Comparison of Effect of Optical and Digital Devices on Reading Performance of Person with Visual Impairment

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ABSTRACT

Purpose: To determine and compare effect of optical and digital devices on reading performance of persons with visual impairment.

Methodology: The research protocol was approved by Ethical Review Board of College of Ophthalmology and Allied Vision Sciences, Lahore (Ref# COAVS/1480:23). This study was conducted in college of ophthalmology and allied vision sciences Lahore. Duration of study was from October to December 2023.sample size was calculated using a formula whose level of significance (α) is 5, power of test (1-β) is 80. The sample size was 27, and calculated by using the non-probability convenient sampling technique. Individuals with NVA worse tham 3M unit and above age ranges 15 years or above were included in this study.The individuals having any inflamatory disease were excluded from this study. The questionnaire consisted of several questions on reading performance with optical and digital devices, performa contained visual acuity improvement in both eyes with optical and digital devices. P-value was calculated by using Wilcoxon Signed Ranks test. P-value <0.05 was considered significant.

Results: It indicates the probability of obtaining the observed results (or more extreme) if there is no actual difference between the near visual acuity with the Zoomer and the Magnifier. In this case, the p-value is 0.027. The difference of Near Visual Acuity with Optical and digital devices was not significant (p = 0.435).

Conclusion: There is no difference in Near Visual Acuity between the Zoomer and the Magnifier. Near Visual Acuity is lower with the Zoomer compared to the Magnifier.

Key Words: Vision impairment, Optical device, Digital device, Zoomer.

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INTRODUCTION

Vision impairment is a substantial universal drain, distressing 2.2 billion people wide-reaching and 2.9 million people age 40 and older in the United States.[1,2] Visual acuity of 20/70 or below in the healthier seeing eye is considered low vision. Nevertheless, the functional difficulties that visually impaired patients face

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in doing their everyday tasks are not captured by this numerical value. As a result, the National Eye Institute (NEI) updated its characterization of low vision to include visual loss combined with functionally incapacitating elements including vision loss that obstructs daily living activities, social interaction, occupational or professional activities, or learning.[3] Just about each patient with low vision has around system of strain in performing everyday vision-related everyday jobs, which can lead to reduced value of natural life and considerable social impressions.[4]

Reading becomes extremely difficult for those who are visually impaired, but advances in technology have made a number of tools more accessible. The purpose of the study is to clarify the relative benefits and drawbacks of using optical and digital technologies to assist people with vision problems during reading. By 2050, there will likely be 535 million blind or severely visually impaired individuals worldwide, up from the current predictions of 338 million.[5] Blindness and vision impairment (VI) can directly impact bodily dysfunction and limits in day-to-day activities. They can also exacerbate symptoms of anxiety and despair. A significant depressive condition affects roughly 5% of individuals with VI or blindness, whereas anxiety disorders affect about 7% of them.[6]

The average age of the population is rising, more people are reaching adulthood in many nations across the world due to rising sociodemographic status and life expectancy, and the burden of disease is moving towards non-communicable diseases and disabilities. the majority of primary causes of vision impairment, such as corrected refractive errors and cataracts.[7]

The study may look into things like comprehension, reading speed, usability, and user happiness with digital and optical devices.[8]It might also explore the particular requirements and preferences of people who are visually impaired, taking into account things like the user interface as a whole, text-to-speech capabilities, and font customization. For those who are blind or visually impaired, reading is not just a useful ability but also a tool for social integration, self-expression, and empowerment. It is imperative that individuals with visual impairments have access to a wide range of reading materials via adapted technologies in order to enable them to fully engage in educational, professional, and recreational activities.[9]

METHODOLOGY

The research protocol was approved by Ethical Review Board of College of Ophthalmology and Allied Vision Sciences, Lahore (Ref# COAVS/1480:23). This study was conducted in college of ophthalmology and allied vision sciences Lahore. Duration of study was from October to December 2023.sample size was calculated using a formula whose level of significance (α) is 5, power of test (1-β) is 80. The sample size was 27[1], and calculated by using the non-probability convenient sampling technique. Individuals with NVA worse tham 3M unit and above age ranges 15 years or above were included in this study.The individuals having any inflamatory disease were excluded from this study. The questionnaire consisted of several questions on reading performance with optical and digital devices, performa contained visual acuity improvement in both eyes with optical and digital devices. P-value was calculated by using Wilcoxon Signed Ranks test. P-value <0.05 was considered significant**.**

RESULTS

This study included 27 individuals with visual impairment. Mean age of candidates was 23±8. This study presents descriptive statistics for three different conditions of near visual acuity—Unaided, Magnifier, and Zoomer. Wilcoxon Signed Ranks Tests, a non-parametric statistical test used to assess whether there is a significant difference between paired samples. 13 participants did not show a difference in their comfort level between the two devices. 9 participants rated their comfort level with the digital device higher than with the optical device. 5 participants rated their comfort level with the digital

device lower than with the optical device. 11 participants had equal near visual acuity scores with the Zoomer and the Magnifier. 3 participants had higher near visual acuity scores with the Zoomer compared to the Magnifier. 13 participants had lower near visual acuity scores with the Zoomer compared to the Magnifier. There is no actual difference between the near visual acuity with the Zoomer and the Magnifier. In this case, the p-value is 0.027.

Table - 1: Difference Between Near Visual Acuity with Optical and Digital Devices

Near Visual Acuity	Frequency	Minimum value	Maximum value	P-value
Near Visual Acuity (Unaided)	27	3.2	8.0	1.5305
Near Visual Acuity (Magnifier)	27	1.00	3.20	0.55574
Near Visual Acuity (Zoomer)	27	1.00	3.20	0.54901

P-value was calculated by using the Wilcoxon Signed Ranks test.

For the "Near Visual Acuity (Unaided)" condition, the average near visual acuity was 5.444, with a minimum value of 3.2 and a maximum value of 8.0. The standard deviation of 1.5305 suggested some variability in the acuity values. For the "Near Visual Acuity (Magnifier)" condition, the average acuity was 1.6500, with a minimum value of 1.00 and a maximum value of 3.20. In the "Near Visual Acuity (Zoomer)" condition, the average acuity is 1.4444, with a minimum value of 1.00 and a maximum value of 3.20.

It suggested that there was no significant difference in Near Visual Acuity with optical and Digital reading devices.

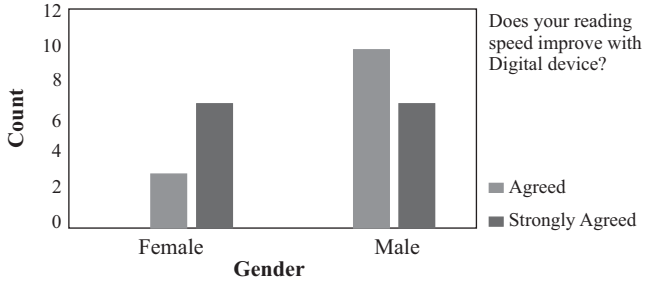
Table - 2: Does your reading speed improve with Digital device? - Does your reading speed improve with Optical device?

Does your reading speed improve with Digital device? Does your reading speed improve with Optical device?				
Gender	Negative Ranks	Positive Ranks	Ties	P-Value
Female	6	4	10	0.435
Male	9	8	17	
Total	15	12	27	

The Wilcoxon Signed Ranks Test was used to assess whether there was a significant difference between the paired conditions (reading speed with a digital device vs. reading speed with an optical device). The negative and positive ranks helped to identify the direction of the differences.

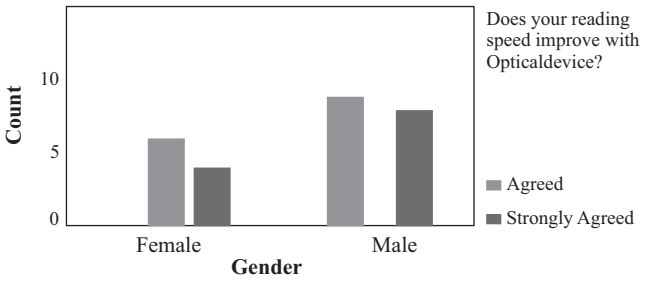
In this case, an equal number of participants rated their reading speed higher and lower with the digital device compared to the optical device. The ties indicated instances where participants did not perceive a difference in reading speed between the two devices. The P-value provided a summary of the ranking data. 15 participants did not show a difference in their reading speed between the two devices. 7 participants rated their reading speed with the digital device higher than with the optical device. 5 participants rated their reading speed with the digital device lower than with the optical device.

Fig - 1: Does your reading speed improve with Digital device?



This table showed that how many individuals were satisfied with digital low vision aids. When we asked the patient about their improvement in speed of reading with digital devices than 10 male individuals showed positive agree response and 7 showed highly positive response. While in females 3 were agreed and 7 were strongly agreed that their reading speed is increased digital devices.

Fig - 2: Does your reading speed improve with Optical device?



This figure showed that how many individuals were satisfied with optical low vision aids. When we asked the patient about their reading speed improvement with optical device than 10 male individuals showed positive agree response and 6 showed highly positive response and only one individual speed was decreased. While in females 6 were agreed and 4 were strongly agreed that their reading speed is increased.

DISCUSSION

Of the five senses, sight is the most basic as it deals with almost all daily tasks. A decrease in visual acuity begins to impact the quality of life even before the diagnosis of severe visual impairment or blindness. Physical (mobility and independence), social (communication and conversation initiation), and psychological (emotional well-being and coping) elements of a person's life are all affected by visual impairment, with frequency and severity varying by age group.[10]

It has been demonstrated that vision impairment negatively affects young people' participation in social activities when compared to age-matched groups. The correlation between the level of engagement and the degree of visual loss has long been disregarded. People who are visually impaired find it more difficult to interact with others because they are unable to read facial expressions or do simple acts of civility like picking up dropped objects from the floor for others. As such, they are unable to fully engage in society. Their perception of themselves may deteriorate as their involvement increases.[11]

According to US Census demographic statistics from 2000, 937,000 (0.78%) of all Americans over 40 were expected to be blind (US definition). One in four Americans, or 2.4 million, had low vision. Age-related macular degeneration accounted for 54.4% of cases of blindness in white people, while cataracts and glaucoma caused more than 60% of blindness in black people. The most common cause of impaired vision in whites, blacks, and Hispanics was cataracts, which accounted for almost 50% of bilateral vision lower than 6/12 (20/40). By 2020, there will be 1.6 million blind persons in the United States, up 70% from the current figure. People with low vision are also predicted to see a rise in this population.[12] When comparing our findings to those of active comparators, we discovered extremely low-confidence evidence of negligible or no favorable effects on HRQOL that were inaccurately assessed by group programs and/or psychological therapies (SMD ..0.09, 95% CI -0.39 to 0.20; participants = 600; studies = 4; I2 = 67%).

Children in Indian schools for the blind have been using LVDs, according to reports by Pal et al.and Gogate et al.[13] A different study revealed that about 75% of the 31 kids who had a CF of at least ½ meter could read standard print with LVD. We gave away complimentary LVDs to both schools, which included stand and hand magnifiers with different diopters. We have assisted educational institutions in establishing an LVD library and in encouraging students to use the LVD to study printed textbooks both during and after school.

In one study, traditional optical low vision aids (LVAs) were contrasted with four electronic head-mounted devices (HMDs): Jordy, Flipper port, Mayport, and NuVision. The objective was to identify potential variations in macular disease patients' performance for practical visual tasks and laboratory clinical measures. We looked into potential influencing elements for success. In order to perform a battery of clinical assessments and common visual tasks, ten patients with age-related macular disease (AMD) and ten with early-onset macular disease (EOMD) each employed four HMDs, regular glasses, and an optical LVA that had previously been prescribed. Distance, average, and near acuity, as well as contrast sensitivity, were the clinical assessments. Writing a check, identifying

goods on a shelf, and reading text in three different sizes were the visual activities.[14]

According to our research, a person's quality of life is significantly damaged even prior to receiving a diagnosis of blindness, visual impairment, or severe vision loss. New treatments should be created or current ones should be improved in order to enhance vision, slow the progression of eye diseases, or, at the absolute least, postpone the beginning of visual impairment or declining visual acuity and the consequent loss of quality of life. Even with all of the treatments available, some people with declining VA still experience daily problems. Social services and rehabilitation are clearly essential to preserving a good standard of living and reducing the functional handicap resulting from VA loss.[15]

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Reading comprehension is essential for education and learning. Teachers and researchers may create more inclusive learning environments by creating better techniques to serve students with visual impairments by understanding how optical and digital technologies affect reading ability.[19]

One essential component of social inclusion is information access. The development of tools that allow people with visual impairments to independently participate in a variety of activities, such as reading books, accessing web content, or conducting work-related and educational tasks, can be facilitated by knowing which kind of gadget is most successful.

This comparison aids in assessing how people with vision problems interact with various gadgets. This covers elements including comfort, convenience of use, and general contentment. These kinds of findings are helpful for creating interfaces that are easy to use and when making assistive technology more user-friendly.[20]

The results of this research can help shape laws that support the accessibility and use of assistive technology by those who are blind or visually impaired. Additionally, it can help lobbying efforts to guarantee these people equitable access to jobs, education, and other facets of life.

Comprehending the influence of both digital and optical gadgets enables a more customized utilization of assistive technology. It is feasible to customize solutions to meet the specific needs and preferences of visually impaired people by contrasting these two categories of gadgets.

CONCLUSION

There is no difference in Near Visual Acuity between the Zoomer and the Magnifier. Near Visual Acuity is lower with the Zoomer compared to the Magnifier. The decision between optical and digital devices may be influenced by elements including cost, mobility, and ease of use. Both kinds of devices can be useful in conjunction for visually impaired people, depending on the situation and particular reading activities. The study emphasizes how crucial it is to take into account each person's preferences and needs when choosing reading aids for those who are visually impaired.

Conflict of Interest: None to declare

Ethical Approval: The study was approved by the Institutional Review Board / Ethical Review Board Vide No.COAVS/1480/23/.

Author Contributions: Irum Kausar: Concept, Drafting, Data Collection, Literature Review.

Madiha Nazly: Data Collection, Critical Review,

Data Analysis.

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