REFRACTIVE ERRORS AMONG RURAL SCHOOLCHILDREN IN SOUTH EGYPT

By

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ABSTRACT

Background: *Visual impairment caused by uncorrected refractive errors (RE) represents a major cause of correctable blindness that affects a wide range of children worldwide. Delay in diagnosis and correction can have serious impacts on the quality of life and socioeconomic development of the affected children. There is increasing needs for screening programs to document the prevalence, types and extent of refractive errors.*

Objectives: *To determine the prevalence, types and extent of refractive errors among the rural schoolchildren in South Egypt.*

Methods: *In this cross sectional study, 6333 students of 10 primary schools in rural areas of three governorates in South (Upper) Egypt (Qena, Luxor and Aswan) were screened and their cycloplegic refraction had been determined.*

Results: *Refractive errors were found in 519 students with overall prevalence of 8.2%. The frequency increased significantly among younger age students (≤ 8 years) compared to elder children (> 8 years old) (9.9% and 7.7% respectively) and between inhabitants of Aswan compared to Luxor and Qena governorates (10.9%, 6.3% and 7.7% respectively) with no significant difference between female and male students.*

Conclusions: *The overall prevalence of uncorrected refractive errors among rural schoolchildren in South Egypt was found to be 8.2%. Astigmatism was the most commonly reported type of RE followed by myopia and lastly hypermetropia. The study recommends regular screening for RE between schoolchildren together with education to students, their tutors and guardians about the importance of early management of that problem.*

Keywords: *Refractive errors, schoolchildren, anisometropia, amblyopia, Upper Egypt.*

INTRODUCTION

Visual impairment caused by uncorrected refractive errors (RE) represents the second cause of correctable blindness that affects approximately 153 million individuals worldwide. Children in the 5–15 years age range are particularly at risk with nearly 13 million affected; three-quarter of them live in the underdeveloped

countries **(Resnikoff et al., 2008**, **Naidoo et al., 2016)**.

Delay in diagnosis and correction of RE can have serious impacts on the quality of life and socioeconomic development of the affected children that occurs through reduction of their learning capabilities and hence employment opportunities **(Holden et al., 2014)**.

Decrease awareness about the magnitude of problem of RE between students, their families and even the entire community with deficient prevention and treatment facilities create major obstacles for proper correction of that issue **(Bourne et al., 2013)**.

As the condition is almost asymptomatic and the health care arrangements are usually lacking; there is increasing needs for screening programs to document the prevalence, types and extent of refractive errors among children in these communities **(Flaxman et al., 2017)**.

Several surveys regarding frequencies of RE among school children were conducted in different regions around the world with widely variable outcomes. The reported prevalence of RE in some of nearby countries varied as follows: India 2.6- 5.5% **(Kalikivayi et al., 1997**, **Chaturvedi and Aggarwal, 1999**, **Dandona et al., 2002**, **Padhye et al., 2009)**, Central Ethiopia 6.3% **(Mehari and Yimer, 2013)**, Darfur Sudan 6.4% **(Alrasheed et al., 2016)**, Eastern Nigerian 9.7% **(Ezinne and Mashige, 2018)**, Shiraz Iran 6.46% **(Yekta et al., 2010)** and in Darnah Libya 116% **(Elmajri, 2017)**.

Various reports were obtained from different regions of Egypt but most of them were conducted at the Northern governorates which show great environmental as well as socioeconomic differences compared to the southern governorates (Upper Egypt) **(El-Baioumy et al., 2007**, **Hassanien et al., 2001**, **Elkot et al., 2016**, **Nassar, 1998**, **El-Sayed, 1993)**.

There was a great deficiency of reports about the prevalence and extent of RE among schoolchildren in Upper Egypt. Therefore, there was a dire need for researcher to document the extent and impact of that problem in Upper Egypt, drawing attention of the government and nongovernmental organizations to this vital health issue.

It was therefore decided to carry out this cross sectional study that aimed to establish the prevalence, types and magnitude of RE among school children in three of South (Upper) Egypt

governorates. The outcomes of this study was expected to help suggesting appropriate management of RE and consequently amblyopia in Upper Egypt.

METHODS

This cross-sectional study aimed at screening 6-12 years old school children for the presence of uncorrected errors of refraction. The study was conducted at the beginning of the 2017 academic year and included students in rural areas of South Egypt governorates. Ten schools were randomly selected and distributed as four schools in Qena and three schools for each of Luxor and Aswan governorates.

Sample size:

As previously reported, expected prevalence of refractive errors between primary school children was assumed to be 22.1% **(El-Baioumy, 2007)**. Marginal error of 5% with 95% confidence level was applied and additional 10% for expected non-response rate was added. So, the minimal sample size was 282 children. Aiming for detection and correction of significant refractive errors; screening was extended and sample size was considerably enlarged.

In this cross sectional study cluster sampling method and total coverage had been implemented; from the schools list located in each selected governorate, governmental schools were randomly selected consecutively with raffle method and the entitled students were included. Schools have been chosen to represent most of the South Egypt population status. The selected school had been considered as a cluster and all the students of the selected schools in the group of 6-12 years old were included.

Ethical consideration:

- Approval of research by the local ethical committee was obtained before conducting the study.
- Verbal and/or written consent were obtained from all parents and controls after explanation of the whole procedures.
- All the data and the patients and results of the study are confidential and the patients has the right to keep it.
- Parents have the right to withdraw their child from the study at any time without giving any reason.
- All stages of the study were adherent to the guidelines of the Declaration of Helsinki.

- All parents have the right to refuse to participate in the study with no negative effect on service delivered to their children.

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Exclusion criteria:

Previous ocular surgeries, cornea or lens opacities as well as earlier history of eye injuries were among exclusion criteria. Parents or guardians' refusal to participate and missing the screening day were also considered as causes for exclusion from the study.

The screening was done in transient previously prepared places inside schools. Participating school had been visited two weeks before the screening day. During these visits the purpose and procedures of the study were explained to the students as well as to school staff and teachers. The day for vision screening was defined ensuring maximal attendance of the students on that date.

Following detailed history taking, each student was exposed to complete ophthalmological examination including uncorrected and best corrected visual acuity, slit lamp examination, cycloplegic refraction and fundoscopy. Cycloplegic refraction was done after dilatation of the pupils using 1% cyclopentolate eye drops (Cycloplejico, Alcon Cusi, Br, Spain) administered three times every five minutes. Assessment of refraction was then done using autorefractometer (Topcon RM-800, Tokyo, Japan).

For the purposes of this study, spherical equivalent (SE) was calculated by algebraic adding half of cylinder to full amount of spherical power. Myopia was defined as SE of ≤ -0.50 diopter (D), hypermetropia by SE ≥ +2.00 D while astigmatism was defined as cylinder power of ≥ 1.00 D if one or both eyes. Myopia and hypermetropia were further defined as low, moderate and high. Anisometropia was considered when difference in refraction was present between SE or cylinder power of both eyes of at least one diopter. Anisometropia was nominated as amblyogenic when: myopic (≤ -4.00 D), Hyperopic (≥ +2.00 D) or cylindrical (± 1.00 D or more). Distribution of types of astigmatism was done based on the focus of principle meridians.

Statistical analysis:

The collected data were verified, coded and analyzed using the

Statistical Package for Social Sciences (IBM-SPSS/PC/VER 24). Descriptive statistics as mean, standard deviation, median, range, frequencies and percentage were calculated. Chi square test were used to compare the difference in distribution of frequencies among different groups while Student t-test and Mann-Whitney U test were used to test the mean differences in continuous variables between groups (parametric and non-parametric).

Multivariable logistic regression analysis was calculated to explore the significant baseline sociodemographic factors influencing RE (Odds Ratio -OR-, 95% confidence interval -CI- and p-value). Significant test results were considered when p value was ≤ 0.05.

Figure (1): Geographical location of Upper Egypt

Geographical background:

Upper Egypt represents the southern Egyptian governorates located mainly within subtropical region between latitudes 22º N and 26º N (Fig. 1). The climate in the study region is desert climate characterized by hot summer and mild winter. Aswan and Luxor are the highest temperature cities in summer in Egypt.

By the end of 2017, the total population in study area was 5.995 million inhabitants (3.224 million in Qena, 1.270 million in Luxor and 1.501 million in Aswan

governorates) with total number of primary schoolchildren reached 527,473 (221,344 in Qena, 133,206 in Luxor and 172,923 in Aswan governorates). Aswan governorate has more pronounced racial diversity than Qena and Luxor including Nubian ethnicity. Populations in Upper Egypt area are frequently related to low socioeconomic status **(CAMPAS, 2017)**.

RESULTS

This cross section study was planned to screen refractive errors (RE) of 6582 students in 10 primary schools that located in rural areas of three governorates in Upper Egypt. Only 6,333 students were examined denoting response rate of 96.2%.

Table (1): Relationship between baseline characteristics and refractive errors among the studied Schoolchildren in Rural Upper Egypt

Variable	Category	RE (n=519)	Normal (n=5,814)	Total (n=6,333)	P-value
Age/years	Mean ±SD	8.89 ± 1.6	9.30 ± 1.7	9.27 ± 1.7	< 0.001*
	Median (Range)	9 (6 - 12)	9 (6 - 12)	9 (6 - 12)	
Age Category	≤ 8 year	241 (46.4%)	2,189 (37.7%)	2,430 (38.4%)	<0.001**
	> 8 year	278 (53.6%)	3,625 (62.3%)	3,903 (61.6%)	
Sex	Male	248 (47.8%)	2,855 (49.1%)	3,103 (49%)	= 0.289**
	Female	271 (52.2%)	2.959 (50.9%)	3,230 (51%)	
Governorate	Aswan	194 (37.4%)	1,591 (27.4%)	1,785 (28.2%)	<0.001*
	Luxor	110 (21.2%)	1,633 (28.1%)	1,743 (27.5%)	
	Qena	215 (41.4%)	2,590 (44.5%)	2,805 (44.3%)	

* Unpaired t-test, **Chi-square test

The mean age of the included students was 9.27 ± 1.7 years (ranged from 6-12 years). The base line characteristics of the examined school children as regards to age group, sex, area of inhabitance were shown in **table (1)**.

Refractive errors were found in 519 students with overall prevalence of 8.2%. The frequency increased significantly among younger age students (≤8 years) compared to elder children (>8 years old) (9.9% and 7.7% respectively) and Also between inhabitants of Aswan compared to Luxor and Qena governorates (10.9%, 6.3% and 7.7% respectively) with no significant difference between female and male students **(Table 1)**.

Table (2): Mean score of refractive errors among examined rural schoolchildren in Upper Egypt

RE Type	Category	Right Eye	Left Eye	P-value
Myopia	**Mean ± SD**	-1.86 ± 2.0	-1.77 ± 1.9	**= 0.041***
	Median (Range)	-1.1 (-15: -0.5)	-1.3 (-15: -0.5)	
Hyperopia	**Mean ± SD**	3.16 ± 1.2	2.98 ± 1.0	= 0.298*
	Median (Range)	2.75 (2 – 6.6)	2.5 (2 – 6.9)	
Astigmatism	**Mean ± SD**	-0.99 ± 1.9	-1.03 ± 1.9	= 0.824*
	Median (Range)	-1.5 (-5.5: 5)	-1.5 (-8: 4)	

*Mann-Whitney U-test

The mean values of different types of refractive errors in both eyes were verified in **table (2)**. There was no significant difference between the mean score of hyperopic and cylindrical errors for both eyes while right eyes revealed low significant myopic tendency compared to left eyes of examined school children (p value 0.041) **(Table 2)**.

Table (3): Prevalence of refractive error types between students in Upper Egypt

Variable	Right Eye		Left Eye	
	No.	**%**	**No.**	**%**
Refractive Errors/Total group (n = 519/6,333)	470	7.4	502	7.9
Myopia (SE)	309	4.9	322	5.1
• **Low (-0.5: -3.00 D)**	263	4.2	285	4.5
• **Moderate (-3.00: -6.00 D)**	28	0.4	22	0.4
• **High (≥-6.00 D)**	18	0.3	15	0.2
Hyperopia (SE)	156	2.5	160	2.5
• **Low (+1.00 - +2.00 D)**	85	1.3	88	1.4
• **Moderate (+2.00 - +5.00 D)**	62	1.0	68	1.1
• **High (>+5.00 D)**	9	0.1	4	0.1
Astigmatism	362	5.8	374	5.9
Myopic Astigmatism (≤ -1.00 D)	263	4.2	275	4.3
Hyperopic Astigmatism (≥ +1.00 D)	99	1.6	99	1.6

D= diopter, SE= Spherical equivalent

The most commonly encountered types of refractive errors were astigmatism followed by myopia then hypermetropia (5.9%, 5.1% and 2.5% respectively). High hypermetropia was the least frequent subtype of RE (0.1%) while low myopia represented the most common one (4.5%) **(Table 3)**.

Table (4): Relationship between baseline characteristics and refractive errors among the studied schoolchildren in rural Upper Egypt

Variable		Myopia (n=322)		Hyperopia (n=160)		Myopic astigmatism (n=275)		Hyperopic astigmatism (n=99)	
		No. (%)	P-value*	No. (%)	P-value	No. (%)	P-value	No. (%)	P-value
Age Category	• ≤ 8 year	134 (5.5%)	= 0.219	85 (3.5%)	**< 0.001**	120 (4.9%)	**= 0.034**	59 (2.4%)	**= 0.011**
	• > 8 year	188 (4.8%)		75 (1.9%)		155 (4%)		40 (1.0%)	
Sex	• Male	161 (5.2%)	= 0.712	67 (2.2%)	**= 0.040**	136 (4.4%)	= 0.471	43 (1.4%)	0.273
	• Female	161 (5.0%)		93 (2.9%)		139 (4.3%)		56 (1.7%)	
Governorate	• Aswan	119 (6.7%)	**= 0.001**	58 (3.2%)	**= 0.003**	108 (6.1%)	**< 0.001**	44 (2.5%)	**< 0.001**
	• Luxor	81 (4.6%)		26 (1.5%)		64 (3.7%)		11 (0.6%)	
	• Qena	122 (4.3%)		76 (2.7%)		103 (3.7%)		44 (1.6%)	

*Chi-square test

Distribution of myopia was not found to be significantly different between young (≤ 8 years old) and elder students (> 8 years old) or between male and female schoolchildren. On the other hand there occurrence in Aswan was significantly greater compared to Luxor and Qena governorates (6.7%, 4.6% and 4.3% respectively) **(Table 4)**.

On the other hand, prevalence of hypemetropia significantly increased among children ≤ 8 years old compared to students > 8 years old (p value <0.001) as well as among females compared to male schoolchildren (p value = 0.040). Hypermetropia was also found more frequently among Aswan governorate students compared to Qena and Luxor children (3.2%, 2.7% and 1.5% respectively) **(Table 4)**.

Table (5): Types of astigmatism among examined schoolchildren in Upper Egypt

Astigmatism	No. (n=374)	%
Simple Astigmatism	212	3.3
• Simple myopic astigmatism	186	2.9
• Simple hyperopic astigmatism	26	0.4
Compound Astigmatism	115	1.8
• Compound myopic astigmatism	60	0.9
• Compound hyperopic astigmatism	55	0.9
Mixed Astigmatism	57	0.9

Astigmatism was the most commonly reported type of RE in the present study representing 5.9 % of total population and 72.1% of refractive errors. Myopic astigmatism represented 73.5% of total astigmatism, 53% of total refractive errors and 4.3% of total population while simple myopic type constituted 49.7% of total astigmatism, 35.8% of total refractive errors and 2.9% of total population. Additionally, compound myopic astigmatism represented 16% of total astigmatism, 11.6% of total refractive errors and 1% of total population.

Hyperopic astigmatism represented 26.5% of total astigmatism, 19% of total refractive errors and 1.6% of total population. Simple hyperopic astigmatism represented 7% of total astigmatism, 5% of total refractive errors and 0.4% of total population while compound hyperopic astigmatism represent 14.7% of total astigmatism, 10.6% of total refractive errors and 0.9% of total population. Mixed astigmatism represent 15.2% of total astigmatism, 10.1% of total refractive errors and 1% of total population **(Tables 4, 5)**.

Table (6): Relationship between baseline characteristics of anisometropia and amblyogenic anisometropia among the studied schoolchildren in rural Upper Egypt

Variable		Anisometropia (n=243)		Amblyogenic anisometropia (n=201)	
		No (%)	P-value*	No (%)	P-value*
Age/years	≤ 8 year	112 (4.6%)	= 0.012	98 (4.0%)	= 0.002
	> 8 year	131 (3.4%)		103 (2.6%)	
Sex	Male	122 (3.9%)	= 0.375	100 (3.2%)	= 0.442
	Female	121 (3.7%)		101 (3.1%)	
Governorate	Aswan	89 (5.0%)	= 0.005	70 (3.9%)	= 0.038
	Luxor	51 (2.9%)		42 (2.4%)	
	Qena	103 (3.7%)		89 (3.2%)	

*Chi-square test

Pure cylindrical anisometropia was found among 153 cases representing 63% of total anisometropia, while spherical anisometropia was present in 47 cases (19.3%). Students that had both spherical and cylindrical anisometropia were 43 representing 17.7% of total anisometropia.

Anisometropia represented about 3.8% of total population and 46.8% of students having refractive errors. Its prevalence was not affected by sex of students (P value 0.375) but was found to be more frequent in schoolchildren ≤ 8 year old compared to elder ones. Once more, anisometropia was found to be more significantly prevalent in Aswan compared to 2.9% in Qena and 2.0% in Luxor governorates (p value 0.005) **(Table 6)**.

Cylindrical amblyogenic anisometropia represented 56.2% (113 students) of total amblyogenic anisometropia, while pure spherical amblyogenic anisometropia represented 23.4% (47 students) and mixed cases represented 20.4% (41 students) of total amblyogenic anisometropia. This demonstrated that astigmatism was the most common cause of refractive amblyogenic anisometropia.

Similarly, amblyogenic anisometropia was found to be more prevalent in students < 8 years old as well as among Aswan governorate schoolchildren (p value 0.002 and 0.038 consecutively). On the other hand sex was not found to affect its prevalence (p value 0.442) **(Table 6)**.

Table (7): Socio-demographic Determinants of Refractive Errors among the studied Schoolchildren in Rural Upper Egypt, 2017: Multivariable Logistic Regression Analysis

Variables		Adjusted OR*	P-value	95% CI*	
				Lower	Upper
Age	≤ 8 years	1 (Reference)			
	> 8 years	0.704	**< 0.001**	0.587	0.843
Sex	Male	1 (Reference)			
	Female	1.060	= 0.524	0.885	1.270
Governorate	Qena	1 (Reference)			
	Luxor	0.829	= 0.121	0.635	1.052
	Aswan	1.476	**< 0.001**	1.203	1.810
Constant			**< 0.001**		

*OR=Odds Ratio, **CI=Confidence Interval

In the logistic regression model **(table 7)**, the odds of developing of refractive errors was significantly higher among young (<8 years old) schoolchildren (odds ratio (OR) = 0.704, P value < 0.001) and students living in Aswan governorate (OR= 1.476, P value < 0.001) **(Table 7)**.

DISCUSSION

Decreased learning abilities and mental underdevelopment with subsequent loss of working opportunities and compromised quality of life are among serious effects of uncorrected refractive errors **(Bourne et al., 2013)**. Early screening programs for refractive errors (RE) can reveal the extent and the depth of this problem helping its management **(Holguin et al., 2006)**.

In the current study the prevalence of RE was found to be 8.2%. This was in agreement with study done in rural areas of South India where overall prevalence of errors of refraction reached 8.6% **(Kalikivayi et al., 1997)**. Also results obtained from other studies conducted in Southern Nigeria and Northwest Ethiopia have supported that of the recent one where frequency of RE ranged from 7.3% to 9.7% among screened primary schoolchildren **(Yared et al., 2012**, **Ezinne and Mashige, 2018** and **Ekpenyong et al., 2020)**.

In Egypt, the nearest results of RE prevalence was obtained from study done in Al-Minya governorate in middle Egypt on 7–15 years old students where 11.9% of enrolled students were found to have uncorrected errors of

refraction **(Hassanien et al., 2001)**.

Otherwise and inconsistent with the previous outcomes, prevalence of RE obtained from several surveys conducted in northern governorates of Egypt revealed considerably higher values. Elkot et al conducted their study among primary school students in rural areas of Menouf district and found the prevalence of refractive errors to be 24% out of 480 study population **(Elkot et al., 2016)**. Also studies conducted in Menoufia, Tanta and South Sinai governorates revealed also higher frequencies of RE between observed schoolchildren in such areas (36.8%, 17.5% and 26.6% respectively) **(El-Sayed, 1993**, **Arafa et al., 1999** and **Yamamah et al., 2015)**.

Moreover, researchers from surrounding countries also reported higher frequencies of RE among primary school children than the recent study. Their results varied from 13.7% to 64.4% **(Al Wadaani et al., 2013**, **Aldebasi, 2014** and **Mahjoob et al., 2016)**.

On the other hand, several studies from different countries reported prevalence of refractive errors in rural areas to vary from 2.9% to 3.4% among children between 5-15 years old. These reports had shown much lower values than the current study **(Padhye et al., 2009**, **Pokharel et al., 2000** and **Fotouhi et al., 2007)**.

The wide differences of reported frequencies of refractive errors among different studies could be related to; variations of sample size, geographical distribution, ethnicity and age of the screened population. Also increased prevalence of RE in rural regions could be attributed to the prompt development of those areas with increase indoor on the expense of outdoor activities that results in eye strain.

In the present study 249 of the targeted students could not be screened because of absence or refusal of screening indicating response rate of 96.2%. The majority of former studies reported response rates that varied from 92.3% to 97.8% **(Dandona et al., 2002**, **Rezvan et al., 2012**, **Yared et al., 2012**, **Al Wadaani et al., 2013**, **Sewunet et al., 2014** and **Ezinne and Mashige, 2018)**.

In the current study astigmatism was found to be the most prevalent type of RE among the whole examined children followed by myopia and hypermetropia. Similar results were obtained by **Goh et al.,** in Gombak District, Malaysia and Dandona et al in Mahabubnagar

district in the southern India **(Dandona et al., 2002** and **Goh et al., 2005)**.

Different results were obtained by Rezvan et al from Northeastern Iran and **Khoshhal et al.,** in their meta-analysis where they found astigmatism to prevail followed by hypermetropia and myopia in the Middle East region **(Rezvan et al., 2012** and **Khoshhal, 2020)**.

On the other hand, several researchers found myopia to be the most common error of refraction followed by astigmatim and finally hypermetropia **(Pi et al., 2010**, **Mehari and Yimer, 2013**, **Sewunet et al., 2014**, **Alrasheed et al., 2016** and **Ezinne and Mashige, 2018)**. Padhye et al also reported the prevalence of myopia, hypermetropia and astigmatism to be 1.45%, 0.39% and 0.21% respectively **(Padhye et al 2009)**.

The recent study failed to confirm the sex prevalence of refractive errors with no significant differences between both sexes. This was in contrast to the findings of many investigators as most of them reported increase prevalence of refractive errors particularly myopia among females compared to male students of the same age group **(Dandona et al., 2002**, **Goh et al., 2005**, **Al Wadaani et al., 2013** and **Sewunet et al., 2014)**.

On contrary, an exceptional report suggested preponderance of refractive errors among male compared to females schoolchildren **(Norouzirad et al., 2015)**.

In the present study myopia represented 5.1% of total population and 62% of students with RE with low myopia was the most common subtype (4.5%). Many other researchers supported these results **(Yared et al., 2012**, **Mehari and Yimer, 2013**, **Mohamed et al., 2014**, **Rashad et al., 2018** and **Ezinne and Mashige, 2018)**.

Hypermetropia represented 2.5% of total population and 30% of refractive errors. Unlike myopia, hypermetropia was more common in younger children (≤ 8 year old). This was in agreement with several reports and could be explained by the tendency of eye to become more myopic with the age (emmetropization) **(Fotouhi et al., 2007**, **Casson et al., 2012** and **Elmajri, 2017)**.

Schoolchildren from Aswan governorate showed uppermost frequencies of all types of refractive errors. This may be due to ethnic or genetic factors as variety of populations living there are mainly of Africans and Nubian

ethnicity. Also the higher prevalence of RE should lead to increase awareness about importance of detection and management of that problem in this community.

Astigmatism was found to be the most common type of RE in the present study representing 5.9% of total population and 72.1% of the entire refractive errors. This finding was in agreement with other investigators **(Hashemi et al., 2014**, **Norouzirad et al., 2015** and **Mittal et al., 2016)**. Compound myopic type was found in 4.3% while compound hyperopic astigmatism was the least represented by 0.9% of total population. Comparable findings were obtained also by several authors **(Mehari and Yimer, 2013, Aldebasi, 2014** and **Yamamah et al., 2015)**.

On the other hand, **Khoshhal et al.,** in their meta-analysis, had considered astigmatism to be insignificant problem in the Middle East compared to other regions of the world **(Khoshhal et al., 2020)**.

Prevalence of anisometropia was found to be 3.8% of total screened population and 46.8% of students having RE while amblyogenic anisometropia represented nearly 3.2% of total children as well as 82.7% of total anisometropia. These results were in agreement with reports from Qassim Province, Saudi Arabia and from Alexandria, Egypt where frequencies of RE were 3.6% and 3.0% respectively **(Aldebasi, 2014** and **Elsahn, 2014)**.

Then again considerably higher frequencies of anisometropia were reported by other researchers considering Egyptian students from Cairo and also from Brazilian school children (61.7% and 13.2% respectively) **(Ferraz et al., 2015** and **Rashad et al., 2018)**.

Amblyopia could be associated more commonly with astigmatism followed by hypermetropia and to less extent with myopia. While patients with myopic anisometropia of 2-3 diopters range could use the less myopic eye for distant vision and the more myopic one for near vision; so amblyopia usually do not develop. While in cases of astigmatic and hyperopic anisometropia unequal accommodation between both eyes could predispose for development of amblyopia **(Tanlamai and Goss, 1979)**.

Among number of limitations, the recent study did not demonstrate the racial distribution of screened students and its effect on the prevalence of RE. Also

there was no screening of schoolchildren in urban areas and no comparison of the results with that of rural areas to study of the effect of urbanization on the prevalence and magnitude of refractive errors.

The current study is considered as one of the largest screening surveys for students in Upper Egypt. The study tried to draw attention to the problem in area that is lacking for proper health services and it is expected to have a great value in planning and management of refractive errors. Early detection and treatment of refractive errors and particularly anisometropia is expected to have a great impact on the prevention and treatment of amblyopia expanding the benefits of screening programs of schoolchildren as in the present study.

The recent study found that the overall prevalence of uncorrected refractive errors among rural schoolchildren in Upper Egypt to be 8.2%. Astigmatism was the most commonly reported type of RE followed by myopia and lastly hypermetropia. The study recommends regular screening for RE between schoolchildren together with education to students, their tutors and guardians about the importance of early management of that problem.

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