RESEARCH ARTICLE

Prevalence of refractive errors and their effects on academic achievement on primary school children in Baghdad 2023

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ABSTRACT

Introduction: Refractive error impairs vision; therefore, it is one of the most common causes of visual impairment. In schoolchildren, it frequently remains undiagnosed for a long period. So, early detection and proper management in children will prevent a possible deterioration in a child's vision.

Objective: This study was designed to estimate the prevalence of refractive errors and their related visual impairment in primary school children and to determin its possicle effect on academic achievement and potential risk factors for developing them.

Methods: A cross-sectional study was conducted from 1 March to 31 May 2023 in Baghdad, Iraq, among a sample of 982 eligible primary schoolchildren aged 6 to 12 years, selected using multistage stratified random sampling. A questionnaire was created to gather sociodemographic and clinical data, and some ophthalmological examinations were conducted to evaluate visual acuity, the type of refractive error, and the degree of refraction.

Results: Refractive errors occurred in 16.1% of primary school children; One-fourth of them were already diagnosed and wearing spectacles. Myopia was found in 7.3 %, myopia plus astigmatism in 2.3 %, hypermetropia in 2.2 %, astigmatism in 2.2 % and hypermetropia plus astigmatism in 1.9%. Age 10-12 years, residents in urban areas, poor academic achievements of pupils, family history of refractive errors, and more hours of activities requiring concentration showed statistically significant associations with refractive errors, with p-values of 0.035, 0.022, 0.007, 0.000, and 0.000, respectively. Headache and blurred vision were common symptoms associated with refractive errors, with a p-value of 0.0001 for both. In contrast, gender and parental level of education had a statistically non-significant association with refractive errors. The spectacle coverage rate was significantly associated with gender (P 0.041) higher in males, academic achievement (P 0.002) higher with good achievement, family history (P 0.045) and mother's level of education (P 0.000) and father's level of education (P 0.001), with higher rates found with higher levels of education.

Conclusion: Refractive errors are found in about one-sixth of primary school children and are not recognised in two-thirds of them. Older students, those residing in urban areas, individuals with refractive errors in first-degree relatives, and those with poorer academic achievement are statistically significant associations with refractive errors. Headache and blurred vision may be the presenting symptoms of refractive errors.

Key words: Refractive errors, myopia, primary school children, academic performance, Baghdad.

INTRODUCTION

Visual impairment due to uncorrected refractive error affects 200–250 million people worldwide. Uncorrected vision is the second or third leading cause of blindness in many developing countries. The refraction is defined as the ratio of the refractive power of the lens and cornea (the refractive media) to the axial length of the globe, so refractive error refers to the mismatch between the optical components of the eye so that the retinal image is out of

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focus.[1]

There are three types of refractive error: myopia, hypermetropia and astigmatism. In the myopic (short-sighted) eye, distant objects are brought to focus in front of the retina because the eyeball is too long (axial myopia) or the refractive elements of the eye are too powerful (refractive myopia).[2] In the hypermetropic (long-sighted) eye, distant objects are brought to focus behind the retina because the eyeball is too short (axial hypermetropia) or the refractive elements of the eye are inadequate (refractive hypermetropia). In astigmatism, the eye's refractive power varies depending on which meridian light enters the eye. The absence of any refractive errors is called Emmetropia, where light is brought to a clear focus on the retina without any accommodative (focusing) effort.[3] Presbyopia is difficulty bringing near objects into focus due to the normal, steady, age-related decline in the accommodative power of the lens.

Refractive error leads to low vision. It is, therefore, one of the most common problems of visual impairment. The importance of awareness in addressing this problem has been demonstrated to reduce the risk of blindness and improve vision quality.[4] In schoolchildren, refractive errors frequently remain undiagnosed for a long period. Awareness with early diagnosis and management will prevent the possible deterioration in a child's vision and visual impairment.[4,5]

Undetected refractive errors in childhood may lead to behavioural problems and adversely affect social interaction, as well as academic or sporting performance at school. Under-corrected refractive error may account for up to 75% of all vision impairment in high-income countries. Although interventions to treat refractive errors (e.g., spectacles) are cost-effective and straightforward, global estimates indicate that approximately 670 million people are considered visually impaired due to a lack of access to corrective treatment.[3]

According to the latest estimates from the World Health Organisation (WHO), approximately 314 million people worldwide live with visual impairment due to either eye diseases or uncorrected refractive errors. Of these, 45 million are blind, 90% of them live in low-income countries. The WHO has grouped uncorrected refractive error with cataracts, glaucoma, trachoma, macular degeneration, infections, and vitamin A deficiency among the leading causes of blindness and vision impairment worldwide.[5]

In Iraq, a 2009 survey conducted by the Ministry of Health, reported by the WHO, estimated that low vision in schoolchildren accounted for 8.5%.[6] Unfortunately, they are not given much importance in our society. Until recently, there was no effective system for preschool visual examinations of children in either the government or private sectors.[6]

Correction of refractive error and low vision are among the priorities of global initiatives for Vision 2020.[7] Refractive errors are usually present in the childhood and continue in the adult life.[8] Their diagnosis and treatment have gained increased importance nowadays, with the growing use of vision in activities such as watching TV, using smartphones and computers, and playing video games, especially among children.[9]

In Iraq, studies addressing refractive error, particularly in schoolchildren, are scarce. Therefore, this study aimed to estimate the prevalence and types of refractive errors, as well as their impact on academic achievement and eye health, among primary schoolchildren in Baghdad in 2023. And to describe the potential risk factors which may affect the degree of refraction and to estimate the spectacle coverage rate and the factors that affect them.

METHODS

Setting and study design: A cross-sectional survey was conducted in Baghdad's governorate primary schools from 1 March to 31 May 2023. Baghdad is approximately divided socio-economically into two equal districts: Al-Karkh and Al-Risafa.[10] Each district is divided into three educational directorates, overseeing 175 to 220 primary schools.[11] These schools accommodate 420,000 students, comprising 56% males and 44% females, from Baghdad's total population of approximately 6.7 million.[12,13]

Ethical Considerations: The Ethical Committees of the Arab Council for Health Specialisation in Iraq, Community Medicine, and the Ministry of Health approved the research protocol for this study. Written agreements were obtained from the administrators of the schools enrolled in this study. Data were kept confidential and only used for purposes of this research. Administrative communication was conducted with the Baghdad health directorates and the Ministry of Education, as well as its education directorates in Baghdad, to obtain their permission for the fieldwork.

Definition of the case; inclusion and exclusion criteria: The target population of our study consisted of students from primary governmental schools in Baghdad. We employed a multistage stratified random sampling method to select the sample. We excluded students older than 12 years with low vision for reasons other than refractive errors or refusal to participate. Students with incomplete data were also excluded.

Sampling and sample size:

A: Sample size: The following equation is used to calculate the appropriate sample size in the study:[14]

$$n=(Z1\text{-}\alpha/2)^2P(1\text{-}P)d^2$$

Where: **n** is the sample size, **Z1-α/2** is the standard deviation at a confidence level of 95%, which is 1.96, **P** is the estimated percentage of probability for the event to be measured, **1-P** is the probability for the event not to occur, and **d** is the percentage of the acceptable error in our study equal to 0.05.

The sample is selected using multistage stratified random sampling. So, we divided the population into strata that can have exactly ns units sampled from each, where ns is the desired number of sample units in the stratum. A sample from each class, therefore another equation used to estimate the sample size within each class:[14]

NF=N1+nN, where,

NF is the sample size for each class, **n** is the sample size for the classes from the 1st to the 6th class. Number of all students in the school, **N** is the population within each class.

In Iraq, a survey done in 2009 about eye problems among primary school children showed that 8.5% of the pupils suffered from low vision with visual acuity of less than 6/12; from that, we can assume the probability of refractive errors in our population is 10%, then:

$$n=(1.96)^2*0.1(1-0.1)\ 0.05^2 = 138$$

According to the population within each class, as mentioned below, the sample size for each class is calculated as:[13] The 1st class sample size =138 subject then we added a 28 subject for non-response, which is estimated to be 20%. Then 166 for the 1st class, 164 for the 2nd, 164 for the 3rd, 164 for the 4th, 164 for the 5th and 164 for the 6th. So, the sample size for all is 996.

B- Sampling technique: The sample in our study was selected using a multistage stratified random sampling technique. Baghdad is divided into two districts: Al-Karkh and Al-Risafa. Al-Karkh Education Directorate includes 600 primary schools, distributed as follows: 220 in Al-Karkh 1, 195 in Al-Karkh 2, and 185 in Al-Karkh 3. Al-Risafa Education Directorate includes 595 primary schools, distributed as follows: 215 in Al-Risafa 1, 203 in Al-Risafa 2, and 177 in Al-Risafa 3. We selected 21 primary schools from all directorates—18 from urban areas and three from rural areas. All classes in each selected school were included in the study. We randomly selected 7-8 students from each class, resulting in 42-48 students per school. The selection of schools and students within each class was done using a simple random sampling technique.

Outcomes and procedure: The study team consisted of the researchers, a nurse, and an expert optometrist. Tools of the study:

1. Snellen chart to measure the visual acuity.
2. Retinoscopy (also called skiascopy) is used to objectively determine the refractive error of the eye (farsighted, nearsighted, astigmatism) and the need for glasses.[15]
3. Trial case lenses and frames.

Data collection tools: The data were collected through questionnaires and physical examinations of the eyes and vision. The data collection was conducted through direct interviews with selected pupils, information gathered from the pupils' families and teaching staff, as well as an ophthalmological examination performed by the researcher and an optometrist. After that, the cases of refractive errors are referred to the ophthalmologist to prove the diagnosis, measure the accurate degree of refraction and prescribe spectacles for them.

1. Questionnaire: The questionnaire was designed to collect the child's sociodemographic characteristics, clinical findings potentially related to refractive errors, and eye examinations conducted by the study team. The questionnaire consists of three parts: the first part is filled by the researcher with some help from the teaching staff and school administrator, the second part is the ophthalmological 30 examination filled by the researcher, and the third part is filled by the child's family. The variables listed in the questionnaires are age, residence, level of education of the parents, family, and school achievement of the child. The respondent is asked to indicate whether they experience headaches or blurring of vision and to estimate the number of hours the child practices activities that require concentration, such as watching TV, using smartphones, playing video games, or studying. It is grouped into three categories: less than 2 hours, 2–4 hours, and more than 4 hours.
2. General examination: to visualise any deformity in single or both eyes such as sequent, ptosis, proptosis, or any apparent eye disease signs. Pupil reaction to light in both eyes and ocular muscles reflex.
3. Visual acuity: This is to be assessed by both the optometrist and the researcher using a Snellen chart, with or without glasses.
4. Retinoscopy: the test performed by the expert optometrist or ophthalmologist to determine the type of refractive error.
5. Trial case lenses: to record the degree of refraction and to mention whether the refractive error type is combined with another one. Visual acuity notation for Distance vision according to ICD-11-CM range WHO classification of visual impairment

Data management and statistical analysis: The data were managed and analysed using computer software SPSS version 21. The data were encoded in the software with a serial number for each subject and legal values (codes) for each individual categorical variable, as well as scales for continuous variables.

Analysis plan used in the study:

1. Frequency tables and graphs.
2. Chi-square test to find the presence or absence of significant association between the categorical variables (gender, age group, residence, family history, educational level of parents, academic achievement, headache, type of headache, blurring in vision, visual needs in concentration category, visual impairment, refraction of the eye, type of refractive errors and early detection of refractive error or wearing spectacles).
3. An independent sample t-test was used to define the significance of the association between refractive error and continuous variables (age, academic score, and visual needs in concentration). It is also used to assess the association between the visual acuity score and various categorical variables, such as gender, residence, family history, headache, and blurring of vision.
4. Analysis of variance (ANOVA) was used to investigate the association between continuous variables and categorical

variables with more than two categories, such as the relationship between academic score, age, and visual needs in concentration and the type of refractive errors. It is also used to analyse the association between the visual acuity score, the parent's educational level, and the categories of academic achievement and visual needs.

5. A confidence level of 95% with a p-value equal to or less than 0.05 was considered significant.

RESULTS

The study included 982 primary school children from government primary schools in Baghdad, with a response rate of 98% for participation. Refractive errors was present in 158 students (16.1). Age ranges from 6 to 12 years, with 516 (52.5%) of the sample being males and 466 (47.5%) females. Of the students, 83.7% lived in urban areas, and 16.3% lived in rural areas. For the parental level of education, 45.5% of fathers and 45.5% of mothers completed a university-level education. Approximately 40% of students held a good academic performance. A first-degree relative with refractive errors was presented in 138 (14.1%) of the sample. Only 86 (7%) of the sample used their eyes in work requiring concentration at home or school, such as reading or playing, for less than 2 hours, while 688 (70%) used them for 2-4 hours. For other sociodemographic features of the sample, see Table 1.

Age, residency, overall academic achievements of parents, family history of eye diseases or the use of glasses, and hours of eye use in work requiring concentration per day show a statistically significant association with refractive errors, with p-values of 0.035, 0.022, 0.007, 0.000, and 0.000, respectively. In contrast, there is no statistically significant association between refractive errors and gender, as well as the level of education of fathers and mothers. Table 1 shows more details.

Table 2 shows the relationship between the

Table 1 | Sociodemographic features of the total sample with their associatiom with the presence of refractive errors

Features		Normal vision		Refractive errors		Total		Statistical significance
		No.	%	No.	%	No.	%	
Gender	Male	441	85.5	75	14.5	616	52.5	NS†
	Female	383	82.2	83	17.8	466	47.5	
Age group	6 – 7	226	86.3	36	13.7	262	26.6	X^2= 6.708, P = 0.035*
	8 – 9	277	86.6	43	13.4	320	32.6	
	10 – 12	321	80.3	79	19.7	400	40.7	
Residence	Urban	680	82.7	142	17.3	822	83.7	X^2= 5.250, P = 0.022*
	Rural	144	90	16	10	162	16.3	
	Primary	82	80.4	19	19.6	101	10.4	
Father's educational level	Secondary	322	83.2	65	16.8	387	39.4	NS†
	University	384	85.7	64	14.3	448	45.5	
	Higher education	37	80.4	9	19.6	46	4.7	
Mother's educational level	Primary	86	81.1	20	18.9	106	10.8	NS†
	Secondary	330	84.6	60	15.4	390	39.7	
	University	379	84.8	68	14.2	447	45.5	
	Higher ed.	29	74.4	10	25.6	39	4	
Academic achievement of student	Good	338	86.2	54	13.8	392	39.9	X^2= 9.978, P = 0.007*
	Intermediate	369	84.2	66	15.2	435	44.3	
	Poor	117	75.5	38	24.5	155	15.8	
Family history of refractive errors or wearing glasses	Positive	93	67.4	45	32.6	138	14.1	X^2= 32.453, P = 0.000*
	Negative	731	86.6	113	13.4	844	85.9	
Hours of using eyes in activities requiring concentration/ day	Less than 2 hr	66	97.1	2	2.9	68	7	
	2 – 4 hr	589	85.6	99	14.4	688	70	X^2= 24.139, P = 0.000*
	More than 4 hr	169	74.8	57	25.2	226	23	
Total		**824**	**83.9**	**158**	**16.1**	**982**	**100**	

† NS: not statistically significant. * Statistically significant is if a p-value is less than 0.05. X^2 : chi-square test

Table 2 | Relationship between the types of refractive error with headache and vlarity of vision

Types of refrctice errors	Total (%)	Headache				Vision clarity			
		Yes	%	No.	%	Blurred	%	clear	%
Myopia	72 (45.6)	32	44.4	40	55.6	25	34.7	52	65.3
Hypermetropia	22 (13.9)	7	31.8	15	68.2	5	22.7	17	77.3
Astigmatism	22 (13.9)	6	27.3	16	72.7	14	63.6	8	36.4
Myopia & Astigmatism	23 (14.6)	12	52.2	11	47.8	10	43.5	8	56.5
Hypermeteropia & Astigmatism	19 (12)	6	31.6	13	68.4	5	26.3	14	73.7
Total	158	63	39.9	95	60.1	59	37.3	99	62.7
		Chi square = 4.677, P = 0.322				Chi square = 10.078, P = 0.039			

types of refractive error and their association with the presence of headaches and blurred vision. Myopia was the most common type of refractive error seen among the sample, 72 out of 158 (45.6 %), while hypermetropia plus astigmatism was the least diagnosed, 19 (12%). Myopia plus astigmatism was the type with the highest proportion of headaches at 52.2%. However, a headache has no statistically significant association with the type of refractive errors. Astigmatism alone was the type of refractive error most commonly associated with blurred vision in 14 out of 59 (23.7%) cases, and blurred vision was statistically significantly associated with refractive error, with a p-value of 0.039.

Only academic achievements of students, family history of refractive errors, or the use of glasses, and hours of eye use in activities requiring concentration per day show a statistically significant association with visual impairment in both eyes, with p-values of 0.017, 0.000, and 0.003, respectively. See table 3

Table 4 shows the mean age, academic score and hours of using the eyes in work requiring concentration and their association with the presence of refractive errors. These three social variables have shown statistically significant association with having a refractive error, with p-values of 0.003, 0.000, and 0.000, respectively.

Table 5 shows the variables that have a statistically significant association with visual acuity score. These include residence, family history of eye disease or wearing glasses, headache, and clarity of vision, with p-values of 0.01 for residence and 0.000 for the others.

To test the association between the type

Table 3 | Association of visual impairment in both eyes with sociodemographic variables

Variables		Visual impairment in both eyes								Total	Statistics
		Normal		Near Normal		Moderate low		Severe low			
		No.	%	No.	%	No.	%	No.	%		
Gender	**Male**	541	87.4	50	9.7	13	2.5	2	0.4	516	NS †
	Female	397	85.2	59	12.7	8	1.7	2	0.4	466	
Age group (years)	**6 – 7**	233	88.9	23	8.8	5	1.9	1	0.4	262	NS †
	8 – 9	285	89.1	32	10	3	0.9	0	0	320	
	10 - 12	330	82.5	54	13.5	13	3.3	3	0.8	400	
Residence	**Urban**	700	85.2	99	12	20	2.4	3	0.4	822	NS †
	Rural	148	92.5	10	6.3	1	0.6	1	0.6	160	
Academic achievement	**Good**	347	88.5	33	8.4	10	2.6	2	0.5	392	X^2= 15.466
	Intermediate	380	87.4	46	10.6	7	1.6	2	0.5	435	P= 0.017*
	Poor	121	78.1	30	19.4	4	2.6	0	0	155	
Family history of RE	**Positive**	94	68.1	34	24.6	8	5.8	2	1.4	138	X^2=47.026
	Negative	754	89.3	75	8.9	13	1.5	2	0.2	844	P= 0.000*
Visual needs hours/day	**<2**	67	98.5	1	1.5	0	0	0	0	68	X^2= 20.142
	2 -4	600	87.2	75	10.9	11	1.6	2	0.3	688	P= 0.003*
	>4	181	80.1	33	14.6	10	4.4	2	0.9	226	

† NS: not statistically significant. * Statistically significant is if a p-value is less than 0.05. X^2 : chi-square test

Table 4 | t-test for refractive error associations with the continuous variables

Variables	Refraction of the eyes				Statistical significance	
	Normal vision n= 824		Refractive error n= 158			
	Mean	SD	Mean	SD †	T test	P value
Age (years)	8.9	±1.942	9.4	±2.029	2.928	0.003*
Academic score (%)	77	±13.741	73	±14.312	3.541	0.000*
Visual needs (hours)	2.78	±0.986	3.21	±1.089	4.946	0.000*

† SD: Standard Deviation. * Statistically significant is if a p-value is less than 0.05.

of refractive error and the mean age, mean percentage of academic score, and mean hours of work requiring concentration using the eyes, we conducted an analysis of variance. Only age shows a statistically significant association with the type of refractive error, with a p-value of 0.046. See Table 6.

DISCUSSION

The refractive error of the eye is one of the most important causes of low vision and blindness. The importance of awareness in addressing this problem has been demonstrated to reduce the risks of blindness and improve vision quality.[16] The correction of refractive errors as early as possible and avoidance of the risk factors for developing them are regarded as the most important aspects of preventive measures.

The prevalence of refractive error varies from one country to another; it was 9.8% in Saudi Arabia in 2010,[18] 22.1% in Egypt in 2007,[19] and 19.7% in Qatar in 2008.[20]

In this study, the prevalence of refractive error among primary schoolchildren in Baghdad was 16.1%, which is higher than the prevalence reported in a 2009 survey conducted in Iraq, where the prevalence of low vision due to refractive errors was approximately 8.5%.[6] This difference might be due to the different targeted populations, which were the whole of Iraq in the previous survey and Baghdad in ours. Baghdad is a more populous and more urban city compared to the rest of Iraq.

Table 5 | Association of visual acuity score and some socio-clinical variables

Variable		Visual acuity score		Statistical significance	
		Mean	SD	T test	P value
Gender	Male	96.99	8.643	0.057	0.954
	Female	97.02	8.146		
Residence	Urban	96.70	8.771	2.577	0.010*
	Rural	98.56	5.945		
Family history	Yes	93.26	12.551	5.732	0.000*
	No	97.61	7.340		
Headache	Yes	93.78	11.350	5.962	0.000*
	No	97.77	7.334		
Clarity of vision	Blurred vision	94.92	9.361	3.719	0.000*
	Clear vision	97.47	8.101		

† SD: Standard Deviation. * Statistically significant is if a p-value is less than 0.05.

Myopia was the most prevalent refractive error type, with a rate of 7.3%, followed by myopia combined with astigmatism, hypermetropia, astigmatism alone, and hypermetropia plus astigmatism at rates of 2.3%, 2.2%, 2.2%, and 1.9%, respectively. These results are consistent with those of many Middle Eastern countries, including Jordan, Iran, Egypt, and Qatar.[19,20, 21, 22]

In our study, we found that only one-fourth of refractive errors had already been diagnosed, and patients had been wearing spectacles prior to the study. This result was higher than the 15.8% reported from Jordan,[21] nearly similar to the 25.2% reported from Bangladesh,[23] but much lower than the 66% reported from Iran.[22] The higher rate from Iran may be attributed to the inclusion of a wider age group, from 5 to 55 years.

Age: The current study has shown a significant association between refractive error and age, with a higher prevalence in older children, as indicated by a p-value of 0.003. Age also affects the type of refractive error; the mean age of patients with myopia was higher, at 9.9 years (95% CI, 9.5–10.3 years), a p-value of 0.041, compared to the mean age of patients with other types of refractive errors. Studies from Egypt[19] and India[24] found a similar result. There was no statistically significant association between age

Table 6 | ANOVA for types of refractive error association with continuous variables

Variable		Mayopia	Hypermetropia	Astigmatism	Mayopia + Astigmatism	Hypermetropia + Astigmatism	Total	Statistical significance
		No. 72	No.22	No. 22	No. 23	No. 19	158	
Age (years)	Mean	9.90	8.91	8.73	9.43	8.84	9.41	F = 2.484
	±SD †	1.754	2.180	2.074	2.253	2.192	2.029	P = 0.046*
Academic score %	Mean	71	73	75.3	73.8	74.7	72.7	NS**
	±SD †	13.692	14.654	17.521	14.462	12.510	14.312	
Visual needs (hours)	Mean	3.13	3.09	3.09	3.65	3.26	321	NS**
	±SD †	1.047	1.151	1.019	1.152	1.147	1.089	

† SD: Standard Deviation. * Statistically significant is if a p-value is less than 0.05. ** Non-significant

and low vision (VA less than 6/12), which differs from studies conducted in Jordan,[21] Egypt,[19] and Qatar.[20]

Gender: In the current study, 52.5% of refractive errors were found in females, and 47.5% were found in males; however, this difference was not statistically significant (p =0.163). This result is consistent with that from an Indian study,[24] but differs from that from Jordan,[21] Egypt,[19] and Qatar.[20] The higher prevalence in females may be due to a steeper cornea, a steeper crystalline lens, and shorter eyesight than in males.[25] In addition, more staying at home for the girls may expose them to more work that requires eye concentration. In our study, gender was not found to affect the type of refractive errors (p-value = 0.42). In contrast, males with refractive error wear spectacles more frequently than females, at 33.3% versus 18.1%, and this difference was statistically significant, with a p-value of 0.028. This contradiction may be due to females being less likely to complain or more shy about wearing glasses.

Residence: Refractive errors are more prevalent in children residing in urban areas than in rural areas, at 17.3% and 10%, respectively, with a p-value of 0.022. Similarly, the mean VA score is higher in rural residents than in urban. This difference may be explained by the fact that urban areas have increased night-time ambient lighting[25-27] and more activities requiring concentration compared to rural areas. No statistical significance was found between the type of refractive errors and wearing spectacles.

The educational level of the parents: We found no statistically significant association between the refractive errors and the educational levels of the parents; however, a significant association was found with the rate of wearing spectacles. There is a probability that an increase in educational level will lead to an increase in spectacle coverage rates and early detection of refractive errors.

Student Academic Achievement: The mean academic score in pupils with normal vision was higher than the mean academic score in pupils with refractive errors but not to the type of errors; this difference was statistically significant (P < 0.000). This association might be because academic achievement depends on more study time, which is a matter that requires good enough sight to understand the lessons. Similarly, the academic achievement of the pupils had a statistically significant association with mean visual acuity (p = 0.041). We found that the pupils with poor achievement had a mean VA score of 95.45 (95% CI, 94–97), while the pupils with good achievement had a mean VA score of 97.40 (95% CI, 96.60–98.20). In line with this result, correction of refractive errors was significantly associated (p= 0.002) with a higher academic level among pupils.

Family history of refractive errors: A family history of one or more types of refractive error is thought to be an important risk factor for developing errors in refraction, as refractive errors have a genetic basis.[28, 29] We found that a family history of refractive errors is associated with a statistically significant correlation with the development of refractive errors and a lower mean visual acuity (VA) score in children, with myopia exhibiting the strongest association with family history. The presence of a family history of refractive errors aids in the early detection and correction of refractive errors; a family history of refractive errors has a statistically significant association (P < 0.000) with wearing spectacles.

Headache: In this study, a statistically significant association was found between the presence of refractive errors but not the type and headache (P < 0.000). Additionally, we found that headache is significantly associated with decreased visual acuity, and correcting errors relieves headache (p = 0.004). Headache, which is usually periocular in children, is a possible presentation of refractive error.[24] Headache might be developed due to over-contraction of ocular muscles to overcome refractive errors.

Blurring in vision: Most children with refractive errors experienced blurred vision (p < 0.000), and wearing spectacles alleviated it (p < 0.000). Children with refractive errors may complain of difficulty seeing distant or near objects, which can induce more accommodative power in the eyeball, resulting in fatigue of ocular muscles and the development of headaches, especially if left untreated.[30]

There was a statistically significant association (P= 0.039) between the types of refractive error and blurring in vision. The results have shown that blurred vision was more prevalent in individuals with astigmatism and myopia combined with astigmatism than in those with other types. The reason behind that may lie in the fact that astigmatism is a common vision problem caused by an error in the shape of the cornea. With astigmatism, the front surface of the eye (the cornea) or the lens of the eye has an irregular curve, which can change the way light is passed to the retina (or refracted), causing blurry, fuzzy, or distorted vision.

According to the visual acuity score, there was a significant association (P 0.000) between the VA score and blurred vision; the mean VA score was 97.47(95% CI, 96.91 – 98.3) in children with clear vision versus 94.92 (95% CI, 93.54 – 96.29) in those with blurred vision.

Visual needs in concentration: We found the mean hours requiring visual concentration per day was higher within the children with refractive errors than in pupils with normal refraction (P 0.000). Similarly, the high mean hours was associated with a statistically significant decrease in mean visual acuity (p=0.000). There was no significant association between the type of refractive error and the mean hours needed in concentration per day.

CONCLUSION

Compared to the previous survey, this study revealed an increased prevalence of refractive errors in primary school children, with about two-thirds of them remaining undiagnosed, which affects their academic achievement. Refractive errors cause headaches and blurred vision. Older students residing in urban areas, those with refractive error in first-degree relatives, the academic achievement of the students, and the hours spent on activities requiring concentration are significantly associated with refractive errors. Myopia is the most common refractive error reported, and its presence was significantly associated with a family history of refractive errors.

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Abbreviations list: Analysis of variance (ANOVA), Confidence interval (CI), Statistical Package for the Social Sciences (SPSS), Television (TV), The International Classification of Diseases, 11th Revision, Clinical Modification (ICD-11-CM), Visual Acuity (VA), World Health Organisation (WHO).

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