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Comparative study of distance vision testing between standard Snellen chart versus wall mounted Snellen iPad device

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Abstract
The study aimed to compare the distance visual acuity assessments obtained using a Snellen Chart displayed on an iPad tablet with those obtained using the traditional light-box Snellen Chart. The Snellen iPad app and Eye Chart HD iOS app were utilized to assess visual acuity in 300 new patients aged 8 years and older at the Ophthalmology Outpatient Department. The study excluded patients with visual acuity less than 6/30. Visual acuity was measured using both the iPad Mini 2 with the Eye Chart HD app and the classic Snellen Light-Box Chart. The results showed that the Snellen iPad app and the classic light-box Snellen Chart produced comparable findings, suggesting that the iPad app can be a viable alternative for visual acuity assessment. The study also identified potential confounders, such as prior memorization of the traditional Snellen Chart and variations in device brightness. Future research should consider controlling for these factors and explore the use of premium apps, compare both devices under varied conditions, and utilize a larger sample size to further validate the use of tablet computers for visual acuity testing in clinical settings.

Keywords: Mobile applications, eye chart, health technology, iPad app, visual acuity, Snellen chart

Introduction
Snellen Wall Chart is viral, but there are several situations when its use is considered inadequate, especially if it requires six meters or 20 feet of observation distance. The smaller Snellen charts are intended to examined at closer ranges of 3-meter charts. However, the charts are enormous, heavy, and frequently immobile owing to wall attachment, leading to issues. There needs to be more space for proper viewing distances and restricted access to a Snellen chart in primary care settings and hospital wards. As a result, although it is clinically necessary, visual acuity is frequently overlooked or only crudely tested during a complete physical examination.

Since mobile technology devices have become more common, medical mobile applications have rapidly increased, and anybody with a suitable device may access these tools for little to no cost [1]. Most of the medical professionals and students are willing to utilize such devices [2].These applications are believed to change remote monitoring, patient education, point-of-care medicine, and illness self-management. While ideal conditions are required for the development of testing standards for visual acuity, practitioners assessing visual acuity in unusual situations can select from a wide range of visual acuity applications [3]. When searching for iOS-enabled applications with the phrase "visual acuity" App Store for Apple in Philippines has more than 50 apps accessible. On searching for Android applications in the Google Play store, similar results appear. Thus, healthcare practitioners have a wide range of possibilities when using mobile technology to evaluate visual acuity.

Only three studies compare the usage of mobile applications and gadgets with the Snellen Wall Chart [4-6]. But rather than being done at a patient's bedside, in an outpatient or primary care clinic these investigations were all carried out in optometry clinics and academic settings. This research work aims to determine if portable tablet computers are appropriate for testing patients' visual acuity, particularly in the outpatient setting.

Method
Study design
This work implements a cross-sectional study design ranging from December 2019 to November 2023. Cross-sectional works are frequently used to inform public health initiatives by determining the prevalence of a particular outcome within a specific population.

Study setting
The research was performed at the Ophthalmology Outpatient Department (OPD).

Study population
The Ophthalmology Outpatient Department's (OPD) newly registered patients are taken for the study sample. Martin Bland [8] recommended a sample size 300 for the Bland-Altman analysis to achieve a trustworthy standard error with a 95% confidence interval. The study's possible biases were reduced thanks to random sampling.

Inclusion criteria
The purposeful sampling technique was implemented to determine the respondents. Only individuals who satisfied the requirements, such as new patients who were 8 years of age or older among both genders, are involved in the research.

Exclusion criteria
Patients with visual acuity of below 6/30 were excluded from the study.

Results
To recruit the participants for the present study, a total of 312 patients were approached; 8 participants were excluded, 4 patients refused to participate in the present study and remaining 300 participants were enrolled in the present study. The mean age of the participants was 39.2 years (±12.8 years) within the age from a minimum of 19 to a maximum of 79 years. Among the 300 patients, there are 123 men and 177 women. They had their visual acuity tested twice, once for testing each modality. This led to an overall of 600 eyes being evaluated for testing each modality.
The participant's Snellen VA from the two testing modalities was translated to LogMAR scores through the following formula:

$$\text{LogMAR VA} = \log(1 \text{ Snellen Visual Acuity})$$

According to the findings, on the 300 subjects 81 individuals experienced pinhole visual acuity for their left eye and were placed in Pair 4, whereas 75 out of 300 experienced the same for their right eye. The calculated standard deviation scores are likewise more similar and range from 0.13 to 0.26, while each group's corresponding mean scores are closer to one another (Range: 0.09-0.25). As a consequence of the Standard Error Mean of each pairing being equal to 0.02, the findings from each participant group examined utilizing two modalities produced values that were reasonably near to one another.
The paired findings from the two modalities show that when individuals from each modality were matched in theiPad VA OD and Snellen VA OD, the difference's confidence range produced a minimum variance of 0.02 and a maximum variance of 0.6. In this group, the average difference is 0.04. Additionally, the individuals matched for the iPad VA OD and Snellen VA OD tests had a minimum variance of 0.01 and a maximum variance of 0.49, with an average variance of 0.03.
According to the findings, the right eye's mean CI among the two tested modalities is 0427. As a result, the iPad app's results are acceptable when compared to the standard light-box Snellen Chart for visual acuity in the right eye. As mentioned, the testing methodology is within concordance when the discrepancy exceeds ± 1.96 SD.
The visual acuity of thee left eye is tested with iPad Mini 2 app, agrees with the conventional light-box Snellen Chart. The outcome shows that in the left eye, the CI mean-variance across the two tested modalities is 0.0304. As mentioned, the two testing methods are in agreement with one another when the discrepancy is not greater than ± 1.96 SD.
The results indicated that the right eye employing pinhole had a mean difference of 0.0129 among the two methods examined. As a result, the visual acuity of the iPad Mini 2 app, when evaluated in the right eye through a pinhole, is comparable to that of a conventional light-box Snellen Chart. As mentioned, the two testing methods are in agreement with one another when the discrepancy is not greater than ± 1.96 SD.
According to the findings, CI's average variation between the two modalities evaluated in the left eye through a pinhole is -0.0039. As a result, the iPad Mini 2 app's visual acuity results, when tested in the left eye with a pinhole, are comparable to those of the classic light-box Snellen Chart. As mentioned, the two testing methods are in agreement with one another when the discrepancy is not greater than ± 1.96 SD.

Discussion
A comparison work was conducted among 300 individuals between Eye Chart HD. It was shown to agree with the traditional light-box Snellen Chart while measuring visual acuity in the outpatient clinic utilizing a conventional light-box Snellen Chart. Examining the participants' right and left eyes' gross visual acuity revealed confounders that might have influenced the outcomes. The first among them is a patient-related component, where the participant may have previously remembered the traditional light-box Snellen Chart prior to their examination due to the Snellen Chart's substantial and widespread use in medical facilities across the country. On the other hand, the Eye Chart HD app on the iPad Mini 2 app may randomly select the letters utilized during the visual acuity examination, removing any opportunity for memorizing the side of the individuals.
Considering these factors, the statistical analysis demonstrated that when subjects completed pinhole visual acuity testing, there was a high degree of agreement between the two evaluation techniques. This suggests that the iPad software may effectively replace the conventional light-box Snellen Chart.
These results are consistent with the published studies that examined the agreement among the iPad app and conventional testing modalities. However, two among these studies had some drawbacks. According to Zhang *et al.* [1], the visual acuity agreement among modes is only reliable when the participants' visual acuity is higher than 20/200 (6/60) since none of the subjects had vision poorer than 20/100 (6/30) and were not evaluated beyond this point.
Another research hypothesized that the assessments may concur when removing the iPad screen's glare [3]. The researchers came to the conclusion that a glare filter was required after conducting the first phase of analysis and testing. This examination study sets the iPad brightness level to the highest level (100%). The brightness level in this trial was adjusted to 75%. Interestingly, no one brought up the glare issue, indicating that the overall lighting conditions may have been better than in the prior research.

The brightness level of the Gounder *et al.* (2014) investigation was set at 75%, and an anti-glare filter wasn't necessary to provide precise visual acuity measures [10]. However, it shows that the applications utilized in this study are distinct from those employed in the other studies described above. Eye Chart HD, a free download from the iTunes Store, is used in this study. The Eye Chart HD was chosen because (1) it can be freely downloaded from the iTunes Store, (2) It is possible to order the letters at randomly. (3) 1.5 meters is the specified testing distance, and (4) the claimed inaccuracy percentage is just 20.2% [6] whereas inaccuracy percentage on free applications are more than 30%.

Conclusion

This research aimed to determine whether the iPad software could successfully replace the traditional light-box Snellen Chart to determine patients' visual acuity. It demonstrated that, when utilized in the outpatient department, the outcomes from the Eye Chart HD software running on an iPad Mini 2 matched those of the conventional light-box Snellen Chart. The development of technology and the availability of software programs have made our work much easier and faster, and additional individuals have benefited from early visual acuity screening. As a result, people are now more aware of the significance of maintaining good eye health and regularly checking on their vision condition. However, nothing can replace a professional eye exam performed by board-certified ophthalmologists.

Conflict of Interest

Not available

Financial Support

Not available

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