

# Prevalence of Persistent Refractive Amblyopia amongst School-Children in North India: A Population-Based Observational Study of Childhood Visual Deficit and Its Correlation with Heterophoria & NPC

Kamal Pant<sup>1</sup>, Salal Khan<sup>2</sup>, Rajat Bansal<sup>3</sup>

<sup>1</sup>Associate Professor & HOD; <sup>2,3</sup>Optometry Scholar,  
Department of Optometry, UP University of Medical Sciences, Saifai.

Corresponding Author: Kamal Pant

## ABSTRACT

**Aim:** The aim and purpose of this population-based cross-sectional study was to determine the prevalence of persistent refractive Amblyopia and its correlation with heterophoria as well as NPC (Near point of convergence) in school-children in Etawah, UP.

**Material & Methods:** This population-based cross-sectional study was conducted in the govt. schools during July to December, 2019. Total 2966 subjects were enrolled by exhaustive-stratified sampling procedure to represent the underlying population. All were subjected to eye examination (Monocular LogMAR visual acuity, objective & subjective refraction, cover test, PBCT & NPC) and the responses/ data were recorded & evaluated with the Pearson Chi-square test in IBM SPSS version 21, to know the prevalence and the major cause of Amblyopia their correlation with Heterophoria & NPC in those subjects.

**Results:** Out of 2966 subjects (Males=1594 & Females=1372), 36 subject, (1.21%) were having amblyopia. The common symptoms including headache, watery eyes, itching, and redness of eyes were observed. Commonly experienced symptoms (statistically significant with the Pearson Chi-square test in IBM SPSS version 21) amongst amblyopes (in order of prevalence) were Headache (100%,  $p<0.05$ ), Watery eyes (83.3%,  $p<0.05$ ), Itching (41.6%,  $p<0.05$ ), Redness (5.5%,  $p<0.05$ ). Statistically highly significant ( $p<0.05$ ) correlation was

found between amblyopia & Heterophoria as well as NPC with the BCVA.

**Conclusion:** Amblyopia prevalence persisting beyond traditional treatment ages was significantly higher amongst school-children. Early detection of the cases of amblyopia by the eye screening at the time of admission in the school with the help of optometrists may prevent the bad consequences.

**Key words-** Persistent amblyopia, Amblyogenic factors, Visual impairment, Occlusion, Vision screening.

## INTRODUCTION

Amblyopia is a condition that permanently affects the vision if not treated early and it could later affect the health and quality of life of the child. The decline of visual acuity at an early age can be easily treated, but if left untreated, it can lead to an amblyopia.<sup>1</sup> Amblyopia has been defined as a “decrease of visual acuity for which no causes can be detected by the physical examination of the eye, caused by vision deprivation or abnormal binocular interaction” (Von Noorden 1996). It can occur from 4 months until 8 years of age.<sup>2</sup> If not treated before the development of central vision, the efficacy of treatment is poor after 8 years of age.<sup>3,4</sup> Before the age of 8 years, there is a potential to improve vision so it is essential to intervene

timely.<sup>5,6,7</sup> Amblyopia is commonly a monocular condition, but it can also be binocular.<sup>8</sup>

Amblyopia can impact quality of life because of its effect on patients, ability to perform sports and physical activities, social activities and their career of choice.<sup>9,10</sup>

It can happen due to variety of factors: strabismic (ocular misalignment), anisometropic (a significant difference in refractive error between fellow eyes), form deprivation (exclusion of all visual information except light due to physical obstructions such as corneal/lenticular opacification or eyelid ptosis), significant uncorrected refractive error (high levels of astigmatism or hypermetropia), or a combination of these features.<sup>11, 12</sup>

Amblyopia is an important cause of non-correctable (when not treated timely) unilateral visual impairment in industrialised countries.<sup>13</sup> Early detection of the amblyogenic risk factors and institution of the well tolerated as well as highly effective treatment options<sup>14,15,16</sup> within the sensitive period of development can result in proper recovery and attainment of the normal visual acuity. The detection of amblyopia and associated risk factors therefore depends on parental self-referral and high degree of suspicion by primary healthcare providers.

Amblyopia often referred to as 'lazy eye' results from anomalous visual experience during the critical period of visual development in the early years of childhood and may affect multiple aspects of visual function.<sup>8,17,18</sup> Untreated amblyopia does not self-rectify,<sup>19</sup> and it impacts reading skills<sup>20</sup> and significantly increases the risk of severe visual impairment of both eyes in later life<sup>21</sup>.

The severity and the type of amblyopia will largely govern the kind of treatment modality to be followed. The standard treatment options are glasses to correct refractive errors (near-sightedness or far-sightedness, astigmatism) and eye patching (occlusion therapy) ranging from 1hour (part time) to full time occlusion.<sup>22, 23</sup>

The sound eye is covered with an eye patch to encourage the weaker eye to work harder to improve visual acuity. The success rate of patching depends mainly and maximally on compliance; the reported rates of compliance range widely from 49% to 87%.<sup>24, 25</sup> Occlusion can be instituted through drug therapy also, eye drops containing atropine or a similar drug are used to temporally blur vision in the good eye. They relax the muscles in the eye so that the lens will not focus for a few hours.<sup>26,27</sup>

The amblyopic treatment challenges involve the parents, when the parents are uncertain about the benefits of the treatment, unaware about the process or cause of amblyopia and are under stress or have relationship pressure.<sup>28</sup> So, the parents understanding of amblyopia and its impact on their children's well-being is very much crucial.<sup>29-32</sup>

The purpose of this study was to report and compare the prevalence and symptoms of persistent refractive amblyopia post-traditional treatment age (8 years).<sup>19,33,34</sup> and its correlation with Heterophoria as well as NPC in school-children.

## **MATERIAL & METHODS**

This cross-sectional population-based study was conducted in the Govt. Schools of the Etawah district of Uttar Pradesh, during July to December, 2019. Total 2966 subjects were enrolled by exhaustive-stratified sampling procedure to represent the underlying population. School children were clinically examined and screening in their school premises during school hours and taking their written informed consent.

Examination Protocol followed-

1. Distance monocular crowded logMAR unaided and aided (if applicable) visual acuities as well as with and without a pinhole were recorded.
2. Ocular alignment was assessed with use of Cover-uncover, Alternate cover test and Prism Bar Cover Test (PBCT) using

an accommodative target with and without spectacle correction (if applicable) at distance (3m) and at near (40cm).

3. NPC (Near point of convergence) was recorded with the help of RAF ruler.
4. Cycloplegic/ dry Retinoscopy was done followed by subjective refraction to achieve the BCVA.
5. Class Teacher/ Parents completed child's detailed history of any eye surgery, occlusion therapy and spectacle wear.
6. Follow-up subsequent to the examination, teachers and all parents of the concerned children received a detailed report advising them of clinical findings and the requirement of any further management at higher level.

The responses /data were recorded & statistically evaluated with the Pearson Chi-square test in IBM SPSS version 21, to know the prevalence and the major cause of Amblyopia.

Definitions of Persistent amblyopia:

1. Multiethnic paediatric eye disease study (MEPEDS) definition: Unilateral amblyopia;  $\geq 2$  line interocular difference in visual acuity, measured through a pinhole, with BCVA of 0.2 logMAR (6/9.5 Snellen, 20/32) or poorer in the worse eye in the presence of a unilateral amblyogenic factor consistent with the affected eye. Amblyogenic factors included strabismus at a distance and near fixation with/without spectacle correction, a history of strabismus surgery, anisometropia ( $\geq 1.00D$  difference in hyperopia,  $\geq 3.00D$  difference in myopia,  $\geq 1.50D$  difference in astigmatism in any meridian). Bilateral amblyopia; BCVA poorer than 0.3logMAR (Snellen, 20/40) in both eyes in the presence of a bilateral amblyogenic factor.<sup>35</sup>
2. Refractive error study in children (RESC) definition: Amblyopia was defined as BCVA (measured through a pinhole)  $\geq 0.3\log\text{MAR}$  ( $\leq 20/40$  Snellen) in at least one eye associated with one or more of the following potential causes: 1. esotropia,

exotropia or vertical tropia at 4m fixation, or esotropia or vertical tropia at 0.5m (strabismic amblyopia); 2. Anisometropia of  $\geq 2D$  spherical equivalent refractive error (SER) (Anisometropic amblyopia); or 3. Hyperopia of  $\geq 6D$  SER. Unilateral amblyopia: If only one eye met the criteria. Bilateral amblyopia: If both eyes met the criteria separately.<sup>36</sup>

Children with history of amblyopia treatment were not categorised as having persistent amblyopia unless they met definition-1 or definition-2. To examine the magnitude of amblyopic visual acuity deficits, based on the BCVA in the amblyopic eye, severe amblyopia was defined as BCVA  $> 0.6\log\text{MAR}$ .<sup>37</sup>

## RESULTS

Out of total 2966 subjects (Males=1594 & Females=1372), 36 subjects, 1.21% (males-13, 36.2%; females-23, 63.8%) were found to have Amblyopia and remaining 2930 (98.79%) were non-amblyopic. The common symptoms including headache, watery eyes, itching, and redness of eyes were observed. The age group of 9-22 years were having the most number of amblyopes. Most commonly experienced amblyogenic factors in female (23) than the male (13), had a significantly amblyopia prevalence ( $p < 0.05$ ). Commonly experienced symptoms (statistically significant with the Pearson Chi-square test in IBM SPSS version 21) amongst amblyopes (in order of prevalence) were Headache (100%,  $p < 0.05$ ), Watery eyes (83.3%,  $p < 0.05$ ), Itching (41.6%,  $p < 0.05$ ), Redness (5.5%,  $p < 0.05$ ). It was evaluated amongst vision impaired amblyopic children using criteria of pinhole acuity 0.2logMAR (6/9.5 Snellen) plus an amblyogenic factor. Statistically, highly significant ( $p < 0.05$ ) correlation was found between amblyopia & Heterophoria as well as NPC with the BCVA.

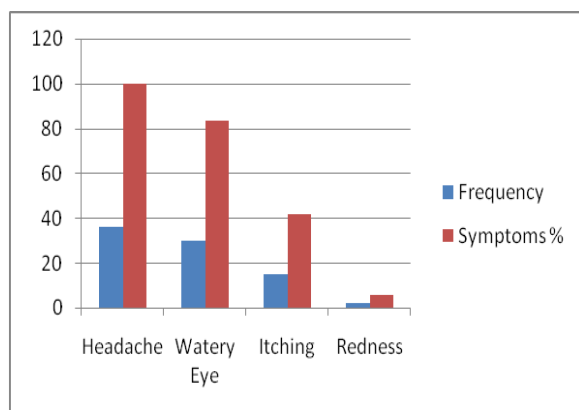


Figure- 1 Amblyopia Frequency and Symptoms

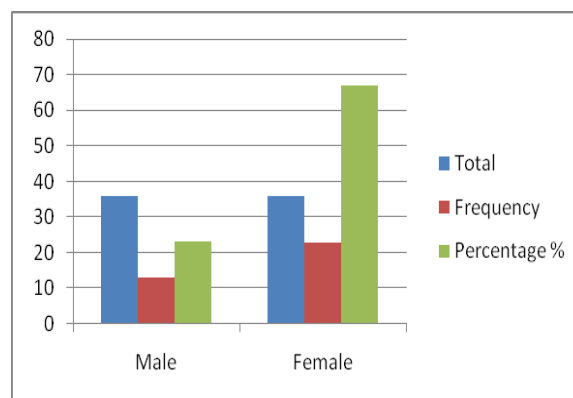


Figure- 2 Amblyopia Frequency (%)

## DISCUSSION

Present Study	Study by-Harrington S, et al. <sup>38</sup>	Study by-Zhu H, et al. <sup>40</sup>
1. Cross-sectional study (Etawah, July-December 2019).	Cross-sectional study (Ireland, UK January-April 2019).	Cohort-study (South-west China, June-July 2018).
2. Total 2966 subjects. (36-Amblyopic)	Total 1621 subjects. (47-Amblyopic)	Total 3050 subjects. (25-Amblyopic)
3. Observed symptoms were Headache (10%), Watery eyes (83.3%), Itching (41.6%), Redness (5.5%).	These aspects were not considered, Only type of Amblyopia was studied.	These aspects were not considered. Only type of Amblyopia was studied.
4. Those suffered from weak NPC as well as phoria were mainly present.	The aspects such as NPC and phoria not included.	The aspects such as NPC and phoria not included.
5. Data analysis was performed using SPSS version 21.	Analysis was performed using SPSS version 24.0.	Data analysis was done using statistical tools SPSS statistics version 13.

Quite similar results of prevalence of amblyopia were observed in all these studies regardless of the area and place of study. The minor differences resulted probably due to different definitions of the amblyopia and cut off criteria employed in all these studies. The present study was very specific in nature where the comparison was done of the visual deficit with the heterophoria and NPC.

### Limitations:

1. Amblyopic patient was defined only on the basis of pinhole criteria by MEPEDS and RESC definition.
2. Not possible to show all the amblyogenic factors and true prevalence of amblyopia as the exhaustive sampling was confined to a very small area.
3. Time frame has limited the sample size as it is not the true representation of the geographical area (Need to do the sampling from all area of the district). Also, not all students were exactly residing in the same place where school is located.

## CONCLUSION

Amblyopia prevalence persisting beyond traditional treatment ages was significantly higher amongst school-children. Uncorrected refractive error, compliance with spectacle wear and socioeconomic disadvantage were important contributing factors of Amblyopia. Children without obvious visible eye defects were less likely to access eye care, resulting in missed opportunities for intervention where necessary. So, the early detection of the cases of amblyopia by the eye screening at the time of admission in the school with the help of optometrists/ Eye care professionals will certainly prevent the bad consequences of this disorder.

This study is the first to report amblyopia prevalence in District of Etawah, Uttar Pradesh. Further research is needed to explore the possible causes of amblyopia and to create awareness about the amblyopia as well as about the protection and prevention of eyes from such types of visual deficit amongst the students, teachers and parents.

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