Prevalence of Refractive Errors in Primary School Children in The New Valley

Omar Mohammed Ali, Ahmed Mahmoud Fahmy Fathallah, Mohammed Anwar Sayed, Doaa Anwar Mohamed Said*
Department of Ophthalmology, Assiut University Hospital, Faculty of Medicine, Assiut University, Egypt.
Corresponding Author: Doaa Anwar Mohamed Said
E-mail: doaa2nwr@gmail.com

Abstract:

Purpose: To assess refractive error prevalence in primary school children aged 6-12 in the New Valley, Egypt.

Design: Observational, cross-sectional study.

Methods: This study included 500 children, who were categorized into eight groups based on their refractive status: emmetropia (normal), hypermetropia, myopia, simple hypermetropic astigmatism, simple myopic astigmatism, compound hypermetropic astigmatism, compound myopic astigmatism, and mixed astigmatism.

Results: Following cycloplegia, 136 children (27.2%) had no refractive error, while 364 (72.8%) were diagnosed with various refractive errors. The most prevalent conditions were mixed astigmatism (24.8%), hypermetropia (20.8%), and simple myopic astigmatism (8.8%). Less common errors included compound hypermetropic astigmatism (6.4%), compound myopic astigmatism (6.4%), and myopia (4.8%). Simple hypermetropic astigmatism was the least frequent, identified in only four children (0.8%).

Conclusion: This study is a crucial screening survey for upper Egypt students. This study discovered that astigmatism, hypermetropia, and myopia were the most common errors.

Keywords: Myopia; Hypermetropia; Astigmatism.

Introduction:

Refractive errors are among the four non-fatal conditions in the top 20 causes of disability-adjusted life years. Considering alternative causes of visual impairment, refractive errors in most cases are treated by prescribing glasses, which is one of the most economical interventions in eye care. If left untreated, refractive errors can impact performance, lower productivity and employability, and affect patients' quality of life overall. [(1)]

Refractive errors can take several forms:

1. Myopia occurs when light focuses in front of the retina rather than directly on it due to an excessively long eye or a curved cornea. This makes distant objects appear blurry.
2. Hyperopia occurs when light focuses behind the retina rather than directly on it due to an excessively small eye or a flat cornea. This makes close-up objects appear blurry.
3. Astigmatism occurs when there is an irregularity in the shape of the cornea, which results in light focusing on multiple points rather than one. This can cause both close-up and distance vision to appear blurry. [(2)]

Eyeglasses, contact lenses, or surgical treatment treat refractive errors. [(2)]

Patients and Methods

This observational cross-sectional study was conducted at El Dakhlah General Hospital from December 2022 to June 2023. Five hundred children participated in the current study.

Ethical Considerations

The study was done in cooperation with primary schools in remote villages, after

obtaining approval from the Health Directorate and the Educational Administration in the region, informing the children's families, and obtaining consent for participation from the patients. The study's approval was granted by the Faculty of Medicine Ethics Committee, Assiut University (the Institutional Review Board (IRB) local approval number: (04-2023-200047).

Inclusion Criteria

Age: (6- to 12-year-old), Hypermetropia: (+1 diopter (D) to +8 D), **Myopia**: (- 0.5 D to -10 D), Astigmatism: (0 to 6 D).

Exclusion Criteria

Retinopathy of Prematurity, diseases of connective tissue (e.g., Marfan or Stickler syndromes), Glaucoma, Cataract, Previous ocular surgery, Systemic diseases.

Methods

All patients have been examined regarding:

1. Visual acuity at the Snellen chart, manifest and cycloplegic refraction by (Huvitz HRT-7000 autorefractometer).
2. Ocular motility was assessed using duction and version in 9 distinct visual gazes.
3. An indirect ophthalmoscope was used to evaluate the anterior segment via slit lamp and fundus examination.

Examination Technique:

Cycloplegia was done by three drops of 1% cyclopentolate administered 5 min between each drop, and autorefractive measurements were achieved 30 min after the instillation of the last drop. Auto refraction readings of the three following measurements were obtained, and the average will be computed automatically in each eye. Each child was reexamined until three measurements were within 0.50 diopters (D) if any two measurements varied by > 0.50D.

Pupil dilation and light reflex were assessed. When there was no light reflex and the pupil dilated to a size of 6 mm or more, cycloplegia was deemed complete.

Statistical Analysis

Data was obtained and examined utilizing SPSS (Statistical Package for the Social Sciences, version 20, IBM, Armonk, New York). The Shapiro test determined the data's compliance with normal distribution. Quantitative data with normal distribution are expressed as mean ± standard deviation. Nominal data are given as a number (n) and a percentage (%). A chi-square test was put into practice for such data. Level of confidence was kept at 95% and hence, the P value was believed significant if < 0.05.

Results

Age and sex between the studied children (n=500):

The mean age of enrolled children was 9.46 ± 2.13 years (Mean (SD)), with a range of 6 and 12 years. Most 290 (58%) of children were 10-12 years old, and 210 (42%) patients were 6-9 years old. Of those children, 191 (38.2%) were males, and 309 (61.8%) were females.

100 (20%) children are known to have RE. Of those patients with known RE, 70 (14%) children wear eyeglasses.

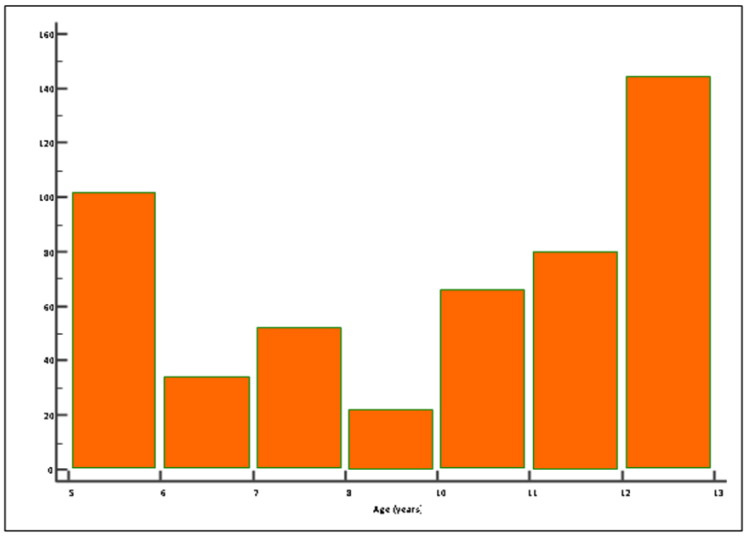

Figure 1: Age distribution among the studied children

Refractive errors before cycloplegia in the studied children (n=500):

180 (36%) children had no refractive errors before cycloplegia. The most frequent errors were simple myopic astigmatism (17.6%), mixed astigmatism (14%), and myopia (12.4%). Compound myopic astigmatism, Simple hypermetropic astigmatism, and compound hypermetropic astigmatism were detected in 50 (10%),10 (2%), and 18 (3.6%) children, respectively. Hypermetropia was detected in 22 (4.4%) children.

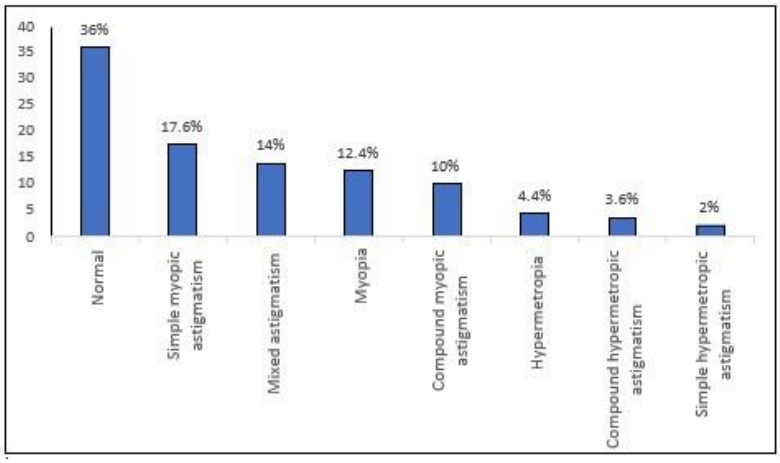

Figure 2: Refractive errors before cycloplegia in the studied children

Refractive errors after cycloplegia in the studied children (n=500):

A total of 136 (27.2%) children had no refractive errors (RE) after cycloplegia, and 364 (72.8%) children had different RE. The most frequent errors were mixed astigmatism (24.8%), hypermetropia (20.8%), and simple myopic astigmatism (8.8%). Compound hypermetropic astigmatism, compound myopic astigmatism, and myopia were found in 32 (6.4%), 32 (6.4%), and 24 (4.8%) children, respectively. Only four children had simple hypermetropic astigmatism.

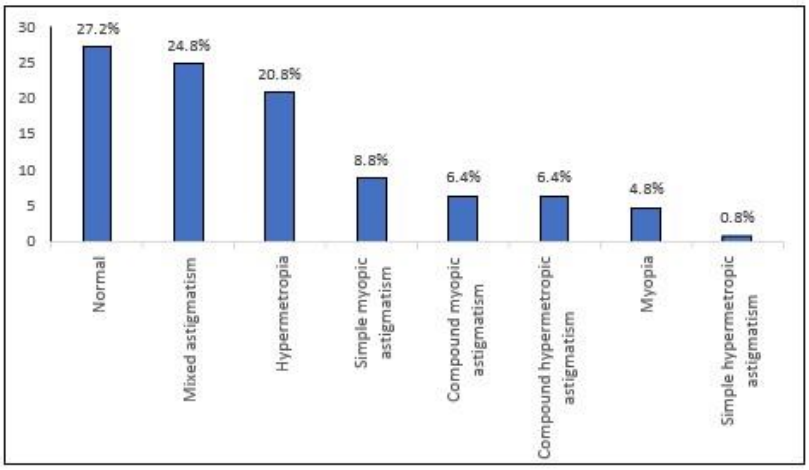

Figure 3: Refractive errors after cycloplegia in the studied children

Refractive errors after cycloplegia among normal children before cycloplegia:

One hundred eighty children had no refractive errors (RE) before cycloplegia. After cycloplegia, 112 (62.5%) children had no RE, and 68 (37.5%) had hypermetropia.

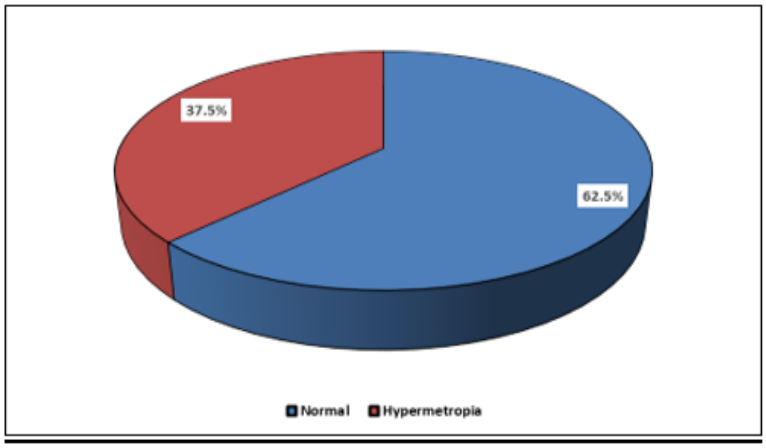

Fig.4: Refractive errors after cycloplegia among normal children before cycloplegia

Refractive errors in children based on sex:

The children of males and females did not significantly differ from one another regarding different types of refractive errors (p= 0.98). Meanwhile, after cycloplegia, there was a significant disparity between both sexes (p= 0.007).

The most frequent errors in male children after cycloplegia were mixed astigmatism (25.1%), hypermetropia (16.8%), and simple myopic astigmatism (12.6%). Meanwhile, the most frequent errors in female children after cycloplegia were mixed astigmatism (24.6%), hypermetropia (23.3%), and compound myopic astigmatism (8.4%).

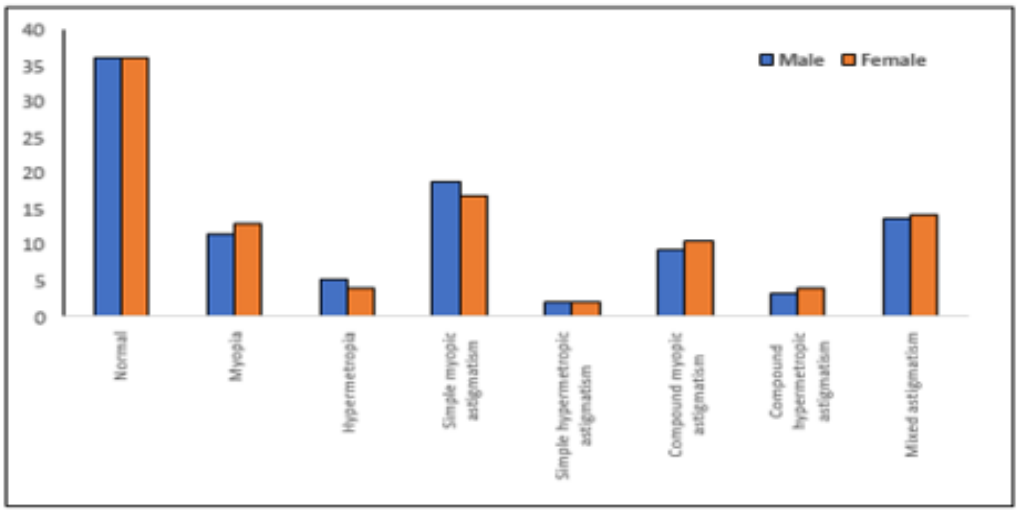

Figure 5: Refractive errors before cycloplegia in children based on sex

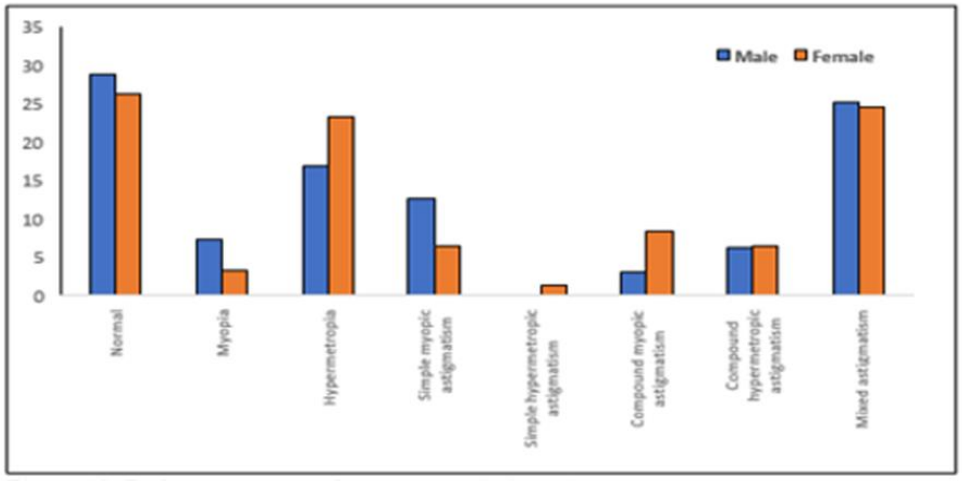

Figure 6: Refractive errors after cycloplegia in children based on sex.

Refractive errors in children based on age group:

There were significant disparities between different age groups regarding different types of refractive errors, either before or after cycloplegia. The most frequent errors in the 6-9 years group before cycloplegia were simple myopic astigmatism (24.8%) and mixed astigmatism (17.1%). Meanwhile, the most frequent errors in the 10-12 years group were myopia (14.5%), followed by simple myopic astigmatism (12.4%). The most frequent errors in the 6-9 years group after cycloplegia were mixed astigmatism (30.5%), while the most frequent errors in the 10-12 years group were hypermetropia (26.2%).

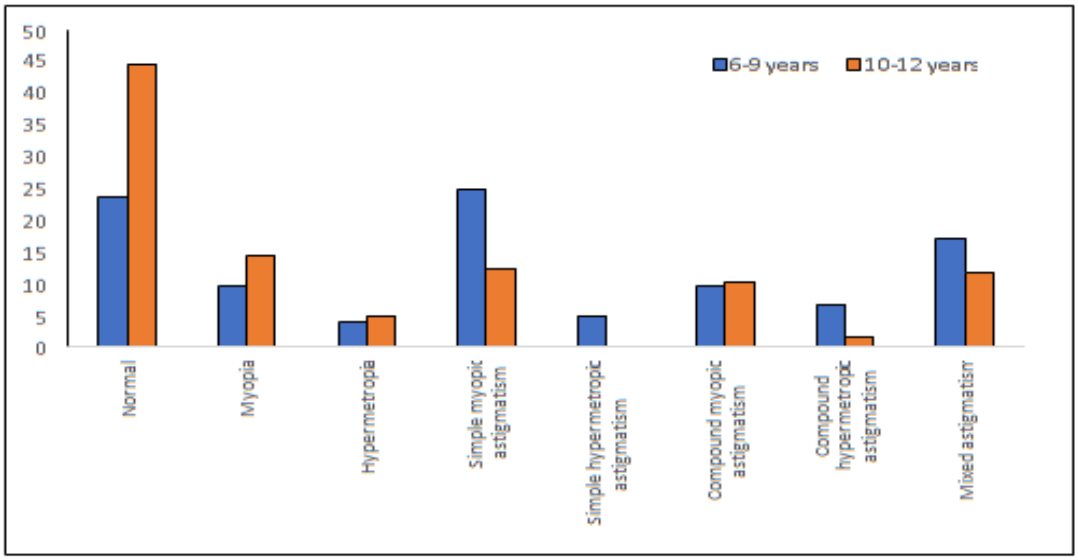

Figure 7: Refractive errors before cycloplegia in children based on age group

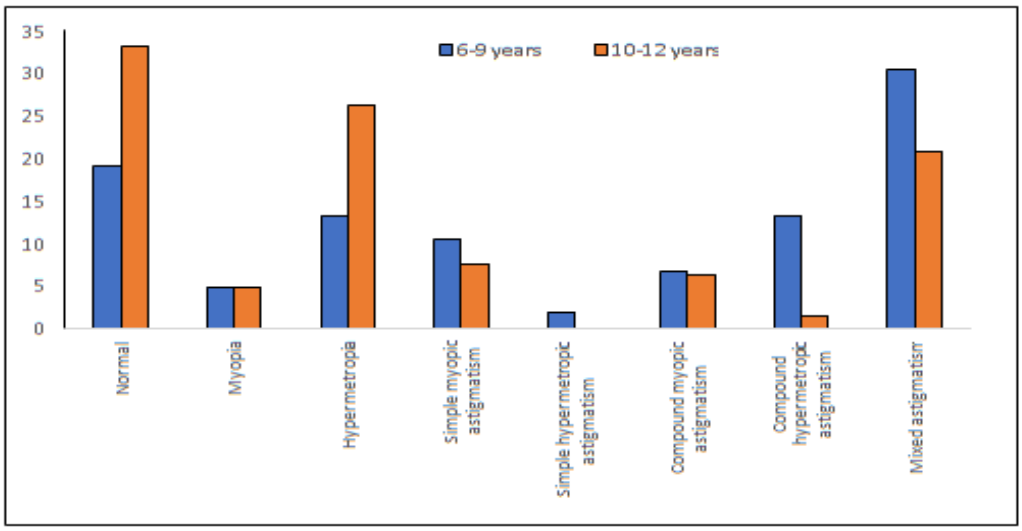

Figure 8: Refractive errors after cycloplegia in children based on age group.

Discussion

Refractive errors impact a significant fraction of the global population, irrespective of age, gender, or ethnicity. We can easily diagnose, measure, and correct these RE, which may become a major cause of visual impairment and even blindness if not corrected (3,4).

We executed this cross-sectional study to assemble RE prevalence, types, and magnitude among primary school children in the New Valley governorate.

The main principal findings of the current study are that (72.8%) of the children included have various kinds of refractive errors. There was also a significant difference between age groups in different types of refractive errors. It was postulated that Cycloplegia is the recommended course of action in specific clinical situations, such as those involving young age groups, latent hyperopia, persistent or intermittent esotropia, pseudomyopia, and accommodative spasm. (24). In this study, the percentage of myopia decreased from (12.4%) to (4.8%), while white hypermetropia increased from (4.4%) to (20.8%) after cycloplegia.

The current study recruited a total of 500 school children. The mean age of enrolled children was 9.46 years, ranging from 6 to 12 years. The vast majority, 290 (58%) of children were 10-12 years old, and 210 (42%) patients were 6-9 years old. Of

those children, 191 (38.2%) were males, and 309 (61.8%) were females.

In agreement with this finding, a previous study evaluated refractive errors in 6,333 students. The mean age of children was 9.27 ± 1.7 years, ranging from 6 to 12 years old. A total of 3,103 (49%) children were males, and 3,230 (51%) children were females (6). Also, a previous study enrolled 320 school children between the ages of 7 and 12 with a mean ± SD of (9.11 ± 1.62) years. Fifty percent of children were males [(7)].

In **Egypt**, the study conducted on children aged 7 to 15 in the **Al-Minya** governorate in middle Egypt showed the closest results on the prevalence of refractive errors, with 11.9% of enrolled students having uncorrected errors of refraction. [(10)]. In an **Assiut** district survey, 66.9% of students aged 6 to 10 had one or both eyes with a severe refractive error of ±0.50 or worse. Myopia, at 93.7%, was the most prevalent refractive defect, followed by hypermetropia at 5.3%. This is more than what our study found. [(25)].

Studies in **Tanta**, **Menoufia**, and **South Sinai** governorates also revealed higher frequencies of refractive errors between observed schoolchildren in such areas (36.8%, 17.5% and 26.6% respectively) [(12,13)].

On the other hand, several studies from different countries reported that refractive errors in rural areas vary from 2.9% to 20% among children aged 5-15, which showed much lower values than this study [(14,16)].

In the present study, we discovered that the most common errors were mixed astigmatism (24.8%), hypermetropia (20.8%), and simple myopic astigmatism (8.8%). Compound hypermetropic astigmatism, compound myopic astigmatism, and myopia were found in 32 (6.4%), 32 (6.4%), and 24 (4.8%) children, respectively. Only four children had simple hypermetropic astigmatism.

Similarly, a total of 506 school children with refractive errors were evaluated by **Yamamah et al (2015).** The authors concluded that the most frequent types of RE were astigmatism (318; 62.85%), hypermetropia (75; 14.82%), myopia (64; 12.65%), and anisometropia (49; 9.68%) [(13)]. Also, Children's refractive error prevalence overall was 9.2% for myopia, 12.8% for hypermetropia, and 28.4% for astigmatism [(17)]. According to certain studies, astigmatism prevalence is 34% [(18),] while others reported it to be 52% [(19)]. This result coincided with the findings of **AlThomali et al (2022),** who noticed that the overall prevalence of uncorrected refractive errors among school children in their study was 50.91% (3745/7356). Astigmatism's general distribution was discovered to be 50.14% (3688/7356) [(34)].

The most prevalent type of refractive error in the study population was astigmatism. (24.8%), confirmed by studies carried out globally [(20,21)]. The prevalence of astigmatism varies from 0.65% in Nepal [(22)] to 57.4% in Nigeria [(23)] in previous studies, and the study's findings about rates fell into this range.

In this study, we reported that myopia was found in 24 (4.8%) children. This study's myopia prevalence was comparable with previous studies in the Middle East (4%) [(16)], Africa (4.7%) [(15)], and India (5.3%–7.5%) [(26,27)]. But our finding was lower than other studies in Norway (35%) [(28)], China (38.0%) [(30)], Colombia (14.7%) [(29)], and Asia (14.1%) [(31)]. Myopia was more prevalent in developed than in developing nations, which could account for the higher frequency in these studies.

Also, we noticed that hypermetropia was the most frequent error in the 6-9 years group after cycloplegia (26.2%). **Yamamah et al (2016)** found that refractive errors were significantly more common among young (5–9 years) children and girls (32.1%) [(13)].

Also, **ALThomali et al (2022)** observed in their study that the prevalence of hyperopia was declining with age (20.62% in the 7–9 to 14.58% in the 16–18 years age group) [(34),] which agreed with previous findings [(14,35,36)]. While some earlier studies claimed that there was no gender difference in the frequency of hyperopia [(35,37,38)]. In contrast, males were shown to have a higher

prevalence of hyperopia in previous studies than females [9,14,39].

In this study, regarding the various forms of refractive errors, there were no significant differences between male and female children before cycloplegia. Meanwhile, there was a significant difference between the two sexes after cycloplegia.

Many previous studies reported an increasing pattern of myopia with age [9,39,40]. Furthermore, the dispersion of myopia was found to be higher in females (31.30 vs 35.12% in males and females, respectively) [34], as documented in the majority of previous studies [8,41]. On the other hand, some studies reported no significant difference in the dispersion of myopia between the two sexes [35,38,39].

To our knowledge, although the current study was considered the first one that discussed such an issue in our locality as a point of strength, our study had some limitations, including a relatively small sample size compared to the actual population of such a group.

Another limitation of this study is that we didn't perform long-term follow-ups on those children with refractive errors and their management lines.

In this study, we didn't document the percentage of amblyopic children and the number of children who refused to wear or accept wearing glasses. If considered a strength of this study, a high percentage of examined children came to follow up with their parents after wearing glasses, which may indicate the importance of awareness of our population regarding this problem.

Because of the importance of good visual acuity in this age group, the health system should prioritize identifying affected students and correcting their refractive errors. Periodic screening in schools should be performed, and teachers and their parents should be educated about the effects of uncorrected refractive errors on children's learning abilities and development. A psychiatrist may have a role in such implication.

Future studies with many children should be done in different regions of Egypt to estimate Refractive errors in our region. This should be done with detailed information regarding the cause of refusal, accepting treatment, and the reason for refusal, whether social, financial, or other. Also, we must detect amblyopia in those children and follow up after treatment.

Conclusions:

Uncorrected refractive errors affected a sizable portion of primary school children in The New Valley, Egypt. Primary school children, especially females and rural children, represent a high-risk group for refractive errors, of which the included children were unaware.

This study is regarded as a crucial screening survey for upper Egypt students. The study aimed to highlight the issue of inadequate health care in the area and was anticipated to be very valuable in the planning and treatment of refractive defects.

The current study found that astigmatism, hypermetropia, and myopia were the most frequent errors.

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