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A Multi-Center Analytical Study of Medical Lens Types in Myopia Based on Survey Data and Computational Analysis

Hisham Abbas Mehdi, Mohammed Amer Abbas, Qasim Faleh Alawi, Ali Nashat Fahem, Aliaa Matouq Salman, Ruwiada Hiader Ahmed, Esraa Abaas Hussein, Aliaa Saleh Shaheed, Barakat Biasm Muzhir, Naba Fakhir Sarhan[1*], Mehdi Ebady Manaa [2]

[1] Department of Medical Physics , College of Science , AL-Mustaqbal University , Babylon, Iraq, bashsham120@gmail.com

[2]Intelligent Medical Systems Department, College of Sciences, Al-Mustaqbal University, 51001, Babylon, Iraq, mahdi.ebadi@uomus.edu.iq

College of Information Technology, University of Babylon, Babylon, Iraq

دراسة تحليلية متعددة المراكز لأنواع العدسات الطبية في قصر البصر استنادًا إلى بيانات الاستبيانات والتحليل الحسابي

هشام عباس مهدي، محمد عامر عباس، قاسم فالح عليوي، علي نشأت فاهم، علياء معتوق سلمان، رويده حيدر أحمد، إسراء عباس حسين، علياء صالح شهيد، بركات باسم مزهر،نبأ فاخر سرحان [1*]، مهدي عبادي مانع [3,2]

[1] قسم الفيزياء الطبية ، كلية العلوم / جامعة المستقبل bashsham120@gmail.com

[2] قسم الانظمة الطبية الذكية ، كلية العلوم ، جامعة المستقبل ، 51001 ، بابل ، العراق mahdi.ebadi@uomus.edu.iq

قسم شبكات المعلومات ، كلية تكنولوجيا المعلومات ، جامعة بابل ، بابل ، العراق

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ABSTRACT

Background: This study explores the optical properties of lenses used in vision correction, focusing covers the structure and function of the human eye, particularly the cornea and lens, retina, and optic nerve. It discusses common vision problems such as myopia (nearsightedness) and its correction using concave lenses. The study highlights the impact of optical properties, such as refraction and focal length, on vision improvement and examines the importance of selecting the appropriate lens type for treatment.

Materials and Methods: The study examined 102 individuals, 82 of whom suffered from eye diseases. 51 individuals were diagnosed with myopia, ranging in age from under 18 to over 60 years, with most cases associated with astigmatism. Additionally, 20 individuals were diagnosed with hyperopia. There were 9 cases of eye inflammation, all among the elderly, and 2 cases of cataracts. Meanwhile, 20 individuals were healthy with no eye diseases. Diagnostic tools such as the Auto Refractor Keratometer, E Chart, and a trial lens set were used for examinations.

Results: The results indicated that the 18-30 age group had the highest prevalence of myopia, while other age groups showed moderate infection rates. Some cases were associated with chronic diseases such as diabetes and hypertension. Regarding treatment methods, 10 individuals used contact lenses, 20 wore prescription glasses, 5 underwent eye surgery.

Keywords: Myopia, Vision Correction, Lenses, Glasses, Astigmatism.

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1. INTRODUCTION

Eye health is a vital priority in human life because vision quality has a direct impact on one's quality of life and capacity to execute daily tasks. In this context, medical lenses are critical for vision correction and treating a variety of eye ailments. Since the introduction of lenses in optical therapy, there have been constant developments in their design and materials, with the goal of improving optical performance and patient comfort[1]. Different types of medical lenses help to correct various visual impairments, such as myopia, hyperopia, and astigmatism, and work to enhance patients' quality of life by giving clearer and more precise vision[2]. The lens's flexible surface curvature has a significant impact on its accommodation capabilities. The lens morphology and GRIN vary with aging and during accommodation[3]. is created by a shift in the shape of the lens caused by ciliary muscle contraction[4]. The lens's accommodative capacity allows humans to clearly view objects at various distances. The lens's accommodative capacity is connected with its biological parameters[5]. The lens grows during life, creating layer-by-layer structure, lens sutures, and the appropriate gradient refractive index (GRIN); thus, its biological properties change with age [6]. In young persons, there is a balance between corneal positive and lens negative spherical aberration[7]. Understanding the lens and its role in accommodation and visual quality is critical for creating remedies for aged or diseased lenses. Patients with a high Kappa angle have more visible horizontal coma compensation. which is frequent in hyperopia[8]. The compensatory effect of aberration reduces as age increases. In the aged the lens's compensating impact on corneal aberration is clearly diminished, if not eliminated[9]. According to the World Health Organization's World Report on Vision 2019, the number of persons with eye conditions has increased globally in recent decades. Cataract remains the leading cause of visual impairment in poor countries [10].The aging of the population has increased the frequency of chronic posterior eye illnesses such as age-related macular degeneration (AMD), glaucoma, and cataracts [11]. Air pollution, chronic steroid usage, and an increase in the incidence of allergic diseases have all been linked to ocular surface problems such as keratoconjunctivitis sicca or dry eye [12].

2. RELATED WORK

In an earlier study [13]. To study the preventive behaviours of greater close work distance, discontinuing near work, and spending more time outside in recess based on parent self-report in myopia prevalence and progression among myopic children aged 9-11 years.

In an earlier study [14]. A systematic examination of near work and myopia, including measurement, correlations, processes, and clinical implications.

In an earlier investigation [15]. A comprehensive review and meta-analysis examined the link between near occupational activities and myopia in children.

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In an earlier investigation [16]. The goal is to evaluate the relationship between near-work and myopia advancement in the student population. The causes of myopia incidence are not fully explained. Methods: This retrospective-prospective, descriptive study included 100 students with certified myopia of up to -3 Dsph.

In an earlier investigation [17]. To investigate the relationship between time spent at near work and reading and spherical equivalent refraction (SER) in a population-based sample of 12-year-old Australian schoolchildren.

In an earlier investigation [18]. To explore the characteristics of various near-work related behaviors among primary students, as well as their connections with changes in myopia-associated ocular biometric parameters throughout a one-year period of follow-up.

3. THE PROPOSED SYSTEM

3.1 The main steps of the proposed methodology

Figure (1) Illustrates the main steps of the proposed methodology

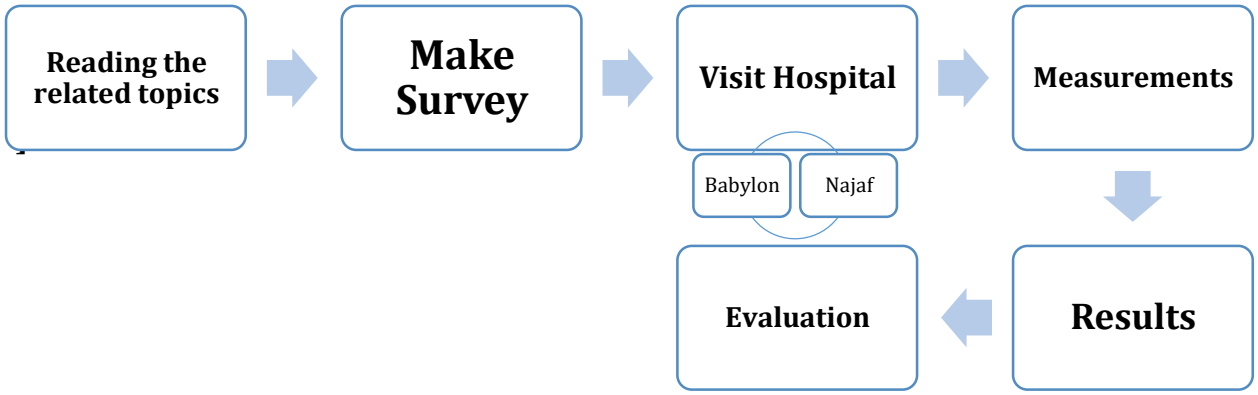

Figure 1: Illustrates the main steps of the proposed methodology

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3.2 First Step: Study the Project

A comprehensive study is We conducted on the properties of lenses in treating eye conditions, where we explored and understood eye problems through several reliable sources. We then obtained a book from Al-Mustaqbal University on (28/10/2024) to facilitate the task. Following this, we began researching hospitals and centers that could assist us in gathering data, speaking with patients, and collecting sufficient information to obtain accurate analyses and results. Subsequently, we achieved our objectives and visited Al-Hilla Teaching Hospital and Al-Hakim General Hospital, where we started collecting, analyzing, and evaluating data. All the hospital staff and patients were remarkably cooperative with us. Afterward, we held discussions, implemented our ideas, and reached a valuable and beneficial study.

3.3 The second step Make a Survey

A survey was conducted among professionals and patients to gather insights into the most commonly used types of lenses, the challenges they face during treatment, the devices used for examination and treatment, and how patients are managed. This survey greatly facilitated the preparation of our methods for hospital visits and the completion of this research to ensure a focused study on lenses.the hospitals that provided the most support for conducting this study are listed in the figure (2) below.

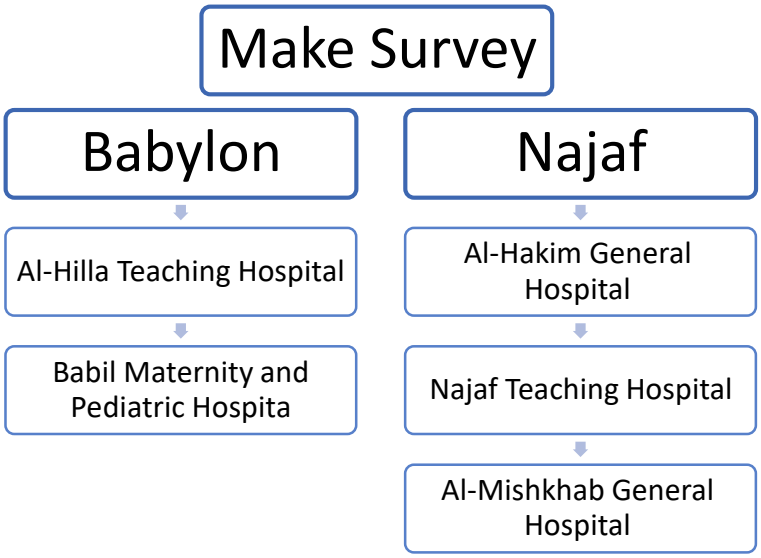

Figure 2 : Illustrates the Make survey of hospitals.

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3.4 The third step : Study Design

The hospitals that were visited for study purposes are listed in the figure (3) below.

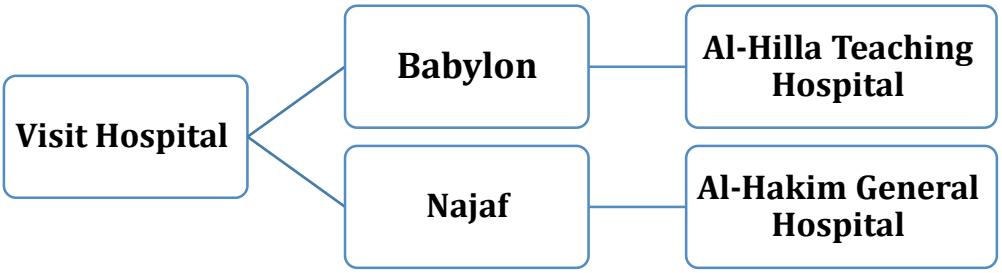

Figure 3: Illustrates the Hospital visits.

3.5 The fourth step : Measurements

The devices used in the study are listed in Table (1) below.

Table 1 : Illustrates the devices and their uses.

No.	Devices	Uses
1	Auto refractor keratometer	• Measuring the eye's refractive power (to determine eyeglass prescriptions). • Measuring corneal curvature (to diagnose astigmatism or determine the appropriateness of contact lenses)[19].
2	E Chart	It is used to assess visual acuity by instructing the patient to identify the direction of the letter "E" in various sizes from a set distance[20].
3	Trial Lens Set	It is used in hand examinations to precisely determine visual parameters[21].

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3.6 The fifth step : make evaluation

Table 2: Explains the evaluation tools and the use of each tool.

make evaluation	used
Snellen Chart	Used to judge visual acuity from a distance[22].
Retinoscope	A tool used to assess how light refracts within the eye[23].
Refractometer	An automated instrument for measuring refractive errors with great precision[24].
Manual Refraction Test	Conducted with a "phoropter" or trial lenses[25].
Keratometer	Used to quantify corneal curvature, which is important in determining refraction[26].
Dark Room Test	Examines the eye's reaction to light and darkness to see how light refracts under different situations[27].
Slit Lamp	Used to inspect the front area of the eye, including the cornea, to confirm that there are no underlying problems with refraction[28].
Tonometry	While not directly used for diagnosing myopia or hyperopia, it monitors intraocular pressure to rule out other disorders like glaucoma[29].
Near Vision Test	Used to test near vision, especially in cases of hyperopia or reading difficulty[30].

3.7 Standard values

Table 3: Standards for Myopia and Astigmatism by Age.

Age Group	Myopia (Near-sightedness)	Astigmatism
Under 18 years	-0.25 to -6.00	0.50 to 2.00
18 to 30 years	-1.00 to -8.00	Less than 2.00
31 to 45 years	Stable at adolescent levels	1.00 to 2.50
46 to 60 years	Stable or slight changes	1.00 to 2.50 (may increase after surgery)
Over 60 years	Changes due to aging or surgery	Up to 3.00 or more depending on condition

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4. RESULTS AND DISCUSSION

Analysis is the process of reviewing data obtained during a study or experiment to uncover patterns, trends, and correlations between variables. The analysis's goal is to reach scientific or practical conclusions that will help the study achieve its objectives. Here are the processes to analyze results and implement them:

A. Data Collection: Initially, data was gathered at hospitals through visits and questionnaires tailored to the nature of the research.

B. Data Organization: The data was structured into tables or graphs to make it easier to read and analyze. This includes organizing the data into groupings or categories. C. Comparing Results: The findings were compared to reference standards or values.

D. Trend and Pattern Analysis: We looked for obvious patterns or trends in the data. Is there a relationship between lens type and visual quality? Do lenses that guard against UV rays produce superior results?

E. Interpretation: After data analysis, the results are interpreted in accordance with the research hypotheses or questions. It is decided whether the findings support or contradict the original hypotheses.

F. Drawing Conclusions: Based on the analysis, conclusions are drawn that can help improve products or scientific applications. In the case of lenses, the conclusion may be based on how well they protect against UV radiation or improve visual clarity.

G. Recommendations: Finally, recommendations may be made based on the results, such as suggesting improvements in lens design or recommending certain lenses for specific cases.

Results analysis helps provide accurate information that supports scientific or medical decisions and aids in developing tools and techniques used in the research field.

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Case 1: A Study on the 102 population Patients:

In the study, 102 people were examined, 82 of whom had eye problems. Fifty-one people were diagnosed with myopia, ranging in age from under 18 to over 60. It was discovered that the vast majority of these myopia cases were associated with astigmatism. During the examination, 20 people were diagnosed with hyperopia, all in the same age range, with the majority of cases associated with astigmatism.

The study also included nine cases of eye irritation, all of which were among elderly patients, as well as two cases of cataracts. On the other hand, 20 healthy individuals were found to be free of any eye disorders. These patients were evaluated using advanced diagnostic equipment such as an automatic refractive keratometer, E-graph, and a set of trial lenses.

A particularly striking finding from the study was the abnormally high number of people between the ages of 18 and 30 who were diagnosed with myopia and astigmatism. This age group was the most affected, accounting for 37 of the 51 cases of myopia studied.

This is alarming, as it highlights a growing problem that is likely to worsen due to modern lifestyle changes such as excessive use of electronic devices, prolonged exposure to screens, and a lack of adequate information about eye health. These findings highlight the urgent need for preventative measures and focused interventions to raise awareness and protect the vision of current and future generations.

This nuanced understanding constitutes a fundamental call to action to properly address this growing public health threat.

4.1 Nearsightedness (Myopia)

Myopia, also known as nearsightedness, is a visual disorder in which near things are clearly seen while distant ones are hazy and do not come into focus[31]. A normal eye exam can establish the degree of myopia. Blurred vision can be corrected with glasses, contact lenses, or refractive surgery[32].

Age: Regarding myopia With astigmatism, the ages under 18 years had a low percentage of cases. Ages ranging between 18 and 30 had the highest percentage of cases. Ages between 31 and 45 years showed a smaller number of cases, while ages ranging between 46 and 60 years recorded the lowest percentage of cases of myopia. Meanwhile, ages above 60 years had a moderate number of cases, as shown in Table (4) and Figure (4) below.

Table 4: Summary statistics for age Cases and degree of Myopia with astigmatism.

Variables		Cases	sph		cyl		axis	
			RE	LE	RE	LE	RE	LE
Age (Year)	Under 18 years old	2	-1.75	-0.75	-1.00	-0.50	180°	175°
	18-30 years old	37	-1.00	-1.50	---	---	---	---
	31-45 years old	3	-1.25	---	---	---	---	---
	46-60 years old	1	-1.00	-0.75	-0.50	-1.00	180°	165°
	Over 60 years old	8	-2.00	-1.75	-1.50	-2.50	150°	140°

Clarification of several terminology and numbers in Table 4 above.

• Sph stands for Sphere. It indicates the degree of near- or farsightedness. A negative value (-) implies nearsightedness. A positive (+) value reflects farsightedness (the ability to see distant objects more clearly than nearer ones).

• Cylinder is shortened to Cyl. It shows the extent of astigmatism, a distortion in the cornea's or lens's curve. Astigmatism is present if there is a number, whether it be positive or negative. Astigmatism is most typically described by a negative (-) number. It indicates no astigmatism if it reads "Plano" or is left empty.

• Axis is represented by a number between 0° and 180°. It denotes the orientation of the astigmatism (the location of the abnormal curvature on the cornea). This number is meaningless if Cyl contains no value.

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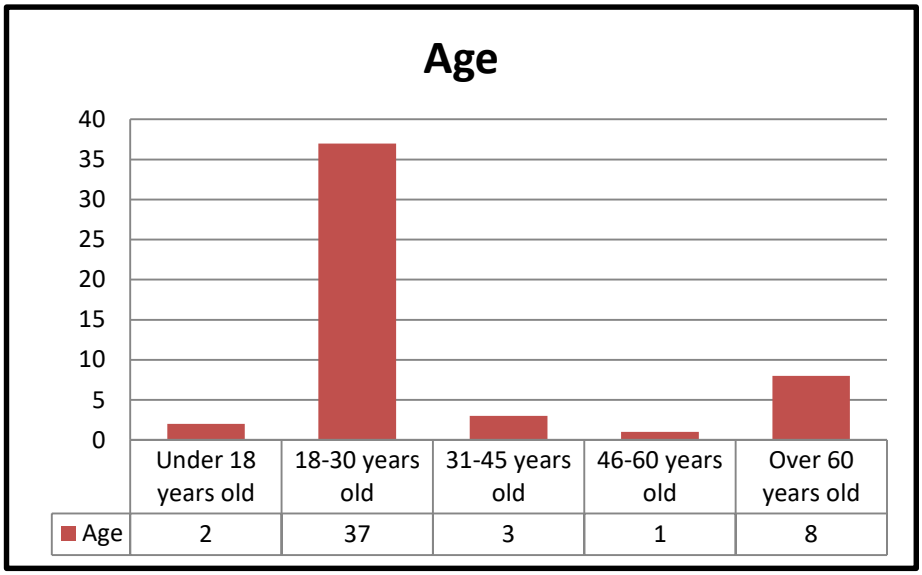

Figure 4: A statistic of ages and the recorded cases of myopia.

Gender: The gender distribution was nearly equal across all age groups, with only a very slight difference. The percentages are presented to compare the age groups among the study groups in Table (5) and Figure (5).

Table 5: Frequencies and percentages of age categories comparisons among the study groups.

Gender		Patients Group
Sex (No.)	Male	31
	Female	20

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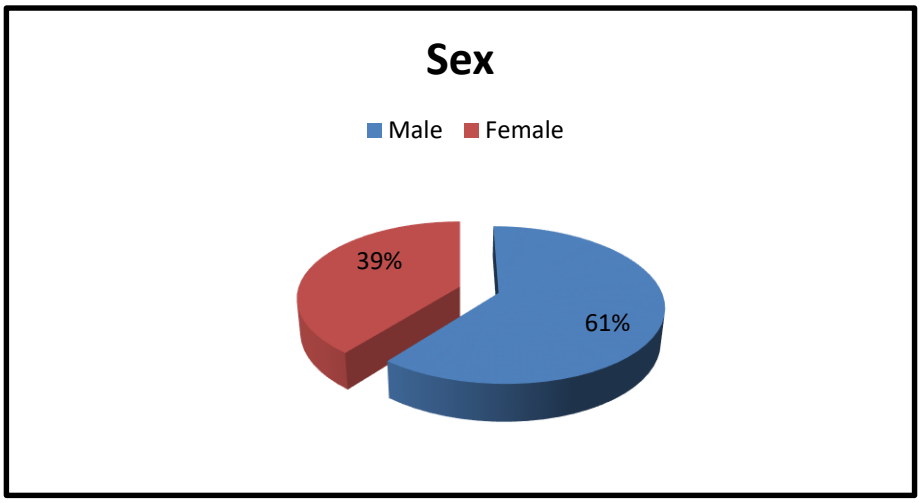

Figure 5: A statistic for both genders.

4.2 Chronic diseases

Sometimes, myopia is associated with chronic diseases, either hereditary, like diabetes and hypertension, or other diseases, as shown in Table (6) below.

Table 6: Hereditary diseases associated with myopia and cases.

Variables		Cases
Chronic diseases	**Hypertension**	**3**
	Diabetes Mellitus	**2**
	Other diseases	**1**

4.3 Treatment Method

Here, we conducted a statistical study on patients with myopia who used lenses, glasses, underwent surgical intervention, or did not use any treatment, as shown in Table (7) and Figure (6) below.

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Table 7: Statistics on patients with myopia who used contact lenses, glasses, underwent surgery, or did not use any treatment.

Treatment Method	Description	number of cases
Lenses	Use of contact lenses (soft, rigid, or hybrid) to correct refractive errors	10
Glasses	Use of prescription glasses to adjust focus and improve vision	20
Surgical Intervention	Procedures such as LASIK or PRK to reshape the cornea.	5
No Treatment	Patients choose not to undergo any corrective measures.	16

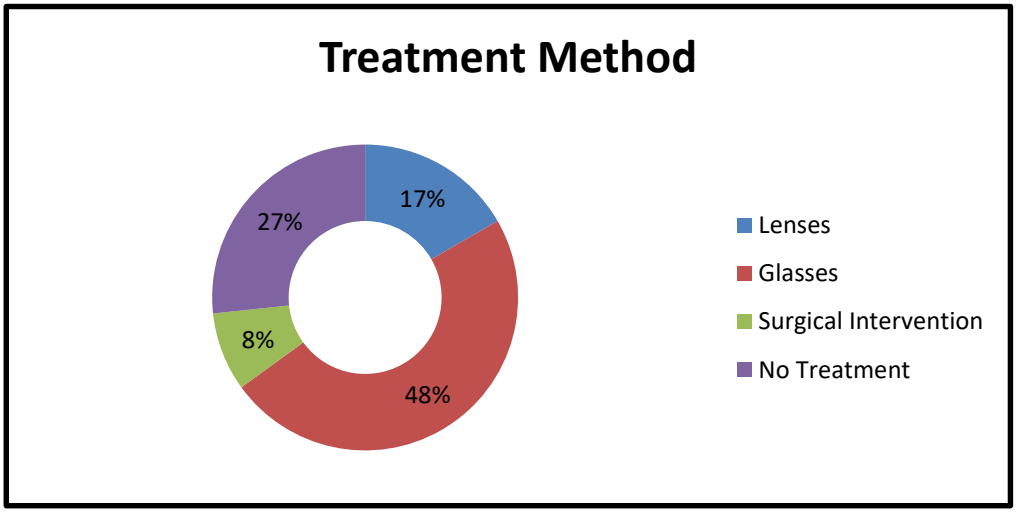

Figure 6: Statistics on patients with myopia who used contact lenses, glasses, underwent surgery, or did not use any treatment.

Case 2: Other diseases

There are many eye diseases, but what we found during the survey process within the hospital, collecting information, and analyzing it, were eye inflammation and cataracts. As shown in Table (8) and Figure (7) below.

Table 8: Illustrates cases of eye inflammation and cataracts.

diseases	Causes	Number of cases
eye inflammation	• Infection: Bacterial, viral, or fungal infections can affect various components of the eye, such as the conjunctiva or cornea[33]. • Allergy: Allergies to environmental pollutants such as dust, pollen, or smoke can induce ocular irritation, resulting in allergic conjunctivitis[34]. • Dryness: A lack of tears or dry eyes can cause irritation and inflammation of the eyeball[35].	9
cataracts	• Aging is the most common cause, as proteins in the eye lens alter with age, resulting in clouding[36]. • Genetic factors: A family history of cataracts raises the risk of getting the illness[37]. • Smoking: Smoking is thought to be one of the causes of cataracts[38].	2

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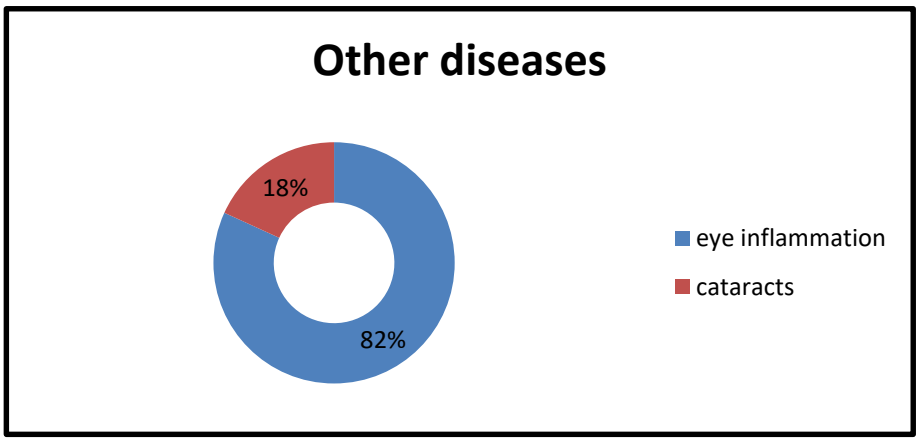

Figure 7: Statistics on other diseases.

5. CONCLUSION

This study implies a possible relationship between age and the prevalence of myopia and is occasionally related to chronic diseases such as diabetes and hypertension, which can be genetic or acquired. Our analyzes and observations during hospital visits revealed that excessive use of electronic devices, prolonged screen time, and a lack of information about eye care all contributed to the development of the problem.

Conflict of interests.

There are non-conflicts of interest.

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الخلاصة

تستكشف هذه الدراسة الخصائص البصرية للعدسات المستخدمة في تصحيح النظر، مع التركيز على بنية وعمل العين البشرية، خصوصًا القرنية والعدسة، الشبكية، والعصب البصري. كما تناقش المشاكل الشائعة في الرؤية مثل قصر النظر وتصحيحه باستخدام العدسات المقعرة. تسلط الدراسة الضوء على تأثير الخصائص البصرية مثل الانكسار والطول البؤري على تحسين الرؤية، وتبحث في أهمية اختيار نوع العدسة المناسب للعلاج.

المواد والأساليب: شملت الدراسة فحص 102 فردًا، منهم 82 يعانون من أمراض عينية. تم تشخيص 51 فردًا بقصر النظر، تراوحت أعمارهم من أقل من 18 إلى أكثر من 60 عامًا، مع ارتباط معظم الحالات باللابؤرية. بالإضافة إلى ذلك، تم تشخيص 20 فردًا بمدّ البصر. كما وُجدت 9 حالات التهاب في العين، جميعها بين كبار السن، و2 حالة مياه بيضاء . بينما كان 20 فردًا يتمتعون بصحة عينية جيدة دون أمراض. استخدمت الدراسة أدوات تشخيصية مثل جهاز قياس الانكسار الأوتوماتيكي(Auto Refractor Keratometer) ، لوحة فحص الرؤية(E Chart) ، ومجموعة العدسات التجريبية للفحص.

النتائج: أشارت النتائج إلى أن الفئة العمرية بين 18–30 سنة كانت الأعلى في انتشار قصر النظر، بينما أظهرت الفئات العمرية الأخرى معدلات إصابة معتدلة. ارتبطت بعض الحالات بأمراض مزمنة مثل السكري وارتفاع ضغط الدم. فيما يخص طرق العلاج، استخدم 10 أفراد العدسات اللاصقة، وارتدى 20 فردًا نظارات طبية، وخضع 5 أفراد لعمليات جراحية في العين.

كلمات مفتاحية: قصر النظر، تصحيح الرؤية، العدسات، النظارات، اللابؤرية.

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