المجلد الخامس- العدد الثاني – فبراير 2026
Volume 5 (Issue 2) February 2026

مجلة قورينا العلمية QSJ
Qurina Scientific Journal
ISSN: 2959 – 746

Diagnosis of Common Refractive Errors in Children Using Non-Surgical Techniques

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الملخص:
الخلفية: تُعدّ عيوب الانكسار من أهمّ جوانب ضعف البصر لدى الأطفال، وتمثّل مشكلة صحية عامة هامة، لا سيما في الدول النامية. قد تؤثر عيوب الانكسار سلبًا على نموّ الأطفال في جميع جوانبه، وقد تؤدي إلى إعاقة بصرية دائمة إذا لم يتمّ اكتشافها مبكرًا. هدفت هذه الدراسة إلى تقييم مدى انتشار عيوب الانكسار وأنماطها بين الأطفال المراجعين لعيادة ومستشفى طب العيون في بنغازي، ليبيا. المنهجية: أُجريت الدراسة في مرافق الرعاية الصحية المختارة لطب العيون. تمّ إجراء دراسة مقطعية، حيث جُمعت البيانات الديموغرافية أولًا، ثمّ أُجري فحص سريري للعين، شمل تقييم حدّة البصر، وقياس الانكسار، وتقييم أجزاء العين (الأمامية والخلفية)، وسُجّلت جميع البيانات المُجمّعة. النتائج: أظهر الأطفال في هذه الدراسة انتشارًا أعلى لضعف البصر. تُعدّ عيوب الانكسار السبب الرئيسي لضعف البصر (قصر النظر وطول النظر)، يليها الحول والغمش. كانت نسبة ضعف البصر أعلى لدى الفئة العمرية الأكبر سنًا مقارنةً بالفئات الأصغر سنًا. كانت الإناث يترددن على المستشفى أكثر من الذكور وقت إجراء الدراسة، وقد استُخدمت أكثر من تقنية تشخيصية واحدة. أظهر الأطفال في سن المدرسة معدلًا أعلى من عيوب الانكسار مقارنةً بالفئات العمرية الأصغر. ويُعدّ تصحيح النظر (باستخدام النظارات) الطريقة العلاجية الأكثر شيوعًا. الخلاصة: شاع ضعف البصر بين الأطفال في سن المدرسة في بنغازي، ويعود ذلك أساسًا إلى عيوب الانكسار غير المصححة، مثل قصر النظر، والاستجماتيزم، وطول النظر. تُبرز هذه النتائج الحاجة إلى تحسين برامج الكشف المبكر والفحص، ونهج العلاج لدى الأطفال للحد من عيوب الانكسار التي يُمكن الوقاية منها في مرحلة الطفولة، وتأثيرها طويل الأمد.

الكلمات المفتاحية: عيوب الانكسار؛ ضعف البصر لدى الأطفال؛ طب العيون للأطفال؛ قصر النظر؛ الحول؛ أمراض العيون؛ طول النظر

Abstract: Background: Refractive errors consider the main aspect of Visual impairment in childhood represent a significant public health issue, particularly in developing countries. Refractive errors may adversely affect children development in all aspect and can lead to permanent visual disability if not discovered early. This study aimed to assess the prevalence and pattern of refractive errors among children attending ophthalmology clinic and hospital in Benghazi, Libya. Method: The study conducted in the selected health care facilities for ophthalmology. A cross-sectional study performed, first colleting demographic data, second clinical ophthalmic examination were performed, including acuity assessment, refraction, and segment evaluation (anterior and posterior), all data collected was recorder. Results: Children in this study exhibit a higher prevalence of visual impairment. Refractive errors are the main cause of visual impairment (myopia and hyperopia), followed by strabismus and amblyopia. The older age group had a higher visual impairment than the younger groups. Female participants were attending the hospital more often than males at the time of the study more than one diagnostic technique had been used. School-aged children showed a higher burden of refractive errors compared to younger age groups. Correction of vision (glasses) is the most

common management method used. Conclusion: Among school-aged children in Benghazi visual impairments were common, primarily due to uncorrected refractive errors such as myopia, astigmatism, and hyperopia. These findings highlight the need for improve early detection and screening program, treatment of approach in children to reduce preventable childhood refractive errors and its long-term impact.

Keywords: Refractive Errors; Childhood visual impairment; Pediatric ophthalmology; Myopia; Strabismus; Eye diseases; Hyperopia.

I. INTRODUCTION

"Vision is critical for daily activities, and visual impairment is one of the most serious disabilities. Visual impairment at birth or during childhood can affect learning, communication, employment, health, and quality of life, and the effects are often life-long. (Brown *et al.*, 2003). Although the proportion of infants and school-aged children with visual impairment is less than 5%, children with visual impairment account for 20% of individuals with visual impairment worldwide, after adjustment for disability-adjusted life years (Sun, 2000). The control of visual impairment and blindness in children is a priority of the World Health Organization's VISION 2020 program. (Gilbert & Foster, 2001). Uncorrected refractive error is one of the most common causes of visual impairment in children. Increasing evidence indicates that uncorrected refractive error is a main cause of avoidable blindness in many regions, including Chile, Africa, and Malaysia" (Ellwein *et al.*, 2000; Naidoo *et al*., 2003; Goh *et al.*, 2005).

Minor decline in vision (<6/12 or just below the driving standard) has increasing the risk of death and physical, social, and intellectual issues in humans older than 50 years (Taylor *et al.*, 2003). The worldwide monetary effect of uncorrected refractive mistakes is an anticipated 268.eight billion worldwide dollars, primarily based totally on population The global economic impact of uncorrected refractive error is an estimated 268.8 billion international dollars, based on population and economic data combined with a meta-analysis of prevalence studies (Smith *et al*., 2009).

In Libya particularly in Benghazi, their limited studies published regarding prevalence of refractive errors, diagnoses approach among school aged children, to identify these factors as necessary to improve and development of children vision screening programs, treatments, and pediatric eye care approaches.

1.2 The Aim to Accomplish:

This study aimed to assess the prevalence of refractive errors, as well as the non-invasive diagnostic approaches used among school-aged children attending Al-Sabri Polyclinic and Al-Nahr Central Hospital in Benghazi Libya.

II. GROWTH AND DEVELOPMENT OF CHILD'S EYE

The eye growth and development of hid many challenging anatomical and physiological alterations starting from the intrauterine life until the early puberty. After the early puberty, the axial duration of eye, this is defined due to the fact the anterior posterior diameter of the eye, remains unaltered in healthy subjects. The eye refractive status still to change in adults due to aging processes. The eye development starts in the 3-week embryo, from the optic vesicles. The preliminary three years of existence is the vital duration for eye development, and fast growth in. Clear vision is mandatory for the development of visual cortex in this critical period. It is well-known that everyday person viuale capability develops at three years of age (Fredrick, 2004).

The coordinated boom of eye's refractive additives to attain a plano refraction is known as emmetropization. If any failure takes place on this process, refractive mistakes develop. The axial period is both too short, inflicting hypermetropia, or too long, inflicting myopia. Astigmatism is because of extraordinary shapes in cornea. Very high degrees of hypermetropia (>5D) are not normal in newborns. The cornea and lens can also additionally flatten generally inside years; however, the axial period regularly pauses behind. This reasons everlasting hyperopia, that is referred to as nanophthalmos. Generally, eyes with hyperopia of extra than five diopters have little hazard of emmetropization (Mutti, 1992).

2.1. The cornea:

Is an avascular, obvious tissue that lets in mild transmission into the eye. The cornea performs a vital

function withinside the refraction of the eye; it really works as a concave-convex lens in contact with the aqueous and the tear film (AAO, 2009). The cornea outer aspect has an oval configuration with an average horizontal diameter of 12.6 mm and an average vertical diameter of 11.7mm. The outer surface of the cornea is the main refractive element of the eye contributing with approximately +48 diopters to the convergence of the light in the retina (Colina, 2000).

Refractive Index (nn*n*): While ~1.376 is the standard, it varies by layer (epithelium ≈is approximately equal to ≈ 1.401, stroma ≈is approximately equal to ≈ 1.369).

Total Power: Roughly 40–45 D (anterior surface is +48.8 D, posterior is -5.8 D).

❖ Reason of Cornea Transparency:

- Collagen fibers are arranged uniformly and regularly in the stroma, reducing light scattering.
- lack of blood vessels, which stops light from being absorbed and dispersed.
- The corneal endothelium uses active ion pumps to maintain controlled hydration.
- Collagen fibrils have a uniform diameter and spacing, which facilitates effective light transmission.
- non-keratinized epithelium that preserves optical clarity.

2.2. Refractive Errors (Ametropia):

Refractive errors are existed while the attention fails to convey parallel light (remote objects) to cognizance at the retina. Ametropia, that is described because the presence of any of the refractive disorders, is the maximum generally diagnosed ailment of the human eye. Ametropia includes the hyperopia (Farsightedness), myopia (Nearsightedness) and astigmatism (abnormal curvature of the cornea). The most common refractive error in the pediatric population is myopia (near sight). The World Health Organization estimates refractive disorders to be 2-10%worldwide. The incidence is discovered to be lots better withinside the Far East. The occurrence of astigmatism of one diopter or extra is 50% in infancy. The occurrence decreases swiftly at some stage in the system of emmetropization. Only few youngsters increase astigmatism extra than 1 diopter via way of means of 6 years of age (Maida *et al.*, 2008).

2.2.1. Myopia:

Is (short-sighted) eye, distant objects are brought to focus in front of the retina. This can be due to the fact the eyeball is just too long (axial myopia) or the refractive factors of the attention too powerful (refractive myopia), (Johnstone, 2008).

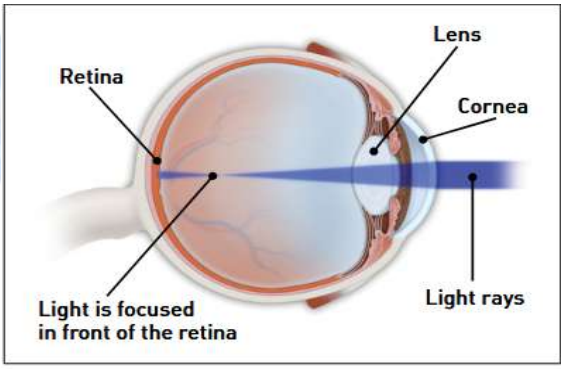

Fig.1: Myopic Eye.

Sub-categorizing the classification of myopia:

1. Axial myopia: A refractive state that can be attributed to excessive axial elongation.
2. Refractive myopia: A refractive state that can be attributed to changes in the structure or location of the image forming structures of the eye, Ex (the cornea and/or lens).
3. Curvature myopia: The lens or cornea is more curved than usual (steeper cornea), (Flitcroft *et al.*, 2019).
4. Index myopia: Is because of an extrade withinside the refractive index of the internal optical media of the eye (lens, aqueous humor or vitreous). Changes in index myopia are not unusualplace in diabetics and may arise in avitaminosis A and D.
5. Positional myopia: Is produced via way of means of anterior placement of crystalline lens withinside the eye.

2.2.2. Hypermetropia (Hyperopia):

Is (long-sighted) eye, distant objects are brought to focus behind the retina. This can be due to the fact the eyeball is simply too short (axial hypermetropia) or the refractive factors of the attention are inadequate (refractive hypermetropia), (Johnstone, 2008).

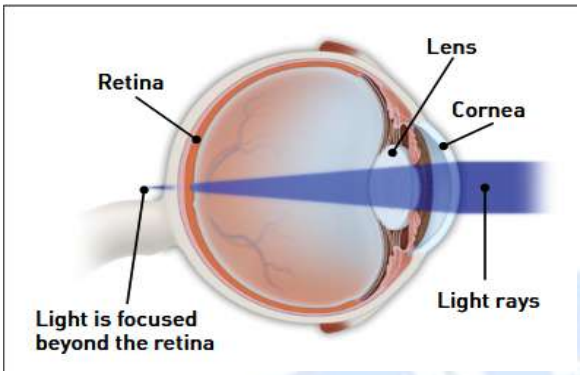

Fig.2: Hyperopic Eye.

2.2.3. In astigmatism:

Astigmatism that causes blurred vision due either to the irregular shape of the cornea, or on occasion the curvature of the lens. The eye had varied refractive power depending on which meridian light enters the eye. If those meridia lie at 90° to every apart from everyday astigmatism is stated to exist. If the meridia lie at 90° to every different however now no longer always withinside the horizontal or vertical meridia, that is termed 'indirect astigmatism'. If the meridia do now no longer lie at 90° to every aside from that is termed 'abnormal astigmatism' and is difficult to correct with lenses (Johnstone**,** 2008).

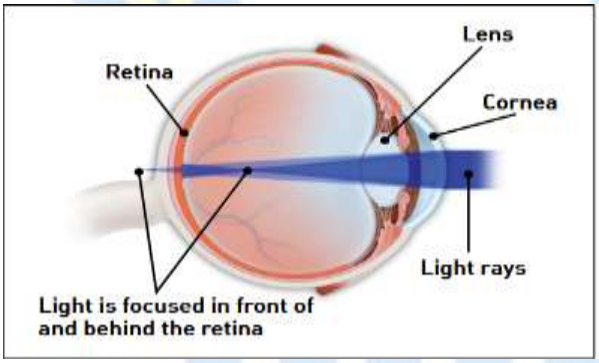

Fig.3: Astigmatism Eye.

2.2.4. Amblyopia:

Amblyopia is the blend of two Greek words; amblyos – blunt and opia –vision. The parents commonly use the lazy eye terminology instead of ambloypia. Due to the suppression of the blurred imaginative and prescient from the diseased eye, the hazard of improvement of unilateral Amblyopia is a lot better than the threat of bilateral amblyopia. Congenital cataracts are one of the critical etiologies for amblyopia, even as senile cataracts are the maximum not unusualplace treatable reason of imaginative and prescient loss the various elderly. Any pathology that outcomes in strange visible revel in in a single or eyes earlier than the important duration of seen development might also result in amblyopia. The important length typically ends at 6-eight years of age (Morishita & Hensch, 2008).

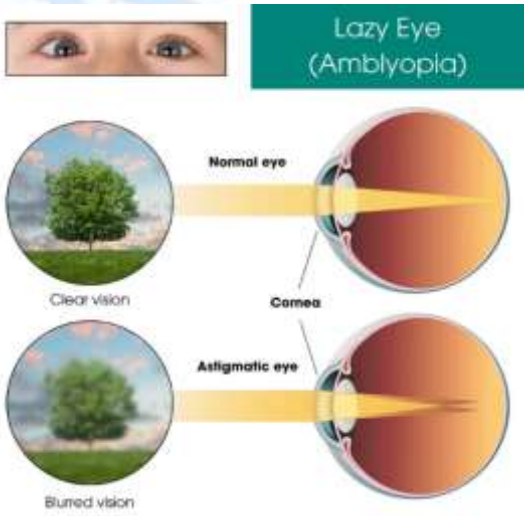

Fig.4: Amblyopia.

2.2.5. Strabismus:

Strabismus (Squint) is a misalignment of the eyes, which compromises the capacity to attention each eye at the identical target. This misalignment is due to an imbalance some of the extraocular rectus muscles. Strabismus is some of the maximum not unusualplace pediatric ocular pathologies, taking place in more or less 2–4% of children (Williams *et al*., 2008; Greenberg *et al*., 2007). It can be gift at beginning, particularly in untimely or low beginning weight deliveries (Connor *et al*., 2002) Or be obtained all through childhood, regularly withinside the placing of comorbid illnesses inclusive of imaginative and prescient deprivation, cataracts, or retinoblastoma (Abramson *et al*., 1998; Weakley *et al*., 2001). Prolonged strabismus and the resultant visible discordance may also disrupt the brain's visible machine because it develops, making it A major purpose of amblyopia. It can also be averse to the development of binocular vision (Wright *et al*., 2003).

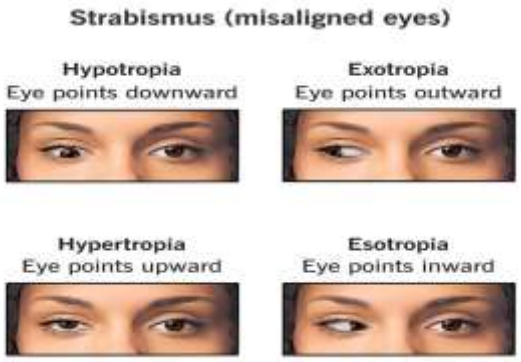

Fig.5: Strabismus (Squint)

2.2.6. Congenital Cataract (Infantile):

Cataract is an n opacification of the crystalline lens. Are occurred within the first year of life. (Shiels & Hejtmancik, 2017). The majority of bilateral congenital or infantile cataracts now no longer related to a syndrome haven't any identifiable cause.

Causes:

1. Genetic mutation is likely the most common cause. Over fifteen genes worried in cataract formation had been identified, and the inheritance is most customarily autosomal dominant even though it is able to be X-connected or autosomal recessive. (Reddy, 2004). Within the equal pedigree, there may be enormous morphologic variation.
2. Systemic associations include metabolic disorders such as galactosemia, Wilson disease, hypocalcemia and diabetes. Cataracts may be a part of a number of syndromes, the most now no longer unusual place being trisomy 21. Intrauterine infections such as rubella, herpes simplex, toxoplasmosis, varicella and syphilis are some other causes. (Reddy, 2004).

2.3. Diagnosis:

2.3.1. Clinical examination (Visual Acuity):

The evaluation of the visible acuity (VA) is with the aid of using some distance the maximum typically finished take a look at in ophthalmology. Its objectives to degree the spatial decision of the eye - or better - the visible system. A regular VA calls for intact optics (clean cornea and lens, and glasses if needed), a regular function of the relevant retina (fovea) and optic nerve, and intact visible pathways past the optic nerve (chiasm, optic tract, Thalamus, optic radiation, and seen cortex). Herman Snellen, a Dutch ophthalmologist, is taken into consideration the inventor of this test. (Jansonius, 2010).

2.3.1.1. Visual acuity chart: layout and usage:

Figure (6), (right panel) presents a modern VA chart. It includes five optotypes consistent with row (’line’). The spacing among the traces equals the scale of the optotypes under the spacing. The duration modifications a number of the lines with an issue of 1.26, that is, 0.1 log units. This implies 0. three log devices with 3 lines, that is, a doubling or halving of the size (1.263 = 2, 1.26-three = 0.5). Next to every line various is given: the denominator of Snellen, or D. This variety shows the not unusual place distance at which a healthful eye is truly able to treatment the corresponding optotypes. (Jansonius, 2010).

2.3.1.2. Optotype size and minimal angle of resolution:

Optotypes are designed on a 5x5 grid. A VA of 1.0 corresponds to an optotype top of 5 arcmin and a gap duration of 1 arcmin, (Figure (6), that is, the standard spatial resolution (consistent with the Raleigh criterion) of the visible device is 1 arcmin. The hole length is likewise known as the minimum attitude of resolution (MAR), and an opportunity manner for expressing visible acuity is the logMAR, in which the bottom of the logarithm is 10 and MAR in arcmin (Jansonius, 2010).

Fig.6: Snellen Chart.

2.3.2. Diagnostic Devices:

2.3.2.1. Autorefractometer:

An autorefractor or automatic refractor is a computer-controlled tool used withinside the direction of an eye fixed examination to provide an objective size of a person's refractive mistakes and prescription for glasses or touch lenses. This is done with the aid of using measuring how light is modified because it enters a person's eye (Medina, 2015). The majority of autorefractors calculate the vision correction an affected character needs (refraction) with the useful resource of the use of using sensors that come upon the reflections from a cone of infrared light (Medina, 2015). Cycloplegic refraction is often recommended in children to eliminate the effect of accommodation and obtain accurate refractive measurements, particularly in cases of hyperopia or suspected amblyopia (kanski, 2022).

Fig.7: Autorefractometer.

2.3.2.2. Retinoscopy:

Is an examination method that objectively measures the refractive blunders of the eye. This is carried out with the aid of using searching through an optical device known as a retinoscope to look at the motion of reflected light in a patient's pupil (Hollis *et al.*, 2022). This goal evaluation lets in the examiner to evaluate refractive blunders without subjective enter from the patient, making it A beneficial device for comparing infants, younger children, adults with developmental delays, and others who might not otherwise Be capable of cooperate for subjective refraction (American Association for Pediatric Ophthalmology and Strabismus, 2023). Retinoscopy can also be used to assess accommodative characteristic and to evaluate for ocular floor and media pathologies which include cataracts (Elliott, 2020).

Fig.8: Retinoscopy.

2.3.2.3. Slit lamp examination:

Its biomicroscope that give a focused beam of light with variable height, width, and angle. This particular tool allows three-dimensional visualization and dimension of the quality anatomy of the adnexa and anterior phase of the eye. Able to detect dry eye, corneal abnormalities, and eyelid disorders (Davison *et al*., 2005).

Fig. 9: Slit lamp examination.

2.3.2.4. Fundus examination (Fundoscopy):

Known as clinical procedure used to evaluate the posterior segment of the eye, including the Retina, Optic Disc, Macula, Retinal Blood Vessels, and Choroid. It is an essential diagnostic technique for detecting and

monitoring a wide range of ocular and systemic diseases that affect the eye. The examination is commonly performed using direct or indirect ophthalmoscopy, fundus photography, or advanced imaging modalities such as optical coherence tomography. (American Academy of Ophthalmology, 2022).

Fig.10: Fundus examination (Fundoscopy).

2.4. Management:

2.4.1. Refractive Errors Management (Optical Correction):

Spectacles, contact lenses, refractive surgery, intraocular lenses and clear lens extraction are the modern-day techniques of refractive correction (kanski, 2011). Spectacles are the simplest, safest, and most cost-effective way to correct refractive error. In resource rich countries spectacles are used to correct about two thirds of refractive errors. (Webber, 2007). Many low-income settings services and spectacles may be unavailable or unaffordable for most of the population, contact lenses (Evans & Rowlands, 2004; Gilbert *et al.*, 2008). A minority of the population with refractive errors makes use of corrective contact lenses, which are used either daily or for extended wear (overnight weekly/monthly), (Webber, 2007).

2.4.2. Amblyopia Management:

The preliminary step withinside the control is the correction of the underlying etiology, if possible. Surgical treatment of the strabismus, or the congenital cataract, correction of the refractive errors thru glasses or contact Lenses are the principal remedy modalities for the correction of the maximum not unusual place reasons of amblyopia. In a few pathologies, which include nystagmus, retinoblastoma, it isn't always feasible to take away the underlying reason of blurred vision totally (Matta *et al.*, 2010).

3. **2.4.3. Strabismus Management:**

Abnormal eye actions are often related to pediatric eye deviations and they could impact the control of the cases. Accommodative styles of esotropias can be absolutely cured with spectacles. Surgical correction is determined in line with the perspective of deviation, if the deviation isn't always corrected via way of means of the spectacles all through follow-up (Hughes, 2000).

III. METHODOLOGY

3.1. Study design:

This a cross-sectional descriptive study was conducted to assess children's vision and prevalence of eye disorders and other corresponded approaches (diagnosis, and treatment) among school-aged children attended Al-Sabri Polyclinic and Al-Nahr Central Hospital in Benghazi, Libya. The study conducted from the first of September to the end of November 2025.

3.2. Sample Size:

A total of (447) children were included in the study, all collected questionnaires were complete. valid responses were obtained from all participants. Study population composed from school aged children between (6 -16 years old) who attended the selected hospitals during study period.

3.3. Data Collection Tool and Assembling Methods:

A structured questionnaire was used, specifically designed for the purpose of this study approved from department of optometry and vision science. Composed from seven main sections in addition to demographic data. These sections included:

Demographic data: Contain age, gender, and nationality.

- First section: Medical history and complaints: focusing on ocular history of participants, genetic diseases and also, with presenting visual complaints.
- Second section: The clinical examination:

Assessment of visual acuity and ocular health used (Snellen chart for both eyes).
Autorefractor to examine refractive errors.
(Retinoscopy and Cycloplegic) refraction.
Slit lamp examination to assess anterior segment abnormalities.
Assessment for both eye for difference in visual acuity.

- Third section: Examination conclusion: recording the finding.
- Fourth section: Screening practices and barriers: information related to vision screening frequency, available equipment, and challenges.
- Fifth sections: Knowledge and attitudes: assessment of eithers their awareness regarding early detection of eye disorders.
- Six sections: Treatment: documentation of prescribed or recommended treatment options for each patient.
- Seventh section: (Recommendations and suggestions).

3.4. Data Analysis:

The Statistical Package for the Social Sciences (SPSS) version 23 was used to evaluate the data. Descriptive data described as frequencies, percentages mean, and standard deviations.

3.5. Ethical Approval:

The study was approved from Medical Technology college - Optometry &Vision Science department, ethical guidelines used prior research procedures and consent was taken for each patient in the research. The data keep it confidential and only for research purpose. Also was permitted form Benghazi Teaching Hospital for Ophthalmology.

IV. RESULTS

4.1. Descriptive Results:

Section one: The Demographic Data of participants:
A total of 447 questionnaires were received, all were valid. As noted, 276 were females (61.7%), and 171 were males (38.3%), presenting higher females' participation in the study in Table (1) and Figure (11).

Table 1: Distribution of participants according to Child's Gender:

Gender	no.	%
Male	171	38.3
Female	276	61.7
Total	447	100

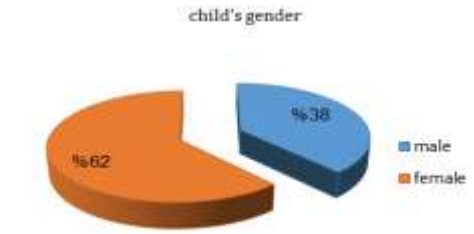

Fig.11: Distribution of participants according to Child's Gender.

Table (2), and Figure (12) represent that, the majority of participants were Libyan nationals (74.5%), while (25.5%) were non-Libyan, indicating that the study sample was predominantly Libyan.

Table 2: Distribution of participants according to Child's Nationality:

Nationality	no.	%
Libyan	333	74.5
Non-Libyan	114	25.5
Total	447	100

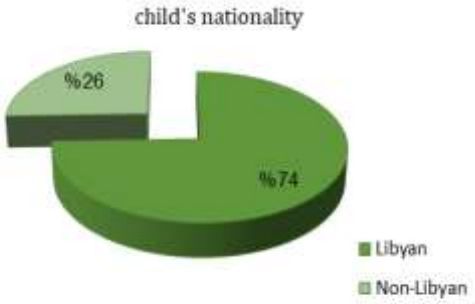

Fig.12: Distribution of participants according to Child's Nationality.

As seen in Table (3), and Figure (13), The participants' ages ranged from 6 to 16 years. The largest age group was [9–11] years (31.1%), followed closely by [12–14] years (30.4%). The [6–8] years group included (17.7%), and the [15–16] years group comprised (20.8%).

Table 3: Distribution of participants according to Child's Age:

Age	no.	%
6 – 8	79	17.7
9 – 11	139	31.1
12 – 14	136	30.4
15 - 16	93	20.8
Total	447	100

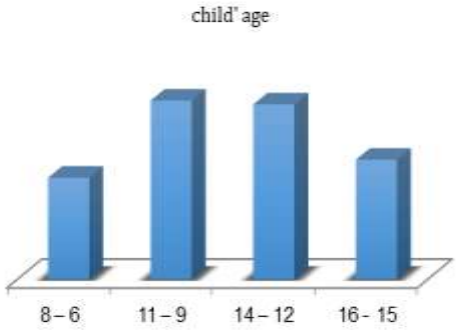

Fig.13: Distribution of participants according to Child's Age.

From Table (4), and Figure (14) all participants (447, 100%) were recruited from hospitals, while no participants were recruited from clinics, schools, camps, or different settings.

Table 4: Distribution of participants according to place of examination:

Place	No.	%
Hospital	447	100
Clinic	-	-
School	-	-
Camp	-	-
Other	-	-
Total	447	100

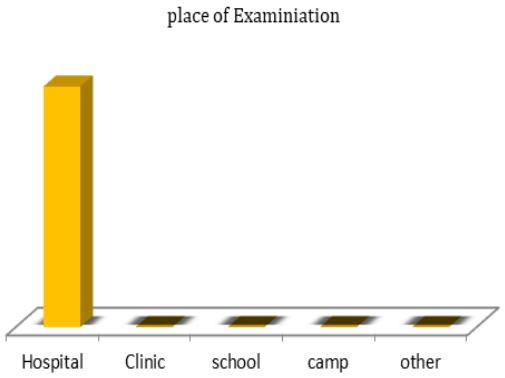

Fig.14: Distribution of participants according to place of examination.

Section Two: Medical History and Complaints:

The Table (5), Figure (15), and Figure (16) show the distribution of participants according to the presence of visual problems. The majority of participants reported having at least one visual problem, accounting for (88.3%) of the total sample, while (11.6%) reported no visual problems. The most frequently reported condition was Hazy Vision (27.3%), followed by no specific visual problem (15.9%), and Blurred Vision (12.3%). Other visual complaints included Blurred Vision with Headache (5.6%), Distance Vision Problems (4.0%), Near Vision Problems (3.1%), and Double Vision (3.6%). Refractive Errors were reported by (6.7%) of participants, whereas Severe Visual Impairment was the least common condition (1.8%). Overall, the results indicate a high prevalence of visual problems among the studied sample, with varying types and frequencies of visual complaints.

Table 5: Distribution of participants according to visual problems:

Response		No Specific Visual Problem	Hazy Vision	Blurred Vision	Blurred Vision, And Headache	Distance Vision Problems	Near Vision Problems	Double Vision	Refractive Errors	Severe Visual Impairment	Other Ocular Conditions	Total
Yes	No.	71	122	55	25	18	14	16	30	8	36	395
	%	15.9	27.3	12.3	5.6	4.0	3.1	3.6	6.7	1.8	8.1	88.3
No	No.	-	-	-	-	-	-	-	-	-	-	52
	%	-	-	-	-	-	-	-	-	-	-	11.6
Total	No.	-	-	-	-	-	-	-	-	-	-	447
	%	-	-	-	-	-	-	-	-	-	-	100

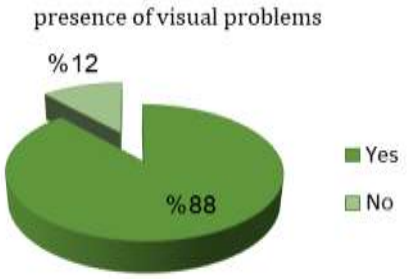

Fig.15: Presence of Visual Problems.

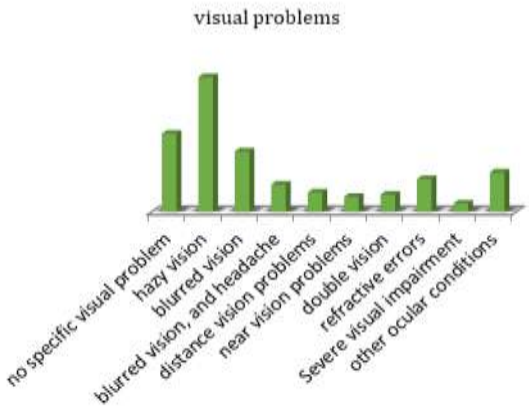

Fig.16: Visual Problems.

The multiple response analysis shown in Table (6), and Figure (17) 72.8% of cases experienced the most often reported symptom, Trouble Seeing Far Objects, followed by Frequent Headaches, seen in 68.6% of participants. Common too was trouble seeing nearby objects, noted by 57.7% of cases. Additional signs included 29.1% of recurrent eye rubbing or itching, 22.3% of learning or attention challenges at school, and 14.9% of head tilting or closing one eye while reading. Only (3.5%) of participants reported less frequent symptoms of drooping eyelid/squint. Participants' capacity to pick more than one symptom led the overall proportion of cases to go above (100%). The findings generally show that among the sample under study, especially those linked to distance vision and migraines, visual-related symptoms are rather prevalent.

Table 6: Prevalence of Visual Symptoms Based on Multiple Response Analysis:

Symptoms	no.	%
Difficulty seeing distant	313	27.1
Difficulty seeing near objects	248	21.5
frequent eye rubbing or itching	125	10.8
head titling/closing one eye while reading	64	5.5
Learning or attention difficulties at school	96	8.3
frequent headaches	295	25.5
drooping eyelid/squint	15	1.3
Total	447	100

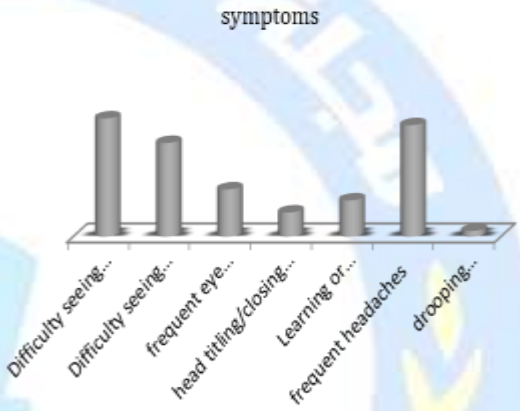

Fig.17: Distribution of participants in line to the symptoms

The Table (7), and figures (18), and Figure (19) show that the majority of participants (95.8%) reported no previous family history of eye diseases. Only a small proportion of the sample reported a positive family history, mainly related to genetic eye conditions, with low percent of responses. Glaucoma was reported by only one participant (0.2%). Overall, the findings indicate that a family history of eye diseases was uncommon among the studied sample.

Table 7: Distribution of children according to previous family eye diseases:

Response		Genetic	Glaucoma	No Specific Disease	Total
Yes	No.	9	1	9	19
	%	2.0	0.22	2.0	4.22
No	No.	-	-	-	428
	%	-	-	-	95.8
Total	No.	-	-	-	447
	%	-	-	-	100

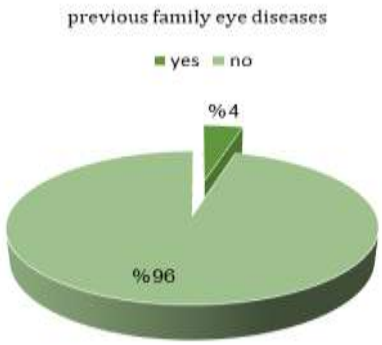

Fig.18: Previous family eye diseases.

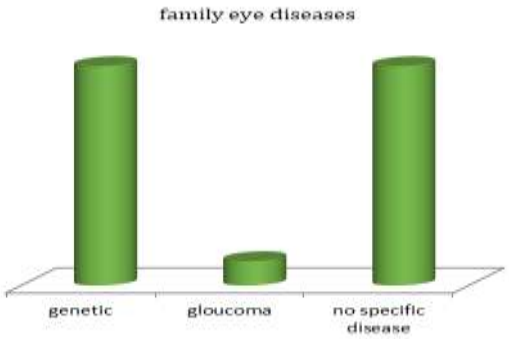

Fig.19: Family Eye Diseases.

The Table (8), and Figure (20) show the participants' responses regarding whether the child had previously been unable or unwilling to wear glasses. The majority of children (98%) did not experience any difficulty, while only a small proportion (2%) had previously been unable or unwilling to put on glasses to put on glasses. These results indicate that non-compliance with wearing glasses was uncommon among the studied sample.

Table 8: Previous Inability or Unwillingness of the child to wear glasses:

Response	no.	%
Yes	9	2.0
No	438	98
Total	447	100

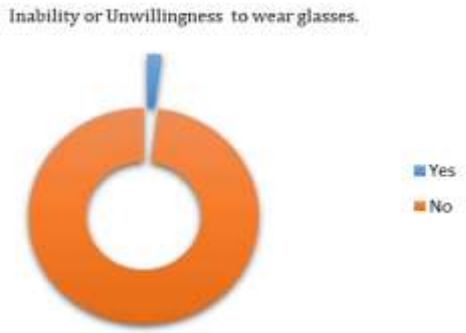

Fig.20: Previous Inability or Unwillingness of the child to wear glasses.

Section three: The Clinical Examination:

(A): Visual Acuity Evaluation:

The results of the visual acuity test are presented in the Table (9). The Mean visual acuity for the Right Eye was (0.49) with (SD = 0.464), with scores ranging from 0 to 3. For the Left Eye, the Mean visual acuity was slightly lower at (0.44) with (SD = 0.267), ratings additionally starting from zero to 3. These findings indicate that, on average, visual acuity was similar between both eyes, although the variability was higher in the right eye in compared to the left eye.

Table 9: Visual Acuity Test.

Acuity test	Mean	S.D	Minimum	maximum
Right	0.49	0.464	0	3
Left	0.44	0.267	0	3

The Table (10) presents the results of vision correction. The Mean correction for the Right Eye was (0.70) with (SD = 0.16), ranging from 0 to 1, while the Left Eye had a Mean of (0.73) with (SD = 0.30), with a range from 0 to 6. These results indicate that, on average, the degree of correction was slightly higher in the left eye, and there was greater variability in the left eye compared to the right eye.

Table 10: Visual Acuity with correction:

Correction	Mean	S.D	Minimum	Maximum
Right	0.70	0.16	0	1
Left	0.73	0.30	0	6

The Table (11), and Figure (21) show the presence of a difference of more than two lines between the right and left eyes on the Snellen chart. The majority of participants (71.6%) exhibited a difference greater than two lines, while (28.4%) did not show such a difference. These results indicate that interocular differences in visual acuity were common among the studied sample.

Table 11: Difference of More than two lines between two eyes on the Snellen chart:

Response	No.	%
Yes	320	71.6
No	127	28.4
Total	447	100

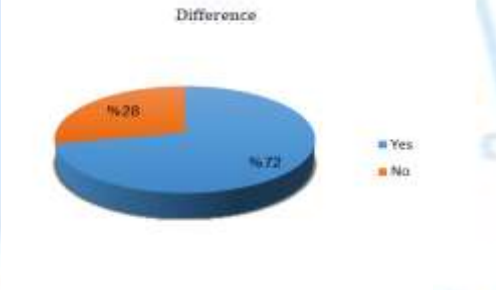

Fig.21: Difference of More than two lines between two eyes on the Snellen chart.

B) instrumental Examinations:

The Table (12), Figure (22) present the use of the Autorefractor among the children and the corresponding Mean and Standard Deviation of refractive parameters for both eyes. The vast majority of participants (99.1%) underwent Autorefractor measurement, while only (0.9%) did not. For the right eye (OD), the Mean axis was (2.98 ± 112.9), the Mean sphere (1.71 ± 3.2), and the Mean cylinder (0.99 ± 1.34). For the left eye (OS), the Mean axis was (3.0 ± 63.7), the Mean sphere (2.4 ± 3.5), and the mean cylinder (3.0 ± 58.2). These results indicate that almost all participants were assessed using the Autorefractor, providing reliable measurements for both eyes.

Table 12: Use of Autorefractor and Mean ± of Refraction Parameters (OD, and OS):

Response	No.	%	Mean ± S.D						
			OD Axi	OD Sph	OD Cyl	OS Axi	OS Sph	OS Cyl	OD Axi
Yes	443	99.1	2.98 ± 3.2	1.71±1.34	99.0±63.7	3.0±3.5	2.4±8.8	112.9±58.2	2.98 ± 3.2
No	4	0.9	-	-	-	-	-	-	-

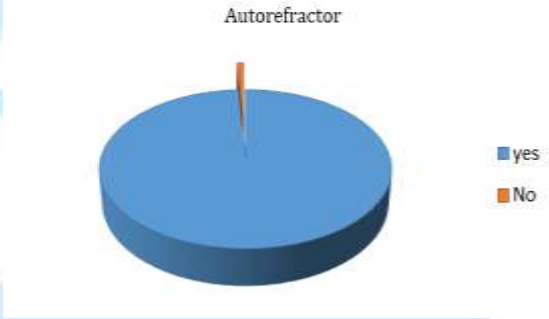

Fig.22: Use of Autorefractor.

From Table (13), and Figure (23), it seems that, only a small proportion of children (0.9%) underwent retinoscopy, while the majority (99.1%) did not. For those assessed, the mean values for the right eye (OD) were: axis (0.01 ± 0.88), sphere (0.004 ± 0.21), and cylinder (0.39 ± 0.07). For the left eye (OS), the Mean values were: axis (0.01 ± 5.98), sphere (0.007 ± 0.23), and cylinder (0.88 ± 11.3).

Table 13: Frequency of Retinoscopy Performance and Mean ± S.D of Refraction Parameters (OD, and OS):

Re	no.	%	Mean ± S.D					
			OD axi	OD sph	OD cyl	OS axi	OS sph	OS cyl
yes	17	99.1	0.01±0.21	0.004±0.07	0.39±5.98	0.01±0.23	0.007±0.09	0.88±11.3
No	430	0.9	-	-	-	-	-	-

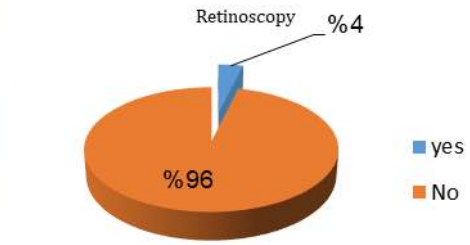

Fig.23: Retinoscopy Performed.

The Table (14), Figure (24) present the performance of Cycloplegic Refraction among the children. Cycloplegic refraction was performed in (24.2%) of the sample, while it was not performed in (75.8%). Among those who underwent Cycloplegic Refraction, the Mean refractive values for the right eye (OD) were (0.87 ± 2.11) for axis, (0.37 ± 0.93) for sphere, and (23.27 ± 54.31) for cylinder. For the left eye (OS), the corresponding Mean values were (0.89 ± 2.16), (0.40 ± 0.97), and (25.23 ± 55.68), respectively. Overall, Cycloplegic Refraction was performed in approximately one quarter of the study sample, with similar refractive measurements between both eyes.

Table 14: Frequency of Cycloplegic Refraction Performance and Mean ± of Refraction Parameters (OD, and OS):

Response	no.	%	Mean ± S.D					
			OD axi	OD sph	OD cyl	OS axi	OS sph	OS cyl
yes	108	24.2	0.87±2.11	0.37±0.93	23.27±54.31	0.89±2.16	0.40±0.97	25.23±55.68
No	339	75.8	-	-	-	-	-	-

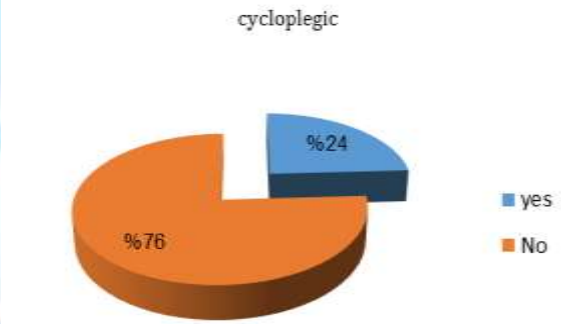

Fig.24: Frequency of Cycloplegic Refraction Performance.

The table (15), Figure (25), and Figure (26) summary Slit Lamp Examination findings among the children. In (6.94%) abnormal Slit Lamp were observed in children, while no abnormal findings were showed in majority of participants (93.06%). The most common abnormality was Dry Eye, reported in (3.6%). Other findings were infrequent an included Eyelid and Conjunctival Conditions, Atrophy (Optic/Ocular), Pupil abnormalities, Corneal Diseases (0.9%,0.4%,0.4%,0.22%). Overall, slit lamp examination results were predominantly normal, with a low prevalence of anterior segment abnormalities.

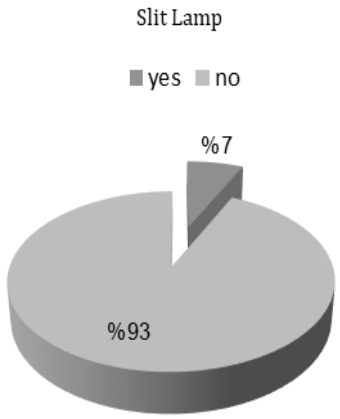

Fig.25: Slit Lamp Examination.

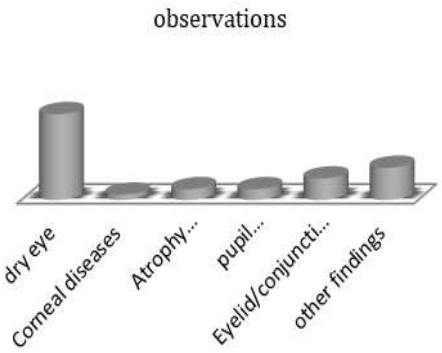

Fig.26: Observations of abnormal Slit Lamp.

C) Examination Conclusion:

The Table (16), and Figure (27). Based on several response analysis, whereby individuals were free to list more than one diagnosis. The most often mentioned diagnosis was myopia, or nearsightedness (35.9%), then astigmatism (28.2%), and Hyperopia, or farsightedness (22.7%).Less frequent diagnoses were amblyopia (lazy eye) at 7.6% and strabismus (squint) at 4.6%; just a very tiny fraction of cases revealed no significant refractive error (0.6%) or other disorders (0.4%).Generally speaking, the data suggest that among the sample under study refractive errors were the most often reported disorders.

Table 16: Most Probable Diagnosis (multiple responses analysis):

Diagnosis	no.	%
Myopia (Nearsightedness)	242	35.9
Hyperopia (Farsightedness)	153	22.7
Astigmatism	190	28.2
Amblyopia (Lazy Eye)	51	7.6
Strabismus (Squint)	31	4.6
No significant refractive error	4	0.6
Other	3	0.4

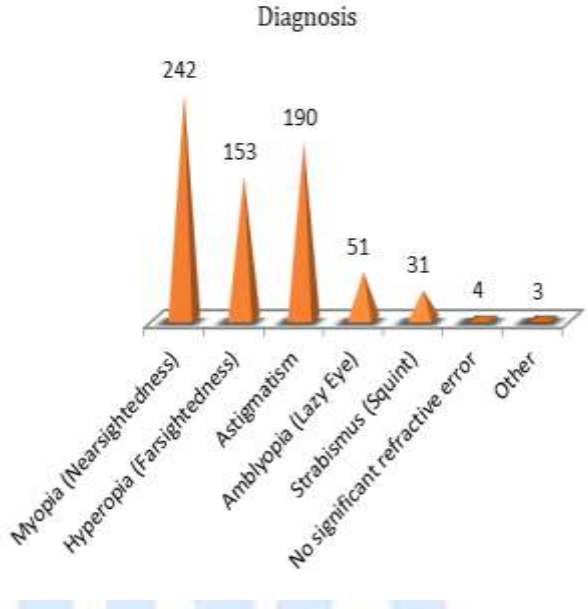

Fig.27: Most Probable Diagnosis.

Table 15: Slit Lamp Examination:

Response		Dry Eye	Corneal Diseases	Atrophy (Optic/Ocular)	Pupil Abnormalities	Eyelid/Conjunctival Conditions	Other Findings	Total
Yes	No.	16	1	2	2	4	6	31
	%	3.6	0.22	0.4	0.4	0.9	1.4	6.94
No	No.	-	-	-	-	-	-	416
	%	-	-	-	-	-	-	93.06
Total	No.	-	-	-	-	-	-	447
	%	-	-	-	-	-	-	100

The Table (17), and Figure (28) present data on whether the child was prescribed or advised to wear glasses. The majority of participants (94.6%) received a Prescription or Advice for glasses, while only a small proportion (5.4%) did not. Among those prescribed or advised, the Mean refractive values for the right eye (OD) were: axis (2.10 ± 2.35), sphere (1.11 ± 1.22), and cylinder (80.58 ± 70.94). For the left eye (OS), the Mean values were: axis (2.44 ± 4.55), sphere (1.31 ± 4.37), and cylinder (91.37 ± 71.37

Table 17: Prescription of glasses for the Child:

Response	no.	%	Mean ± S.D					
			OD axi	OD sph	OD cyl	OS axi	OS sph	OS cyl
yes	423	94.6	2.10±2.35	1.11±1.22	80.58±70.94	2.44±4.55	1.31±4.37	91.37±71.37
No	24	5.4	-	-	-	-	-	-

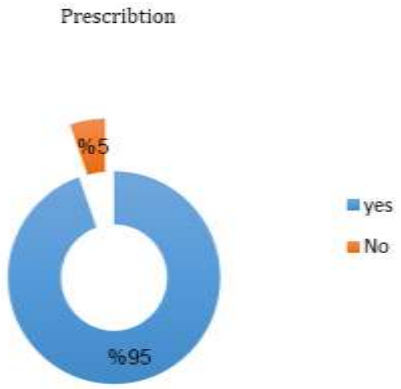

Fig. 28: Prescription of glasses for the Child

Section Four: Screening Practices and Barriers:

Table (18), and Figure (29) Multiple response analysis will help you to show the equipment availability at the screening locations, therefore enabling more than one item every site. The most often available tool was the Snellen Chart (28.0%), then the Autorefractor (27.8%), then the Slit Lamp (23.3%) and Cycloplegic Drops (19.4%). Retinoscope (1.2%), Direct Ophthalmoscope/Fundus Examination (0.1%), and other unknown tools (0.1%) were among less often available instruments. While more specialized equipment was scarce at the screening sites, these findings suggest that fundamental visual acuity and refractive evaluation methods were often accessible.

Table 18: Responses analysis:

Equipment	no.	%
Snellen Chart	447	28
Autorefractor	443	27.8
Retinoscope	19	1.2
Cycloplegic Drops	310	19.4
Slit Lamp	372	23.3
Direct Ophthalmoscope/Fundus Examination	2	0.1
other	1	0.1

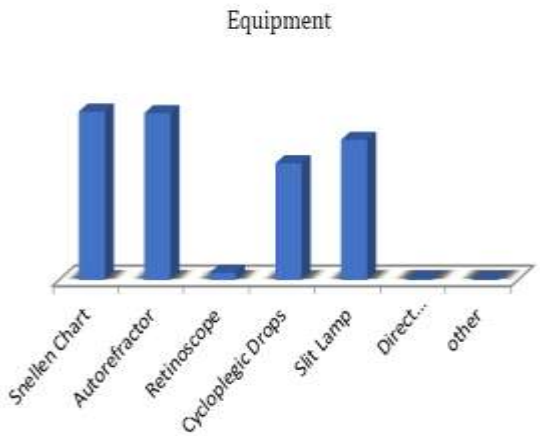

Fig.29: Available Equipment at the Screening Site.

Table (19), and Figure (30) explained the majority of children (86.8%) underwent Annual vision screenings, while (8.7%) were screened only at School. A smaller proportion of children were screened when visual complaints arise (2.9%) or under other unspecified circumstances (1.6%). These results indicate that annual vision screening is the standard practice at the facility.

Table 19: Children's vision screening frequency:

Vision Screening	No.	%
At School Enrollment	39	8.7
Annually	388	86.8
When Complaints Arise	13	2.9
Other	7	1.6
Total	447	100

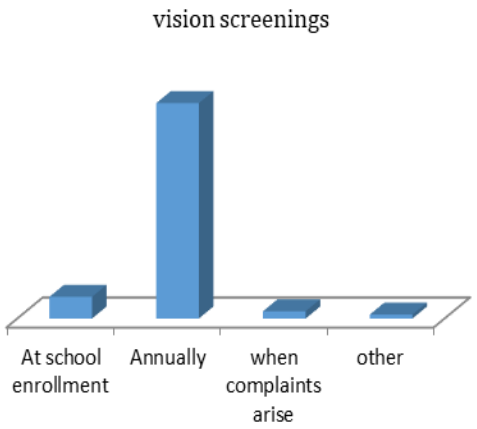

Fig.30: Children's vision screening frequency.

Table (20), and Figure (31) Based on a multiple response question, show the primary obstacles to early vision screening in the region; participants may choose more than one barrier. Limited Time in School (61.8%) was the most often cited obstacle, followed by Lack of Equipment (22.4%), and Parental Refusal or Lack of Awareness (12.2%). Less often noted obstacles were Distance or Accessibility (2.4%), Cost of Screening or Glasses (1.0%), and other considerations (0.2%). No participants mentioned Lack of Trained Staff as a hurdle. These findings imply that early eyesight screening in the region is mostly hampered by logistical limits inside schools.

Table 21: Main Barriers to Early Vision Screening in the Area (multiple responses analysis):

Main Barriers	no.	%
Lack of equipment	110	22,4
Lack of trained staff	0	0
Parental refusal/Lack of awareness	60	12.2
Cost of screening/glasses	5	1.0
distance/Accessibility	12	2.4
limited time is school	304	61.8
other	1	2

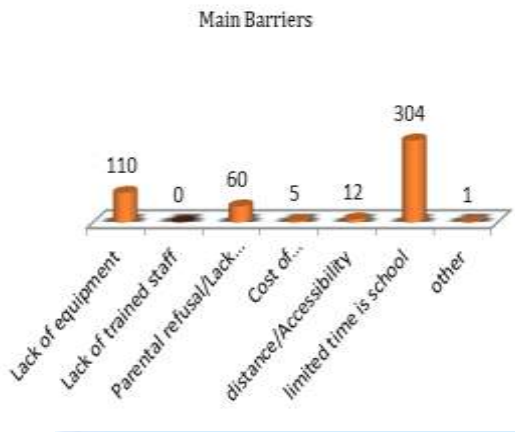

Fig.31: Main Barriers to Early Vision Screening in the Area

Section Five: Knowledge and Attitudes:

Table (21), and Figure (32) present that, all participants Strongly Agreed with the that early detection of refractive errors in children improves learning. While none of them choose any of the other responses options. As indicates a unanimous recognition among the respondents of the importance of early refractive error detection for enhancing children's educational outcomes.

Table 21: Early Detection or Refractive Errors:

Agreement Level	No.	%
Strongly Disagree	-	-
Disagree	-	-
Natural	-	-
Agree	-	-
Strongly Agree	447	100
Total	447	100

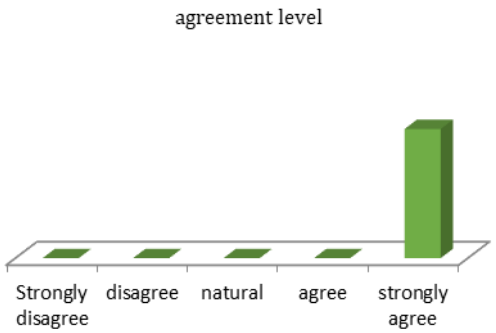

Fig. 32: Agreement level

From Table (22), and figure (33), Figure (34), (99.1%) of participants reported school screening programs are not sufficient, with the main reported barriers being lack of time in school (54.1%) and medical negligence to provide required medical equipment (26.4%).

Table 22: Evaluation of School Program Sufficiency:

Response		Lack Of Time Is School	Failure To Provide Required Medical Equipment	Unspecified/Other	Total
Yes	no.	-	-	-	4
	%	-	-	-	0.9
No	no.	242	118	83	443
	%	54.1	26.4	19.5	99.1
Total	no.	-	-	-	447
	%	-	-	-	100

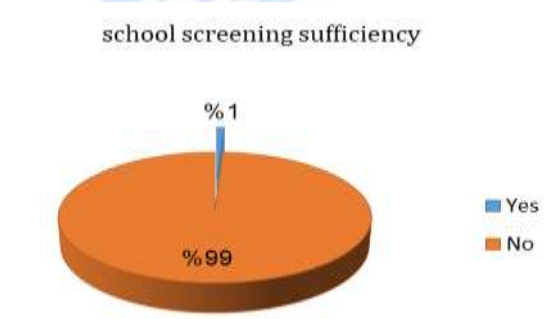

Fig.33: Evaluation of School Program Sufficiency.

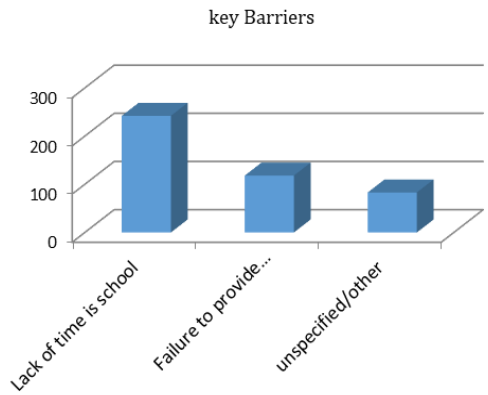

Fig. 34: Barriers to Implementing School Screening Programs.

Section Six: Treatment:

Table (23), and Figure (35), Participants were having freedom to choose more than one treatment option, therefore a multiple response analysis helps to show the distribution of treatment alternatives. As a result, the overall number of answers is more than the actual sample size. This helps to explain why the sum of frequencies is more than the number of people who took part in the study. With management mostly consisting of glasses and contact lenses reflecting the great incidence of refractive errors among the sample under study, the results reveal that therapy for Myopia was the most often reported (36.3%). After this, 29.2% of people were treated for Astigmatism, which was treated only with glasses, which shows that we still rely on glasses to fix this problem. Twenty-two-point three percent of recorded treatments involved hyperopia, which was also treated with glasses and contact lenses. Less often noted therapies included those for lazy eye (7.2%), in which glasses and occlusion therapy were used in addition to glasses, and Squint (5.0%), which was mostly treated with glasses. Generally, the findings show that spectacle correction is still the most common treatment for most visual problems found; more complex therapies were noted less often, with or without contact lenses.

Table 23: Treatment (Multiple response analysis):

Treatment	no.	%
Suquint → glasses	33	5
Lazy Eye → cover un cover test and glasses	48	7.2
Myopia → glasses and contact lenses	241	36.3
Hyperopia → glasses and contact lenses	148	22.3
Astigmatism → Treatment (only glasses)	194	29.2

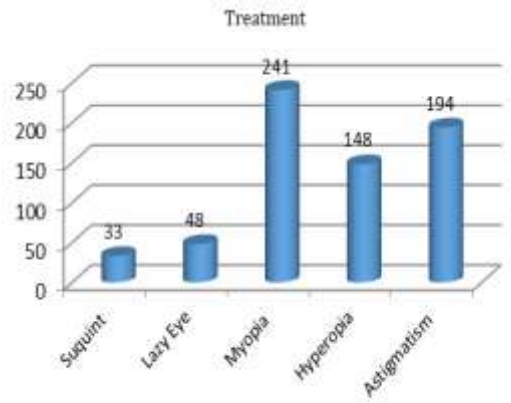

Fig.35: Treatment.

Section Seven: Recommendations and suggestions:

Table (24) participants were permit to pick many options; as shows the recommendations and advice found by them. The total number of answers therefore surpasses the sample size, and the percentages represent the proportion of whole responses rather than particular participants. Emphasizing the supposed need for greater public awareness of early vision screening and eye health, the most often recommended advice was raising awareness campaigns (28.2%). Supporting low-income families (25.5%) and training healthcare workers (25.2%) followed this quickly, therefore emphasizing worries regarding both service access and staff capacity. Many people also advised modern screening equipment (21.2%), therefore showing knowledge of the need of current technology in boosting screening accuracy and efficiency. Participants see awareness, social support, professional education, and technical resources as supplementary techniques vital for enhancing school-based vision screening programs.

Table 24: Recommendations and suggestions (Multiple Response analysis):

Suggestion	no.	%
Increase awareness campaigns	446	28.2
provide modern screening equipment	335	21.2
train healthcare staff	398	25.2
support how-income families	403	25.5

V. DISCUSSIONS

Uncorrected refractive errors are the main cause of moderate and severe visual impairment and account for 43% of the world's causes of visual impairment "(Nzuki, 2004). This study aimed to diagnosis of refractive errors among children attending health care facilities in Benghazi. Regarding demographic data, female participants exhibit higher proportion (61.7%) than male (38.3%) reflect more female children seeking hospitals for diagnosis and treatment at the time of study, it could be due differences in health-seeking behavior, parental awareness, or sociocultural factors may have contributes to higher female children presentation at hospitals setting. While in contrast at sub-Saharan countries study males (61.6%) participants were more than females (38.4%) (Saleh & Gaffer, 2023).

Also, predominantly the majority of participants in the study were Libyan nationality, as the study was done in Benghazi Libya. Higher incidence of visual impairment was noted in age group [9–11] years (31.1%), followed by [12–14] years (30.4%), and [15–16] years group (20.8%), the reason may due increase academic, higher work and teaching demands. While near to this result highest incident reported among age group between 6 to 10 years and age group 11 – 16 years (Saleh & Gaffer, 2023).

The study exhibits higher prevalence of visual impairment among children (88.3%), as at list with one visual impairment, and obviously hospital-based sample is not equal to a community-based sample. WHO in same context (WHO, 2019). Also, higher than Malaysian study (10.1%) (Gilbert & Foster, 2001), and a Chilean report (14.7%), (Maul, *et al.*, 2000) and South African study (1.2%), (Naidoo *et al.*, 2003). This desperation in prevalence of visual impairments between studies may related to difference in environmental, socioeconomic factors, and health care seeking.

The prevalent diagnosis among children was myopia (Nearsightedness) (35.9%), which could be related to pushy near vision tasks, and higher screen time. This finding is compatible with study as were myopia taken as the most common diagnosis among children by (Shah & Satani, 2023). In contrast Ethiopian study illustrate surface eyelid infections ocular allergies were common diagnosis among children attending Jimma University Hospital. (Demissie & Demissie, 2014). While Salman noted Allergic conjunctivitis as the most prevalent disease in his study (salman, 2010). Second diagnosis in this study was hyperopia (22.7%), in contrary to this expectation hyperopia exhibit only (3.25%), (Pi LH, *et al.*, 2012). This variation as result of contrast in diagnostic criteria, distribution of age in the study, and cycloplegic refraction use.

The prevalence of strabismus (squint) was (4.6%), near to the result of Chinese study (4.9%), and on the other hand of squint was (12%) in study conducted in Iraqi (Hnoosh, 2014) (1.6%) Kathmandu (Hornby *et al.*, 2002; Nepal *et al.*, 2003).

Difficulty seeing distant (27.1%), frequent headaches (25.5%), and difficulty seeing near objects (21.5%), were the most complain from participants. (4.2%) children had family history with eye disease. (98%) of children experience any difficulty wearing glasses, while only (2%) had. Furthermore, differences in visual acuity had been noticed between the right and left eyes are consistent with findings from clinical studies emphasizing the importance of monocular visual assessment in children (AAO, 2022), this reflects the need of early detection and diagnosis to avoid long term visual impairment, also this emphasizes the monocular eye assessment as visual impairment(unilateral) could remain undiscovered without single eye assessment.

Furthermore, (86.8%) underwent annual vision screenings, while (8.7%) were screened only at School, where the most frequent tools used among children Snellen Chart (28.0%), was also used Autorefractor, Slit Lamp, retinoscopy, Cycloplegic refraction. Which reflect the accessibility in routine clinical eye setting contribute to correct diagnosis, and comprehensive evaluation. Also, Gilbert and Foster and Resnikoff *et al.*, highlighting the use of different diagnostic methods and examination for eyes diseases lead to improve detection, reduce risk of misdiagnosis (Gilbert & Foster, 2001; Resnikoff *et al.*, 2004).

The study showed (94.6%) of children took a prescription or advice for glasses. Also, history of eye diseases was uncommon among children and glaucoma was the only diseased missioned, in visual acuity test was found interocular differences in children examined. In context of a study from Saudia Arabia described refractive errors as the main cause of visual impairment among school-aged children with high proportion of children treated with glasses (Alrasheed *et al.*, 2017).

The This study has some limitations that. First, design based only on hospital make it lose the generalizability to the general pediatric population, as attending hospitals are more likely due to visual complaints compared to those attend community. Further, disparity in diagnostic devices and examination methods may affect comparability with other studies.

Despite these, this study highlighted the afflict of refractive errors for children at Benghazi city, focusses on the need of regular eye screening, early detection, prompt intervention, and the awareness of the impact of long-term refractive errors of children general and educational life.

CONCLUSIONS

Uncorrected refractive errors such as myopia, astigmatism, and hyperopia were common, as the main cause of visual impairments among school-aged children in Benghazi. Discovered with multiple diagnostic methods. The majority of these children required optical correction. However, school vision screening programs were considered insufficient due to limitations in time and resources. These findings

highlight the need for early detection, improving screening programs, provide approachable treatments of visual problems for children and increasing parental awareness regarding long term refractive errors.

RECOMMENDATIONS

1. Routine screening for children at school, and allocated enough time to ensure each child get screening.
2. Give low-income families inexpensive or free eye exams and corrective tools.
3. Emphasize in providing corporation between health and education sectors to enhance the design, execution, and sustainability of school eyesight screening programs.
4. Increase awareness and provide eye health education for parents, and promotes the important of frequent and early eye checkup.
5. Provide modern appropriate screening and diagnostic tools.
6. Supporting and emphasize on improving training programs for eye care professional and screening staff.

ACKNOWLEDGMENT

We would like to express our sincere thanks and appreciation to our respected supervisor, Dr. Dareen Al-Sharif Ahmed Jadallah, who guided and supported us throughout all stages of this research. We also extend our gratitude to the Head of the Department, Dr. Abdul Fattah Al-Mahdawi. Our thanks also go to the Department Coordinator, Ms. Zainab Al-Haiblo. Also, we would like to express gratitude to every staff member who helped during research at Al-Sabri Polyclinic and Al-Nahr Central Hospital.

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