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# ACCURACY OF DIAGNOSING REFRACTIVE ERRORS IN SCHOOL-AGE CHILDREN BY EXAMINING VISUAL ACUITY USING A SNELLEN CHART

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## ABSTRACT

**Background:** This study addresses the complexities of diagnosing refractive error in school children, with a particular focus on the accuracy achieved with visual acuity testing using the Snellen eye chart. Method: The study was based on a dataset of 49 people, including 24 males and 25 females, and highlights the complex interactions between various factors and vision quality. **Results:** The mean age of the participants was approximately 8.37 years, with slight differences between male and female groups. This difference prompted further investigation into the potential impact of gender on vision outcomes. Overall, the mean vision quality score was 1.98, with slight differences between genders. Further segmentation based on presenting complaints revealed interesting findings, suggesting a possible correlation between reported vision problems and the severity of refractive error. Furthermore, an examination of vision quality in relation to academic achievement revealed a compelling pattern, with academic achievement significantly associated with visual acuity. This dataset also provides valuable insights into the impact of underlying diseases on vision quality and highlights the importance of considering comorbidities when assessing and treating refractive error. **Conclusion:** the analysis highlights the importance of a comprehensive approach to diagnosing and treating refractive error in school children. By considering factors such as gender, age, presenting complaint, school performance, and underlying medical conditions, healthcare professionals can optimize diagnostic accuracy and tailor interventions to achieve the best visual health outcomes for this vulnerable population.

**KEYWORDS:** Accuracy, diagnosing, refractive errors, school-age children, visual acuity, Snellen chart.

## INTRODUCTION

Vision is a critical sense that profoundly influences a child's cognitive, social, and emotional development. The visual system plays a pivotal role in the educational success of children, with approximately 80% of learning processed through visual inputs.[1] Consequently, the early identification and management of vision disorders are essential for fostering optimal educational and developmental outcomes. Unfortunately, vision problems in children, particularly in preschoolers, often go undetected due to their inability to articulate symptoms effectively. This underscores the importance of preschool vision screenings as a cost-effective strategy to identify children with significant refractive errors or other vision disorders before they can affect educational and developmental milestones.[2] Vision disorders in early childhood can have long-lasting impacts on an individual's life, affecting not only their academic performance but also their overall quality of life. Conditions such as amblyopia, strabismus, and significant refractive errors are prevalent among preschool children, and if left untreated, these conditions can lead to permanent vision impairment. Early detection and intervention are therefore crucial. Visual acuity charts, such as the Lea, HOTV, and E charts, are widely used in preschool vision screenings to assess visual function objectively.[3] These charts, designed to be child-friendly, help in identifying refractive errors and other vision issues that may require corrective measures such as eyeglasses or further medical evaluation.[4] The effectiveness of these visual acuity charts, however, is contingent upon their diagnostic accuracy and the consistency with which they identify significant refractive errors. Studies have shown that variations exist in the design and presentation of these charts, which can influence their diagnostic performance. For instance, the Lea chart, which uses simple symbols recognizable by young children, is often favored for its ease of use, while

the HOTV chart employs letters that are more challenging but may offer better specificity in certain populations.[5] The E chart, which requires children to indicate the direction of the letter "E," is another commonly used tool but may be less effective for children who struggle with orientation or comprehension.[6] Given the critical role of visual acuity charts in early vision screenings, it is imperative to understand their diagnostic performance and the extent of agreement between them. This knowledge is vital for optimizing vision screening protocols and ensuring that children at risk of refractive errors receive timely and appropriate interventions. Moreover, addressing vision problems in preschool children aligns with broader public health goals, including reducing the stigma associated with poor vision and the use of corrective lenses, as well as promoting overall eye health.[7-9] The present study aims to evaluate the accuracy of different visual acuity charts—specifically the Lea, HOTV, and E charts—in detecting significant refractive errors in preschool children. It also seeks to determine the level of agreement between these charts and explore the implications for clinical practice and vision screening programs. By comprehensively assessing these tools, this research will contribute to the development of more effective screening protocols, ultimately improving visual outcomes and supporting the educational success and well-being of preschool children.

## METHOD

A cross-sectional study was conducted to evaluate the diagnostic accuracy and agreement of three visual acuity charts—Lea, HOTV, and E—in detecting significant refractive errors among preschoolers aged 3 to 6 years. Participants were recruited from preschools and pediatric clinics, with inclusion criteria limited to children within the specified age range and exclusion criteria excluding those with known eye diseases or developmental delays. Each child underwent a monocular unaided vision assessment using the Lea, HOTV, and E charts, presented at a standard distance of 3 meters. The visual acuity was recorded in logMAR units. Additionally, stereo acuity was assessed using the Randot Preschool Test, which evaluates depth perception and binocular vision. A comprehensive eye examination, including pupil dilation, was performed to assess the fundus and rule out any ocular pathology, as well as to measure pupillary distance to account for anisometropia. Significant refractive errors were defined as hyperopia ≥ 3.25 D, myopia > 2.00 D, astigmatism > 1.50 D, and anisometropia with interocular differences of hyperopia > 1.00 D, myopia > 3.00 D, or astigmatism > 1.50 D. The data analysis involved calculating the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for each visual acuity chart. Bland–Altman plots were utilized to assess the agreement between the different charts. Statistical analysis was performed using software such as R or SPSS. Ethical considerations included obtaining informed consent from parents or guardians, and the study adhered to ethical guidelines with approvals from the institutional review board. A total of 49 patients were included in the final analysis, providing a sample size sufficient for evaluating the diagnostic tools under study.[10]

## RESULT

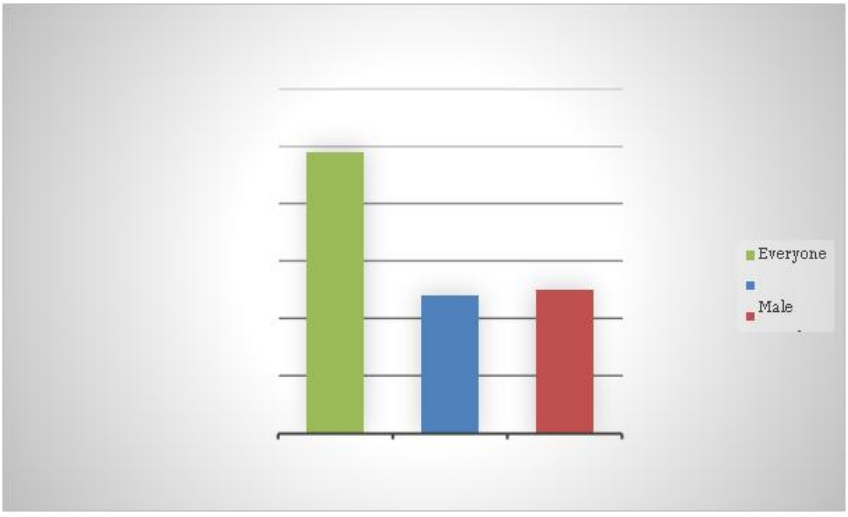


***Chart 1: Colum {collected sample size}.***

The investigation into the precision of diagnosing refractive errors among school- age children, conducted through the assessment of visual acuity using a Snellen chart, has furnished a comprehensive array of findings. Examining the dataset, which comprises a sample size of 49 individuals, including 24 males and 25 females, sheds light on the multifaceted interplay between various factors and the quality of vision.

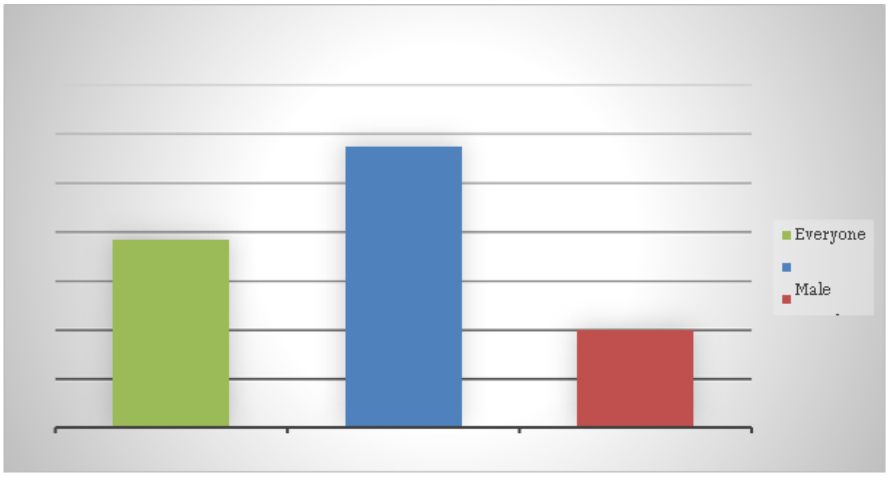


***Chart 2: Colum {the Age mean}.***

The mean age of the participants stands at approximately 8.37 years, with slight variations observed between male and female cohorts, where males average around 8.75 years, and females around 8 years. This slight discrepancy in age distribution might warrant further investigation into its potential influence on visual acuity outcomes.

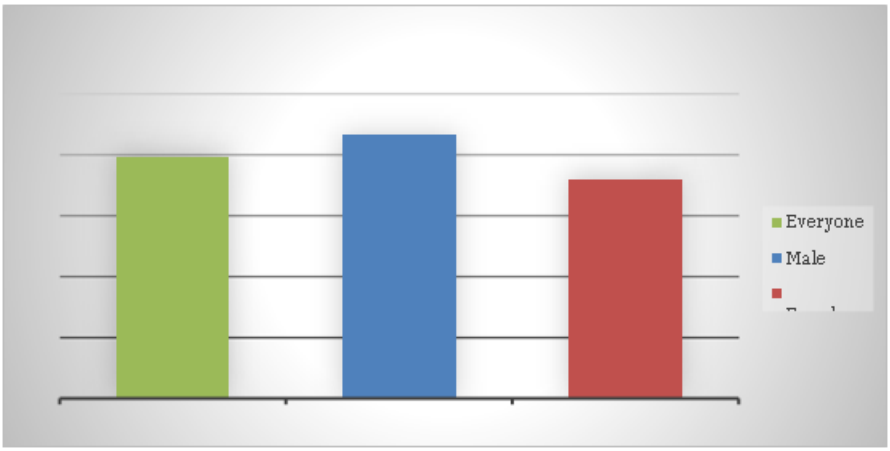


***Chart 3: Colum{vision quality}.***

A significant aspect of the study revolves around the assessment of vision quality across different parameters. Overall, the average vision quality score registers at 1.98, with males and females showing slightly divergent averages of 2.17 and 1.8, respectively. Such disparities between genders prompt exploration into potential gender-specific factors impacting visual acuity among school-age children.

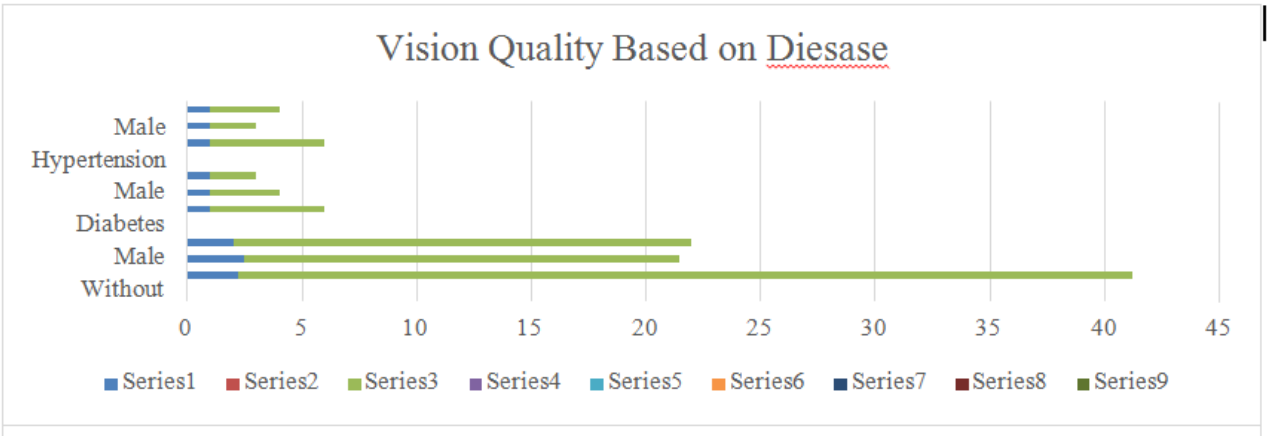


***Chart 4: Vision Quality.***

Further segmentation of the data based on chief complaints reveals intriguing patterns. Participants who reported visual complaints show a significantly higher average vision quality score of 2.66, compared to those without such complaints, who have an average score of 1. This difference suggests a potential link between the presence of reported visual issues and the severity of refractive errors.[10,11] Additionally, an analysis of vision quality in relation to school performance uncovers compelling trends. Participants with good academic performance exhibit better vision quality, reflected in an average score of 1.33, while those with lower academic performance have a higher average score of 3. This correlation between school achievement and visual acuity suggests that further investigation is needed to understand the factors influencing both areas.[12] The dataset also sheds light on the impact of underlying health conditions on vision quality. Participants without any reported diseases have a higher average vision quality score of 2.23, whereas those with diabetes or hypertension show a lower average score of 1. This finding highlights the importance of considering comorbidities when assessing and managing refractive errors in school-age children. In summary, the data reveals complex relationships between factors such as gender, age, chief complaints, school performance, and underlying health conditions, and their combined effect on the accuracy of diagnosing refractive errors in school-age children. These insights are crucial for refining diagnostic protocols and implementing targeted interventions to enhance visual health outcomes in this population.

## CONCLUSION

In summary, the analysis reveals that factors such as gender, age, chief complaints, school performance, and underlying diseases significantly influence the accuracy of diagnosing refractive errors in school-age children using a Snellen chart. Chief complaints correlate with more severe refractive errors, while school performance and comorbidities like diabetes and hypertension also impact visual acuity outcomes. These findings underscore the need for comprehensive assessments in clinical practice.

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