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Evaluating the Usability of the AKUDia Mobile App for Blood Sugar Monitoring: A Feasibility Study

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Abstract

A variety of ultra-invasive portable blood sugar test kits have been available on the market; these kits require drawing blood from capillaries, which can still be painful and uncomfortable and even enhance the risk of infection. To develop a non-invasive blood sugar meter that is painless and comfortable to use, innovation is required. AKUDia, a mobile application for monitoring blood sugar, was developed as a smart wearable device to help older adults with diabetes stay healthy. This study aimed to measure the usability of the AKUDia application using a usage questionnaire. In terms of a feasibility study, this was quantitative. USE Questionnaire contains a list of questions encompassing 30 questions divided into four dimensions: Usefulness, Ease to use, Ease of learning, and Satisfaction. 50 respondents were recruited for this study, meeting the inclusion criteria of DM patients who had completed a week-long training program on using the AKUDia application. Samples were selected by simple random sampling, and descriptive and univariate data analyses were performed. The AKUDia feasibility test results demonstrated a usability value of 83%, which was classified as very feasible; an ease of use value of 74 percent, which was classified as feasible; an ease of learning value of 83%, which was classified as very feasible; and a satisfaction aspect of 71% at the feasible level. The average usability value of the four categories (usability, ease of use, ease of learning, and satisfaction), which was obtained at 78 percent, indicates that the AKUDia application's usability is at a practicable level. The usability of the AKUDia application is feasible. Governments should support the use and implementation of this innovation in addition to healthcare professionals like doctors and nurses. Information technology systems have the potential to serve as an instrument for illness prevention, treatment, and rehabilitation in addition to promoting health. Future studies should be enhanced to investigate, through experimental research, how the AKUDia application supports nursing care and health management for individuals with diabetes mellitus and the general population.

Keywords: AKUDia, Diabetes Mellitus, Mobile Application, Usability.

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1. INTRODUCTION

The prevalence of diabetes mellitus (DM), a chronic illness, is rising (Pannu et al., 2022). Globally, the number of people with diabetes mellitus aged 20 to 79 years increased from 151 million (4.6%) in 2000 to 537 million (10.5%) in 2021. It is projected that this trend will continue, with 637 million (11.3%) expected in 2030 and 783 million (12.2%) anticipated in 2045 (Mehra et al., 2023). Recently, DM affects over 16 million people in Indonesia, accounting for 33% of the nation's health spending (Badriah, Bahtiar, & Andang, 2022). Several initiatives have been contributed in place by the government, such as the Healthy Community Movement, which aims to prevent and promote disease by encouraging regular health screenings, increased physical activity, and the five pillars of diabetes management: meal planning, physiotherapy, activity, medication administration, and blood sugar monitoring (Setiawan et al., 2021).

Comprehensive government programs have not had the best effect on reducing cases of diabetes, according to the findings of Basic Health Research, which showed that the prevalence of diabetes increased significantly in Indonesia from 6.9 percent in 2013 to 8.5 percent in 2018, and cases in West Java DM increased from 1.3 percent to 1.7 percent (Ariyanto, et al., 2021). Cipto National Referral Hospital Mangunkusmo Hospital in Indonesia reports that the condition has complications in addition to its increasing prevalence. These complications encompass 33.40 percent diabetic retinopathy, 34 percent neuropathy, 1.3 percent amputations, 13.3 percent heart disease (including angina, MCI, and heart failure), 5.3 percent stroke, and 10.9 percent peripheral arterial disease (Kementerian Kesehatan Republik Indonesia, 2017).

Many precautions have been taken to avoid complications, which comprises monitoring blood sugar levels, which serve as crucial indicators of blood sugar control, and controlling diabetes mellitus (DM). They haven't exactly been very successful thus far, nevertheless, as evidenced by the low behavior for DM prevention and the continuing increasing DM prevalence. Residents of Tasikmalaya City report having a sweet tooth in 55.77 percent of cases, and 53.59 percent report consuming sweets more than once a day. 30.07 percent smoke, 43.89 percent participate in less physical activity, and 62.23 percent of people regularly eat fatty foods. All these figures are higher than the national average (Badan Penelitian dan Pengembangan Kesehatan Kemenkes Republik Indonesia, 2019). Due to the condition of the elderly, the majority of whom have diminished physical abilities, phenomena in society demonstrate that families who care for older adults with diabetes desire to avoid visiting primary healthcare facilities for their safety and comfort (Badriah et al., 2019).

Since family empowerment has been identified in other studies to be effective in enhancing family behavior and support in controlling blood sugar levels, it is hoped that a non-invasive blood sugar level check tool can be used at home under family supervision (Badriah et al., 2021). A plethora of highly intrusive portable blood sugar test kits have arrived on the market; these kits take blood samples from capillaries, which are still painful and uncomfortable and may potentially pose a risk for infection (Abidin et al., 2015). Even with disposable strips, they remain expensive (Bruen et al., 2017; Prawiroredjo & Julian, 2019). Thus, the development of a non-invasive blood sugar meter—a convenient and painless device for monitoring blood sugar levels—is imperative. Previous studies have established the sensitivity level of NIR LEDs at the fingertips. Due to its highest correlation score for the sensitivity of the non-invasive NIR LED blood sugar sensor, the thumb was selected (Badriah et al., 2022). The next step requires developing a smart wearable device that can access blood sugar levels in real-time in order to monitor and detect blood sugar levels.

Currently, on the market, various smartwatches have the function of detecting health conditions in the form of heart rate, body temperature, and even Body Mass Index (BMI), encompassing the watch (Apple Inc., 2021), Fitbit (Fitbit, 2019), and Galaxy watch (Samsung,

2019). Because of its closed operating system, the smartwatch is unable to optimize the data on board. The project will develop a wearable smart device called AKUDia, a mobile application for monitoring blood sugar, to help older adults with diabetes maintain their health. The usefulness of AKUDia must first be assessed using a use questionnaire to ascertain whether the program is beneficial, simple to use, easy to learn, and provides user satisfaction.

The AKUDia application can monitor the blood sugar levels of diabetics in real-time using data from non-invasive blood sugar tests employing NIR LED sensors that are connected to a smartwatch. This is the way this study differs from the previous one. Interested parties, involving medical professionals (physicians, nurses, dietitians, and pharmacists), as well as families, may examine these results at any time and from any location using smartphones. As of right now, the products available only display blood sugar test results on the Smart Watch; other people cannot access the results in real-time via their smartphones. This study aimed to measure the usability of the AKUDia application using a usage questionnaire.

2. RESEARCH METHOD

This study employed a quantitative descriptive design to examine the usability level of is AKUDia Application. The AKUDia application is a system administered to compile the results of evaluating blood sugar levels from a blood sugar measuring sensor. Figure 1 illustrates the AKUDia application.

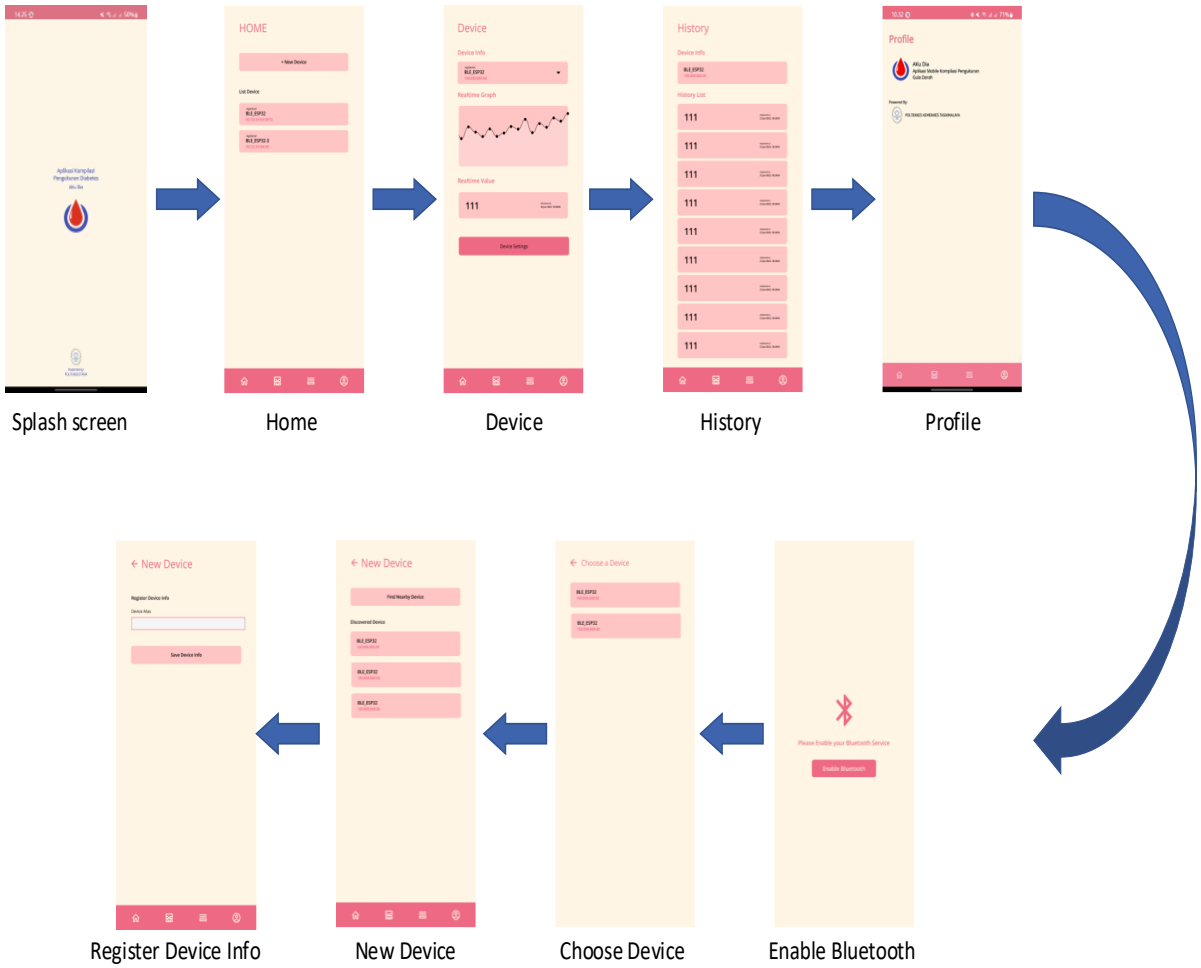

Figure 1. AKUDia Application Design.

The Kahuripan Primary Health Center in Tasikmalaya's diabetic population was the study's subject. The sample size determined by the Slovin formula for population 49 and e, or 10% sampling error, ranged from 29 to 36 samples. With the inclusion criteria of DM patients who had received one week of instruction on using the AKUDia application, a sample of fifty respondents was obtained for this study. To select participants for the study from the entire population and calculate the number of respondents, a straightforward random sampling technique was employed.

A questionnaire that was employed to evaluate the AKUDia application's usability served as the study's instrument. The study's questionnaire adopted the use question set. The questionnaire with 30 statements compensates for usability, ease of use, learning curve, and satisfaction (Setiawan, et al., 2022). To adapt the editor to the particular application being tested, the questions were translated into Indonesian (Lund, 2001). When the Pearson product-moment test was implemented to evaluate the validity of the questionnaire, the results ranged from 0.366 to 0.682. When the Cronbach Alpha coefficient was applied to test for reliability, the results were 0.837. A list of questions categorized based on elements of application usability measurements comprises the questionnaire, as Table 1 illustrates. Filling out the questionnaire involved using a Likert scale with five affirmative questions ranging from strongly disagree to agree strongly. With the Likert scale (1=Strongly Agree to 5=Strongly Disagree), each respondent had an opportunity to complete all of the questionnaire's questions.

Table 1. Use a Questionnaire with a Usability Aspect.

No	Statement
	Usefulness
1.	AKUDia helps me AKUDia helps me be more effective.
2.	AKUDia aids in my increased productivity.
3.	AKUDia is practicalIt's simple to use AKUDia.
4	AKUDia gives me more control over my health.
5.	AKUDia makes it simpler for me to complete the things I want to.
6.	AKUDia is suitable for me.
7.	AKUDia exceeds my expectations in every way.
8.	AKUDia performs all of the functions I would anticipate.
	Ease to Use
9	AKUDia is simple to use.
10	Using AKUDia is easy.
11.	AKUDia is easy to use.
12	My goals for AKUDia can be achieved in the fewest possible steps.
13	AKUDia is able to modify.
14	AKUDia is adaptable and simple to use.
15	I don't need written instructions to use AKUDia
16	To my knowledge, AKUDia is not inconsistent in any manner.
17	AKUDia would be fun for both infrequent and frequent users.
18	When I make mistakes, I can quickly and easily fix AKUDia.
19	Every time I use AKUDia, I am successful.
	Ease of Learning
20	I quickly mastered the use of AKUDia.
21	I recall using AKUDia quickly.
22	Utilizing AKUDia is simple to learn.
23	I mastered AKUDia very quickly.

	Satisfaction
24	I am pleased with AKUDia
25	I would suggest AKUDia to a friend.
26	AKUDia is enjoyable to use
27	AKUDia fulfills my needs in terms of functionality.
28	AKUDia is amazing.
29	I think I have to have AKUDia.
30	AKUDia is a pleasure to use.

The data was collected in November 2022. To ensure that the questionnaire was completed and input into the computer, data screening was done. As a result, all questionnaires had been submitted and no participants pulled out of the study. Under approval number KP-KEPK/0170/2022, the Tasikmalaya Indonesia Ministry of Health Poltekkes Ethics Committee approved the study, which also complies with all applicable ethical standards. This study has implemented the necessary ethical principles, which include providing respondents with adequate free time, maintaining respondents' confidentiality, informing them of the purpose of the study having them sign consent forms, and creating an environment that is as comfortable as possible for data collection.

The AKUDia application's usability was evaluated through descriptive data analysis. The four usability parameters of usability, ease of use, learning, and satisfaction were analyzed by calculating the percentage of respondents who completed the questionnaire. The following formula is used to determine the results of usability measurements: The following formula can be employed to determine the eligibility percentage (%): (score observed) / (score anticipated) = 100. The usability was classified as follows based on how many percentages were interpreted: very bad (<21%), bad (21-40%), enough (41-60%), feasible (61-80%), and very feasible (>80%).

3. RESULTS AND DISCUSSION

The majority of the respondents were female, of legal age, and had completed their high school education, according to Table 2's analysis of their details. The responses provided by participants utilizing the use questionnaire and the AKUDia application are presented in Table 3.

Table 2. Respondent characteristics (n = 30).

Variable	Frequency	Percentage (%)
Gender		
Male	10	33
Female	20	67
Education		
Elementary – Junior High School	8	27
Senior High School	19	63
College/University	3	10
Age		
Adult	23	77
Elderly	7	23

Table 3. The Results of Respondents' Answers.

No	Statement	Likert Scale Assessment					Score
		SDA	DA	UD	A	SA	
1	AKUDia helps me be more effective.	0	0	13	25	12	
2	AKUDia aids in my increased productivity	0	1	15	23	11	
3	AKUDia is practicalIt's simple to use	0	0	11	24	15	
4	AKUDia gives me more control over my health	0	0	0	31	19	
5	AKUDia makes it simpler for me to complete the things I want to	0	0	1	19	30	
6	AKUDia is suitable for me	0	0	7	18	25	
7	AKUDia exceeds my expectations in every way.	0	1	12	32	5	
8	AKUDia performs all of the functions I would anticipate.	0	1	13	25	11	
	Usefulness	0	3	72	197	128	400
9	AKUDia is simple to use.	0	0	0	26	24	
10	Using AKUDia is easy.	0	0	1	23	26	
11	AKUDia is easy to use.	0	0	3	26	21	
12	My goals for AKUDia can be achieved in the fewest possible steps.	0	0	0	21	29	
13	AKUDia is able to modify.	5	10	24	8	3	
14	AKUDia is adaptable and simple to use	0	0	12	24	14	
15	I don't need written instructions to use AKUDia	8	12	18	8	4	
16	To my knowledge, AKUDia is not inconsistent in any manner.	0	0	14	24	12	
17	AKUDia would be fun for both infrequent and frequent users.	0	1	21	23	5	
18	When I make mistakes, I can quickly and easily fix AKUDia.	13	15	18	4	0	
19	Every time I use AKUDia, I am successful.	1	13	18	11	7	
	Ease of Use	27	51	129	198	145	550
20	I quickly mastered the use of AKUDia	0	0	18	17	15	
21	I recall using AKUDia quickly	0	0	15	18	17	
22	Utilizing AKUDia is simple to learn	0	0	1	25	24	
23	I mastered AKUDia very quickly	0	0	12	15	23	
	Ease of Learning	0	0	46	75	79	200
24	I am pleased with AKUDia	0	0	12	14	24	
25	I would suggest AKUDia to a friend	0	0	24	26	0	
26	It is fun to use AKUDia	0	12	16	21	1	
27	AKUDia fulfills my needs in terms of functionality.	0	15	18	16	1	
28	AKUDia is amazing.	0	0	23	21	6	
29	I think I have to have AKUDia.	0	0	25	21	4	

30	AKUDia is a pleasure to use.	0	0	24	20	6	
	Satisfaction	0	27	142	139	42	350
	Total Observation Score	27	81	389	609	394	1500

Using formula 1, the following outcomes were obtained for each aspect to determine a usability presentation value on the usefulness dimension based on data in Table 3:

a. Score for the aspect of Usefulness

$$\text{Usefulness (\%)} = \frac{(0x1)+(3 x 2)+(72 x 3)+(192x4)+(128x5)}{5 x 50 x8} x100\%$$
$$= \frac{1650}{2000} x100\%$$
$$= 83\%$$

The eight questions that encompass the usefulness component had an eligibility rate of 83 percent. Table 3 demonstrates that the AKUDia application has ratings in the feasibility category ranging from 81 to 100, indicating that it is very viable to be applied by individuals with diabetes.

b. Score for the aspect of ease of use

$$\text{Ease of Use (\%)} = \frac{(27x1)+(51 x 2)+(129 x 3)+(198x4)+(145x5)}{5 x 50 x11} x100\%$$
$$= \frac{2033}{2750} x100\%$$
$$= 74\%$$

The section on ease of use consisted of eleven questions. It fulfilled 74% of the requirements for eligibility. Based on the eligibility category within the 61-80 scale and the ease of use experienced by users, diabetics can use the AKUDia application.

c. Score for the aspect of ease of learning

$$\text{Ease of Learning (\%)} = \frac{(0x1)+(0 x 2)+(46 x 3)+(75x4)+(79x5)}{5 x 50 x4} x100\%$$
$$= \frac{833}{1000} x100\%$$
$$= 83\%$$

The Ease of Learning section was comprised of four questions. It fulfilled 83% of the requirements for eligibility. The AKUDia application, which rates between 81 and 100 on a scale, is fairly practical for diabetics to use from the perspective of application simplicity of learning.

d. Score for the aspect of satisfaction

$$\text{Satisfaction (\%)} = \frac{(0x1)+(27 x 2)+(142 x 3)+(139x4)+(42x5)}{5 x 50 x7} x100\%$$
$$= \frac{1246}{1750} x100\%$$
$$= 71\%$$

The satisfaction section consisted of seven questions. It adhered to 71% of the requirements for eligibility. Based on a scale with a score between 61 and 80 for the feasibility category, diabetics can use the AKUDia application with a high degree of satisfaction from users.

Based on the average usability value of the four characteristic aspects (usability, ease of use, ease of learning, and satisfaction), the overall usability of the AKUDia application was estimated to be 78 percent. The results demonstrate that all use queries are quasi-nary. Most

respondents agree that the AKUDia program is useful, easy to use, and understandable; they are also satisfied that it was reasonably priced to purchase. This is in accordance with the earlier research on the Google Classroom application's usability using the use questionnaire, which illustrates that the percentage level of usability using the use questionnaire demonstrates a workable category on the issue of ease of use (Jannah, Sobandi, & Suwatno, 2020).

Results from other studies on cellular mobile applications that validate the utility of health applications (mHealth) using a system usability scale (SUS) and a post-study system usability questionnaire (PSSUQ) have indicated that overall SUS and PSSUQ correlate strongly against m-Health applications, according to statements produced in response to a questionnaire by 128 respondents (Zhou et al., 2019). Further research reveals that the Material Expert was employed as a tool for making decisions in family planning applications. Six midwives were assessed on their ability to assimilate information and suitability for the material using the due diligence questionnaire developed by the material expert. demonstrates that family planning decision tools can be implemented in a way that is considered feasible (Nurcahyani et al., 2022). Hence, even though they implement different methods, they own the same function to examine the usability of an application, which is a crucial factor in the application development stage before being used on a broader scale.

The AKUDia application's exclusive ability to collect data regarding blood sugar levels constitutes a limitation for this study. To see a picture of self-care for people with diabetes to control blood sugar levels, it has not been completely incorporated with the management of DM management, such as monitoring food recall, physical activity, and consumption of blood sugar-lowering drugs. It is recommended that in the future, researchers formulate applications that encompass additional health features, such as food recall monitors, physical activity, and the use of blood sugar-lowering medications, in the process of controlling blood sugar levels in diabetics.

4. CONCLUSION

Using the use questionnaire, the AKUDia application's usability test revealed that it was feasible and appropriate to use as a means of accessing data on blood sugar level readings that are reported in real-time from sensors sent to the AKUDia application. Governments ought to encourage the use and implementation of this innovation in addition to healthcare professionals like doctors and nurses. Information technology systems possess the potential to serve as a tool for preventing diseases, treatment, and rehabilitation in addition to promoting health. Future studies should be enhanced to investigate, through experimental research, how the AKUDia application supports nursing care and health management for individuals with diabetes mellitus and the general population.

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