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Comparison of Reading Performance with Optical and Electronic Low Vision Devices among Low Vision Children in a Blind School

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ABSTRACT

Aim: To compare the reading performance with various low vision devices among low vision children attending blind school.
Methods: Out of Seventy eight low vision subjects fourteen students with aged eleven to eighteen years who could possibly make out reading with text and Braille were evaluated from three blind schools of Kamrup district, Assam. Cross sectional study design was used to compare reading performance of low vision subjects with both optical and electronic low vision aid devices. After complete eye examination required magnification was calculated for each subject and reading performance was checked with MN reading chart in normal day light illumination by both optical and video magnifier. Obtained data were checked for errors and entered into SPSS (statistical package for the social sciences), version 23.0 statistical software for analysis.
Results: All the subjects improved their vision with the low vision devices. Among these 14 students, seven could read the print and could respond with both type of magnifiers (Optical and electronic). Mean reading speed with optical magnifier was 13.85 (±2.11) words per minute and that with video magnifier was 25.57 (±3.59) words per minute. Reading speed with video magnifier was found to be statistically increased than optical magnifier with a mean difference of 11.71 words ($p<0.001$)
Conclusion: The majority of the students showed evidence of remarkable improvement in reading performance with electronic visual aids (Video magnifier) than the optical visual aids. The size of the print was well above the threshold to achieve maximum reading rate.

Keywords: Visually impairment, Low vision, Low vision device, Reading rate.

INTRODUCTION

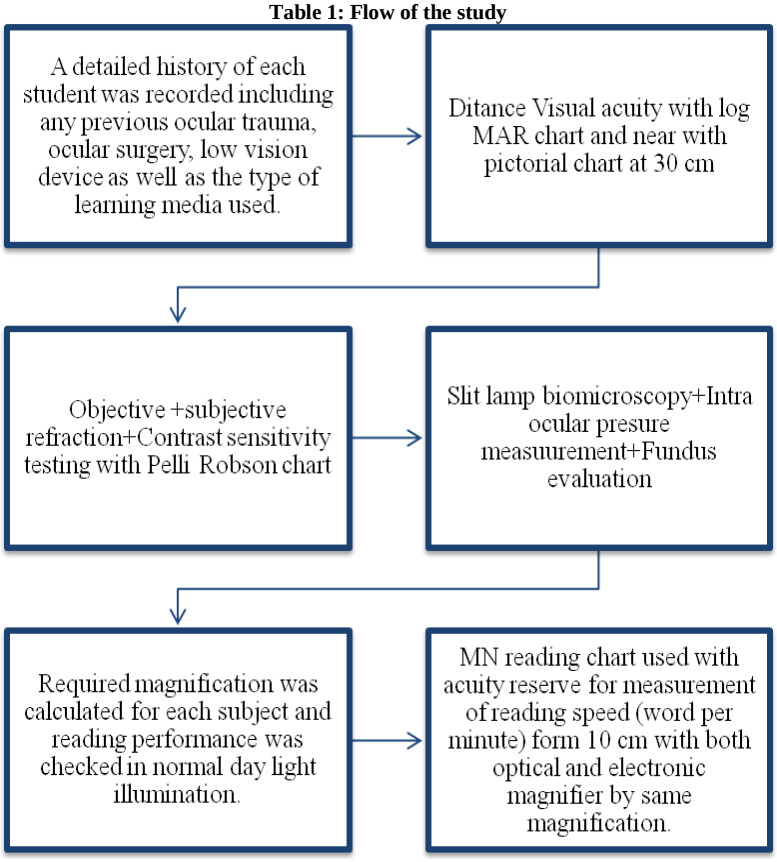
285 million people are visually impaired worldwide: 39 million are blind and 246 million have low vision, of whom a larger number reside in India. About 90% of the worlds visually impaired live in developing countries and 80% blindness is avoidable blindness. Globally, uncorrected refractive errors are the main cause of visual impairment; cataracts remain the leading cause of blindness in middle- and low-income countries. The number of people visually impaired from infectious diseases has greatly reduced in the last 20 years.[1] The WHO working / Functional Definition of Low Vision (WHO,1992) is defined as A person with low vision, who has impairment of visual functioning even after treatment, and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception or a visual field of less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task." The use of the functional definition ensures that people who have vision less than 3/60 are included for the low vision services to help them to utilize their useful residual vision to its maximum potential.[2] Low vision can escalate to lifetime deterioration in the child's visual performance. Reading is one of the most significant outlets for

education and educational progress. If visual disability affects the child's ability to learn, it may be a significant obstacle to the child's educational success. Low vision aids / devices (LVA/LVDs) are one of the means enhancing the vision of a visually impaired with increased magnification / contrast etc. Thus, the aim of this study is to compare the reading performance with optical and electronic low vision devices among low vision children in a blind school.

MATERIALS AND METHODS

This prospective, cross-sectional study was conducted in seventy eight low vision subjects aged 11 to 16 years evaluated from three blind schools of Kamrup district, Assam. Fourteen subjects who could make out reading with text and Braille were included for further evaluation. The study was approved by Institutional review board and adhered to the tenets of Declaration of Helsinki. Written consent was taken from the participants to include their data anonymously in the study through database. In case patient was unable to give their consent, the consent for participation was obtained from the parents or the legal guardians. The flow of the study is tabulated in 'Table 1'

Table 1: Flow of the study



Statistical methods:

The data were entered using Microsoft Excel 2010. Analysis was carried out suing SPSS Version 20. Descriptive statistics (mean, SD, frequency, percentage) for non-comparable variables. Wilcoxon test was used to compare the reading speed between the two methods used.

RESULTS

Demographics

Among the 14 subjects, 78.6% (n=11) were male. The mean age of the subjects was 13±2 years. 28.6% (n=4) among them had a previous eye examination done elsewhere. None of the subjects were found to be using low vision devices in the past. The academic standard of the subjects are presented in 'Figure 1'.

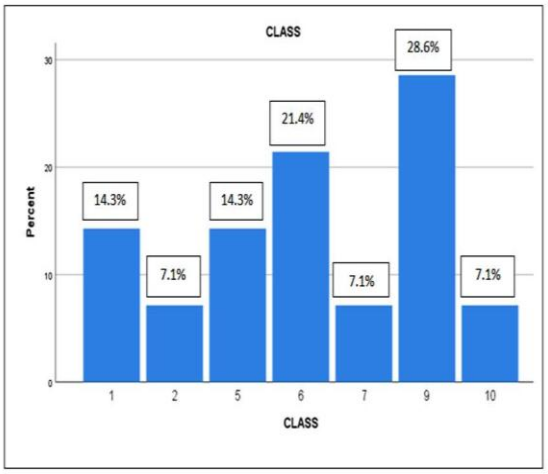


Figure 1: The academic standard of the subjects

Visual profile of the subjects

All the subjects had an unaided distance visual acuity between 3/60 to perception of light. In terms of unaided near visual acuity 57.1% (n=8) students read letters of size greater than 5 mm, 28.6% (n=4) can read less than 5 mm size letters and 14.3% (n=2) students cannot read near print. However, 7.1 %(n=1) subjects had an aided visual acuity between 6/6 to 6/18, 6/18 to 6/60. 35.7% (n=5) subjects had an aided visual acuity between 6/60 to 3/60 whereas rest had a visual acuity lesser than 3/60. The aided near acuity was 64.3% (n=9) subjects that could make out read letters of size greater than 5 mm. The anterior and posterior ocular conditions associated with low vision are tabulated in 'Table 2' and 'Table 3'. 35.7% (n=5) subjects had a normal colour vision and 14.3% (n=2) were total colour blind. 50% (n=7) were unable to assess their colour vision. 42.9 (n=6) has a full visual field and 28.6 % (n=4) had a constricted field when assess in confrontation manner.

Table 2: Anterior chamber Ocular condition involved

Disease /Ocular condition	Frequency	Percentage
Unable to access	1	7.1%
Aphakia	1	7.1%
Cataract	1	7.1%
Coloboma	1	7.1%
Glaucoma	1	7.1%
Microphthalmos	5	35.7%
Pseudophakia	2	14.3%
Subluxated/dislocated lens	1	7.1%
Refractive error	1	7.1%

Table 3: Posterior segment ocular conditions

Disease/Condition	Frequency	Percentage
Unable to assess	2	14.3%
Coloboma	5	35.7%
Optic atrophy	2	14.3%
Other	1	7.1%
Posterior staphyloma	1	7.1%
Retinal detachment	3	21.4%

Low vision device for the subjects

Both spectacle magnifier and spectacles were prescribed for students 35.7% (=5) each. Video magnifier was prescribed for 14.3% (n=2) subjects. Both pocket magnifier (illuminated) and dome magnifier were prescribed with a frequency for 7.1% (n=1) each. The reading speed with optical magnifier (RSWOM) and Reading speed with video magnifier (RSWVM) are showed in 'Figure 2' and 'Figure 3'. A statistically significant increased reading speed was noted with video magnifier when compared with the optical magnifier ($p<0.001$). 'Table 4

Figure 2: Graph showing reading speed of subjects with optical magnifier

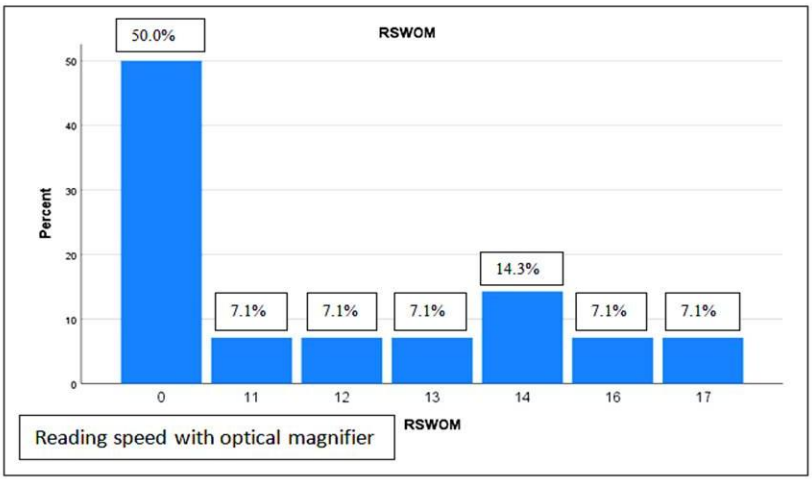


Figure 3: Graph showing reading speed of subjects with video magnifier'

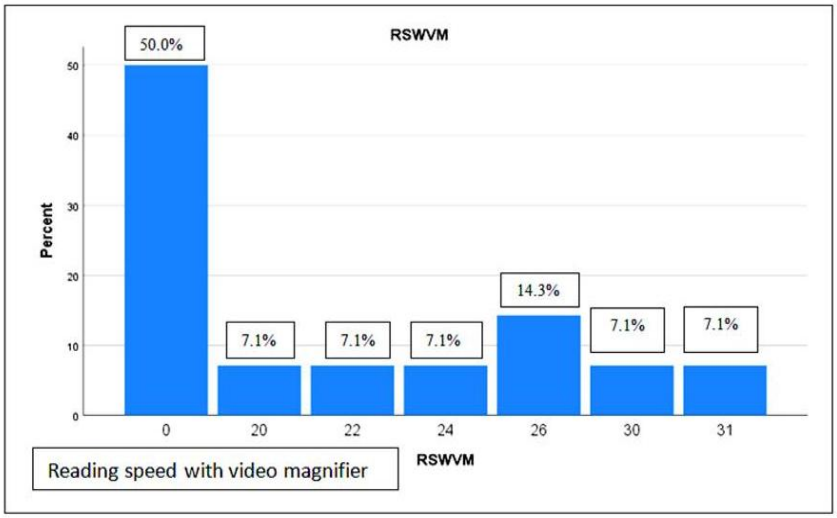


Table 4: Comparison of the reading speed using video and optical magnifier

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	p-value
				Lower	Upper			
RSWOM – RSWVM	-11.71	1.88	0.71	-13.46	-9.96	-16.40	6	<0.001*

DISCUSSION

This study describes the reading performance in low vision individual can be enhanced using electronic low vision devices with an advantage of being several magnifying options along with contrast flexibility. Reading speed depends on the ability of an individual to acknowledge words. When vision is reduced, it merely affects the reading speed. Children with low vision attain poorer reading performance due to slower reading speed and accuracy. The outcome of the present study suggests that use of low vision devices can accelerate reading speed accompanied with demand in print sizes above threshold to achieve maximum reading rate.

Table 5: Summary of various relevant researches

Author	Age	Visual impairment criteria	Findings
Rokiah Omar et al (2005) [6]	-	low vision subjects with normal reading speed (Group A) and slow reading speed (Group B)	No significant relationship on visual status and reading performance between the two groups. However low vision subjects with normal reading speed had better comprehension ability compared the slower reading ones. Thus concluded that the visual status does to play a significant role in reduction of comprehension, rather could be attributed due to the slower reading speed.
Jan E Lovie-Kitchin et. al. (2001)[7]	17-18 yrs	Visual acuity less than 6/120	Individuals with higher magnification as well as with above threshold letter size achieves the maximum near reading speed.
Krishna Kumar Ramani et. al. (2014)[8]	Age: 05-16 yrs	Best corrected visual acuity less than 6/18 for distance (cerebral palsy + visual impairment)	An improvement in the reading speed, accuracy and fluency was noted in three subjects with MDVI using optical and electronic low vision devices as well as non-optical device
John J Taylor et al (2017)[4]	Age: Over 18 years	Visual acuity of 0.7 log MAR (6/30) or worse	Maximum participants preferred portable electronic vision enhancement systems (p-EVES) for leisure reading and for a longer duration. Additionally, helped to carry out more specific tasks using the same.
Zorica Toncic et al (2017)[9]	Age: 12-17 yrs	Best corrected visual acuity less than 0.3 and more than 0.05	Reading speed and functional reading improved after using low vision aids.
Gordon E. Legge et al (2016)[10]	-	Visual acuity 20/60 for distance	Suitable print size, display size and text magnification often matter for low vision children. Inter line as well as inter word spacing with adequate contrast enhances reading performance.

There has been a diversity of researches (Table 5) which emphasize the efficacy of electronic low vision devices in enhancing their reading performance. Shi W et.al. in their study compared the near reading task with optical and electronic low vision devices in patient with low vision, and found a significant improvement in the reading speed with the electronic low vision device. [3] In a randomized controlled trial, Taylor et.al (2017) offers evidence that portable electronic vision enhancement systems (p-EVES) devices may play a significant role in complementing the spectrum of low vision aids used to minimize operation limitation for near vision tasks. [4] However, our study results were consistent to the formers in terms of increased reading performance with electronic devices.

In contrast to the reading ability, studies were not limited to the reading speed with electronic and optical devices alone. In a study by Feng et.al. (2017) tried comparing the illumination of low vision devices on reading speed using contrasted enhancement in the reading speed and comfort level using back illuminated devices with larger font size appearence.[5] However, our results imply that patients with varying degrees of visual impairment may benefit from the use of back-illuminated electronic reading devices when attempting reading tasks since subjects mean reading speed was significantly faster on a back-illuminated device with regular font (25.57 ± 3.59 words per minute) than a optical device with magnified font (13.85 ± 2.11 words per minute).

This study demonstrated that while text magnification may be of some benefit in minimizing losses in reading performance with worsening VA, back illumination significantly increase reading speed and comfort, particularly in patients with visual impairment. As portable electronic devices become extremely versatile, both medical professionals and patients will continue to adopt them in a variety of healthcare scenarios. Electronic reading devices are particularly promising since they may easily magnify text and enhance contrast without cumbersome equipment or significant effort from the user. Additional efforts should be made to adapt structured reading texts to digital media in order to better determine the reading efficiency of electronic devices. Further research could also investigate other possible uses of electronic devices as visual aids for patients with impaired visual function.

CONCLUSION

Reading performance in low vision individuals can be benefitted using electronic low vision aids with diverse of assessing options being incorporated within it. These aids would also enhance the daily living of visually impaired individuals.

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Conflict of interest: There is no conflict of interest of any of the authors with the results of this study

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