The consistency of visual acuity measurement using PEEK acuity and Snellen-E performed by trained teachers in elementary school students

CrossMark

Ari Andayani[1*], Ni Made Gita Saraswati[1], Ni Made Ari Suryathi[1],
Ni Kompyang Rahayu[2]

[1]Department of Ophthalmology, Faculty of Medicine, Universitas Udayana/Sanglah General Hospital, Bali, Indonesia
[2]Department of Ophthalmology, Bali Mandara General Hospital, Bali, Indonesia

*Corresponding to:
Ari Andayani; Department of Ophthalmology, Faculty of Medicine, Universitas Udayana/Sanglah General Hospital, Bali, Indonesia; Email: akoe.arie35@gmail.com

ABSTRACT

Background: Visual impairment in children affects growth and development, psychological, social, daily activities, which reduce the quality of life. Children often don't realize that they see "lack of" and do not complain of any difficulty in seeing. Collaboration between medical and non-medical personnel could be developed as a tiered health service team. Teachers as educators could help the health service team through health education and eye screening. The purpose of this study was to find out the consistency of visual acuity measurements by trained teachers using PPEK acuity and Snellen-E.

Methods: This study is an analytic cross sectional study conducted on 178 samples in elementary school. Visual acuity was measured by trained teachers using PEEK Acuity and Snellen-E cards and ETDRS by an ophthalmologist. Data analysis using Bland Altman and Rank-Spearman correlation test.

Results : Mean difference in visual acuity measurement with PEEK Acuity by trained teacher and ETDRS by ophthalmologist are 0,0028 logMAR (p = 0,543; 95% CI -0,0063 – 0,0119; 95% limit of agreement -0,11766 - 0,12326). Mean difference in visual acuity measurement with Snellen-E by trained teacher and ETDRS by ophthalmologist shows 0,0090 logMAR (p = 0,103; 95% CI -0.0018 – 0.0198; 95% limit of agreement -0.13426 – 0.15225). Mean difference in visual acuity measurement with PEEK Acuity and Snellen-E by trained teacher shows -0,0062 logMAR (p = 0.248; 95% CI -0,0175– 0,0052; 95% limit of agreement -0,15667 – 0,144269).

Conclusion: Visual acuity measurement using PEEK Acuity and Snellen-E by trained teachers and ETDRS by an ophthalmologist are consistent and could replace each other.

Keywords: PEEK Acuity, Snellen-E, ETDRS, Visual Acuity
Cite this Article: Andayani, A., Saraswati, N.M.G., Suryathi, N.M.A., Rahayu, N.K. 2021. The consistency of visual acuity measurement using PEEK acuity and Snellen-E performed by trained teachers in elementary school students. *IJBS* 15(2): 145-148. DOI: 10.15562/ijbs.v15i2.325

INTRODUCTION

Visual impairment in children can impact growth and development, psychological, social, and daily activities that reduce the quality of life. Children often don't realize that they see "less" and do not complain of any difficulty in seeing. Visual impairment due to refractive error occurs in about 13 million at 5-15 years old.[1] Refractive errors are the third cause of blindness in Indonesia, with a prevalence of 0.14% and about 10% of 66 million children in Indonesia suffering refractive error.[2]

Collaboration between medical and non-medical personnel could be developed as a tiered health service team.

Educators could help the health service team through health education and disease screening. Visual impairment and blindness can be prevented through visual impairment screening. Correct visual acuity measurement method with simple and easy instruments plays an important role in accurate visual acuity measurement.

Cellular technology is developing rapidly, especially in the use of mobile phones. Nowadays, smartphone software used to measure visual acuity was developed, called PEEK Acuity (Portable Eye Examination Kit), designed based on Android according to ETDRS standards.[3] This study highlights the

topic of the consistency of visual acuity measurement by the trained teacher with the conventional method using Snellen-E chart and a new approach using PEEK acuity that can be used in the community, especially at school.

METHODS

This study was an analytic observational study with cross sectional design. This study was conducted at SD Negeri 5 Ubung Denpasar in November 2019. The subject was all students with visual acuity measurement with PEEK Acuity and ETDRS by trained teachers and ETDRS by an ophthalmologist. Inclusion criteria of

this study are all the students whose parent are willing their children to become study subjects by filling the informed consent. Subjects who have best-corrected visual acuity less than 6/60, eye infection, and do not undergo the examination until complete are excluded.

The subject's visual acuity was measured three times. First with Snellen-E, second with PEEK Acuity, and the last with ETDRS. The trained teacher does Snellen-E and PEEK Acuity measurements, and ETDRS were measured by an ophthalmologist. To determine the effectiveness of learning regarding measurement using PEEK Acuity and Snellen-E, an intra-observer and inter-observer test was performed in the preliminary study. The preliminary study was done a week before the study. Teachers were trained using Snellen-E and PEEK Acuity. The intra-observer test was done by pre-test before the training and post-test after the training. Inter-observer tests were done by measuring visual acuity by PEEK acuity and Snellen-E on 50 eyes from 25 students. The Health Research Ethics Committee (Ethical Clearance) Faculty of Medicine Udayana University (2165/UN14.2.2.VII.14/LP/2019).

RESULTS

The characteristics of trained teachers can be seen in **Table 1**. The intra-observer test was conducted by delivering the pre-test before and post-tests after training. We found mean scores of pre-test 42±13.03 and post-test 84±5.47 (p = 0.002). Inter-observer test result from the measurement of visual acuity by PEEK acuity and Snellen E on 50 eyes from 25 students show the mean difference score was -0.008 logMAR (p = 0,420; CI 95% -0.0278-0.0118) with 95% limit of agreement 0,1443-0.1283 shown in **Figure 1**. Rank Spearman

Table 1. Teacher Characteristics

| Characteristics	Total N=5	p*
Age (Year)	29,8 ± 4,91	
Sex (%)		
Male	4 (80)	
Female	1 (20)	
Level of Education (%)		
Diploma	1 (20)	
Bachelor	3 (60)	
Magister	1 (20)	
Result		
Pre test	42 ± 13,03	0,002
Post test	84 ± 5,47	
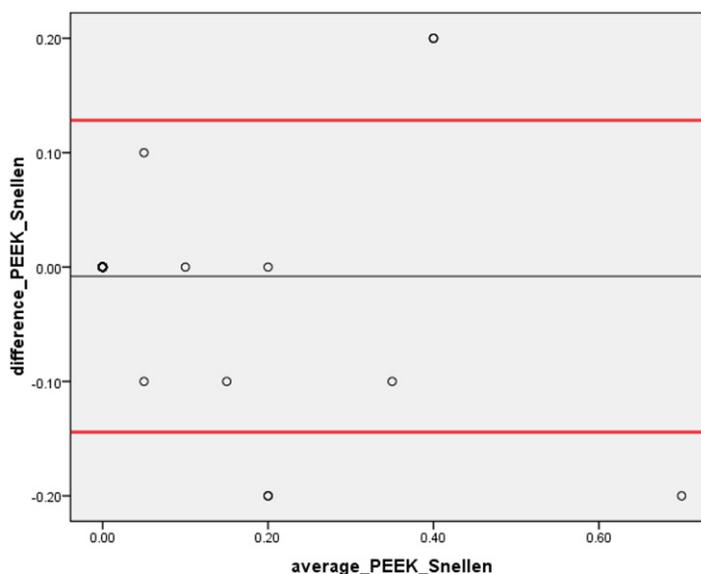
Figure 1. Bland Altman Plot in Preliminary Study
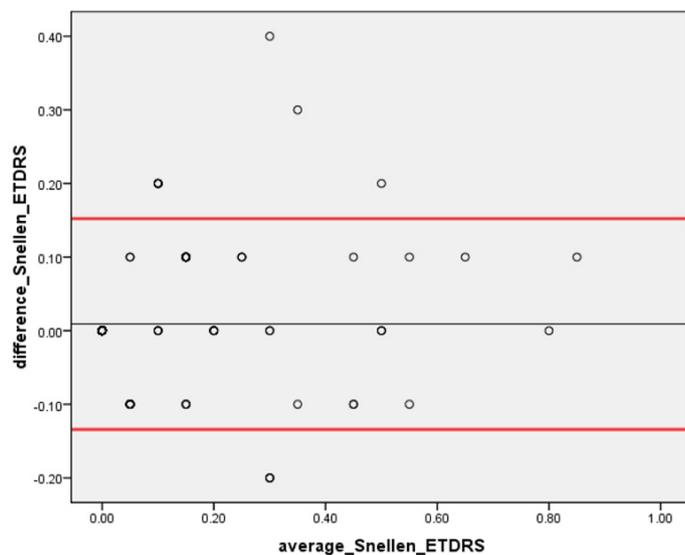
Table 2. Subject Characteristics

Characteristics	Total N=178
Age (Year)	12 (10-12)
Sex (%)	
Male	51 (57,3)
Female	38 (42,7)
Visual Acuity (LogMAR)	
Snellen	0 (0-0,9)
PEEK	0 (0-0,7)
ETDRS	0 (0-0,8)

Table 3. Results of 3 Pairwise Comparison of Visual Acuity Measurement showing Bland-Altman and Spearman Correlation Analysis
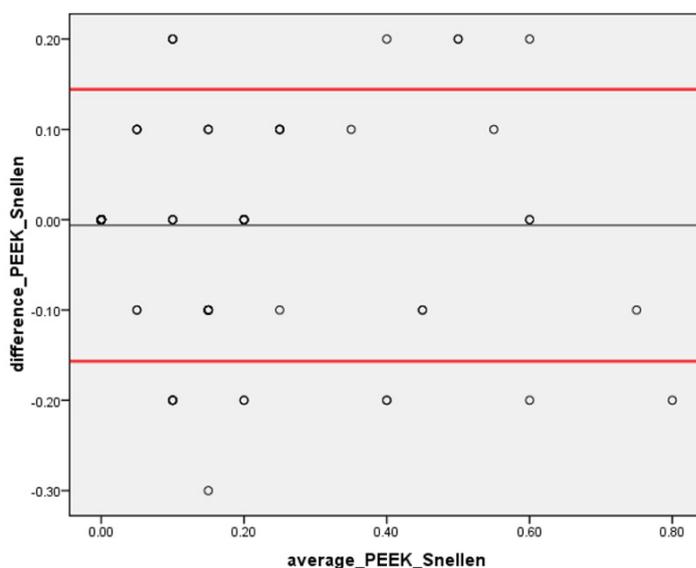
	Mean difference (LogMAR)	p	95% CI Mean difference (LogMAR)	95% *Limit of Agreement* (LogMAR)	Spearman Correlation
PEEK-ETDRS	0.0028	0.543	-0.0063-0.0119	-0.11766 – 0.12326	0.840
Snellen-ETDRS	0.0090	0.103	-0.0018-0.0198	-0.13426 – 0.15225	0.833
PEEK-Snellen	-0.0062	0.248	-0.0175-0.0052	-0.15667 – 0.144269	0.836
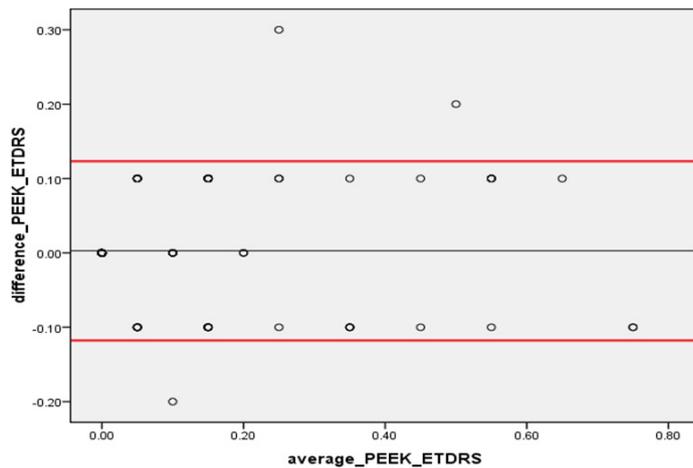
Figure 2. PEEK Acuity-ETDRS Bland Altman Plot

Figure 3. Snellen E-ETDRS Bland Altman Plot

Figure 4. PEEK Acuity–Snellen E Bland Altman Plot

coefficient correlation analysis showed r-value at 0.902 (p< 0.001).

This study was conducted in 178 eyes (89 subjects). The subject characteristics are shown in **Table 2**. Using Bland Altman analysis, visual acuity measurement data were analyzed by Spearman correlation (**Table 3**, **Figure 2**, **Figure 3** and **Figure 4**).

The correlation analysis was conducted to compare PEEK with Snellen E-Card. Table 3 and Figure 2-4 show the statistical comparison between the two tests. The spearman correlation showed that both Snellen and PEEK have a strong correlation coefficient and, thus, have strong diagnostic accuracy compared to the ophthalmologist examination (ETRDS). Also, the result of PEEK and Snellen has a strong correlation which indicates that these tests tend to produce similar results.

DISCUSSION

The visual acuity instrument that is popular and easy to use today is the Snellen card. Although widely accepted, Snellen has inconsistent changes in the number, size, and spacing between letters on each line. Varying letters have a different level of clarity in reading, which will disrupt the patient's ability to read letters correctly, resulting in measurement bias. To overcome the limitation of the Snellen card, an ETDRS was developed, which was recognized more superior and often used in VA measurement in various research.[4,5]

Cellular technology is developing rapidly, especially in the use of mobile phones. The medical community is embracing cellular technology in distributing health information, patient monitoring, research, and telemedicine for remote areas. Based on data from the digital marketing research institute E-marketer estimated in 2018, the number of active smartphone users in Indonesia is more than 100 million people.[6]

Nowadays, smartphone software used to measure visual acuity was developed, called PEEK Acuity (Portable Eye Examination Kit), designed based on Android according to ETDRS standards. This study used the Snellen E card, a traditional VA instrument, and PEEK acuity, a new instrument in VA measurement. Snellen E cards are used

to prevent the subject from memorizing the optotypes. VA measurement by Snellen E and PEEK acuity by trained teacher compared to measurement by opthalmologist using ETDRS aim to prove whether VA measurement by trained teacher using Snellen E or PEEK acuity could in the future replace the measurement of ophthalmologist in the community, especially during visual impairment screening. Studies about PPEK Acuity began conducted widely. One of the studies conducted by Bastawrous in 2015 in the population aged over 55 years old showed that PEEK Acuities agreed well with those of the ETDRS and Snellen charts.[7]

This study showed consistency in 3 pairwise visual acuity measurements; thus, these methods could replace each other. Training of visual acuity measurement with PEEK Acuity and Snellen E could be done as task shifting effort to improve early detection of visual impairment in the community, especially at school.

The result study cannot represent subjects with severe visual impairment (<6/60) despite the findings. In addition, this study is a community-based study in primary school children, so further research needs to be done on the adult population and hospital-based.

CONCLUSION

Measurement of visual acuity using PEEK Acuity and Snellen-E by trained teachers and ETDRS by an ophthalmologist are consistent and could replace each other.

CONFLICTS OF INTEREST

All authors declared that there is no conflict of interest regarding the publication of this article

FUNDING SOURCES

ETHIC APPROVAL

This study was ethically approved with ethical clearance number 2165/UN14.2.2.VII.14/LP/2019

AUTHOR CONTRIBUTION

All authors had equal contribution in writing and revising this article

REFERENCES

1. World Health Organization. Vision 2020: The Right To Sight. Global Initiative for The Elimination of Avoidable Blindness: Action Plan 2006-2011. Geneva: WHO 2007

2. Persatuan Dokter Mata Indonesia. Vision 2020 di Indonesia. PERDAMI. 2017 [cited 2019 May 3]. Available at: https://perdami.id/vision-2020-indonesia/.

3. Venecia B, Bradfield Y, Trane RM, Bareiro A, Scalamogna M. Validation of Peek *Acuity* application in pediatric screening programs in Paraguay. *Int J Ophthalmol* 2018;11(8): 1384-1389

4. Kaiser PK. Prospective Evaluation of Visual *Acuity* Assessment: A Comparison of Snellen versus ETDRS Charts in Clinical Practice. *Trans Am Ophthalmol Soc* 2009; 107: p 311-24

5. American Academy Ophthalmology. 2017-2018. Optic of the Human Eye. In AAO Staff (eds). Clinical Optics. BCSC Section 3. San Fransisco : AAO p. 78–79

6. Rahmayani I. Indonesia Raksasa Teknologi Digital Asia. 2015 [cited 2019 May 7]. Available at: https://kominfo.go.id/content/detail/6095/indonesia-raksasa-teknologi-digital-asia/0/sorotan_media

7. Bastawrous A, Rono HK, Livingstone IA, Weiss HA, Jordan S, Kuper H, et al. Development and Validation of a Smartphone-Based Visual *Acuity* Test (Peek *Acuity*) for Clinical Practice and Community-Based Fieldwork. *JAMA Ophthalmol.* 2015;133(8): 930-937