



Development of Digital Health Literacy Instruments for Students of the Faculty of Health Science, Universitas Dian Nuswantoro

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background and Objective: In the health sector, students' ability to filter incoming information and make sound decisions is critical. The purpose of this research is to create a digital health literacy measurement tool for health students.

Methods: This research is a study of developing a digital health literacy measurement tool for health faculty students whose validity and reliability have been tested. Online questionnaires were distributed to 337 active students. The questionnaire went through several stages of development, including literature review, expert review, trial and field test.

Results: The questionnaires related to digital competence and health literacy were used to conduct the literature review. Following various reviews, the main references for this research are "Digital competency framework for citizens-DigComp 2.1" and "Health literacy scale." According to the expert's opinion, the invalid (unimportant) questions were "I can distinguish appropriate and inappropriate digital content to share on social media so that my privacy and that of others are not

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jeopardized." and "I know how to find useful health information on the internet." Questions were removed in order to be distributed to trials. According to the test results, all questions meet the validity assumption. The Pilot Test results were tested on 337 respondents during the field test stage to ensure that all valid questions and question items were accepted.

Discussion: This study found 24 good questions to measure digital health literacy based on nine indicators, namely: Access to Health Information (2 questions), health information management (2 question), integration of health information (2 questions), and evaluation of health information (2 questions), information and data literacy (2 question), communication (1 question), collaboration (2 question), digital content creation (2 question), safety (4 questions), and problem-solving (5 questions).

Keywords: *Digital health literacy; students of the faculty of health science; the digital competencies framework for citizens-DigComp 2.1; E- health literacy scale.*

1. INTRODUCTION

People are becoming more aware of health information globally as media and sources of health information develop, which is often referred to as global health information disclosure; however, because the diversity of information can be confusing, an understanding of health literacy is required, which includes how to access, understand, assess, and apply correct health information. Misunderstandings and even misinformation can occur as a result of receiving information through the wrong medium [1] According to Yustitia et al (2020), health-related content in online media ranks first due to the highest percentage of incorrect information, up to 27%. Meanwhile, Facebook/Twitter/Instagram (92.4%) are the most commonly used media to spread false health information, followed by Whatsapp/Line/Path (62.8%) and websites (34.9%) [2]. Misinformation, particularly health-related misinformation, can spread faster than accurate information. One percent of well-known hoaxes reach 1,000 to 100,000 people, while exact details rarely reach more than 1,000 people [3,4].

Indonesia has a penetration rate of 71.1% for internet users but has poor digital literacy skills (52 of 62 countries globally). The data shows that Indonesia has a clear disadvantage in using digital technology, and it is easy to negatively impact digital technology through misinformation and Hoax. Indonesia had experiences facing Infodemic during the election and COVID-19 diseases [5,6].

Students are the most significant internet users in Indonesia. The survey by Association of Indonesian Internet Service Providers (APJII) related to the Internet user group, which is mainly in the age group 19 to 34 years by 49.52%, while

the age group 35 to 54 years is in second place with a value of 29.55%, followed by the age group 13 to 18 years and the age group above 54 years worth 16.68 and 4.24% [7].

The ability to search, find, understand, and interpret health information from electronic sources and apply the acquired knowledge to address or solve health problems is referred to as digital health literacy [8]. Health literacy skills are necessary for health students to sort out doubtful information. Good health literacy skills will have an impact on students' ability to filter incoming data and make appropriate decisions in the health sector [9]. The digital era has produced billions of information daily until this era is identified with the period of information flooding. This information has had an impact on existing data in the health sector. Health information among health faculty students who are doubtful requires digital health literacy efforts. Digital health literacy is a skill, knowledge, and practice related to health and is needed by someone to understand digital-based information [10]. With the global digitalization of the health sector and the widespread availability of Web-based applications, understanding the true Digital Health Literacy Instruments is essential (eHealth literacy). The Digital Health Literacy Instrument (DHLI) can be used in the health sector to assess operational skills, navigation skills, information retrieval, evaluate reliability, determine relevance, add self-generated content, and protect privacy [11]. Due to a lack of digital health literacy, health students are unable to sort through the amount of information received through online media or social media, which leads to incorrect decisions about matters directly or indirectly related to health [12].

The Faculty of Health, Universitas Dian Nuswantoro, has had excellent research on

health literacy to improve health status. This excellent research has been stated in the health faculty research master plan 2020-2024 [13]. Health literacy which is leading research, requires the role of students in the health faculty environment, which is the closest part of the implementation of this research. The low ability of digital health literacy will impact students' inability to sort information received through social media or online media and risk making mistakes in making decisions about matters directly related to health or not.

This study aims to develop a digital health literacy measurement tool for health students, to describe the digital health literacy skills possessed by students of the Faculty of Health, Universitas Dian Nuswantoro.

2. METHODS

This research is development research. In connection with the limitation of community activities, data collection is carried out online using the GForm on the link: <https://bit.ly/DHLFKESUDINUS2022> Which is shared in class and class groups as well as in personal messages.

Calculate the research sample using the slovin formula with an error tolerance of 5%. The population of 1,642 people is a student of the health faculty of University of Dian Nuswantoro, so the research sample is 321 respondents (minimum sample). The sampling technique will use snowball sampling according to the members of the class/class of students who fill in.

Respondents who have completed filling out the questionnaire will get souvenirs.

This research has been approved by the Health Research Ethics Commission of Dian Nuswantoro University with the number 293/EA/KEPK-Fkes-UDINUS/VII/2022.

The objectives of this research are:

- a) Literature review of existing and used theories and questionnaires on digital health literacy, e-Health literacy, or health literacy.
- b) Develop a digital health literacy initial questionnaire for health students.
- c) Validate the content of the questionnaire by health literacy experts and conduct a pre-test on the questionnaire.
- d) Using the developed questionnaire to measure digital health literacy in health students (field test)

3. RESULTS

3.1 Review of Literature

This literature review analyzed existing questionnaires related to digital competence and health literacy. Following the completion of various reviews in this study, the main reference is digital competence, specifically "The digital competences framework for citizen-DigComp 2.1" [10] and "e Health literacy scale" [14]. Table 1 shows a digital health literacy questionnaire designed from the results of a literature review.

Table 1. Digital health literacy questionnaire designed from the results of a literature review

No	Statement	1	2	3	4	5
1	I can identify the keywords and tags required to search the internet for information on the desired topic.					
2	I know where and how to save information or websites on my cellphone if I need them in my daily life.					
3	In everyday life, I can "chat" using commonly used chat applications (for example, Facebook, WhatsApp, Line, and so on).					
4	I can manage group chats on my phone (for example, Facebook Messenger or WhatsApp, Line, Telegram), such as creating groups, adding members, and deleting groups.					
5	I can use commonly used chat applications (such as Facebook, WhatsApp, and Line) to share material (messages, files, pictures, and links) with other group members.					
6	I can use and recommend various strategic media (Facebook, hashtags on Instagram, and Twitter) to mobilize community participation in environmental activities or topics.					
7	I can select the most appropriate application on my mobile phone or					

No	Statement	1	2	3	4	5
	computer to collaborate with friends to create a document from an activity, such as pictures, leaflets, and so on.					
8	I am capable of managing and resolving issues that arise when writing and communicating using digital tools (for example, inappropriate comments, hoaxes, and so on) on my social media.					
9	When using social media on the internet, I can manage my social media to avoid actions that could jeopardize the reputation of my digital data.					
10	I can make videos using tutorials on YouTube and Instagram on how to make short videos with health content on a tablet or mobile phone.					
11	I know how to add dialogue and images to existing short videos on the internet to produce new videos.					
12	I can protect my social media accounts (twitter, FB, Instagram) using various means (adequate passwords, login controls etc.)					
13	I can detect risks when receiving tweets or messages from other people with fake profiles or phishing attempts					
14	I can choose the most appropriate method to protect my personal data and that of others (e.g. address, phone number, etc.) when sharing digital content on social media.					
15	I can distinguish appropriate and inappropriate digital content to share on social media so that my privacy and that of others are not compromised.					
16	I can create digital health campaigns using social media (e.g. twitter, FB) that can be shared and used by others on smartphones or tablets.					
17	I can identify simple problems that may arise when using digital equipment and what help is needed to solve these problems.					
18	I can make adjustments on my computer/smartphone/tablet such as making the letters bigger so that they can be read on the screen					
19	I can choose digital technologies and tools that can be used to create well-defined knowledge and innovation					
20	I can collaborate with friends to understand and solve routine and conceptual problems in the use of digital equipment					
21	I can evaluate whether the situation of the newly discovered digital environment while browsing is appropriate					
22	I know what health information is available on the internet					
23	I know where to find useful health information on the internet					
24	Internet can be used as a source of health information					
25	I know how to find useful health information on the internet					
26	I know how to use the internet to answer health questions					
27	I know how to use the health information found to help with work					
28	I can evaluate health information found on the internet					
29	I can distinguish correct health information and incorrect health information on the internet					

Annotation: 1: Very Unimportant; 2: Not Important; 3: Between Important and Unimportant; 4: Important; 5: Very Important

3.2 Expert Review

The questionnaire then asks experts who understand digital technology and health questions about the questionnaire's design based on the literature review. This stage gathers six experts with both practitioner and

educational backgrounds. These experts were then asked to rate the components of Digital Health Literacy competence that are important for the general public from very unimportant to very important [11]. The following is a recapitulation of the expert's assessment.

Table 2. Digital competencies assessment results by experts using item correlation coefficient [11]

No	Item correlation coefficient	Standard	Information
1	0,686	0,3	Valid
2	0,567	0,3	Valid
3	0,537	0,3	Valid
4	0,516	0,3	Valid
5	0,668	0,3	Valid
6	0,594	0,3	Valid
7	0,588	0,3	Valid
8	0,579	0,3	Valid
9	0,897	0,3	Valid
10	0,609	0,3	Valid
11	0,308	0,3	Valid
12	0,293	0,3	Invalid
13	0,897	0,3	Valid
14	0,690	0,3	Valid
15	0,697	0,3	Valid
16	0,783	0,3	Valid
17	0,731	0,3	Valid
18	0,596	0,3	Valid
19	0,780	0,3	Valid
20	0,931	0,3	Valid
21	0,347	0,3	Valid
22	0,137	0,3	Invalid
23	0,436	0,3	Valid
24	0,766	0,3	Valid
25	0,370	0,3	Valid
26	0,687	0,3	Valid

The expert's assessment will consider the question valid if the item correlation coefficient value is 0.3. Based on this expert's judgment, the invalid item is the question, "I can distinguish appropriate and inappropriate digital content to share? on social media so that my privacy and that of others are not compromised." And "I know

how to find useful health information on the internet."

In addition to using the value of the correlation coefficient, the validity also uses the content validity of Aiken's V [15]. The results of the content validity of Aiken's V are listed in Table 3.

Table 3. Digital competencies assessment results by experts using Aiken's V [15]

No Soal	Expert										$\sum s$	V
	1	2	3	4	5	6	7	8	9	10		
1	5	3	5	5	4	5	5	5	5	4	27	0,675
2	4	4	5	3	5	5	3	5	5	4	27	0,675
3	3	3	4	4	5	4	3	3	4	4	34	0,85
4	4	4	4	5	5	5	3	4	5	5	29	0,725
5	3	3	5	4	4	4	3	4	5	4	27	0,675
6	5	3	5	5	5	5	5	4	4	4	35	0,875
7	5	4	5	5	4	5	4	4	5	4	26	0,65
8	3	3	3	4	4	4	2	4	4	4	38	0,95
9	5	4	5	5	5	5	4	5	5	5	35	0,875
10	5	4	4	4	5	5	4	5	5	4	36	0,9
11	5	4	5	5	4	5	5	5	4	4	37	0,925
12	5	4	5	5	4	5	5	4	5	5	28	0,7
13	4	3	4	4	4	4	3	4	4	4	31	0,775
14	5	3	4	4	4	5	4	4	4	4	30	0,75

No Soal	Expert										$\sum s$ 36	V 0,9
	1	2	3	4	5	6	7	8	9	10		
15	5	3	4	4	5	4	3	4	4	4	32	0,8
16	4	3	4	4	5	5	4	4	5	4	30	0,75
17	5	2	4	4	4	4	4	4	5	4	30	0,75
18	4	2	4	4	4	5	5	4	4	4	36	0,9
19	3	3	5	4	5	5	3	5	5	4	32	0,8
20	5	3	5	5	5	5	4	5	5	5	37	0,925
21	4	4	5	5	4	4	3	5	4	5	33	0,825
22	5	5	5	4	5	5	4	5	4	4	36	0,9
23	4	4	5	4	4	4	3	5	4	4	31	0,775
24	4	3	4	4	4	5	4	5	5	4	32	0,8
25	5	4	5	5	5	5	5	5	4	3	36	0,9
26	5	4	5	5	5	5	5	5	5	4	38	0,95

Aiken's V coefficient value ranges from 0 – 1 [16]. So that the item questions are considered to have adequate content validity.

3.3 Pilot Test

The questionnaire then changed the results from the expert to the format for a pilot test. Answers changed answers to expert questions ranging from very unimportant to very important to 7

scales (1=cannot, 2=very tricky and need help, 3=difficult to need help, 4=easy to need help, 5=easy to help others, 6=very easy if no problem, 7=very easy and solves the problem). This pilot test was distributed to 30 respondents from FKES Udinus students, then the validity and reliability were calculated. The following are the results of the truth and reliability tests for 30 respondents:

Table 4. The results of the validity and reliability of the pilot test

No	Question	R Count (R Table = 0.361)	Mean	Status
1	I can identify the keywords and tags required to search the internet for information on the desired topic.	0,827	5,79	Valid
2	I can "chat" in everyday life using commonly used chat applications (for example, Facebook, Whatsapp, Line, and so on).	0,630	4,83	Valid
3	I can manage group chats on my phone (for example, Facebook Messenger, WhatsApp, Line, and Telegram), such as creating groups, adding members, and deleting groups.	0,709	4,62	Valid
4	I can use commonly used chat applications (such as Facebook, WhatsApp, and Line) to share material (messages, files, pictures, and links) with other group members.	0,472	5,70	Valid
5	I can use and recommend various strategic media (Facebook, hashtags on Instagram, and Twitter) to mobilize community participation in environmental activities or topics.	0,636	4,45	Valid
6	I can manage and resolve issues that arise when I write and communicate using digital tools (for example, inappropriate comments, hoaxes, and so on) on my social media.	0,661	5,46	Valid
7	When using social media on the internet, I can manage my social media to avoid actions that may harm the reputation of my digital data.	0,549	6,45	Valid
8	I know how to add dialogue and images to existing short videos on the internet to create new ones.	0,797	6,70	Valid
9	I can use various methods to protect my social media accounts (Twitter, Facebook, and Instagram) (adequate passwords, login controls etc.)	0,723	6,37	Valid
10	When I receive tweets or messages from people with fake profiles or phishing attempts, I can detect risks.	0,494	6,83	Valid

No	Question	R Count (R Table = 0.361)	Mean	Status
11	When sharing digital content on social media, I can select the most appropriate method to protect my personal data and that of others (e.g., address, phone number, etc.).	0,558	3,12	Valid
12	I can create digital health campaigns using social media (e.g., Twitter, Facebook) that others can share and use on smartphones or tablets.	0,746	3,25	Valid
13	I can identify simple issues that may arise when using digital equipment and what assistance is required to resolve these issues.	0,734	5,91	Valid
14	I can change the size of the letters on my computer/smartphone/tablet to make them easier to read on the screen.	0,582	4,20	Valid
15	I can select digital technologies and tools to generate well-defined knowledge and innovation.	0,770	4,66	Valid
16	I can work with friends to understand and solve routine and conceptual issues related to the use of digital equipment.	0,760	6,16	Valid
17	When browsing, I can assess whether the situation in the newly discovered digital environment is appropriate.	0,774	6,04	Valid
18	I am aware of the health information that is available on the internet.	0,774	4,29	Valid
19	I know where to look on the internet for useful health information.	0,641	3,5	Valid
20	Students' knowledge, competence, and involvement in seeking health information can be enhanced by using online health information .	0,756	5,37	Valid
21	I understand how to use the internet to find answers to medical questions.	0,689	5,45	Valid
22	I understand how to use health information found on the internet to assist with my work. I can evaluate health information found on the internet.	0,738	5,66	Valid
23	On the internet, I can tell the difference between correct and incorrect health information.	0,779	5,66	Valid
24	Accessibility, Quality, and Readability of Health Information on the Internet	0,710	6,25	Valid

Based on the results of the pilot test, all questions are considered valid because the r count is more significant than r table, and the mean value is greater than 3 [17].

3.4 Field-Test

Based on the pilot test results, the field-test stage was then carried out, namely distributing questionnaires to Faculty of Health Science students. The questionnaire was completed by 337 students. The following are the results of the field tests that have been carried out.

Based on the Table 5, the r count has exceeded the r table, and the Cronbach alpha value if items are deleted is smaller than the Cronbach alpha value of 0.947, so all question items have met the validity assumption.

4. DISCUSSION

The measurement instrument developed is one of the measurement questionnaires that can comprehensively measure digital health literacy in health students, including the ability to use computers, ethical skills, and health literacy skills. The currently available measurement instrument is still in the form of a self-report assessment, which does not provide information about the level of health literacy competence possessed [18].

According to research, more than a third of the general population cannot understand health information [19]. Those with a low health literacy level will show lower awareness, knowledge, and protective behavior [20-22,18,14]. If a person is in the health sector, there is a demand for

awareness, knowledge, and appropriate protective behavior. Based on the findings, 28.1% of students still find it difficult to assess the quality and reliability of health information, and students with a limited level of digital health literacy will more often use social media to find health information [23]. In addition, health students also, when receiving health information, will have different responses there are 41.9% do

not check the truth of health information because they feel that someone has reviewed it before [24]. These reasons illustrate how health students use digital health literacy skills. So that the instrument for assessing digital health literacy skills will be able to describe the digital health literacy skills of health students objectively [25,26].

Table 5. The results of the field test validity and reliability

No	Question	Mean	SD	R Count (R Table = 0,113)	Cronbach alpha if items deleted
1	I can identify the keywords and tags required to search the internet for information on the desired topic.	5,29	1,422	0,504	0,946
2	I can "chat" in everyday life using commonly used chat applications (for example, Facebook, Whatsapp, Line, and so on).	5,66	1,322	0,640	0,944
3	I can manage group chats on my phone (for example, Facebook Messenger, WhatsApp, Line, and Telegram), such as creating groups, adding members, and deleting groups.	6,09	1,065	0,562	0,945
4	I can use commonly used chat applications (such as Facebook, Whatsapp, and Line) to share material (messages, files, pictures, and links) with other group members.	5,97	1,161	0,656	0,944
5	I can use and recommend various strategic media (Facebook, hashtags on Instagram, and Twitter) to mobilize community participation in the environment on various activities or topics.	5,66	1,260	0,576	0,945
6	I can manage and resolve issues that arise when I write and communicate using digital tools (for example, inappropriate comments, hoaxes, and so on) on my social media.	5,08	1,351	0,638	0,945
7	When using social media on the internet, I can manage my social media to avoid actions that could harm the reputation of my digital data.	5,14	1,506	0,664	0,944
8	I know how to add dialogue and images to existing short videos on the internet in order to create new videos..	5,09	1,561	0,611	0,945
9	I can secure my social media accounts (Twitter, Facebook, and Instagram) using a variety of methods (adequate passwords, login controls etc).	5,14	1,603	0,635	0,945
10	When I receive tweets or messages from people with fake profiles or phishing attempts, I can detect risks.	5,15	1,539	0,575	0,945
11	When sharing digital content on social media, I can select the most appropriate method to protect my personal data and the data of others (e.g., address, phone number, etc.).	4,53	1,741	0,591	0,945

No	Question	Mean	SD	R Count (R Table = 0,113)	Cronbach alpha if items deleted
12	I can create digital health campaigns using social media (e.g., Twitter, Facebook) that can be shared and used by others on smartphones or tablets.	5,26	1,563	0,676	0,944
13	I can identify simple problems that may arise when using digital equipment and what assistance is required to solve these problems.	5,28	1,453	0,604	0,945
14	I can change the size of the letters on my computer/smartphone/tablet to make them easier to read on the screen. I can select digital technologies and tools that can be used to create well-defined knowledge and innovation.	4,70	1,515	0,657	0,944
15	I can work with friends to understand and solve routine and conceptual issues related to the use of digital equipment.	5,07	1,550	0,673	0,944
16	While browsing, I can assess whether the situation in the newly discovered digital environment is appropriate.	5,29	1,434	0,722	0,943
17	I can change the size of the letters on my computer/smartphone/tablet to make them easier to read on the screen. I can select digital technologies and tools that can be used to create well-defined knowledge and innovation.	4,93	1,479	0,694	0,944
18	I can change the size of the letters on my computer/smartphone/tablet to make them easier to read on the screen. I can select digital technologies and tools that can be used to create well-defined knowledge and innovation.	4,89	1,507	0,677	0,944
19	I can work with friends to understand and solve routine and conceptual issues related to the use of digital equipment.	4,94	1,512	0,638	0,944
20	While browsing, I can assess whether the situation in the newly discovered digital environment is appropriate.	5,27	1,354	0,687	0,944
21	I can change the size of the letters on my computer/smartphone/tablet to make them easier to read on the screen. I can select digital technologies and tools that can be used to create well-defined knowledge and innovation.	5,74	1,237	0,645	0,944
22	I can work with friends to understand and solve routine and conceptual issues related to the use of digital equipment.	5,56	1,308	0,672	0,944
23	While browsing, I can assess whether the situation in the newly discovered digital environment is appropriate.	5,36	1,364	0,651	0,944
24	I can change the size of the letters on my computer/smartphone/tablet to make them easier to read on the screen. I can select digital technologies and tools that can be used to create well-defined knowledge and innovation.	5,17	1,448	0,589	0,944

In the initial stage, an expert review is conducted as an expert assessment. Expert judgment is used to collect opinions and perspectives of experts, educators, and practitioners regarding the manufacture of questionnaires because there are no measuring tools available to measure digital health literacy in health students, especially in developing countries. There are ten experts involved in this stage. This expert review resulted in the elimination of one question on the Protecting personal data and privacy indicator and 1 question on the health information access indicator. Based on the expert review, the expert also found that one of the questions on the health information access and safety indicators was the essential item of question or information. This study identified 26 items on digital health literacy that are important for health students. Two question items that question removed at the expert review stage were "I can distinguish appropriate and inappropriate digital content to be shared on social media so that my privacy and that of others are not disturbed." and "I know how to find useful health information on the internet." Health information access is still far from ideal, especially for the older population and those economically disadvantaged. Research findings by Czaja also found less computer experience in African Americans and Hispanic Americans than in European Americans in a sample of 1204 individuals aged 19 to 91 [27].

The next stage is to conduct a pilot test on 30 samples of respondents who are health faculty students. At this stage, all items have met the assumption of validity. The pilot test also found that one of the questions on the information and data literacy indicator was the essential item of question or information. This study identified 24 essential digital health literacy items for health students. Digital competency benchmarks, DigComp stated that the leading digital competencies include information and data literacy, communication and collaboration, digital content creation, security, and problem-solving [28].

The final stage was a field test involving 337 health faculty students. At this stage, all items have met the assumption of validity. Based on the field test, the field test also found that one of the questions on the problem-solving indicator (Creatively using digital technologies) was the essential item of question or information. This study identified 24 important digital health literacy items for health students. Creatively using digital technology refers to skills that creatively can

apply to analyze crucial data and adapt to cope with life situations. In addition, health literacy must recognize the multidimensional aspect of health literacy to assess the needs and challenges of the community and be responsive in terms of access, accessibility, and affordability, not only of health information but also of health services and providers.

5. CONCLUSION

Digital health literacy is an ability needed in today's digital era. This paper is the first to develop an instrument for measuring health students' digital literacy skills. This paper finds 24 good questions to measure digital health literacy based on nine indicators, namely: Health Information Access (2 questions), health information management (2 question), health information integration (2 questions), health information evaluation (2 questions), information and data literacy (2 question), communication (1 question) and collaboration (2 question), digital content creation (2 question), safety (4 questions) and problem-solving (5 questions).

DATA AVAILABILITY

The paper and the supporting information file in the article contain all relevant data. This study will assist researchers in identifying critical areas of Development of Digital Health Literacy Instruments for Faculty of Health Science students.

CONSENT

The research was carried out in accordance with research standards in the Republic of Indonesia, and written consent was obtained and kept by the author.

ETHICAL APPROVAL

"This study was approved by Dian Nuswantoro University's Health Research Ethics Commission under the number 293/EA/KEPK-Fkes-UDINUS/VII/2022."

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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