EVALUATION OF READING SCORE IN CHILDREN HAVING DIFFERENT TYPES OF AMBLYOPIA

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ABSTRACT

PURPOSE: *To evaluate reading score words per minute in amblyopic children with the continuous-text reading-acuity test MNREAD.*

METHOD: *Thirty-one participants with amblyopia (age range from 8-years to 6-years) were included in the study. Visual acuity, stereopsis, fusion, and angle of deviation of all children were assessed. MNREAD chart was used to assess binocular reading speed (wpm) in amblyopic children. Pearson chi-square was used to test the significance of results.*

RESULTS: *Out of 31 children with amblyopia, 58.1% were male. Anisometropic amblyopia was identified in 32.2% while 67.7% had strabismic amblyopia. Participants were further grouped according to the severity of amblyopia i.e., mild amblyopia found in 19.4% participants, moderate amblyopia was present in 35.5% while 45.2% had severe amblyopia. Most of the participants (87.1%) had no stereopsis. More than half of the participants (54.8%) had manifest deviation, 19.4% had latent, while 25.8% were orthophoric respectively. Suppression in amblyopic eye was noted at 33cm and 6m in 41.9% and 61.3% participants respectively. The minimum recorded reading speed was 24.00 wpm while maximum recorded reading speed was 88.00 wpm. A significant correlation (p=0.014) was found between severity of amblyopia and reading score (wpm). There was no correlation found between angle of deviation and reading score (wpm) (p=0.247) while there was a high significant correlation found between type of amblyopia and reading score (wpm) (p<0.01).*

CONCLUSION: *Reading score (wpm) in amblyopic children was moderately negatively correlated with the severity of amblyopia and type of amblyopia. Strabismic amblyopic children read more slowly as compared to anisometropic amblyopic children. Children with severe form of amblyopia had lower reading speed as compared to moderate and mild type amblyopic children.*

KEY WORDS: *Reading score, Amblyopia, MNREAD, Children*

INTRODUCTION

Reading is a key task to perform in one's life. Reading difficulty is a significant challenge for many children, especially with bilateral visual impairment and learning disabilities. It is of utmost importance to evaluate reading performance and implement reading programs in school education systems to address if students face reading difficulties in earlier years.[1]Recently, amblyopia, the most common form of monocular visual disability, is considered to have an impact on a child's reading speed. The prevalence of amblyopia among children has been reported to range from 1.1.% to 2.24% in the paediatric age group (5-15 years).[2,3]Amblyopia is an eye condition that not only causes monocular but also binocular vision anomalies such as a decrease in high-contrast visual acuity, contrast sensitivity, depth perception, and driving. It also affects saccadic and pursuit eye movements.[4]Amblyopia influences negatively on fine and gross motor skills, maximum reading speed (MRS), academic as well as professional career, self-esteem, and health-related quality of life issues.[5,6]Hence the psychosocial impact of amblyopia on one's life is undeniable and requires attention to identify its consequences to perform targeted clinical management.

Amblyopia is a visual formative problem that emerges after a specific interruption of visual contribution to one eye early in life. Clinically, unilateral amblyopia is analyzed assuming a child has two or more than two lines of dissension in visual acuity between eyes (0.2 log MAR), even

when amblyogenic factors have been eliminated. Amblyopia commonly occurs between the age of 6 months to 8 years.[7]There are various types of amblyopia i.e strabismic, anisometropic, mixed (aniso-strabismic amblyopia), and stimulus deprivation amblyopia. Strabismic amblyopia is due to misalignment of one eye, and anisometropic amblyopia is caused by the difference in refractive error between eyes, in mixed amblyopia both strabismus and anisometropia are present, while in stimulus deprivation amblyopia the conditions like cataract, the droopy upper eyelid is known as ptosis, opacities of cornea and vitreous obstruction visual stimulus to the visual cortex during the period of visual maturation, thus, causing amblyopia by depriving the visual stimulation to eye.[7,8]

Among various tasks that need refined visual system support, reading is a very difficult task because it requires the decoding of graphemes into phonemes and then the integration of phonemes into words. Visual impairment may make grapheme decoding more difficult which results in slower and/or inaccurate oral reading. In addition, if a visually impaired child directs more attention to recording grapheme, less attention may be directed to the perception, hence, affecting the reading speed.[9]Among other difficulties, the correlation between reading performance and amblyopia is scarcely reported in the literature.[1]Pernicious impact of slow reading on academic performance and learning, which in turn leads to behavioral problems e.g., deterioration of self-esteem in adulthood has already been highlighted in previous studies.[6]

There are multiple tests recommended in literature to determine the impact of vision on reading e.g., The Bailey-Lovie Near Reading Card[10]the Pepper Visual Skills for Reading Test (VSRT)[11]use series of unrelated words, The Cole brander cards,[12]Radner test,[13]and the MNREAD acuity chart[14]use a series of short sentences. However, these tests measure different variables using various types of text samples. We used the MNREAD acuity chart in our study to measure reading difficulties in amblyopic children. The MNREAD acuity chart was introduced to measure reading speed as a function of print size for people with both normal and compromised visual abilities.[14,15,16]The chart is composed of a set of 60- character sentences displayed on three lines. The sentences decrease in size by 0.1 log unit from 1.3 logMAR (equivalent to 20/400 or 6/120 when viewed at 40 cm) to 0.5 logMAR (20/6 or 6/2). The reading speed remains reasonably consistent across a range of large print sizes. With decreasing print size, a critical print size (CPS) is attained after which reading speed is reduced speedily to reach the end point i.e., the smallest print size that can be read and is established as the reading acuity (RA).

It is reported that children with amblyopia read slowly regardless of amblyopia type (ie, strabismic or anisometropic).[17]Determining the impact of amblyopia on reading performance using MNREAD, would be useful to have baseline data from children with monocular visual impairment in our clinical settings to help them perform better in their academic careers. In short, Parents and health professionals jointly can help amblyopic students succeed in their routine academic activities; especially in amblyopic children with learning disabilities. This study is intended to assess binocular reading speed in children with amblyopia to determine their reading performance.

MATERIALS AND METHODS

A proforma-based cross-sectional study was done. Informed consent was first obtained from the parents or guardians of all children who participated in this research. The research protocol was approved by the Ethical Review Board of the College of Ophthalmology and Allied Vision Sciences. All children attended the orthoptic paediatric clinic at Mayo hospital during the study period and, either newly diagnosed or were follow-up cases of anisometropic or strabismic amblyopia with age range between 8-14 years were included in the study. The participants were divided into 2 groups based on the type of amblyopia i.e., anisometropic amblyopia & strabismic amblyopia, and were further sub-grouped according to the severity of amblyopia. We defined amblyopia in terms of visual acuity. i.e., mild (visual acuity of 6/9 to 6/12), moderate (visual acuity worse than 6/12 to 6/36), and severe visual acuity being worse than 6/36. The proforma consists of various tests including age-matched distant and near visual acuity tests. Lang stereo-test was used for testing stereo acuity. Worth four dots test was used for the assessment of sensory fusion. An alternate prim cover test and Krimsky test were used for the measurement of the angle of deviation. we used the Alternate prism cover test (APCT) to measure angle deviation, and, Krimsky test to measure deviation where the vision was poor. MNREAD chart was used for the evaluation of reading scores (wpm) in study participants. Data analysis was done with a statistical package for social sciences (SPSS version 25). Pearson chi-square was used to test the significance of the results.

RESULTS

Out of a total of 31 children included in the study, the majority of them were (61.3%) between 8-10 years of age, while 29.0% were between 11-13 years of age. Fifty-eight percent were male. Anisometropic amblyopiawas identified in 32.2% while 67.7% had strabismic amblyopia. Around nineteen percent of participants (19.4%) had mild amblyopia, 35.5% had moderate amblyopia and 45.2% had severe amblyopia. No stereopsis was found in the majority of participants (87.1%). Out of all the participants, 54.8% had manifest deviation, 19.4% had latent deviation, and 25.8% were orthophoric. The minimum recorded reading speed was 24.00 wpm while the maximum recorded reading speed was 88.00 wpm. Suppression in amblyopic eye noted at 33cm and 6m was41.9% and 61.3% in participants respectively. A significant correlation (p=0.014) was found between the severity of amblyopia and reading score (wpm). There was no correlation found between the angle of deviation and reading score (wpm) (p=2.68) while there was a moderately significant correlation found between the type of amblyopia and reading score (wpm) (p=0.00).

TABLE 1: Reading score of amblyopic children (N=31)

Descriptive study	Minimum	Maximum	Mean	Std. Dev
DVA_RE	0.00	1.00	0.3065	0.289
DVA_LE	0.00	1.00	0.4710	0.349
NVA_RE	0.10	6.30	1.2561	1.400
NVA_LES	0.40	8.0	2.1523	2.425
Reading Score(WPM)	24.00	88.00	54.7419	17.497

The minimum reading speed was 24.00 wpm while the maximum reading speed was 88.00 wpm.

PEARSON CORRELATIONS

- There was a moderately significant negative correlation found between the severity of amblyopia and reading score (r=-.436, p=0.014).
- There was a moderately significant negative correlation found between the severity of amblyopia and reading score (r=-.664, p=0.00)

DISCUSSION

Several studies have reported slower reading speed (wpm) in amblyopia. Kelly et al reported decreased reading performance in amblyopic children under natural, binocular reading conditions due to fixation instability and atypical saccades associated with amblyopia.[17]Calabrese and his coworkers used an MNREAD chart to measure the maximum reading speed (wpm) of normally sighted people from childhood to old age and found that reading speed is age dependent in normally sighted children and reported a steady increase in maximum reading speed from 8 to 16 years (MRS: 140–200 words per minute).[18]Moreover,In a study in which, Gray Oral reading test,(GORT-4) was used to test monocular oral reading performance after amblyopic treatment in children, It is observed that amblyopic eyes have slower reading speed even after patching treatment as compared to the fellow non-amblyopic eye.[19]The result of our study is also consistent with the literature. We also used an MNREAD chart to assess the reading score (wpm) of amblyopic children. The result of our study reveals that the maximum reading scores (wpm) that had been recorded for amblyopic children was 88.00 (wpm) which was below than average reading score of normally sighted similar age-grouped children. It showed that amblyopia has negative impact on the reading ability of children.

Concerning the type of amblyopia on reading performance, studies in amblyopic children reported slower binocular reading in school-age children with strabismic amblyopia.[20,21]Stifter Eet al in their study assessed monocular and binocular reading performance in micro strabismic children, by a standardized test. The result showed that control group children attained a maximum binocular reading speed of 200(wpm).[22]In our cohort no correlation is observed between the angle of deviation or stereopsis with reading score words per minute. However, a highly significant negative correlation exists between the type of amblyopia and reading score wpm ($p<0.01$). Strabismic children read more slowly as compared to anisometropic amblyopic children. Pearson correlation revealed a significant negative correlation between the type of amblyopia and reading score (wpm) ($p<0.05$). In our study participants, a statistically significant correlation ($p=0.014$) is found between the severity of amblyopia and reading score (wpm). It shows that individuals with a severe form of amblyopia read more slowly as compared to mild and moderate forms of amblyopia. Thus, with the increase in the severity of amblyopia, the reading score wpm decreases. Indirect evidence of the visual acuity deficit in amblyopia on fixation instability is reported in the literature. That fixation instability is positively correlated with the severity of amblyopia and is associated with slower reading in adults with macular disease.[23,24]

Previouslyit is reported that, in amblyopic children, the level of stereopsis and fusion was significantly reduced as compared to non-amblyopic children.[25]The level of fusion and stereopsis was evaluated in anisometropic amblyopic children with Lang stereo-test and our results show that most amblyopic children

(87.1%) had no stereopsis. A strong correlation between strabismic amblyopia and interaocular suppression (p=0.01) was being reported in a study done to determine the regional extent of peripheral suppression in amblyopia. In children with strabismic amblyopia, suppression extends were identified beyond central 10°.[26]We used the Worth Four Dot test to assess fusion and suppression in amblyopic children. The result reveals that at 33cm, 41.9% while at 6m, 61.3% had suppression of their amblyopic eye and are in accord with the previously reported findings.

CONCLUSION

It is concluded that reading score (wpm) in amblyopic children is correlated with the type of amblyopia and severity of amblyopia. Strabismic amblyopic children read more slowly as compared to anisometropic amblyopic children. Children with a severe form of amblyopia (visual acuity worse than 6/36 in the amblyopic eye) had lower reading scores as compared to mild and moderate types of amblyopia.

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