Evaluating the impact of AsmaDroid® on knowledge, attitude, and behavior of relapse prevention among asthmatic patients

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Article Info

ABSTRACT

The success of asthma self-management is determined by three essential factors: healthcare professionals, patients, and drugs. Regarding patient factors, the level of knowledge plays a role and leads to a positive attitude and behavior to prevent future attack relapse. This quasi-experimental study aimed to determine the effectiveness of a mobile phone app-assisted educational intervention in improving the quality of knowledge, attitude, and behavior among patients with asthma. The study included 140 participants who were divided into two groups, i.e., control and treatment. The treatment group received and installed the app into their smartphone and then was asked to study all the educational materials in the app for four weeks. A test was carried out before and after the intervention period to examine the effectiveness of the intervention. This study used the statistical program IBM® SPSS® Version 22.0 to analyze data, and a parametric statistical test was utilized to test the statistical hypothesis in this investigation. The study found improvement, as many as 87.14% for knowledge, 77.14% for attitude, and 67.15% for behavior, with a p-value each of 0.01. It could be concluded that digital-based patient education using a mobile app improves the patients' knowledge, attitude, and behavior.

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1. INTRODUCTION

The management of asthma basically depends on three factors, namely: the patients, the healthcare personnel, and medications [1], [2]. In terms of patient, the extent of the patient's understanding of asthma is the most essential factor to consider. According to previous studies, patients with a good knowledge of the disease are more likely to have a positive attitude toward it. It, in turn, leads to constructive habits that can assist in preventing further assaults. As a result, it is essential for the patients to have a solid comprehension of the condition to lessen the likelihood of experiencing future episodes of asthma. Knowledge is another crucial component in forming a person's attitude [3], [4]. Many researchers have concluded that attitudes founded on knowledge are more likely to persist over time than those not.

Confirming the patient's attitudes is necessary to determine their behaviors and prevent asthma relapse [5]–[7]. The patient's awareness of the disease, in this case, asthma, plays a significant role in

determining his or her conduct. Patients with sufficient asthma knowledge are better positioned to make decisions based on their understanding [8]–[10]. In order to reduce the frequency of asthmatic symptoms, exacerbations, and future relapses, it is vital to educate patients about possible allergens and the prevention, treatment, and mechanism of asthma medications [11]. Experience and attitudes about correct or incorrect values, particularly the value of health, are two of the most influential factors in the patient behavior. Although asthma cannot be cured, its clinical manifestations can be effectively managed so they are under control. As there are no curative medical treatments for asthma, it is essential to exercise asthma prevention to avoid exposure to conditions that can trigger the disease [12], [13]. Early intervention to reduce exposure to the asthma risk factors that induce airway hyperreactivity has enhanced asthma control levels. Therefore, giving behaviors that prevent asthma a higher priority than treatment is necessary.

The knowledge, attitude, and behavior is one of primary theoretical frameworks for patient education and health promotion. According to this strategy, a patient's knowledge and attitude are the most influential determinants of whether or not they will alter behavior [14]. The field of information and communication technology (ICT) has experienced rapid expansion, and mobile phone apps are now frequently used not only as communication tools but also to assist with internet access, email, reminders, and other daily activities. It has been discovered that mobile phone app-assisted educational interventions are more effective than traditional ones [15]–[17]. The findings of the systematic investigations led to this conclusion. Unfortunately, there is currently no available study on using mobile phone app as a learning tool to enhance the knowledge, attitude, and practice of asthma patients in Indonesia. Therefore, the study was focused to determine the effectiveness of a mobile phone app-assisted educational intervention in improving the quality of knowledge, attitude, and behavior among patients with asthma. The provision of apps as a form of learning medium for patient education in this study is expected to help improve attitudes and behaviors by providing knowledge that patients can access independently.

2. METHOD

A quasi-experimental design with a non-randomized pretest-posttest control group model was applied for the research project in the Special Region of Yogyakarta, Indonesia, during January and April 2022. This study aimed to determine whether or not a digital self-management intervention, specifically the AsmaDroid® mobile app, is successful in promoting relapse prevention strategies among asthmatic patients. These strategies include knowledge, attitudes, and actions. The study was officially approved by the Ethics Commission of Health Research (KEPK), Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Number 186/EC-KEPK FKIK UMY/IX/2022.

2.1. Study participants

The study employed a quota sampling technique to recruit participants, utilizing a sample size formula devised by Lwanga and Lemeshow [18]. The study's eligibility criteria encompassed individuals aged 19 to 34 who self-reported asthma symptoms, possessed an Android Operating System-enabled smartphone, and were willing to participate in the research by downloading and installing the AsmaDroid® app. The exclusion criteria for this study included individuals who were lost to follow-up, unable to provide complete responses to all the questionnaire items, encountered technical issues during the treatment phase or voluntarily withdrew from the study.

2.2. Research instrument

In this study, the AsmaDroid® asthma self-management mobile phone app was utilized. The mobile app was previously developed in a separate study [19]. The patient education materials within the application were sourced from both the Regulation of the Minister of Health of the Republic of Indonesia Number 1023 of 2008 on asthma control guidelines and the official guidelines from The National Asthma Education and Prevention Program (NAEPP) Expert Panel Report 3. The educational materials covered several key topics including: i) an overview of asthma, ii) asthma classification, iii) recommended methods to avoid potential allergens, iv) long-term management, v) asthma attack management, vi) ways to self-monitor asthma, and vii) strategies to maintain overall health and well-being [20].

The second instrument used in this study was a questionnaire on knowledge, attitude, and behavior to limit asthma attack relapse. This questionnaire was applied in a study similar to the one conducted here [21]. Knowledge, attitudes, and behaviors were the three categories that were probed by the questionnaire. The first variable, which indicated the subject's level of knowledge, consisted of 10 questions items with four possible responses (a, b, c, and d). The results were ranked as "good" (scores between 76 and 100), "average" (scores between 56 and 75), or "low" (scores <56). The second variable, attitude, was evaluated using ten questions based on a four-item Likert scale. If X was greater than the mean, the score was considered positive; otherwise, it was considered negative. The third variable, which was only interested in "yes" or "no"

responses, was used to evaluate the subject's behavior. Similar to the second variable, it was determined whether or not the scores were controlled based on whether or not X was greater than the mean or X was less than the mean. Details regarding knowledge of relapse prevention are presented in Table 1. Table 2 depicts the attitudes toward relapse prevention, and Table 3 outlines the behaviors of relapse prevention.

Table 1. A list of question items of knowledge of relapse prevention

No	Question items (Knowledge of relapse prevention)
1	What is asthma?
	a. Airway narrowing that does not cause coughing.
	b. Airway narrowing that causes a mucus build-up.
	c. Airway narrowing results in coughing, chest tightness, wheezing, and shortness of breath.
	d. Diseases caused by stress.
2	What are the symptoms of asthma?
	a. Non-recurrent shortness of breath, wheezing, chest tightness, and coughs.
	b. Recurrent shortness of breath, wheezing, chest tightness, and coughs.
	c. Cough without shortness of breath.
	d. Coughing and shortness of breath.
3	When is the most frequent recurrence of asthma symptoms?
	a. Midday.
	b. Evening.
	c. Rest time.
	d. Morning.
4	What factors are most likely to develop asthma symptoms?
	a. Excessive activities.
	b. Consuming fatty foods.
	c. Exposure to cold air.
	d. Direct contact with the potential triggers (e.g., cold air, dust, fur, and certain foods).
5	What are the trigger factors for asthma?
	a. Allergens, excessive activity, exposure to pollution.
	b. Stress.
	c. Fatigue.
	d. Smoke.
6	What causes asthma other than allergies?
	a. Certain foods.
	b. Lack of exercise.
	c. Air pollution.
	d. Cold air, respiratory infections, emotions, and environmental pollutants
7	Which of the following statements is true?
	a. If not treated, asthma will go away on its own.
	b. Asthma is a contagious disease.
	c. Non-adherence to control asthma will facilitate the recurrence.
	d. Treatment is only to take medication without regular control.
8	Which of the following statements is false?
	a. Asthma cannot be cured, but can be controlled.
	b. Race/ethnicity influences risk factors for asthma.
	c. Some drugs and other substances, such as hair dye, can cause asthma.
	d. Smoke cannot make asthma worse.
9	What is the way to deal with asthma attacks?
	a. Eat clean and healthy foods.
	b. Avoid triggering factors.
	c. Avoid triggering factors and do regular control.
	d. Take medicine prescribed by the doctor
10	What are the characteristics of controlled asthma?
	a. No limitation of activity, cough, and shortness of breath.
	b. Cough without shortness of breath.
	c. Increased the needs for asthma drugs.
	d. Rarely visit the hospital.

Table 2. A list of statement items of attitudes of relapse prevention

No	Statement items	SA	A	D	SD
1	When my asthma symptoms recur, I immediately check with the doctor.				
2	If my asthma is still mild and not dangerous, I can get enough rest without having to go to healthcare providers.				
3	To prevent asthma relapse, I avoid the factors that cause asthma.				
4	When my asthma symptoms decrease, I don't do asthma control.				
5	I do asthma control if only asthma attacks.				
6	I still do asthma control even though my asthma symptoms have decreased.				
7	I do asthma control with self-awareness without pressures from family.				
8	If my asthma doesn't come back, I do not control it to healthcare providers.				
9	When my asthma flared up, I chose to buy commercial drugs at the shop rather than control the disease to healthcare providers.				
10	When my asthma flared up, I managed it with asthma control medication prescribed by the doctor.				

Table 3. A list of statement items of behavior of relapse prevention

No	Statement items	Yes	No
1	Do you always try to avoid allergens?		
2	Do you go to the doctor immediately when your asthma flares up?		
3	Do you go to healthcare providers when your asthma flares up?		
4	Do you follow your doctor's prescription?		
5	Do you eat foods that trigger your asthma?		
6	Have you needed asthma drugs in the last one week?		
7	Have your asthma symptoms increased in the last week?		
8	Has your asthma relapsed more than twice in the past week?		
9	Has your asthma relapsed more than three times in the last one week?		
10	Do you experience disturbances in daily activities related to your asthma?		

2.3. Intervention

A patient education strategy that was delivered in a digital format via the AsmaDroid® mobile app was the intervention method that was investigated in this study. Both a control group and a treatment group were comprised of participants who were randomly assigned to one of the two groups. While participants in the treatment group downloaded and used the AsmaDroid® app for four weeks on their smartphones, participants in the control group learned about asthma from educational materials obtained from other sources, such as books, posters, pamphlets, and videos. In order to determine how successful, the intervention strategy was, a test was administered both before and after it was implemented. The patient's knowledge, attitudes, and behaviors toward preventing asthma relapse were among the aspects of asthma relapse prevention that were evaluated during the test. The quality of asthma control was also evaluated throughout the test. A statistical examination of the study hypothesis was carried out using the test data.

2.4. Data analysis

In order to do data analysis, this study used the statistical program IBM® SPSS® Version 22.0. The normality of the data, as well as descriptive statistics and proving the study hypothesis, were all accomplished with the assistance of the program. Given that more than 50 people were involved in the research, as shown in Table 4, a Kolmogorov-Smirnov test was carried out to establish whether the data were normal. The outcomes of this test are presented in Table 1, demonstrating that all of the data follow a normal distribution as expected. As a result, a parametric statistical test will be utilized to test the statistical hypothesis in this investigation.

Table 4. The results of kolmogorov-smirnov test of the study

	Test	Significance level	Description
Control	Pretest	0.120	Normally distributed
	Posttest	0.274	Normally distributed
Treatment	Pretest	0.647	Normally distributed
	Posttest	0.466	Normally distributed

3. RESULTS AND DISCUSSION

The use of information and communication technology as a tool to promote access and the transfer of knowledge in educational media is one new method that may be taken in the current era of digital technology. Because of the rapid advancement of technology, it is now feasible to design a system that can assist patients in better comprehending the nature of their illness. Apps for mobile phones have developed into an essential component of today's society, serving not only as a means of communication but also as an instructional instrument for managing and preventing asthma. Previous studies have shown that mobile phone applications are highly appealing to the people who use them, leading to an increase in the users' overall level of knowledge and an improvement in their quality of life and, in some instances, clinical outcomes [22], [23].

3.1. Study participants

A random sample of 140 asthma patients was chosen for this study using a sampling calculation. As can be seen in Table 2, the majority of the people in the sample were female (53.57%; n=75), between the ages of 18 and 22 (67.85%; n=95), and undergraduate students (78.57%; n=110). In addition, all participants had previous experience utilizing mobile health applications (mHealth apps). The findings also suggested that the participants had a limited understanding of preventing future relapses, with 90% of the total participants (n=126) falling into this category. In addition, most participants exhibited unfavorable views and behaviors regarding relapse prevention, with 75.71% of participants having negative attitudes and 106 people having

negative behaviors. Table 5 provides a comprehensive overview of the demographic and background information of the participants involved in the study.

Table 5. A summary of participant background in the study (n=140)

Demographics	n (%)	
	Control (n=70)	Treatment (n=70)
Sex		
Male	28 (40)	37 (52.85)
Female	42 (60)	33 (47.15)
Age		
18–22 years old	47 (67.15)	48 (68.57)
23–27 years old	23 (32.85)	22 (31.43)
Level of education		
Undergraduate	56 (80)	54 (77.15)
Graduate	14 (20)	16 (22.85)
mHealth experiences		
Yes	70 (100)	70 (100)
No	0 (0)	0 (0)
Level of patient's knowledge		
Good	6 (8.57)	8 (11.43)
Poor	64 (91.43)	62 (88.57)
Level of patient's attitudes		
Positive	9 (12.86)	24 (34.29)
Negative	61 (87.14)	46 (65.71)
Level of patient's behaviors		
Positive	19 (27.14)	15 (21.43)
Negative	51 (72.86)	55 (78.57)

3.2. Validity and reliabity tests

Table 6 presents a set of indicators tested for validity across three main categories: X, encompassing question items on knowledge of relapse prevention; Y, comprising statement items that reflect attitudes towards relapse prevention; and Z, consisting of statement items associated with behaviors relevant to relapse prevention. These indicators, characterized by their R-Count values, uniformly exceed the critical threshold of 0.196, which means surpassing the established criteria for validity, affirming the robustness and relevance of the indicators in the context of relapse prevention research.

Table 6. The results of validity test of research instrument questionnaires (n=30)

Indicator	R-Count	R-Table	Results
X1	0.621	0.196	Valid
X2	0.583		Valid
X3	0.600		Valid
X4	0.647		Valid
X5	0.44		Valid
X6	0.508		Valid
X7	0.745		Valid
X8	0.495		Valid
X9	0.559		Valid
X10	0.454		Valid
Y1	0.441		Valid
Y2	0.638		Valid
Y3	0.565		Valid
Y4	0.503		Valid
Y5	0.557		Valid
Y6	0.595		Valid
Y7	0.534		Valid
Y8	0.561		Valid
Y9	0.549		Valid
Y10	0.596		Valid
Z1	0.669		Valid
Z2	0.514		Valid
Z3	0.583		Valid
Z4	0.400		Valid
Z5	0.319		Valid
Z6	0.708		Valid
Z7	0.672		Valid
Z8	0.626		Valid
Z9	0.552		Valid
Z10	0.685		Valid

X: knowledge; Y: attitude; Z: behaviors

The reliability analysis for this study is exemplified by Cronbach's Alpha coefficient, which is 0.840. This score indicates strong internal consistency among the 30 question and statement items included in the analysis. It suggests that all items collectively form a highly reliable scale.

3.3. The effect a digital self-management to the patient's knowledge

The study results showed that the patients in both the treatment and control groups had a low level of patient knowledge based on their scores on the pretest. It was found a significant improvement in the treatment group, with 87.14% of participants, or 61 people, demonstrating improvement and a p-value of 0.001. All these data provide evidence that supports the study's theory. Previous research has shown that educational interventions can enhance asthma knowledge, decrease asthma symptoms, school nurse visits for symptoms, and use drugs to treat asthma [24]. It has been discovered that utilizing mobile technology to educate patients and increase the level of information they possess is an efficient method in Malaysia [25]. A recent systematic analysis also showed that educational interventions in schools that use digital technology could raise asthma awareness and decrease the impact of morbidity indicators [26]. Table 7 presents a detailed analysis of the results obtained from both the descriptive statistics and the paired t-test concerning the patients' knowledge.

Table 7. Result of descriptive and paired t-test of the patient's knowledge

	Treatment		Control	
	Pretest	Posttest	Pretest	Posttest
Good	6 (8.57)	67 (95.71)	8 (11.43)	23 (32.86)
Poor	64 (91.43)	3 (4.29)	62 (88.57)	47 (67.14)
p-value	0.01		1.00	

3.4. The effect of a digital self-management intervention to the patient's attitudes

The participants in this study who were assigned to the treatment group showed a significant change in their mindsets regarding the ability to control and avoid asthma attacks from occurring again. According to Table 3, more than half of the study's participants were rated as having "poor" performance; nevertheless, their scores showed significant growth after participation in the intervention. According to the data presented in Table 8, the 90.00% (n=63) of the people in the treatment group exhibited an improvement in their attitudes, which carries a p-value that is statistically significant at 0.01. It lends credence to the study's premise that increasing knowledge may positively alter an individual's attitude to reduce the likelihood of future asthma attacks. It is in line with the findings of prior research, such as a study conducted in Sudan that emphasized the significance of having sufficient knowledge in cultivating positive attitudes and suitable actions to prevent future asthma attacks and exacerbations. This finding is compatible with those findings. Additionally, a clinical trial study reported that a self-education program that utilized a digital approach improved patients' knowledge and attitudes regarding the appropriate use of drugs, the application of sprays, and the avoidance of potential allergens, which ultimately prevented future asthma attacks [27], [28].

Table 8. Result of descriptive and paired t-test of the patient's attitudes

	Treatment		Control	
	Pretest	Posttest	Pretest	Posttest
Positive	9 (12.86)	63 (90.00)	24 (34.29)	31 (44.29)
Negative	61 (87.14)	7 (10.00)	46 (65.71)	39 (55.71)
p-value	0.01		0.25	

3.5. The effect a digital self-management to the patient's behavior

After the intervention, the analytical tests performed on the patient's actions to control revealed a significant improvement of 67.15% (n=47) with a p-value of 0.01. It confirmed the hypothesis of the study. This improvement follows the findings of previous studies that have demonstrated the effectiveness of mHealth technology combined with individual feedback in promoting health behavior change and improving health outcomes in patients with acute or chronic conditions, including asthma [29]–[31]. According to a clinical review study [32], mobile health apps have been demonstrated to assist asthma self-management by improving knowledge, attitude, and behavior; boosting the quality of life; promoting medication adherence; and reducing the overall expenditures for care.

The management of asthma in patients could be significantly helped by the findings of this study, which has substantial implications. First, it reveals that digital self-management treatments can improve the knowledge, attitude, and behavior of relapse prevention in asthma patients, all essential for effectively

treating this chronic condition. In addition, this research highlights the significant role that mobile health apps play in assisting patients with self-management, which ultimately results in an enhanced quality of life and increased drug adherence. These applications give patients access to essential information about their prescriptions and allow them to manage risk factors that trigger asthma attacks, such as air pollution, allergens, and physical exercise. Patients can also use these apps to track their symptoms and monitor their progress over time. This study can also serve as a basis for future research on the efficacy and usability of digital self-management interventions for patients with asthma and other population groups with chronic diseases. The researchers expect that by continuing to look into this area, they will be able to develop and improve mobile health solutions, offering greater benefits to patients suffering from chronic illnesses.

3.6. Limitation of the study

This study reveals that using a digital self-management intervention successfully reduces asthma relapses by altering various variables, specifically knowledge, attitude, and behavior. However, similar to other types of research, this study has some shortcomings that must be considered when interpreting the findings. Since the subjects were only drawn from a single environment, this study needs to have a limited potential for generalization to other groups. Consequently, the findings can only be generalized to some populations. In order to ensure that the findings can be applied to a broader range of contexts and groups, an additional study has to be conducted. The study uses self-reported data, which is known to have known limitations in terms of memory and social desirability biases, which leads to skewed research findings. It is another one of the study's limitations. In order to improve the data's reliability and validity, it is necessary to investigate the possibility of utilizing several different data collection methods, such as direct observation or medical examination.

The findings may not be able to be generalized due to the limited sample size, which is another constraint that may limit their statistical significance. However, finding people willing to participate in clinical research can be difficult, particularly in cases where the study has stringent inclusion and exclusion criteria. Because of this, further research with larger samples is required to generalize the findings to a broader population and draw firmer conclusions. Another limitation, the outcome measures utilized in this study were confined to knowledge, attitude, and behavior. Because of this, these measures did not adequately capture other crucial components of relapse prevention, such as health-related quality of life or utilization of health services. Consequently, future research should consider outcome measures that are broader in scope and more in-depth to gain a complete comprehension of the influence of the intervention. In addition, in order to improve the analysis of the data, it is essential to take into account the aspects, both psychological and social, which may play a role in influencing the findings of the study.

It is essential to acknowledge these limitations and to plan future research taking them into account. The reliability and validity of the research findings could be improved by taking one or more of some corrective steps, including recruiting a larger sample, carrying out direct observations or medical examinations, carrying out extended follow-up periods, or introducing a control group. However, scientific research can only sometimes capture all the variables influencing a phenomenon. Because of this, a multifaceted approach is required to understand the intervention's impact on asthma patients fully. As a result, in order to reach more all-encompassing results, it may be necessary for researchers from other fields, such as medicine, psychology, and sociology, to work together.

4. CONCLUSION

Knowledge plays a crucial role in ensuring a positive attitude and behavior towards preventing future asthma attacks, which was addressed in this study through a mobile phone app-assisted educational intervention that resulted in significant improvement in knowledge, attitude, and behavior, demonstrating the effectiveness of digital-based patient education. Asthma self-management success depends on healthcare professionals, patients, and drugs. Among patient factors, knowledge is crucial in ensuring a positive attitude and behavior toward preventing future asthma attacks.

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