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EARLY DETECTION OF LOW VISION DETERMINANT FACTORS USING THE E-SIGALON SELF-ASSESSMENT APPLICATION

Deteksi Dini Faktor Determinan Low Vision Menggunakan Aplikasi e-SIGALON Berbasis Pemeriksaan Mandiri

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ABSTRACT

Background: Low Vision is an end-stage condition that cannot be cured. The best treatment for low vision is the early detection. However, there is still no integrated low vision data in health services, the lack of public knowledge about low vision, the low rate of case discovery, and the lack of optimal referral and treatment mechanisms for low vision are problems that must be addressed at this time. **Purpose:** This study aims to detect early low vision determinant factors using a self-assessment application. **Methods:** This study is analytical and quantitative research. Respondents for this research were from five selected populations in East Java who filled out the e-SIGALON application from September to December 2023. The respondents were suspected as having low vision if they had score of 6 or higher. The variables were analyzed using logistic binary regression, the validity and reliability test was also performed. **Results:** From 446 respondents, there were 237 people (53.14%) suspected of low vision but only 66 people came to referral hospital. The low vision suspect showed 12 of the 15 statistically significant questions (p<0.05). The most common was sitting very close to the television/monitor (48.43%), followed by having difficulties in seeing objects in dim light (44.17%) and difficulties in doing the things they want to do (40.13%). **Conclusion**: The e-SIGALON application can be a solution in managing low vision. Through this application, people can easily find out and recognize whether they have low vision or not.

ABSTRAK

Latar Belakang: *Low Vision merupakan kondisi stadium akhir yang tidak dapat disembuhkan. Saat ini, pengobatan terbaik untuk low vision adalah dengan mendeteksinya sedini mungkin. Namun, masih belum adanya data low vision yang terintegrasi dalam pelayanan kesehatan, kurangnya pengetahuan masyarakat tentang low vision, rendahnya tingkat penemuan kasus, serta belum optimalnya mekanisme rujukan dan pengobatan low vision menjadi permasalahan yang harus dihadapi pada saat ini.* ***Tujuan:*** *Penelitian ini bertujuan untuk melakukan deteksi dini faktor determinan low vision dengan menggunakan aplikasi berbasis self-assessment.* ***Metode:*** *Penelitian ini merupakan penelitian analitik dan kuantitatif. Responden penelitian ini berasal dari 5 populasi terpilih di Jawa Timur yang mengisi aplikasi e-SIGALON pada periode September hingga Desember 2023. Terduga mengalami low vision jika memiliki skor lebih dari 6. Variabel dianalisis menggunakan regresi biner logistik, kemudian uji validitas dan reliabilitas juga dilakukan.* ***Hasil:*** *Dari 446 responden terdapat 237 orang (53,14%) terduga low vision namun hanya 66 orang yang datang ke RS rujukan. terduga low vision menunjukkan 12 dari 15 pertanyaan yang signifikan secara statistik (p<0,05). Yang paling banyak yaitu duduk sangat dekat dengan televisi/monitor (48,43%), kesulitan melihat objek dalam kondisi cahaya redup (44,17%) dan sulit melakukan hal yang ingin dilakukan (40,13%).* ***Simpulan:*** *Aplikasi e-SIGALON dapat menjadi solusi dalam penanganan low vision. Melalui aplikasi ini masyarakat dapat dengan mudah mengetahui dan mengenali apakah dirinya mengalami low vision atau tidak.*

INTRODUCTION

Low vision is an end-stage condition of visual impairment. This is because visual acuity cannot be cured with various modalities. Low Vision according to World Health Organization (WHO) occurs when visual acuity is between 6/18 and 3/60 in the best eye with the best correction. Low vision sufferers can become a new burden on the world of health because with vision impairment, a person's quality of life and productivity will be disrupted (1,2). Various studies have explained that visual impairment can reduce a person's quality of life. Aside from economic condition, education, work, and social life will also be disrupted. Apart from that, it can also increase the risk of mental health problems, such as depression and anxiety, and the risk of suicide and death (3–5).

According to data from the World Report on Vision in 2019, 2.2 million people were experiencing visual impairment or blindness, and at least one million people suffering from visual impairment could be prevented. Globally, the main causes of visual impairment and blindness are refractive disorders (36%) and cataracts (17%).

Visual impairment can occur at any age, causing a global financial burden of up to USD 411 billion per year (6). The global prevalence of blindness by region is 7.3/1000 in Africa, 3.5/1000 in the USA, 8.5/1000 in the Eastern Mediterranean, 3.0/1000 in Europe, 6.9/1000 in Southeast Asia, and 5.3/1000 in the Pacific. Global data also shows 3 people with low vision for every blind person (7).

Currently, the best treatment for low vision is to detect it as early as possible to prevent someone with vision impairment from becoming low vision (8). Unfortunately, early detection of sensory disorders in Indonesia is still far from the target, according to data on Indonesia's health profile in 2022, only 14 provinces (41.20%) have achieved the target of 40% early detection of sensory disorders (9). The results of Basic Health Research (Riskesdas 2013) show that the prevalence of low vision in the population aged 6 years and over in Indonesia has reached 0.90%. The main preventable causes of visual impairment are uncorrected refractive errors (42%) and cataracts (33%), while the main causes of unpreventable blindness are cataracts (51%) and glaucoma (8%) (10). This shows that screening for low vision is an important

issue to pay attention to considering the lack of public knowledge and awareness of this disease.

The development of digital technology is rapid and has been incorporated into all elements of society. Digital transformation also provides advantages for the world of health. With this digital transformation, health services can become more effective and cost-efficient. It also opens the door for safe access to digital health facilities anytime and anywhere (11,12). The e-SIGALON application is designed for the general public with a self-assessment method so that it can increase public awareness of the dangers of low vision disease, which can prevent the worsening of low vision disease and blindness. Recently, there has been no integrated case data in health services. The lack of public knowledge about low vision, the low rate of case discovery, and the lack of optimal referral and treatment mechanisms for low vision are problems that must be addressed at this time. Therefore, to overcome this problem, this study aimed at the early detection of low vision determinant factors using the self-assessment method so that they can be easily accessed by the entire community to reduce morbidity and mortality due to low vision.

METHODS

This study used a cross-sectional design with purposive sampling method. The e-SIGALON (Elektronik Sistem Informasi Gangguan Penglihatan Low Vision) application is aimed at all East Java residents to carry out self-screening for low vision, but currently, it is still in the initial stages of launch, so the data obtained only come from the initial five populations that was selected based on age variation from September to December 2023. The study population included people who visited the Alif Laam Miim Islamic Boarding School Surabaya, Sonokwijenan Achievement Children's Home Surabaya, Madrasah Ibtidaiyah KH Romli Tamim Surabaya, JTV Surabaya, and Mojokerto Job Training Center. They voluntarily filled in the e-SIGALON application by scanning the e-SIGALON barcode or via the link https://rsmm.jatimprov.go.id/sigalon/. Figure 1 shows the main page of the e-SIGALON website.

In the e-SIGALON application, several sections must be filled, starting with an informed consent menu. On the first page of the e-SIGALON application, the user will fill in a form related to biodata, containing name, gender, address, phone number, e-mail, age, and whether the filling was done alone or assisted by someone else. On the second page of the e-SIGALON application, users will fill 20 questions related to screening for low vision disorders. After filling all questions on the second page, the user is directed to send answers by pressing the 'Send' button at the bottom of the screen. On the third page, there is a reference to the definition of the score obtained from the results of filling in the assessment form on the previous page. After understanding how to interpret the score obtained, respondents could determine what score they obtained by pressing the 'View Score' button. Finally, on the fourth page, there are score results and a review of the self-assessment form that has been completed. The score is at the top of the screen. If the score is greater than 6 then the person is said to be suspected of having low vision. The questionnaire consists of 15 questions that influence the final score and 5 questions with descriptive purposes to facilitate the resulting referral (13). This application also provides an educational menu feature and a short video using the e-SIGALON application.

The variable examined in this research was the distribution of low-vision characteristics and determinant factors in the initial population. This research also analyzed the association between low vision determinant factors and suspected result using logistic binary regression that looked for significance with $p<0.05$, and exp(b) for the odds ratio of low vision risk factors.

Figure 1. e-SIGALON Main Page

The low vision questionnaire used in the e-SIGALON application was obtained from the visual impairment detection program, Institute Nazareth et Louis-Braille and MAB-Mackay Rehabilitation Centre (13). The questionnaire was translated from English to Indonesian and its validity and reliability were tested using Kendall's Tau test in two Puskesmas in Surabaya. The validity and reliability test results for all questions show that the

questionnaire is valid to use (p < 0.05) for the validity test and p>0.05 for the reliability test.

This study was registered by the Health Research Ethics Committee at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia with reference number 0970/KEPK/IV/2024 dated April 26, 2024.

RESULTS

The total number of e-SIGALON application users from 5 populations was 446 people. From the total population, 237 people (53.14%) were suspected low vision. Of the 237 people, only 66 people sought treatment at the East Java Community Eye Hospital (RSMM) with details in Table 1. From the 66 people (27.85%) who conducted examinations at East Java Community Eye Hospital, there were 13 people (19.70%) with refractive disorders that could be corrected with glasses, while the other 53 people (80.30%) still needed further examination for low vision diagnosis. Table 2 explains the descriptive characteristics of e-SIGALON respondents, the highest number of low visions was suspected in the age group 20-44 years old while based on gender,

women were slightly higher. Table 3 describes the most important determinant factors of low vision suspected namely sitting very close to the television/monitor (48.43%), having difficulties in seeing objects in dim light (44.17%) and having difficulties to do the things they want to do (40.13%). The statistical analysis obtained 12 of 20 questions were statistically significant (p<0.05).

DISCUSSION

From the results obtained, it was found that more than half of the users experienced vision problems that led to low vision. This shows that this disease is actually quite common in society but is still ignored (14). Once a person is suspected of experiencing low vision, the person will be directed to seek treatment and carry out further examinations. Further examinations carried out include distance vision acuity, close reading, contrast sensitivity, visual field, color vision, sensitivity to glare, and vision in both eyes. Further examination depends on the factors causing low vision (15,16).

Table 1
e-SIGALON Screening Result

No	Population	Number of people	Low Vision Suspected	Go to RSMM	Refractive Error	Continued Examination
1.	Alif Laam Miim Islamic Boarding School Surabaya	227	77	-	-	-
2.	Sonokwijenan Achievement Children's Home Surabaya	47	35	35	-	35
3.	Madrasah Ibtidaiyah KH Romli Tamim Surabaya	61	31	31	13	18
4.	JTV Surabaya	61	47	-	-	-
5.	Mojokerto Job Training Center	50	47	-	-	-

Table 2
e-SIGALON Descriptive Characteristic

Variable (n=446)	Suspected		Not Suspected		Total	
	n	**%**	**n**	**%**	**n**	**%**
Age						
1 - 5 years old	2	0.4%	4	0.9%	6	1.3%
6 - 10 years old	2	0.4%	2	0.4%	4	0.9%
11 - 19 years old	14	3.1%	18	4.0%	32	7.2%
20 - 44 years old	84	18.8%	200	44.8%	284	63.7%
45 - 59 years old	40	9.0%	63	14.1%	103	23.1%
$\geq$ 60 years old	7	1.6%	10	2.2%	17	3.8%
Gender						
Man	71	15.9%	116	26.0%	187	41.90%
Woman	78	17.5%	181	40.6%	259	58.10%
Do you wear glasses when reading?						
Yes	87	19.5%	95	21.30%	182	40.81%
No	150	33.63%	114	25.56%	264	59.19%
Do not know	0	0.00%	0	0.00%	0	0.00%
Do you use glasses to see long distances?						
Yes	77	17.26%	106	23.77%	183	41.03%
No	160	35.87%	103	23.09%	263	58.97%
Do not know	0	0.00%	0	0.00%	0	0.00%
When was the last time you had your eyes checked?						
In the last 6 months	50	11.21%	42	9.42%	92	20.63%
Between 6 months to 1 year	36	8.07%	57	12.78%	93	20.85%
Between 1 year to 2 years	28	6.27%	38	8.52%	66	14.8%
Between 2 years to 5 years	28	6.27%	26	5.83%	54	12.11%
More than 5 years ago	25	5.61%	15	3.36%	40	8.97%
Do not remember/ never	70	15.7%	31	6.95%	98	21.97%
Have you ever consulted your doctor about vision problems?						
Yes	83	18.61%	98	21.97%	181	40.58%
No	154	34.53%	111	24.89%	265	59.42%
Do not know	0	0.00%	0	0.00%	0	0.00%
Have you ever gone to a low vision clinic or other type of service to get special optical aids to help your vision?						
Yes	47	10.54%	51	11.43%	98	21.97%
No	190	42.6%	158	35.43%	348	78.03%
Do not know	0	0.00%	0	0.00%	0	0.00%

Table 3
e-SIGALON Determinant Factors

Variable (n=446)	Suspected		Not Suspected		Total		p-value	Exp(b)
	n	%	n	%	n	%		
Does your vision make it difficult for you to do the things you want to do?							**0.04**	8685.40
Yes	179	40.13%	70	15.70%	249	55.83%		
No	57	12.78%	131	29.37%	188	42.15%		
Do not know	1	0.22%	8	1.79%	9	2.02%		
Can you see the Title in large print in the newspaper/textbook?							**0.02**	8685.73
Yes	132	29.60%	200	44.84%	332	74.44%		
No	77	17.26%	8	1.79%	85	19.06%		
Do not know	0	0.00%	1	0.22%	1	0.22%		
Can you see the name, writing, and number on your cellphone or savings book?							**0.01**	3206.72
Yes	176	39.46%	204	45.74%	380	85.20%		
No	61	13.68%	5	1.12%	66	14.80%		
Do not know	0	0.00%	0	0.00%	0	0.00%		
Can you see sentences written in newspapers, magazines, or books?							**0.02**	185.02
Yes	170	38.12%	194	43.50%	364	81.61%		
No	58	13.0%	13	2.91%	71	15.92%		
Do not know	9	2.02%	2	0.45%	11	2.47%		
When you walk on the highway, can you see street signs and street name signs?							0.16	10.26
Yes	82	18.39%	182	40.81%	264	59.19%		
No	155	34.75%	23	5.16%	178	39.91%		
Do not know	0	0.00%	4	0.90%	4	0.90%		
When you crossed the road, did you feel like a car suddenly appeared near you?							**0.01**	9498.41
Yes	115	25.78%	52	11.66%	167	37.44%		
No	118	26.46%	155	34.75%	273	61.21%		
Do not know	4	0.90%	2	0.45%	6	1.35%		
Do you have difficulty watching TV, playing cards, sewing, or other similar activities?							**0.00**	8550.06
Yes	155	34.75%	47	10.54%	202	45.29%		
No	10	2.24%	159	35.65%	169	37.89%		
Do not know	1	0.22%	3	0.67%	4	0.90%		

(Continued)

Table 3
Continued

Variable (n=446)	Suspected		Not Suspected		Total		p-value	Exp(b)
	n	%	n	%	n	%		
Can you see the label on the medicine bottle?							**0.02**	152.33
Yes	138	30.94%	168	37.67%	306	68.61%		
No	98	21.97%	36	8.07%	134	30.04%		
Do not know	1	0.22%	5	1.12%	6	1.35%		
Can you see the prices listed when you shop?							0.33	23.02
Yes	166	37.22%	199	44.62%	365	81.84%		
No	71	15.92%	6	1.35%	77	17.26%		
Do not know	0	0.00%	4	0.90%	4	0.90%		
Can you read letters from other people sent to you?							**0.01**	26326.88
Yes	170	38.12%	203	45.52%	373	83.63%		
No	65	14.57%	4	0.90%	69	15.47%		
Don't know	2	0.45%	2	0.45%	4	0.90%		
Can you read your own handwriting?							**0.02**	612261.83
Yes	185	41.48%	207	46.41%	392	87.89%		
No	51	11.43%	2	0.45%	53	11.88%		
Do not know	1	0.22%	0	0.00%	1	0.22%		
Do you recognize the faces of your family or friends from a distance of 3 m and above?							**0.02**	442.06
Yes	114	25.56%	189	42.38%	303	67.94%		
No	121	27.13%	15	3.36%	136	30.49%		
Do not know	2	0.45%	5	1.12%	7	1.57%		
Do you have difficulty seeing objects in dim light?							**0.03**	937.81
Yes	197	44.17%	121	27.13%	318	71.30%		
No	39	8.74%	81	18.16%	120	26.91%		
Do not know	1	0.22%	7	1.57%	8	1.79%		
Do you tend to sit very close to the television/monitor?							**0.02**	1603.64
Yes	216	48.43%	90	20.18%	306	68.61%		
No	20	4.48%	116	26.01%	136	30.49%		
Do not know	1	0.22%	3	0.67%	4	0.90%		
Has a doctor ever told you that your vision cannot be treated?							0.11	46.65
Yes	22	4.93%	18	4.04%	40	8.97%		
No	215	48.21%	191	42.83%	406	91.03%		
Do not know	0	0.00%	0	0.00%	0	0.00%		

This study is a new effort for low vision screening, which is the first to be conducted in Indonesia, according to the researchers' best research. In the early stages of developing this application, only a small number of respondents were successful in following up and seeking treatment at referral hospitals. Screening and disease prevention according to the hierarchy is the responsibility of the first level health service or community health centers (17). However, currently the e-SIGALON service has not yet been integrated, creating obstacles in following up low vision.

Therefore, further cooperation and outreach is needed to first level health services such as community health centers and primary health clinics to implement the following up the e-SIGALON application result. In the future, it is hoped that this first-level health service will become a filter that directs those suspected of having low vision to go to advanced health services. Apart from that, if suspected low vision does not check their vision, this first-level health service also has the right to carry out further follow-up according to their work area. Apart from the follow-up system still not yet been integrated, the problem of few people suspected low vision did not come for treatment at referral hospitals can be caused by the lack of public knowledge and awareness of this disease. Low vision is a disease that is still rarely known to the public, especially in low-middle-income countries. This makes a barrier to providing effective services and prevents blindness (18). Another research also states that people still cannot differentiate between low vision and blindness, and even more than half of the participants heard about low vision for the first time (14). Currently, outreach and education to the general public are crucial in managing this disease.

Low vision makes person difficult to carry out daily activities. Early symptoms that can be recognized including difficulties in reading, driving, recognizing faces, colors, and seeing computer/television screens clearly (15,19,20). People with low vision generally experience problems in reading, especially small writing such as what we often encounter in newspapers or books, on cellphone screens, letters, or in their own handwriting, so they need special lenses or magnifiers to be able to read well (21). People with low vision have a reduction in viewing distance and distinguishing images. This makes it difficult for them to watch TV, play cards, and sew. Therefore, most of them need to sit closely to the television/monitor to watch clearly. This distance is also influenced by the font type and size (22,23). Brightness also affects a person's seeing ability, when in a dim light, low vision sufferers have to look repeatedly to be able to recognize an object well and other research states that the use of color contrast and brightness adjustment devices can be very helpful (24,25).

Visual acuity in low vision sufferers is reduced to between 6/18 and 3/60 so that the ability to see and recognize the faces of family or friends is reduced and limited to a certain distance, depending on the severity of the sufferer (2). Low vision is divided into several types based on the disease or condition that causes it, namely central vision loss, peripheral vision loss, night blindness, and blurry or hazy vision. This also affects the symptoms that arise. For example, when a peripheral vision loss sufferer crosses the road, they will have difficulty seeing passing vehicles and will feel like cars suddenly appear nearby because their peripheral vision field is limited (7,20). The screening results also showed that 41% of people had their eyes checked in the last year. This result is quite in line with the Ministry of Health's health profile data for 2023, where East Java province succeeded in passing the target of 40%. However, public awareness of checking their eye health must continue to be increased (9,17).

According to several studies, low vision generally does not stand alone but is a progression or vision damage caused by a disease that previously developed, such as cataracts, refractive disorders, eye injuries, cancer, retinitis pigmentosa, age-related macular degeneration (AMD), glaucoma, and diabetic retinopathy (21,26). Low vision has a very bad impact on sufferers because it can cause anxiety about the progression of the disease, disability, and decreased quality of life, including difficulty seeing, walking, reading and even carrying out daily activities (27). This reduction in quality of life also affects a person's mental health. A few people with severe visual impairment want to end their lives (28). Current management of low vision relies on vision aids because it cannot be cured. However, the use of visual aids is still not fully accepted and utilized by the general community. This is a problem that cannot be resolved so prevention is still the best option in managing this disease (29,30).

Research Limitation

Research on low vision is still very few and rarely conducted so there are limitations to comparing with similar studies. This research is still limited to certain populations and has not yet been widely used among the general public. Apart from that, there were also limitations in calculating the sensitivity and specificity values of this screening tool which cannot be carried out due to the lack of follow-up data and further examination for all samples.

CONCLUSION

The e-SIGALON application can be a solution in managing low vision. Through this application,

people can easily find out and recognize whether they have low vision. It is hoped in the further this application can be used in the whole community. Apart from that, a multi-sectoral collaboration involving health policymakers, primary healthcare services, and referral hospitals is needed so that this application can be applied to carry out screening and be followed up to a referral system. The well implementation of this screening system will have a positive impact in preventing blindness and improving eye health, because reducing visual impairment can support the achievement of Sustainable Development Goals (SDG).

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CONFLICT OF INTEREST

The author states there is no conflict of interest in this study.

AUTHOR CONTRIBUTIONS

All authors have actively participated in this study. EAT contributed to the conceptualization, study design, data curation, formal analysis, data interpretation, supervision, manuscript writing, and content revision. MA contributed to the conceptualization, methodology, study design, and content revision. FT contributed to the conceptualization, data curation, formal analysis, data interpretation, and manuscript writing. LM contributed to the data curation, formal analysis, data interpretation, and manuscript writing. EBR contributed to the data curation, formal analysis, data interpretation, and manuscript writing. AAAMK contributed to the data curation, investigation, data interpretation, and manuscript writing. TK contributed to the data curation, Project Administration, and manuscript writing. IK contributed to the data curation, investigation, data interpretation, and manuscript writing. AWN contributed to the data curation, investigation, data interpretation, and manuscript writing. PNR contributed to the data curation, investigation, data interpretation, and manuscript writing.

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