DOI: https://doi.org/10.53350/pjmhs211592687

ORIGINAL ARTICLE

Visual Acuity Screening for early detection on Students Using Twin Cards Optotype

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ABSTRACT
Myopia is seen as a benign condition which is a public health problem and must be given attention, concerning visual problems, quality of life, and economic consequences. Nearly half of the world's blindness has been caused by uncorrected refraction, with myopia occupying a high percentage of the group, meaning myopia is the beginning of blindness. Uncorrected disturbances of visual acuity should be screened This study aims to develop a method of screening for myopia in school children, resulting in twin card optotypes. The study was carried out by diagnostic tests to analyze the sensitivity and specificity of twin card optotypes in screening for visual impairment in schoolchildren using primary data from the visual test. The results of this study are twin card optotypes which can easily be used in almost any condition, without requiring access to electricity, not causing variables bullies in a row of questions on the same letter size. Faster time because it does not cause repeated questions one paper one object. Installation does not require encoding on the wall, avoid memorization and avoid factors from concerns about clinical validity and application accuracy. Conclusion Sensitivity of sharp vision screening method Optotip twin card when compared with snoten optotip vision sharpening method which is 83.33% while specificity is 71.43 %.
Keywords: Screening, myopia, twin card optotypes

INTRODUCTION

East Asian countries have the biggest myopia prevalence in the world. Taiwan, Singapore, China, Hongkong, and Japan have the myopia prevalence accounting for 50% to 80% at the age between 15 to 24. At the same age, America has prevalence rate accounting for 27% to 33%, Australia has it accounting for 37% and India has it accounting for 5% to 10%. Myopia affected around 1,6 billion people worldwide in 2000 and is expected to increase 2,5 billion by 2020. Although refractive disorders can be fixed by optics or surgical procedures, moderate and high myopia are still unresolved health problems.[1]

Technological advances bring major changes in human life. Technology is not only used by adults but also by children. One of the products of the advancement is gadget. Currently, gadgets are relatively affordable. They have many uses such as communication, source of information and entertainment. On the other hand, they can lead to eye health disorders. Reading, operating computer and smartphone, and watching television can trigger myopia. Staring at the monitor in a fairly long period of time causes excessive accommodation of the eyes. Several studies have shown that a constant increase of accommodation power can lead the eyes to suffer myopia.[2]

Early detection is the key to detect the development of the myopia. The sooner it is detected, the better the treatment given. It can be detected through visual acuity examination. The commonly used tool in clinical examination to test the visual acuity is Snellen chart.[3] The evaluation of visual acuity is one of the important eye tests to receive the early detection of visual impairment in children including amblyopia,[4] which is an important indicator for the normal development of the eye. Various optotypes have been used for this purpose, such as Lea symbol graphic, HOTV, Landolt C, and E thumbling. The measure of visual acuity at preschool age can be a dull process and time-consuming because of uncooperative behaviour.[5]

The success of visual acuity examination is determined by the communication of the examiner and the patient. There may be miscommunication caused by the question error from designation inaccuracy of the optotype objects. The patient's feeling of fear of being examined can affect its response accuracy. The patient becomes doubtful with its response, carelessly responding. The accurate response only comes because of chance. Visual acuity is one of the most important records of the data in eye examination. It is like a vital sign for eye care providers, as important as heart rate and blood pressure.[6]

Early detection and treatment for visual impairment are essential to deal with blindness in society, especially for children. Considering the uneven distribution of the certified manpower and the limited access to quality eye treatment for the majority of the residents, innovative community-based strategy such as teacher training in eye screening program needs to be developed to optimize the available human resources.[7]

Teacher as the first component of the student's eye screening program can provide an effective utilization of human resources and early detection of visual impairment which may lead to blindness. Involving teacher in eye screening program will save much time and energy for oculists and their staff, reduce their workload, and provide wider service coverage. Their intimacy is also an important element that eye examination would not be a tense examination but rather a fun activity which can be conducted anytime during school hours.

Eye screening program, running based on community solicitation through community service program, has been available so far but not yet held regularly. The obstacles that arise in conducting eye screening program among others are the School Health Unit program that does not work well, the teacher has not been capable in conducting eye screening using Snellen because he has yet to be trained, and also the school does not have the required tools. It is necessary for teacher to have a training on how

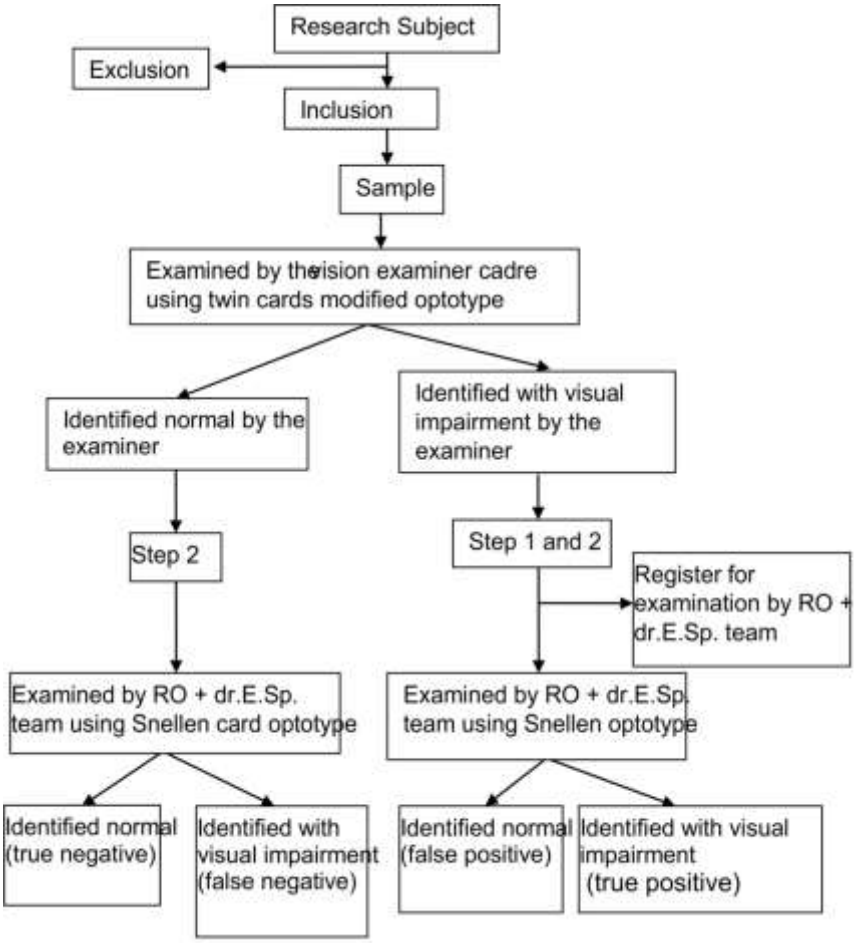
to perform a basic visual test so that teacher can carry out a visual examination in order to detect visual acuity and have students' visual acuity data.

Based on the explanation above, the researcher conveys the idea of twin cards with the intention of removing confusion in reading Snellen graphic, securing accurate response, portable, no electricity required, becoming a fun eye screening, arranged according to the standard.[8] It is called the twin cards because it is made in two equal parts, one for the examiner and the other one for the patient who will be a means in responding by matching the corresponding object. The form is not like Snellen optotype with various object in a graphic but rather with a card containing one object representing one size of visual acuity with a card size of 15 cm x 15 cm.[9]

METHODOLOGY

The type of this research is diagnostic test to analyse the sensitivity and specificity of twin cards optotype in visual impairment screening on students using primary data from eye screening. This is an epidemiologic research with parallel screening design. It is a screening conducted under two-times screening and the result is tested positive if one of the screening results is positive. It uses multiple screening. The screening uses new modified test tool from gold standard test equipment. The sample was referred by the Education Office of Semarang which is Krapyak public elementary school, located on Warigalit street, West Semarang. Permission to conduct the screening was given from the local authority. The research was taken place from February 2017 until September 2017.

Predictor variable in this research is the results of the eye screening on the students using the ordinal scale of Snellen optotype. The outcome variable is the results of the eye screening on the students using ordinal scale of twin cards optotype. The inclusion condition is the participant willing to participate in the research by filling and signing the informed consent in good health. The exclusion condition is that the participant who does not present at the time of the research after taking the eye screening. The method of sample collecting is that including all the students to receive the visual acuity screening. This research uses consecutive sampling technique in collecting the sample. The sample size is measured using the sample size formula for diagnostic test research. The data from the screening examination using twin cards and Snellen that have been collected are tabulated and inserted into a 2 x 2 table. On the table, then, calculation to find the sensitivity, specificity, positive predictive value and negative predictive value from the eye screening to detect myopia in children is conducted.



Students from the selected population who meet the inclusion and exclusion conditions are asked to sign the informed consent in which they would be provided with explanation and information about the research; what to check, how the examination would be conducted, and the significance of the research as well as the side effect. They are allowed to consult and ask for permission to their guardians first before participating.

RESULTS

Teacher, as the vision examiner cadre, are trained with theory and practice for one day. The topics are about the issue on blindness, the importance of early detection of refractive disorder especially myopia, the role of teacher in early detection of eye disease, and visual acuity screening procedure on students. Training process is conducted by Refractionist Optician and experienced ophthalmologist and the procedure has to be explained in detail. Afterwards, the participants repeat the whole procedure in front of the trainers in order to ensure that the vision examiner cadre understand the complete procedure and also to remove their doubt.

Vision examiner cadre are equipped with tools required to conduct the screening such as; twin cards optotype, 6-meters tape to adjust the distance and conducted outdoor with the light source from the sun on a bright day. The examiner and the participant are on chair, sit comfortably and then the participant's eyes are examined alternately. The participant wears eyepatch provided by the researcher on the unexamined eye. A table is placed in front of the participant. Twin cards that would be selected by the participant by matching the picture according to what the examiner asked are placed on it. For the participants who wear glasses, the result is measured based on the vision measurement using glasses or contact lenses.

Vision examiner cadre is given 1 to 2 hours to conduct eye screening on students in each of their school. The data recorded are name, age, gender, habit of playing game, history of their parents wearing glasses, and the use of CBT in their school. Visual acuity status is recorded on all form A for normal visual acuity (emmetropia) or for visual acuity which does not reach 6/6 or 20/20 (ametropia). In-depth data for students who are identified with ametropia are also recorded on form B.

Examination by ophthalmologist and refractionist optician is held an hour after examination by teacher so that there is still time to rest. All students who are identified with visual acuity less than 6/6 or normal value would be re-examined by ophthalmologist and refractionist optician using Snellen optotype. The examination and recording encompass visual acuity examination using flashlight to scrutinize the front segment of the pupil, funduscopic examination using indirect ophthalmoscope conducted by ophthalmologist.

Students who are identified with visual impairment or ametropia less than 6/6 by vision examiner cadre and are confirmed to have visual impairment or ametropia less than 6/6 by ophthalmologist and refractionist optician are considered as true positive. Students who are identified with visual impairment or ametropia less than 6/6 by vision examiner cadre and are confirmed to have no visual impairment or emmetropia reaching 6/6 by ophthalmologist and refractionist optician are considered as false positive.

The second step of the research is to evaluate true negative and false negative. In this stage, students who are identified normal, having no visual impairment, emmetropia, vision reaching 6/6 by vision examiner cadre and are confirmed to have visual impairment, vision reaching less than 6/6 by ophthalmologist and refractionist optician are considered as false negative. Students who are identified normal by vision examiner cadre and are confirmed to have no visual impairment and vision reaching 6/6 by ophthalmologist and refractionist optician are considered true negative. The team is consisted of three refractionist opticians to determine visual acuity and one ophthalmologist to follow-up the examination in school.

Made in four series of twin cards to represent the object with number, variation of alphabet, picture, alphabet E (tumbler), each series of 8 cards represented visual acuity levels from 20/200 to 20/20 which are written on the back of the card held by the examiner, collected in a box so that they are easy to carry and store. The single card is printed in the same pair which is placed in the examiner's position and in front of the participant. The single card size is 15 cm x 15 cm.[10]

The form of this twin cards adopts Cardiff card and the Kay image used in examining vision on babies which is composed of several single cards. If in Kay's image is a booklet of cards that are put together, the twin cards stand separately. The examination is conducted using Cardiff card with the examiner and the participant within a distance of 50 cm or 1 m while the twin cards are held out at a distance of 6 m. The examination using Sheridan Gardner is conducted by means of the card held by the patient is a card with several objects which would later be matched with the cards shown by the examiner so that when the image is shown by the participant, it may be a true random chance or even cause confusion. The twin cards held by the examiner and the participant are single cards that are identical in terms of shape.[11] Masks with cartoon characters that are loved by children such as Batman and Wonder Woman are used to cover one of the eyes of the participant being examined so that the participant becomes happy and feels this activity as a game.[12]

Table. Data analysis 2 x 2

		Gold Standrad Snellen Optotype	
		Visual acuity disorder (+)	Visual acuity disorder (-)
Twin cards optotype	Visual acuity disorder (+)	10	4
	Visual acuity disorder (-)	2	10

DISCUSSION

Previous research conducted by Bailey IL, the Berkeley Rudimentary Vision Test (BRVT), is a simple test to

evaluate the spatial visual acuity in severely impaired patients. BRVT becomes easy and it can be used in barely any condition without access to electricity. The BRVT test consists of three pairs of cards, each card has two pairs of objects on each side with a size of 25 cm. Hinged square cards are related to each other so that there are four objects for one test target.[13] The existing visual acuity test has the potential to cause intervening variables in one line of questions at the same font size.[14] Visual test using Snellen optotype can take a long time. This condition can occur because the examiner throw questions repeatedly to inquire the patient's response about the observation of the object seen. Frequently changing answers can occur because of the lack of clarity of the objects or confusion from the patient caused by the presence of more than one object in each row of Snellen optotype, unless the top row has a single object.[15]

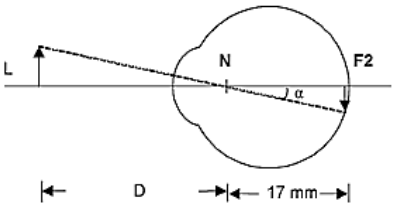
The Snellen optotype is attached to the wall so that it requires a suitable place to put it at a distance of 6 m and still requires nails and hammer. The optotype that has been attached to the wall will be thoroughly observed by other screening participants who are still waiting to get their turn for visual testing and the effect of the duration of the optotype presentation. Memorizing objects may occur. Therefore, the truth of the patient's answer is doubtful, whether it is in accordance with the ability to observe the actual object or because of the memorization.[16]

Visual testing equipment is increasingly sophisticated, modified with electrical capabilities and equipped with lights, remote control, and even computer that relies heavily on electricity with large sizes that is not portable. Despite the rapid adoption of mobile technology, there are concerns regarding the clinical validity and accuracy of the application.**[17]** National clinical health safety authorities have encouraged and advocated that clinical software regulations that are fundamental to clinical practice are evidence-based concepts of medicine, and that clinical decisions need to be supported by the scientific literature.[18] Efforts are needed to modify the existing visual acuity test so that it is easier to use, can be operated by health cadres, does not require special room and lighting requirements, accurate results according to the gold standard.

The difference between this research and the previous ones lies in the tools used, which is twin cards. The twin cards optotype is made of white cardboard with black objects on a white background to provide maximum contrast. It is easier to resolve two objects when the contrast increase, black object on a white background. It is easily achieved by increasing the luminance of the white background.[19] The single-object twin cards optotype adopts Snellen's original graphic which has a single letter on the top of it. Each object has a size equivalent to Snellen. The single-object twin cards optotype is formed of card because to reduce the problem of memorizing the order of letters in the existing Snellen chart since it has been installed for a long time on the wall. [20]

Snellen optotype font size image

The letters on the visual chart are made to measure the smallest space that can distinguish the subject. There are three lines for the 20/20 letters and two spaces making the total letter height of 5 minutes with 1 minute between the lines. To find out how high this is, it will need to be tested using our 20 feet to make the following calculations. The eye section schematic is a simple model of eye optics. It is useful for calculating objects and retinal image sizes. This is explained as follows:



Cross-sectional image of pupil counting object and image size

Calculating the height of the letter L at distance D for a distance of 20 feet and 6 meters. To simplify the number, it can be calculated at 1 degree and then divide by 12 to get 5 minutes [21]

$\tan \alpha = \frac{L}{D}$; $L = D \tan \alpha$

Tan 1 deg = 0.0175
D = 240 in or 6000 mm

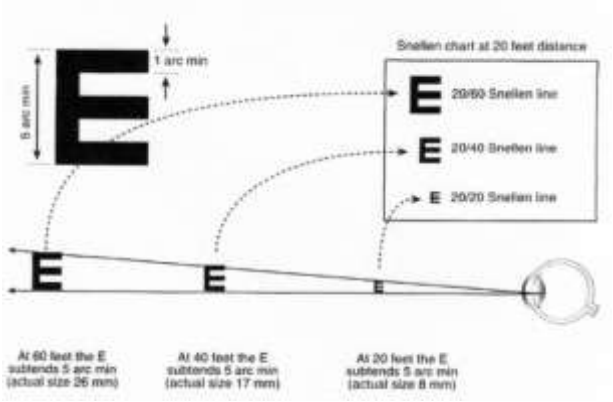
L (1 deg) = 20 ft x 12 in/ft x 0.0175 = 4.2 in for 1 deg
L (1 deg) = 6000 x 0.0175 = 105 mm for 1 deg

L (5 min) = 4.2 / 12 = 0.35 in. Height of a 20/20 letter at 20 ft.
L (5 min) = 105 / 12 = 8.75 mm

The letters in 20/40 visual are twice the height of 20/20 letters and 20/200 letters are 10 times so [22]

L (20/40): 0.70 in or 17.5 mm
L (20/200): 3.5 in or 87.5 mm

Based on the calculations above, the table is arranged as follows



Schematic drawing of font size in Snellen [23]

Visual acuity of 6 meters distance			
Snellen acuity	Decimal fraction	Log MAR acuity	Letter size (in mm)
6/60	0.10	+1.00	87.24
6/48	0.125	+0.9	69.30
6/38	0.16	+0.8	55.05
6/30	0.20	+0.7	43.73
6/24	0.25	+0.6	34.74
6/20	0.32	+0.5	27.59
6/15	0.40	+0.4	21.92
6/12	0.50	+0.3	17.41
6/10	0.63	+0.2	13.83
6/7.5	0.80	+0.1	10.98
6/6	1.00	+0.0	8.73
6/5	1.25	−0.1	6.93
6/3.75	1.60	−0.2	5.51
6/3	2.00	−0.3	4.37

Comparison table of object or letter sizes in various optotypes [24]

Visual acuity tests are performed to evaluate refractive errors including graphs, Snellen line-based vision and LogMAR charts, HOTV and Lea symbol charts. **The sensitivity and specificity of visual acuity tests range between 9-100% and 8-100%**, respectively, as in the MEM tool and Autorefractors colleagues. These are the new tools that provide computerized measurements of refractive errors by directing light onto the retina in the posterior part of the eye and measuring its reflection.[25] Both have a sensitivity and specificity of the test between 46-95% and 53-100%, respectively, for both ocular alignment and stereoacuity as well as for identifying strabismus in general for the close and open test.[26] Tests for some conditions use photoscreens to estimate refractive errors, refractive media clarity, alignment, and other specific parameters of visual acuity screening using optical images of the red reflex. In children, it can also combine extra-ocular tests around the eyes, muscle function, and colour vision evaluation. [27,28]

CONCLUSION

The sensitivity of twin cards optotype visual acuity screening method, compared to Snellen optotype visual acuity screening method, accounts for 83,33% while the specificity accounts for 71,43%. Twin cards optotype complements the existing optotype with cheaper cost, easy to access, and no electricity needed.

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