



## A STUDY OF RELATIONSHIP BETWEEN PUBERTAL AGE AND VISUAL ACUITY IN SCHOOL CHILDREN IN GHAZIABAD

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**ABSTRACT** **Introduction:** It is a known fact that school children suffer from a variety of eye and visual problems. The most common among them is decreased visual acuity, the most common cause of which is Myopia. Most of these cases develop in the age group of 10 to 14 years. We checked for association between age at puberty and decrease in visual acuity in school children in Ghaziabad. **Material and Methods:** 3293 children of government and private schools in Ghaziabad were studied. Visual acuity was measured by Snellen's chart and age was confirmed as on school records. **Statistical analysis:** Data was entered in to MS Excel and analyzed by STATA 14. Result: There was an increase in prevalence of refractive errors in 10 to 14 years age group as compared to before puberty. However, there was no significant decline of visual acuity in this age group although there was a downward trend in the same. **Discussion:** The present study shows the at age of puberty i.e. 10 to 14 years in schoolchildren there is increase in prevalence of refractive errors most probably due to effect of growth hormone on the eye development. **Conclusion:** Screening of schoolchildren of age 10 to 14 years is recommended by an optometrist and spectacles should be prescribed to improve their quality of life.

**KEYWORDS :** Puberty, Visual Acuity, Refractive errors, School children

### INTRODUCTION

Visual acuity (VA) is the ability of an observer to perceive detail and contrast in an image<sup>1</sup>. VA depends on the refractive ability of the eye which is determined by two parameters mainly the axial length (AL) and spherical equivalent (SE) of the eye. VA is the most widely used parameter to measure visual function in the clinic<sup>2</sup>. Visual acuity tests provide information which can be used to diagnose refractive error or pathology in the visual pathway. Correct visual acuity is correlated with increased quality of life like proper mobility, ability to understand and see the blackboard in class especially in case of children<sup>3</sup>. The measurement of visual acuity in children is used as a screening tool for the detection of amblyopia or the development of refractive error<sup>4,5</sup>. Amblyopia is a common developmental disorder of nervous system which requires early intervention and treatment to prevent loss of acuity and loss of binocular vision in the eye<sup>6,7</sup>. Among the causes of decreased visual acuity in children and young adults, the most common cause is myopia<sup>8</sup>. There is a trend of early age of onset and an increase in prevalence of myopia in East Asia<sup>9</sup>. A 13% prevalence of myopia has been seen in school children in India<sup>10</sup> which shows that there is an increase in prevalence of myopia in India<sup>11</sup>. In a prospective longitudinal study of school children in Delhi, the annual incidence of myopia was found to be 3.4% with progression of myopia in 49.2% cases<sup>12</sup>.

Various conditions have been associated with increase in the incidence of myopia including competitive educational environment, long study hours, watching television, smartphone or tablet screens, increased indoor time like playing video games and decreased outdoor activity like playing outside in the playground<sup>13,14,15,16</sup>. More than 6 hours of reading or writing per day and more than 4 hours of playing video games per week has been shown to be associated with progression of myopia<sup>12</sup>. More than 2 hours spent outdoors has been shown to be protective against progression of myopia<sup>12,17</sup>. The incidence of myopia was more in younger age group, especially it increased by 8 to 9 years of age and remained at a higher level till 12 years with girls being at higher risk than boys most probably due to more indoor time, near work and early introduction in urban schools in India<sup>12</sup>.

In studies done school children in Pune, the prevalence of errors of refraction was found to be 21.2% with predominant cases being that of myopia with no statistically significant difference between boys and girls<sup>13</sup>. In another study among school children of age 5 to 16 years in Dehradun, the prevalence of refractive error was 13% with most common cause being myopia whose prevalence was also found to increase with age<sup>19</sup>. In a study conducted on Singapore school children of age 6 to 14 years divided in to early and late puberty according to

peak velocity and Tanner staging, it was shown that the age of onset of myopia was associated with early peak height velocity in both boys and girls. It was also seen that myopia progression was also more that myopia progression was also more in both genders who had peak height velocity. The study concluded that the onset of myopia and progression of myopia may be associated with spurts in height in both genders<sup>20</sup>. The age at which peak height velocity was achieved was earlier in girls (11 years) as compared to boys (12 years). These results indicate that there is a correlation between onset of puberty and change in height and axial length and spherical equivalent of the eye<sup>20,21,22</sup>.

According to studies in Indian school children, in a sample of 2010 school girls across Delhi aged 6 to 17 years, the age of puberty was estimated to be 12.2 to 12.5 years of age<sup>23</sup>. In a similar study in 1306 school boys aged 6 to 17 years, the age of puberty was estimated to be 13.3 to 14 years of age<sup>24</sup>.

Based on these studies, it is clear that there is an association between pubertal age and onset and progression of myopia. With these findings Refractive error was found to be the main cause of visual impairment in school going children in a rural population of southern India with unilateral or bilateral myopia prevalence of 4.1%<sup>10</sup>. A similar study in an urban population in northern India showed myopia to be present in 7.4% of the school going children<sup>11</sup>. In mind, our objective was to study whether there was a change in visual acuity in the pubertal age group in both genders when compared to pre-puberty and post-puberty age group of school children.

### METHODS

A cross-sectional study was conducted by the Santosh Medical College and Hospital, Ghaziabad. Ethical approval was taken from the research committee of the institution before starting the study. The study was conducted in seven schools which included both government and private schools of Ghaziabad, UP. The schools were selected using random sampling technique. 3293 children of both sexes aged 3 to 20 years were randomly selected for the study. The administrative staff in the selected school were contacted and objectives of the study explained. A letter was sent to every parent explaining the procedure and seeking permission to evaluate the child. The age of 10 to 14 years was taken as pubertal age group, 3 to 9 years as pre-pubertal age group and 15 to 20 years as post-pubertal age group for children of both genders.

**Inclusion criteria:** School going children in age group 3 to 20 years and present on the day of the study for whom parental consent was

available.

**Exclusion criteria:** The students who were absent on the day of study and could not be contacted by the teacher or students for whom parental consent was not available.

**Anthropometric parameters:** Age was taken as completed years on school records. Visual acuity was measured using Snellen's chart by an optometrist. Visual acuity noted as a fraction was finally denoted as a number e.g. 6/6 was noted as 1 and 6/12 as 0.5<sup>25</sup>. Children with visual acuity of 1 were said to have normal acuity while less than 1 were said to have impaired visual acuity. Children with visual acuity of 6/9 and less were classified as refractive error.

**STATISTICAL ANALYSIS**

Data which was collected was entered in MS Excel and it was analyzed for statistical significance by STATA 14 software, StataCorp, Texas, USA. One-way ANOVA was used to test for change in visual acuity across the three groups i.e. pre-pubertal, pubertal and post-pubertal.

**RESULT**

A total of 3293 school children of age group 3 to 20 years were screened for this study. In the study population, 610 students were girls and 2690 students were boys. 1167 students belonged to 3 to 9 years of age (pre-pubertal age group). 958 students belonged to 10 to 14 years of age (pubertal age group) and 1168 students belonged to 15 to 20 years of age (post-pubertal age group). The same information is depicted in figure 2 and figure 3 which show the distribution of students according to gender and according to pre-pubertal, pubertal and post-pubertal age group respectively. Table 1 shows the mean visual acuity of both eyes across the three groups in both eyes across the three groups. The mean visual acuity is 0.953 in 3 to 9 years age group which decreases to 0.897 in the 10 to 14 years age group which further shows a decreasing trend in the 15 to 20 years age group with a mean value of 0.875. The same information has been plotted in the form of a histogram in Figure 1.

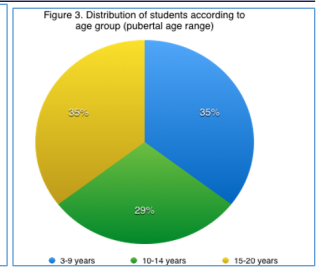
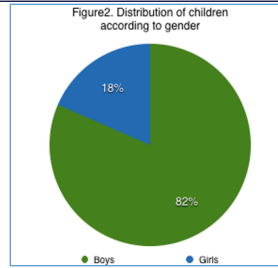
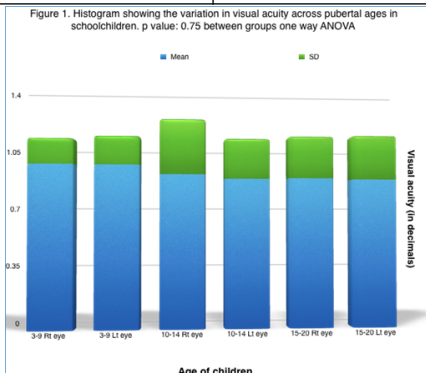
Figure 1 shows the change in visual acuity in the right and left eye across the three age groups. The values of visual acuity were compared across these three age groups for both eyes by one-way ANOVA which showed no significant difference between these groups. However, there was a decreasing trend during puberty and post-puberty when compared to pre-puberty group. The percentage of children with refractive errors was calculated in each group and found to be 21%, 24% and 23% for 3-9 years, 10-14 years and 15-20 years respectively. Table 2 depicts the same information.

**Table 1. Visual acuity in different age groups in both eyes among schoolchildren of both genders.**

Age group	No of children	Visual acuity Mean	Visual acuity SD
3-9 Right eye	1167	0.9538	0.1466
3-9 Left eye	1167	0.9512	0.1647
10-14 Right eye	958	0.8970	0.3187
10-14 Left eye	958	0.8718	0.2322
15-20 Right eye	1168	0.8765	0.2439
15-20 Left eye	1168	0.8705	0.2566

**Table 2. Prevalence of refractive error in different age groups among children.**

Age group (years)	Refractive error(%)
3-9	21
10-14	24
15-20	23



**DISCUSSION**

From the results it can be seen that the majority of students were of male gender 82% in comparison to females 18%. If we look at the distribution of students according to their age group in to pre-pubertal, pubertal and post-pubertal age school children, we can see that pubertal age school children are 30% of the total while pre-puberty and post-puberty are 35% each. This shows that our study population had less children in pubertal age group of 10 to 14 years. This finding is similar to our earlier study<sup>25</sup> in which 1000 school children were studied and the age group of 11 to 14 years had less number as compared to 15 to 20 years. In our study, we found a higher percentage of children who had refractive errors (myopia) in the pubertal age group of 10 to 14 years i.e.24% when compared to before puberty 21%. This shows that there is new onset of refractive errors during puberty which is similar to the other studies where the prevalence of myopia was higher in girls as compared to boys in the age group of 11 to 14 years<sup>26</sup>. In another study, there was an increase in peak axial length velocity and spherical equivalent of eye among girls in 6 to 14 years of age which was not statistically significant<sup>20</sup>.

It has been shown in a rat model that growth hormone administration leads to a significant increase in axial length of eye and onset and progression of myopia<sup>27</sup>, thus, it is possible that hormonal changes of puberty, most notably, increased growth hormone secretion is associated with increased prevalence of myopia in pubertal age group as compared to pre-pubertal age group. This hypothesis has also been tested and proved by other authors also<sup>20,27,28</sup>.

Finally, we decided to see whether there was a difference in mean visual acuity of both eyes between the three groups. There was no statistically significant difference between these groups but there was a decreasing trend in the pubertal age group as compared to pre-pubertal group. The reason for no significant difference may be because of the heterogeneous study population comprising of students of both genders and different socioeconomic status.

**CONCLUSION**

Puberty influences the refractive properties of the eye and leads to the onset of refractive errors in school children during this period. We recommend screening for all children between the ages of 10 to 14 years in the school itself by a trained optometrist and prescribing spectacles to the newly diagnosed children. This is to improve the quality of their life and education.

**LIMITATIONS OF THE STUDY**

The study population was very large and hence needed to be divided in to more homogenous groups according to gender, socioeconomic status, nutritional status for comparing the visual acuity between the various groups. Tanner staging would have been helpful in confirming the onset of puberty in the pubertal age group.

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