 - 9	54	LCD	7 - 9	84	LCD	4 - 6
25	LCD	4 - 6	55	LCD	7 - 9	85	LCD	4 - 6
26	LCD	10 - 12	56	LCD	10 - 12	86	LCD	7 - 9
27	LCD	7 - 9	57	CRT	7 - 9	87	LCD	7 - 9
28	LCD	4 - 6	58	CRT	4 - 6	88	LCD	10 - 12
29	LCD	10 - 12	59	LCD	7 - 9	89	CRT	4 - 6
30	CRT	7 - 9	60	LCD	4 - 6	90	LCD	4 - 6

Appendix (9) Headache and eye strain

N.	Answer	N.	Answer	N.	Answer
1	Always	31	Sometimes	61	Sometimes
2	Always	32	Sometimes	62	Sometimes
3	Sometimes	33	Sometimes	63	Sometimes
4	Sometimes	34	Sometimes	64	Sometimes
5	Sometimes	35	Sometimes	65	Sometimes
6	Always	36	Sometimes	66	Sometimes
7	Always	37	Sometimes	67	Always
8	Sometimes	38	Sometimes	68	Always
9	Sometimes	39	Sometimes	69	Always
10	Sometimes	40	Always	70	Sometimes
11	Sometimes	41	Sometimes	71	Sometimes
12	Sometimes	42	Sometimes	72	Sometimes
13	Sometimes	43	Sometimes	73	Sometimes
14	Sometimes	44	Always	74	Always
15	Sometimes	45	Always	75	Always
16	Sometimes	46	Sometimes	76	Sometimes
17	Sometimes	47	Sometimes	77	Always
18	Sometimes	48	Sometimes	78	Sometimes
19	Sometimes	49	Always	79	Sometimes
20	Sometimes	50	Always	80	Sometimes
21	Sometimes	51	Always	81	Sometimes
22	Sometimes	52	Never	82	Sometimes
23	Always	53	Sometimes	83	Always
24	Sometimes	54	Sometimes	84	Always
25	Always	55	Sometimes	85	Always
26	Sometimes	56	Sometimes	86	Always
27	Sometimes	57	Sometimes	87	Sometimes
28	Sometimes	58	Sometimes	88	Sometimes
29	Sometimes	59	Always	89	Always
30	Sometimes	60	Always	90	Always

Appendix (10) Blur and double vision

N.	Answer	N.	Answer	N.	Answer
1	Never	31	Sometimes	61	Sometimes
2	Always	32	Never	62	Sometimes
3	Sometimes	33	Sometimes	63	Sometimes
4	Sometimes	34	Sometimes	64	Never
5	Never	35	Never	65	Never
6	Never	36	Always	66	Always
7	Always	37	Never	67	Never
8	Sometimes	38	Never	68	Never
9	Sometimes	39	Never	69	Sometimes
10	Always	40	Never	70	Sometimes
11	Always	41	Never	71	Sometimes
12	Always	42	Sometimes	72	Sometimes
13	Sometimes	43	Always	73	Never
14	Sometimes	44	Never	74	Sometimes
15	Sometimes	45	Sometimes	75	Never
16	Sometimes	46	Sometimes	76	Sometimes
17	Never	47	Never	77	Always
18	Never	48	Never	78	Sometimes
19	Sometimes	49	Sometimes	79	Always
20	Never	50	Sometimes	80	Never
21	Sometimes	51	Always	81	Never
22	Never	52	Always	82	Sometimes
23	Always	53	Sometimes	83	Never
24	Sometimes	54	Sometimes	84	Never
25	Sometimes	55	Sometimes	85	Sometimes
26	Always	56	Sometimes	86	Sometimes
27	Sometimes	57	Sometimes	87	Sometimes
28	Sometimes	58	Never	88	Sometimes
29	Never	59	Never	89	Sometimes
30	Never	60	Sometimes	90	Never

Appendix (11) Photophobia

N.	Answer	N.	Answer	N.	Answer
1	Sometimes	31	Never	61	Sometimes
2	Sometimes	32	Never	62	Sometimes
3	Always	33	Sometimes	63	Always
4	Sometimes	34	Sometimes	64	Sometimes
5	Always	35	Sometimes	65	Always
6	Sometimes	36	Sometimes	66	Sometimes
7	Never	37	Never	67	Sometimes
8	Sometimes	38	Sometimes	68	Always
9	Always	39	Never	69	Sometimes
10	Always	40	Always	70	Sometimes
11	Sometimes	41	Sometimes	71	Sometimes
12	Sometimes	42	Never	72	Sometimes
13	Sometimes	43	Sometimes	73	Sometimes
14	Sometimes	44	Sometimes	74	Sometimes
15	Never	45	Sometimes	75	Sometimes
16	Sometimes	46	Sometimes	76	Sometimes
17	Sometimes	47	Sometimes	77	Always
18	Never	48	Sometimes	78	Sometimes
19	Sometimes	49	Sometimes	79	Sometimes
20	Sometimes	50	Sometimes	80	Always
21	Sometimes	51	Sometimes	81	Sometimes
22	Never	52	Sometimes	82	Never
23	Never	53	Always	83	Sometimes
24	Always	54	Sometimes	84	Always
25	Sometimes	55	Sometimes	85	Always
26	Sometimes	56	Sometimes	86	Sometimes
27	Sometimes	57	Sometimes	87	Always
28	Always	58	Sometimes	88	Sometimes
29	Sometimes	59	Sometimes	89	Never
30	Sometimes	60	Never	90	Always

Appendix (12) Fatigue and sleepy

N.	Answer	N.	Answer	N.	Answer
1	Always	31	Sometimes	61	Never
2	Always	32	Sometimes	62	Sometimes
3	Always	33	Sometimes	63	Sometimes
4	Never	34	Sometimes	64	Sometimes
5	Sometimes	35	Sometimes	65	Never
6	Sometimes	36	Never	66	Sometimes
7	Sometimes	37	Always	67	Never
8	Sometimes	38	Sometimes	68	Always
9	Sometimes	39	Sometimes	69	Never
10	Sometimes	40	Never	70	Sometimes
11	Always	41	Sometimes	71	Sometimes
12	Sometimes	42	Sometimes	72	Never
13	Sometimes	43	Sometimes	73	Never
14	Never	44	Sometimes	74	Sometimes
15	Sometimes	45	Sometimes	75	Never
16	Sometimes	46	Always	76	Never
17	Sometimes	47	Never	77	Sometimes
18	Sometimes	48	Never	78	Always
19	Always	49	Sometimes	79	Never
20	Sometimes	50	Sometimes	80	Never
21	Sometimes	51	Sometimes	81	Sometimes
22	Sometimes	52	Never	82	Never
23	Sometimes	53	Never	83	Never
24	Sometimes	54	Never	84	Sometimes
25	Sometimes	55	Always	85	Never
26	Never	56	Sometimes	86	Never
27	Always	57	Never	87	Never
28	Sometimes	58	Sometimes	88	Never
29	Sometimes	59	Sometimes	89	Always
30	Sometimes	60	Never	90	Never

Appendix (13) Foreign body sensation

N.	Answer	N.	Answer	N.	Answer
1	Sometimes	31	Sometimes	61	Sometimes
2	Sometimes	32	Sometimes	62	Always
3	Sometimes	33	Sometimes	63	Sometimes
4	Never	34	Never	64	Sometimes
5	Never	35	Always	65	Sometimes
6	Never	36	Never	66	Always
7	Always	37	Never	67	Sometimes
8	Never	38	Never	68	Always
9	Never	39	Sometimes	69	Always
10	Never	40	Never	70	Sometimes
11	Always	41	Never	71	Sometimes
12	Never	42	Never	72	Sometimes
13	Never	43	Never	73	Sometimes
14	Sometimes	44	Sometimes	74	Never
15	Sometimes	45	Sometimes	75	Never
16	Never	46	Sometimes	76	Sometimes
17	Never	47	Sometimes	77	Sometimes
18	Never	48	Sometimes	78	Never
19	Sometimes	49	Sometimes	79	Always
20	Never	50	Never	80	Sometimes
21	Never	51	Never	81	Sometimes
22	Sometimes	52	Never	82	Always
23	Sometimes	53	Always	83	Never
24	Always	54	Always	84	Never
25	Sometimes	55	Never	85	Never
26	Sometimes	56	Never	86	Never
27	Never	57	Sometimes	87	Sometimes
28	Sometimes	58	Sometimes	88	Sometimes
29	Sometimes	59	Sometimes	89	Sometimes
30	Never	60	Sometimes	90	Sometimes

Appendix (14) Watery eye

N.	Answer	N.	Answer	N.	Answer
1	Always	31	Sometimes	61	Sometimes
2	Never	32	Sometimes	62	Never
3	Never	33	Sometimes	63	Never
4	Never	34	Never	64	Never
5	Sometimes	35	Sometimes	65	Sometimes
6	Sometimes	36	Never	66	Sometimes
7	Always	37	Never	67	Sometimes
8	Sometimes	38	Never	68	Sometimes
9	Never	39	Sometimes	69	Sometimes
10	Never	40	Never	70	Sometimes
11	Sometimes	41	Sometimes	71	Never
12	Never	42	Sometimes	72	Sometimes
13	Sometimes	43	Sometimes	73	Never
14	Sometimes	44	Sometimes	74	Never
15	Never	45	Sometimes	75	Sometimes
16	Always	46	Sometimes	76	Sometimes
17	Never	47	Sometimes	77	Sometimes
18	Sometimes	48	Sometimes	78	Sometimes
19	Sometimes	49	Sometimes	79	Sometimes
20	Always	50	Sometimes	80	Never
21	Never	51	Sometimes	81	Sometimes
22	Sometimes	52	Never	82	Sometimes
23	Never	53	Always	83	Never
24	Never	54	Always	84	Never
25	Sometimes	55	Sometimes	85	Never
26	Never	56	Always	86	Sometimes
27	Never	57	Sometimes	87	Sometimes
28	Never	58	Sometimes	88	Sometimes
29	Sometimes	59	Never	89	Sometimes
30	Never	60	Sometimes	90	Sometimes

Appendix (15) Burning eye

N.	Answer	N.	Answer	N.	Answer
1	Never	31	Sometimes	61	Sometimes
2	Sometimes	32	Sometimes	62	Sometimes
3	Sometimes	33	Always	63	Sometimes
4	Sometimes	34	Never	64	Never
5	Never	35	Always	65	Never
6	Sometimes	36	Sometimes	66	Sometimes
7	Always	37	Sometimes	67	Sometimes
8	Never	38	Sometimes	68	Sometimes
9	Never	39	Always	69	Sometimes
10	Sometimes	40	Sometimes	70	Sometimes
11	Sometimes	41	Sometimes	71	Sometimes
12	Always	42	Sometimes	72	Sometimes
13	Always	43	Sometimes	73	Never
14	Never	44	Always	74	Always
15	Sometimes	45	Always	75	Sometimes
16	Never	46	Always	76	Always
17	Never	47	Sometimes	77	Sometimes
18	Always	48	Sometimes	78	Sometimes
19	Sometimes	49	Sometimes	79	Never
20	Sometimes	50	Sometimes	80	Always
21	Never	51	Sometimes	81	Sometimes
22	Never	52	Sometimes	82	Sometimes
23	Sometimes	53	Sometimes	83	Sometimes
24	Sometimes	54	Sometimes	84	Sometimes
25	Sometimes	55	Sometimes	85	Sometimes
26	Sometimes	56	Sometimes	86	Sometimes
27	Never	57	Sometimes	87	Sometimes
28	Never	58	Sometimes	88	Sometimes
29	Never	59	Sometimes	89	Sometimes
30	Sometimes	60	Sometimes	90	Sometimes

Appendix (16) Itchy eye

N.	Answer	N.	Answer	N.	Answer
1	Sometimes	31	Sometimes	61	Always
2	Sometimes	32	Sometimes	62	Never
3	Sometimes	33	Sometimes	63	Sometimes
4	Never	34	Always	64	Sometimes
5	Sometimes	35	Sometimes	65	Sometimes
6	Sometimes	36	Sometimes	66	Sometimes
7	Sometimes	37	Sometimes	67	Sometimes
8	Never	38	Sometimes	68	Sometimes
9	Never	39	Always	69	Sometimes
10	Sometimes	40	Always	70	Sometimes
11	Sometimes	41	Always	71	Sometimes
12	Sometimes	42	Sometimes	72	Sometimes
13	Sometimes	43	Sometimes	73	Sometimes
14	Never	44	Sometimes	74	Sometimes
15	Sometimes	45	Sometimes	75	Sometimes
16	Sometimes	46	Sometimes	76	Sometimes
17	Sometimes	47	Never	77	Sometimes
18	Sometimes	48	Sometimes	78	Never
19	Never	49	Sometimes	79	Sometimes
20	Sometimes	50	Never	80	Sometimes
21	Sometimes	51	Sometimes	81	Sometimes
22	Sometimes	52	Sometimes	82	Always
23	Never	53	Sometimes	83	Sometimes
24	Never	54	Always	84	Never
25	Sometimes	55	Always	85	Always
26	Never	56	Sometimes	86	Sometimes
27	Sometimes	57	Sometimes	87	Sometimes
28	Sometimes	58	Sometimes	88	Sometimes
29	Sometimes	59	Always	89	Sometimes
30	Sometimes	60	Never	90	Never

Appendix (17) Dryness feeling

N.	Answer	N.	Answer	N.	Answer
1	Sometimes	31	Sometimes	61	Sometimes
2	Sometimes	32	Sometimes	62	Sometimes
3	Sometimes	33	Sometimes	63	Sometimes
4	Sometimes	34	Sometimes	64	Sometimes
5	Sometimes	35	Sometimes	65	Never
6	Sometimes	36	Never	66	Sometimes
7	Sometimes	37	Sometimes	67	Sometimes
8	Sometimes	38	Sometimes	68	Never
9	Sometimes	39	Sometimes	69	Never
10	Sometimes	40	Never	70	Sometimes
11	Never	41	Sometimes	71	Sometimes
12	Never	42	Sometimes	72	Sometimes
13	Sometimes	43	Sometimes	73	Sometimes
14	Sometimes	44	Sometimes	74	Sometimes
15	Never	45	Never	75	Never
16	Sometimes	46	Never	76	Never
17	Always	47	Sometimes	77	Never
18	Always	48	Sometimes	78	Sometimes
19	Sometimes	49	Sometimes	79	Sometimes
20	Sometimes	50	Sometimes	80	Sometimes
21	Sometimes	51	Sometimes	81	Never
22	Sometimes	52	Always	82	Sometimes
23	Never	53	Sometimes	83	Never
24	Sometimes	54	Sometimes	84	Sometimes
25	Always	55	Sometimes	85	Never
26	Sometimes	56	Never	86	Never
27	Always	57	Sometimes	87	Never
28	Never	58	Sometimes	88	Never
29	Sometimes	59	Sometimes	89	Sometimes
30	Never	60	Sometimes	90	Sometimes

Appendix (18) Redness and congestion

N.	Answer	N.	Answer	N.	Answer
1	Never	31	Always	61	Never
2	Never	32	Never	62	Never
3	Never	33	Sometimes	63	Never
4	Sometimes	34	Sometimes	64	Sometimes
5	Sometimes	35	Sometimes	65	Sometimes
6	Always	36	Sometimes	66	Sometimes
7	Sometimes	37	Never	67	Never
8	Sometimes	38	Never	68	Sometimes
9	Sometimes	39	Never	69	Sometimes
10	Never	40	Sometimes	70	Sometimes
11	Sometimes	41	Sometimes	71	Sometimes
12	Never	42	Sometimes	72	Never
13	Sometimes	43	Sometimes	73	Never
14	Sometimes	44	Sometimes	74	Never
15	Sometimes	45	Sometimes	75	Sometimes
16	Never	46	Always	76	Sometimes
17	Never	47	Sometimes	77	Sometimes
18	Never	48	Sometimes	78	Sometimes
19	Sometimes	49	Sometimes	79	Sometimes
20	Always	50	Sometimes	80	Sometimes
21	Sometimes	51	Sometimes	81	Sometimes
22	Sometimes	52	Sometimes	82	Sometimes
23	Never	53	Never	83	Always
24	Sometimes	54	Sometimes	84	Sometimes
25	Sometimes	55	Sometimes	85	Sometimes
26	Always	56	Sometimes	86	Sometimes
27	Always	57	Never	87	Never
28	Never	58	Never	88	Sometimes
29	Sometimes	59	Always	89	Always
30	Never	60	Never	90	Always

Appendix (19) Symptoms during and after work

N.	Answer	N.	Answer	N.	Answer
1	Always	31	Sometimes	61	Never
2	Always	32	Sometimes	62	Always
3	Always	33	Sometimes	63	Always
4	Always	34	Always	64	Sometimes
5	Sometimes	35	Sometimes	65	Sometimes
6	Sometimes	36	Never	66	Sometimes
7	Sometimes	37	Always	67	Sometimes
8	Sometimes	38	Always	68	Never
9	Never	39	Sometimes	69	Sometimes
10	Always	40	Sometimes	70	Sometimes
11	Always	41	Sometimes	71	Sometimes
12	Sometimes	42	Sometimes	72	Sometimes
13	Sometimes	43	Sometimes	73	Always
14	Sometimes	44	Sometimes	74	Sometimes
15	Always	45	Sometimes	75	Sometimes
16	Always	46	Sometimes	76	Always
17	Never	47	Always	77	Sometimes
18	Sometimes	48	Always	78	Sometimes
19	Sometimes	49	Sometimes	79	Never
20	Always	50	Sometimes	80	Always
21	Sometimes	51	Sometimes	81	Sometimes
22	Sometimes	52	Sometimes	82	Always
23	Sometimes	53	Sometimes	83	Always
24	Sometimes	54	Sometimes	84	Never
25	Sometimes	55	Sometimes	85	Never
26	Sometimes	56	Sometimes	86	Sometimes
27	Always	57	Sometimes	87	Sometimes
28	Always	58	Always	88	Sometimes
29	Sometimes	59	Never	89	Sometimes
30	Never	60	Always	90	Always

Appendix (20) Symptoms after wake

N.	Answer	N.	Answer	N.	Answer
1	Sometimes	31	Sometimes	61	Sometimes
2	Never	32	Never	62	Never
3	Never	33	Never	63	Never
4	Always	34	Never	64	Never
5	Never	35	Never	65	Sometimes
6	Sometimes	36	Always	66	Never
7	Sometimes	37	Never	67	Never
8	Never	38	Never	68	Sometimes
9	Always	39	Never	69	Never
10	Never	40	Sometimes	70	Never
11	Never	41	Never	71	Never
12	Sometimes	42	Never	72	Sometimes
13	Sometimes	43	Never	73	Sometimes
14	Never	44	Never	74	Sometimes
15	Sometimes	45	Never	75	Sometimes
16	Never	46	Sometimes	76	Never
17	Always	47	Never	77	Sometimes
18	Never	48	Never	78	Never
19	Sometimes	49	Never	79	Always
20	Never	50	Never	80	Never
21	Never	51	Sometimes	81	Never
22	Sometimes	52	Never	82	Sometimes
23	Never	53	Never	83	Never
24	Never	54	Sometimes	84	Sometimes
25	Sometimes	55	Never	85	Sometimes
26	Never	56	Sometimes	86	Never
27	Never	57	Never	87	Sometimes
28	Never	58	Never	88	Never
29	Sometimes	59	Sometimes	89	Never
30	Always	60	Sometimes	90	Sometimes

Appendix (21) Symptoms relief by analgesics

N.	Answer	N.	Answer	N.	Answer
1	Sometimes	31	Never	61	Never
2	Never	32	Never	62	Never
3	Never	33	Never	63	Never
4	Never	34	Never	64	Never
5	Sometimes	35	Never	65	Never
6	Always	36	Never	66	Never
7	Always	37	Never	67	Sometimes
8	Never	38	Never	68	Never
9	Never	39	Sometimes	69	Sometimes
10	Never	40	Never	70	Never
11	Never	41	Sometimes	71	Never
12	Sometimes	42	Never	72	Never
13	Never	43	Never	73	Never
14	Never	44	Never	74	Never
15	Never	45	Never	75	Always
16	Never	46	Sometimes	76	Never
17	Never	47	Never	77	Never
18	Never	48	Never	78	Never
19	Sometimes	49	Never	79	Never
20	Sometimes	50	Never	80	Sometimes
21	Never	51	Never	81	Never
22	Never	52	Never	82	Never
23	Sometimes	53	Sometimes	83	Never
24	Sometimes	54	Never	84	Never
25	Always	55	Never	85	Never
26	Sometimes	56	Never	86	Never
27	Never	57	Never	87	Never
28	Never	58	Never	88	Never
29	Never	59	Never	89	Never
30	Never	60	Sometimes	90	Sometimes

Appendix (22) Symptoms relief by closing eyes or looking to roof

N.	Answer	N.	Answer	N.	Answer
1	Never	31	Never	61	Never
2	Sometimes	32	Sometimes	62	Never
3	Sometimes	33	Sometimes	63	Sometimes
4	Sometimes	34	Never	64	Sometimes
5	Never	35	Never	65	Sometimes
6	Never	36	Never	66	Sometimes
7	Never	37	Never	67	Sometimes
8	Never	38	Never	68	Sometimes
9	Sometimes	39	Never	69	Never
10	Always	40	Always	70	Sometimes
11	Sometimes	41	Never	71	Never
12	Never	42	Never	72	Sometimes
13	Never	43	Never	73	Always
14	Sometimes	44	Sometimes	74	Always
15	Always	45	Sometimes	75	Always
16	Sometimes	46	Sometimes	76	Never
17	Sometimes	47	Always	77	Never
18	Sometimes	48	Always	78	Sometimes
19	Sometimes	49	Sometimes	79	Sometimes
20	Sometimes	50	Sometimes	80	Sometimes
21	Never	51	Sometimes	81	Sometimes
22	Never	52	Sometimes	82	Never
23	Sometimes	53	Never	83	Never
24	Sometimes	54	Never	84	Sometimes
25	Never	55	Never	85	Never
26	Sometimes	56	Sometimes	86	Sometimes
27	Always	57	Sometimes	87	Never
28	Never	58	Always	88	Never
29	Never	59	Sometimes	89	Sometimes
30	Never	60	Sometimes	90	Sometimes

Appendix (23) Symptoms relief by rubbing the eyes

N.	Answer	N.	Answer	N.	Answer
1	Always	31	Always	61	Sometimes
2	Never	32	Never	62	Sometimes
3	Sometimes	33	Always	63	Always
4	Never	34	Sometimes	64	Always
5	Sometimes	35	Sometimes	65	Always
6	Always	36	Always	66	Sometimes
7	Sometimes	37	Always	67	Sometimes
8	Never	38	Sometimes	68	Sometimes
9	Never	39	Sometimes	69	Sometimes
10	Never	40	Never	70	Sometimes
11	Sometimes	41	Sometimes	71	Sometimes
12	Sometimes	42	Sometimes	72	Sometimes
13	Sometimes	43	Always	73	Sometimes
14	Never	44	Sometimes	74	Always
15	Always	45	Sometimes	75	Always
16	Sometimes	46	Never	76	Sometimes
17	Sometimes	47	Never	77	Sometimes
18	Sometimes	48	Always	78	Always
19	Sometimes	49	Never	79	Always
20	Always	50	Sometimes	80	Sometimes
21	Sometimes	51	Sometimes	81	Always
22	Never	52	Sometimes	82	Sometimes
23	Sometimes	53	Sometimes	83	Always
24	Sometimes	54	Sometimes	84	Never
25	Always	55	Never	85	Always
26	Sometimes	56	Never	86	Sometimes
27	Sometimes	57	Always	87	Always
28	Always	58	Always	88	Sometimes
29	Sometimes	59	Always	89	Sometimes
30	Sometimes	60	Sometimes	90	Sometimes

Appendix (24) Symptoms relief by anti-reflex

N.	Answer	N.	Answer	N.	Answer
1	Never	31	Always	61	Never
2	Never	32	Always	62	Never
3	Always	33	Never	63	Never
4	Sometimes	34	Never	64	Never
5	Sometimes	35	Sometimes	65	Never
6	Never	36	Sometimes	66	Never
7	Always	37	Always	67	Never
8	Never	38	Sometimes	68	Never
9	Never	39	Always	69	Never
10	Always	40	Sometimes	70	Never
11	Never	41	Never	71	Sometimes
12	Sometimes	42	Always	72	Sometimes
13	Sometimes	43	Always	73	Never
14	Always	44	Sometimes	74	Never
15	Always	45	Sometimes	75	Never
16	Never	46	Sometimes	76	Never
17	Sometimes	47	Never	77	Never
18	Always	48	Never	78	Never
19	Sometimes	49	Never	79	Never
20	Never	50	Never	80	Never
21	Never	51	Sometimes	81	Never
22	Always	52	Sometimes	82	Always
23	Always	53	Sometimes	83	Never
24	Never	54	Never	84	Sometimes
25	Never	55	Never	85	Never
26	Never	56	Never	86	Never
27	Sometimes	57	Never	87	Never
28	Sometimes	58	Never	88	Never
29	Sometimes	59	Never	89	Always
30	Never	60	Always	90	Sometimes

Appendix (25) Symptoms relief by taking break or nap

N.	Answer	N.	Answer	N.	Answer
1	Sometimes	31	Sometimes	61	Always
2	Never	32	Sometimes	62	Sometimes
3	Sometimes	33	Never	63	Sometimes
4	Always	34	Sometimes	64	Sometimes
5	Sometimes	35	Sometimes	65	Sometimes
6	Never	36	Always	66	Sometimes
7	Sometimes	37	Sometimes	67	Sometimes
8	Sometimes	38	Sometimes	68	Never
9	Never	39	Sometimes	69	Sometimes
10	Never	40	Always	70	Sometimes
11	Always	41	Never	71	Sometimes
12	Sometimes	42	Never	72	Sometimes
13	Sometimes	43	Sometimes	73	Sometimes
14	Always	44	Sometimes	74	Sometimes
15	Sometimes	45	Sometimes	75	Always
16	Sometimes	46	Sometimes	76	Sometimes
17	Never	47	Sometimes	77	Sometimes
18	Sometimes	48	Always	78	Never
19	Never	49	Sometimes	79	Sometimes
20	Sometimes	50	Sometimes	80	Always
21	Sometimes	51	Sometimes	81	Sometimes
22	Never	52	Always	82	Sometimes
23	Sometimes	53	Always	83	Sometimes
24	Sometimes	54	Always	84	Sometimes
25	Sometimes	55	Never	85	Sometimes
26	Always	56	Sometimes	86	Sometimes
27	Sometimes	57	Always	87	Sometimes
28	Sometimes	58	Sometimes	88	Sometimes
29	Sometimes	59	Sometimes	89	Never
30	Never	60	Always	90	Always

Appendix (26) Having meals regularly and breakfast

N.	Meals	Breakfast	N.	Meals	Breakfast	N.	Meals	Breakfast
1	Never	Never	31	Never	Sometimes	61	Always	Always
2	Never	Sometimes	32	Always	Always	62	Always	Always
3	Never	Sometimes	33	Sometimes	Always	63	Sometimes	Sometimes
4	Always	Always	34	Sometimes	Always	64	Sometimes	Always
5	Always	Always	35	Always	Always	65	Always	Always
6	Always	Always	36	Always	Always	66	Sometimes	Always
7	Sometimes	Always	37	Never	Never	67	Never	Sometimes
8	Sometimes	Sometimes	38	Sometimes	Always	68	Always	Always
9	Always	Always	39	Never	Sometimes	69	Always	Always
10	Sometimes	Sometimes	40	Always	Always	70	Sometimes	Sometimes
11	Sometimes	Always	41	Always	Always	71	Sometimes	Always
12	Sometimes	Always	42	Always	Always	72	Always	Always
13	Sometimes	Always	43	Sometimes	Sometimes	73	Always	Always
14	Always	Always	44	Sometimes	Always	74	Always	Always
15	Always	Always	45	Sometimes	Always	75	Always	Always
16	Sometimes	Always	46	Sometimes	Always	76	Sometimes	Sometimes
17	Sometimes	Always	47	Always	Always	77	Sometimes	Sometimes
18	Never	Sometimes	48	Always	Always	78	Sometimes	Sometimes
19	Never	Sometimes	49	Always	Always	79	Always	Always
20	Sometimes	Always	50	Sometimes	Sometimes	80	Always	Always
21	Sometimes	Always	51	Sometimes	Sometimes	81	Always	Always
22	Sometimes	Always	52	Always	Always	82	Always	Always
23	Sometimes	Always	53	Always	Always	83	Sometimes	Sometimes
24	Sometimes	Always	54	Always	Always	84	Sometimes	Always
25	Always	Always	55	Never	Sometimes	85	Always	Always
26	Always	Always	56	Sometimes	Sometimes	86	Always	Always
27	Never	Sometimes	57	Always	Always	87	Always	Always
28	Sometimes	Always	58	Always	Always	88	Always	Always
29	Sometimes	Always	59	Always	Always	89	Never	Sometimes
30	Always	Always	60	Always	Always	90	Always	Always

Appendix (27) Negative smoking complainers

N.	Answer	N.	Answer	N.	Answer
1	Never	31	Never	61	Always
2	Never	32	Never	62	Always
3	Sometimes	33	Never	63	Sometimes
4	Sometimes	34	Never	64	Sometimes
5	Never	35	Always	65	Sometimes
6	Never	36	Never	66	Always
7	Always	37	Never	67	Never
8	Never	38	Never	68	Always
9	Never	39	Always	69	Always
10	Never	40	Never	70	Never
11	Always	41	Never	71	Never
12	Sometimes	42	Never	72	Sometimes
13	Sometimes	43	Sometimes	73	Sometimes
14	Never	44	Sometimes	74	Always
15	Never	45	Sometimes	75	Sometimes
16	Never	46	Sometimes	76	Always
17	Never	47	Sometimes	77	Sometimes
18	Never	48	Sometimes	78	Sometimes
19	Never	49	Sometimes	79	Sometimes
20	Never	50	Never	80	Always
21	Sometimes	51	Never	81	Sometimes
22	Sometimes	52	Never	82	Always
23	Never	53	Always	83	Sometimes
24	Never	54	Always	84	Never
25	Sometimes	55	Sometimes	85	Never
26	Always	56	Always	86	Always
27	Never	57	Sometimes	87	Never
28	Never	58	Sometimes	88	Sometimes
29	Never	59	Sometimes	89	Sometimes
30	Never	60	Never	90	Sometimes

Appendix (28) Symptoms free after tears naturale e.d.

N.	Headache free	Vision Problems free	Dryness free	Photophobia free
1	Yes	No	Yes	Yes
2	Yes	No	Yes	Yes
3	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes
6	Yes	No	Yes	Yes
7	Yes	Yes	Yes	Yes
8	No	Yes	Yes	Yes
9	No	No	Yes	Yes
10	No	Yes	Yes	Yes
11	No	No	Yes	Yes
12	No	Yes	Yes	Yes
13	No	Yes	Yes	Yes
14	No	No	Yes	Yes
15	No	Yes	Yes	Yes
16	No	Yes	Yes	Yes
17	No	Yes	No	No
18	No	Yes	Yes	Yes
19	No	Yes	Yes	Yes
20	No	No	No	No
21	No	Yes	Yes	Yes
22	No	Yes	Yes	Yes
23	No	Yes	Yes	Yes
24	No	No	Yes	Yes
25	No	Yes	Yes	Yes
26	No	No	Yes	Yes
27	No	Yes	Yes	Yes
28	No	Yes	Yes	Yes
29	No	Yes	No	No
30	No	No	Yes	Yes

Appendix (29) Symptoms free after omega 3

N.	Headache free	Vision Problems free	Dryness free	Photophobia free
1	Yes	No	No	No
2	Yes	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes
4	Yes	No	No	No
5	Yes	No	No	No
6	Yes	Yes	Yes	Yes
7	Yes	No	No	No
8	Yes	No	No	No
9	Yes	Yes	No	No
10	Yes	No	No	No
11	Yes	Yes	Yes	Yes
12	Yes	No	No	No
13	Yes	No	No	No
14	Yes	Yes	No	No
15	No	No	No	No
16	No	Yes	Yes	Yes
17	No	No	No	No
18	No	No	Yes	Yes
19	No	No	No	No
20	No	Yes	Yes	Yes
21	No	No	No	No
22	No	No	No	No
23	No	No	Yes	Yes
24	No	No	No	No
25	No	No	No	No
26	No	No	No	No
27	No	No	No	No
28	No	No	No	No
29	No	No	No	No
30	No	No	No	No

Appendix (30) Symptoms free after physical treatment and exercises

N.	Headache free	Vision Problems free	Dryness free	Photophobia free
1	Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes
3	Yes	No	No	No
4	Yes	No	Yes	Yes
5	Yes	Yes	No	No
6	Yes	Yes	Yes	Yes
7	Yes	No	No	No
8	Yes	No	No	No
9	Yes	Yes	Yes	Yes
10	Yes	Yes	No	No
11	Yes	No	No	No
12	Yes	Yes	Yes	Yes
13	Yes	No	No	No
14	Yes	No	Yes	Yes
15	Yes	Yes	Yes	Yes
16	Yes	No	No	No
17	Yes	Yes	Yes	Yes
18	Yes	No	No	No
19	Yes	Yes	Yes	Yes
20	Yes	No	No	No
21	Yes	Yes	Yes	Yes
22	No	No	No	No
23	No	No	No	No
24	No	Yes	Yes	Yes
25	No	Yes	Yes	Yes
26	No	Yes	No	No
27	No	No	No	No
28	No	Yes	No	No
29	No	No	Yes	Yes
30	No	No	Yes	Yes