

## PREVALENCE OF UNDETECTED REFRACTIVE ERRORS AMONG SCHOOL CHILDREN

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*In Pakistan 11.4% of the blindness is due to uncorrected refractive errors. This study was carried out in two schools of Lahore to find the prevalence of refractive errors among high school children. It was an institution – based, cross sectional study involving the use of structured questionnaire and visual examination of the students. A total of 540 children studying in class 6<sup>th</sup> to 10<sup>th</sup> were examined over a period of two weeks. Vision of all the children was checked. The children with visual acuity less than 6/12 in one or both eyes, underwent objective retinoscopy and subjective refraction. The results revealed that 107 out of 540 (19.8%) of the children had refractive errors. Myopia was the most common refractive error being 43% (46/107) of the total. Astigmatism, both simple as well as mixed / compound was 35.5% (38/107) while hypermetropia was least common i.e. 21.5% (23/107). Strong correlation was found between a positive family history of wearing glasses, watching television closely, close study, studying in dim light and over indulgence in computer or video games. It is recommended that adequate preschool examination of the children be made mandatory and part of the admission policy of all the schools in Pakistan. In addition, there should be periodic examination of the school children at least on annual basis.*

It is estimated that 2.3 billion people worldwide have refractive errors; out of which 1.8 billion have access to adequate eye examination and affordable corrections leaving behind 500 million people, mostly in developing countries with uncorrected error causing either blindness or impaired vision.<sup>1</sup>

The World Health Organization has launched the Global Initiative Vision 2020 in 1999 with the slogan “*The Right to sight*,” that has five priority areas. They have been chosen on the basis of the burden of blindness they represent and the feasibility and affordability of interventions to prevent and treat them. It includes refractive errors although other major causes of blindness like glaucoma and diabetic retinopathy are not included.<sup>2</sup> Refractive errors are usually present in the childhood and continue in the adult life.<sup>3-6</sup> Unfortunately, they are not given much importance in our society which is evident from the fact that there is no effective system of pre-school visual examination of children either in the government sector or in the private sector.

In Pakistan 11.4% of the blindness is due to uncorrected refractive errors including that is caused by aphakia (natural lens extraction during cataract surgery).<sup>7</sup> Efficient pre-school and regular school health services are available in developed countries and the job of detecting (and managing) refractive errors lies mainly on the school health personnel as well as the optometrist. Even in the presence of such efficient school health services

these developed countries are now taking help from community health workers and teachers for the early detection of visual disorders in school children.<sup>8-10</sup> We do not have such regular and efficient school health services in our country. So we can-not at present, utilize school health personnel or the optometrists. However, it is heartening to note that some of the developing countries, including Pakistan<sup>11,12</sup> are now training teachers to screen the children regarding the presence or otherwise of defective vision.

The refractive errors have been associated with certain other factors as well e.g. a positive history of wearing glasses in the family,<sup>13-15</sup> close work or near activity such as prolonged study hours, watching computers / television etc.<sup>16,17</sup> Some studies also indicate genetic causes.<sup>18,19</sup> Still some suspect an interplay between genetics and environmental factors described above.<sup>20</sup> The problem has been recognized as a public health problem<sup>22</sup> in many countries as well as the World Health Organization in its Vision 2020 initiative. It is high time that we too recognize the situation as worthy of investment for the future generations. This study was conducted to determine the prevalence of undetected refractive errors among students of a government and a private high schools. Another objective was to determine any factors associated with the occurrence of these refractive errors such as family history, prolonged near work, etc.

## MATERIALS AND METHODS

It was cross sectional study conducted in Lahore city. Study population consisted of high school students studying from class 6<sup>th</sup> to class 10<sup>th</sup> in a government high school and a private school. A total of 540 students of both schools (270 from each) were included in the study. Sample size was calculated from Stat\_calc utility of the Epi Info software, version 3.2, based upon the following assumptions: Population size of 1612, confidence interval 95%, expected frequency to be 20%.

### Inclusion criteria

All the students from class 6<sup>th</sup> to 10<sup>th</sup> in the selected schools.

### Exclusion criteria

Students studying below 6<sup>th</sup> class and those already using glasses regularly were excluded from the study. However, any student who was prescribed glasses but had not used them regularly was not excluded. Sample of the students was taken according to simple random sampling technique.

Each school was screened for one week (six working days) in which the students were examined by assessing visual acuity from a Standard Snellen Chart. Those having visual acuity less than 6/12 in one or both eyes were tested for the presence or otherwise of a refractive error by pinhole test. Those showing improvement with pinhole (indicating refractive error) were then subjected to retinoscopy and subjective refraction. Automated and cycloplegic refraction, where needed, were carried out at the Ophthalmology Department of Mian Munshi District Head Quarter Hospital, Lahore.

The particulars of each student were filled on a structured questionnaire specially designed for the purpose. The data received from this questionnaire was fed to computer using the Epi Info 3.2.2 Software and further information and results compiled in the light of this data.

## RESULTS

### Demographic Profile

It was observed that only 3.3% of the children of high schools are more than 15 years of age. The majority of the children belong to age group 12-14. This constitutes 66% of the group. It is this vulnerable group that is faced with the impending perils of undetected reduction in vision resulting in reduction of working capacity and in certain cases leading to blindness or visual impairment which can well be avoided.

In our study the results are significantly different between the two types as refractive errors

occur more in private schools as compared to government schools ( $p < 0.05$ ).

Table 1: *Distribution of school children according to age.*

Age	Frequency	Percentage
11	91	16.9%
12	118	21.9%
13	130	24.1%
14	110	20.4%
15	73	13.5%
16	18	3.3%
Total	540	100.0%

Mean Age 13.01 years  
Standard deviation  $\pm 1.39$

Table 2: *School wise distribution of refractive errors.*

School	Refractive error		Total
	Present	Absent	
Government	44	226	270
Private	63	207	270
	107	433	540

Chi 2 ( $X^2$ ) = 4.21                      d.f. = 1                       $p < 0.05$

### Risk factor exposure associated profile

The table 3 shows that 61 out of 107 students who have refractive errors have a positive history of wearing glasses in their families and indicates a very strong relationship between refractive errors and heredity or familial factors. This above table indicates very strong relationship between watching television closely (i.e. less than 10 feet for a standard 21" TV) and refractive errors. However it must be clearly understood that proper sequence of events has to be established by further studies whether this is a cause or an effect.

Table 3: *Correlation between family history and refractive errors.*

Family History		Ref. error	No ref. error
	Positive	61	150
	Negative	46	283
	Total	107	433

Chi 2 ( $X^2$ ) = 18.03                      d.f. = 1                       $p = 0.00002$ .

There is evidence in literature of strong relationship between short distance TV watching and

the development of refractive errors e.g. Singapore-China Study by Tan et al.<sup>17</sup>

Table 4: Association with closely watching television.

Working TV closely		Ref. error	No ref. error
	For 1-5+ Years	19	5
	None to less than 1 Year	88	428
	Total	107	433

Chi 2 (X<sup>2</sup>) = 55.69      d.f. = 1      p = 0.0000

There is a significant statistical difference between little or no computer or video game use (none to < 1 year) and prolonged use thereafter it (1-5 years or more). This is in accordance with other studies e.g. the study by Seet et al in Singapore.<sup>21</sup> This could be called not a direct factor but an intermediate factor attributed to changing "environmental conditions" & having higher education, near work-related occupations involving computers etc and greatly increased family income (table 5).

Table 5: Prolonged indulgence in computer/ video games.

Playing Computer/ Video Games		Ref. error	No Ref. error
	1-5+ Years	17	21
	None to Less than 1 Year	90	412
	Total	107	433

Chi 2 (X<sup>2</sup>) = 15.98      d.f. = 1      p = 0.00006

There appears to be a very strong relationship between close study and refractive errors. For our purposes we have defined a cut off point of 12 inches as minimum distance for reading (Table 6). The table shows that there is strong correlation between studying in dim and night light and refractive errors.

#### Presentation profile

The table shows that more than 85% (91/107) of the refractive errors present with mild to moderate decrease in visual acuity (6/12 to 6/36) which might explain the delay in looking for expert help. The visual acuity of 6/60 or less is represented by only 15% but denotes very high refractive errors and this too, is thought provoking as to why these were left undiagnosed?

Table 6: Association with close study habits (reading books etc. at a distance less than 12").

Close Study	Ref. error	No Ref. error
1-5+ Years	18	6
None to less than 1 year	89	427
Total	107	433

Chi 2 (X<sup>2</sup>) = 48.14      d.f. = 1      p = 0.005

Table 7: Association with studying in dim light (i.e. less than 100 watts ambient light).

Study in Dim Light	Ref. error	No Ref. error
1-5+ Years	3	1
None to less than 1 year	104	432
Total	107	433

Chi 2 (X<sup>2</sup>) = 7.72      d.f. = 1      p = 0.005

Table 8: Uncorrected visual acuity. Right Eye.

Visual Acuity	Frequency	Percent
Severe decrease (<6/60)	19	3.4%
Moderate decrease (6/24-6/36)	18	3.3%
Mild decrease (6/12-6/18)	70	13.2%
Normal to borderline (6/6-6/9)	433	80.1%
Total	540	100.0%

#### Final Outcome (Correction) profile

There were 46/107 (43%) students who had myopia. Hence it was the most common refractive error followed by astigmatism (both simple as well as compound / mixed) which was 38/107 (36%). Hypermetropia was the least common being 21.5% of the total (23/107).

#### Left Eye.

Visual Acuity	Frequency	Percent
Severe decrease (<6/60)	16	3.0%
Moderate decrease (6/24-6/36)	24	4.4%
Mild decrease (6/12-6/18)	67	12.4%
Normal to borderline (6/6-6/9)	433	80.1%
Total	540	100.0%

Table 9: Proportions of types of refractive errors.

Type of Correction	Frequency	Percent
Myopic	46	43%
Hypermetropic	23	21.5%
Simple Astigmatic	23	21.5%
Mixed/Comp. Astigmatic	15	14.0%
Total	107	100.0%

The table shows that myopia was the commonest of all refractive errors i.e. 43% (46/107) being more prevalent in age group 12-15. Astigmatism (simple as well as compound/mixed) was the next commonest, being 36% (38/107) of the total. Hypermetropia is common in age group 11-14 years and is the least common (23/107 or 21%). It is common in younger age groups after which the prevalence starts declining.

Table 10: Refractive errors according to age group.

	11 Yrs	12 Yrs	13 Yrs	14 Yrs	15 Yrs	16 Yrs	Total
Hypermetropia	4	4	7	5	3	0	23
Myopia	4	10	9	12	9	2	46
S. Astigmatism	6	3	9	2	2	1	23
Mixed/Comp. Astigmatism	5	2	3	3	1	1	15
Total	19	19	28	22	15	4	107

The tables 11 show that 44/270 students in the government run school had refractive errors (16.3%) while 63/270 students in the private schools had them. This result is statistically significant ( $p < 0.05$ ). So we can infer that the difference in the result is statistically significant and the prevalence of refractive errors in schools of private sector is higher as compared with those in government sector.

Proportions of different refractive errors show that:

- (i) Myopia is more common among the females i.e.  $(35/82) = 42\%$  as compared to males  $(10/25) = 40\%$ .
- (ii) Hypermetropia is also more common among the females  $(20/82) = 24\%$  as compared with males  $(4/21) = 19\%$ .
- (iii) However astigmatism is more common among the males  $11/25 = 44\%$  as compared with females i.e.  $27/82 = 33\%$ .

All the above variations are not significant statistically. So we can infer that there is no sex predilection for refractive errors.

Table 11: Comparative prevalence of refractive errors (according to school).

Correction	Govt. Girls HS School Dev. Samaj Road	Rehman Model School Sant Nagar
Refractive Error	44	63
Normal	226	207
Total	270	270

Chi 2 = 4.25                      d.f. = 1                       $p < 0.05$

Table 12: Sex wise distribution of refractive errors.

Type of Correction	Female	Male
Hypermetropic	20	4
Myopic	35	10
S. Astigmatic	16	7
Mixed/Comp. Astigmatic	11	4
Total	82	25

#### Proportion of amblyopia

This is manifested by total number of children where full correction was not possible despite ensuring the absence of any discernible organic pathology of the eye. There were a total of 12 out of 107 children with refractive errors (11.2%) in our study where full correction could not be achieved due to amblyopia due to uncorrected refractive errors.

#### DISCUSSION

The Vision 2020 Global Initiative of the World Health Organization aims at early recognition of avoidable causes of blindness and visual disability and its prompt treatment. It has identified uncorrected refractive errors among children as a major area where immediate action is needed. The impact of refractive errors on the individual and on the community cannot be ignored. Refractive errors are the third commonest cause of blindness in Pakistan (11.4%) after cataract (66%) and corneal opacity (12.6%).

School children form a special group because they are most vulnerable to the effects of reduced vision and its impacts on learning capability and educational potential. In addition the management of refractive errors is perhaps the simplest and the most effective eye care that can be provided by involving the community.

The results of a previous study performed in our country (Al-Shifa Eye Hospital, Rawalpindi)<sup>16</sup> shows a prevalence of 4.27% of undetected refractive errors among the school children. With 58.5 million children upto 15 years of age there could be at least 2.5 million children in our country with reduced visual acuity but following the results of the current study, more than 11 million children might be in need of our help.

In this study 107 out of 540 (19.8%) school children had refractive errors. Of these 44 out of 270 were in school children belonging to government school depicting a prevalence of 16.3%, whereas 63 out of 270 (23.33%) were in children belonging to private schools showing a prevalence of 23.33%. The difference in the result is statistically significant regarding the prevalence of refractive errors in schools of government sector as compared with those in private sector.

An unpublished study in Yemen says that prevalence of refractive errors among private students is more, probably due to life style associated with better socioeconomic conditions e.g. television and computer use, close study and chance to get education. However confirmatory information on contributing factors is lacking. There is generally accepted view that attitudes among teachers are different in govt. and private schools. Similarly the socioeconomic status of the students and their parents, their living styles and habits differ a lot and may, theoretically, contribute towards development of refractive errors.

Studies are pointing towards the fact that the prevalence of refractive errors are now linked to increase in academic levels. As an example, the prevalence of refractive errors has increased over the past decades in Singapore as well as Japan. Three studies of population in Singapore showed that prevalence of refractive errors increased with increasing literacy standards (they are the most prevalent in medical students).<sup>12</sup>

Myopia was the most common refractive error in our study, being 43% (46/107) of the total, Astigmatism, both simple as well as mixed/ compound was 35.5% (38/107) while hypermetropia was least common i.e. 21.5% (23/107). This is in accordance with all the studies done so far on this subject, which agree that myopia is indeed the commonest refractive error. This is especially true of Far Eastren nations like Hong Kong, Singapore, Japan etc.

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