

Development and Feasibility Test of the *Self-Management Hypertension (SMH)* Application for Elderly People with Hypertension in Makassar City

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ABSTRACT

Background: The *Self Management Hypertension (SMH)* application is a digital-based educational media solution to improve knowledge of elderly with HT in managing their disease independently, easy to use and can be accessed wherever they are. *Smartphone*-based digital technology, Recently, it has become a very common tool needed by most people, including the elderly, not only as a communication tool but can also be used as a medium for education and information. **Research Objectives:** This research aims to design the development of a *prototype* of the SMH application and to determine the feasibility of the SMH application for self-management of hypertension for the elderly. **Method:** The research method used is *Research and Development (R&D)*. The research subjects for the expert validation test consisted of 3 experts. Meanwhile, the application trial subjects consisted of a one-on-one trial sample of 3 elderly people and a small group trial of 12 elderly people. Data collection uses the *Technology Acceptance Model (TAM)* questionnaire which consists of 13 questions with 4 assessment aspects, namely the convenience aspect, usefulness aspect, trust aspect and user intention aspect. There are 4 Likert scale answer choices ranging from strongly agree to strongly disagree. **Results:** *Expert* validation results show the percentage and eligibility criteria are 86.6%. The results of one-on-one trials show that the ease of application aspect is in the range of 3.25-4.00, the usefulness aspect is in the range of 3.00-4.00, the trust aspect is in the range of 3.67-4.00 and the user intention aspect is in the range of 3.00-4.00. Small group trials showed an average convenience aspect of 3.52, an average usefulness aspect of 3.53, an average trust aspect of 3.69 and an average user intention aspect of 3.64. **Conclusion:** The SMH application has decent content, is easy to use, very useful, and trustworthy, thereby increasing the intention of elderly people with HT to use the SMH application

Keywords: SMH Application, Hypertension, Elderly, Self Management, TAM.

INTRODUCTION

According to the *World Health Organization (WHO)*, there are approximately 1.13 billion HT patients worldwide, and it is predicted that the number of people affected by HT will increase in all regions of the world from 2000 to 2025 to 1.56 billion patients¹⁻⁴. Approximately 60–70% of older adults in almost all countries experience HT⁵. HT complications account for 9.4 million deaths worldwide every year. Hypertension (HT) is the leading cause of death worldwide and is responsible for at least 45% of deaths due to heart disease, and 51% of deaths due to stroke⁶⁻⁷. According to 2018 Riskesdas data, the prevalence of HT in Indonesia has increased from 25.8% in 2013 to 34.11% in 2018⁸. Health Profile Data for South Sulawesi Province In 2020, the number of HT patients in South Sulawesi who received health services was only around 25.6%⁹. Meanwhile, in Makassar City, the percentage of high blood pressure screening services decreased by 41.9%¹⁰.

In 2050, 80% of elderly people will live in low and middle income countries, including Southeast Asia such as Indonesia¹¹. Indonesian Minister of Health, said the number of elderly people in Indonesia is currently around 27.1 million, or almost 10% of the total population, and is expected to increase to 33.7

million, or 11.8% of the total population, in 2025. With the increasing number of elderly people with various health problems, it is a challenge for us to prepare healthy and independent elderly people to minimize the burden on society and the country¹².

Health problems that occur in the elderly need to be recognized and understood by anyone who comes into contact with the elderly in an effort to achieve the optimal level of health for the elderly and prevent the elderly from falling into more serious health conditions such as the emergence of disease and its complications. The most common diseases in the elderly based on Basic Health Research in 2018 are hypertension (57.6%), arthritis (51.9%), stroke (46.1%), dental and oral problems (19.1%), obstructive pulmonary disease chronic disease (8.6%) and diabetes mellitus (4.8%)⁸. Hypertension is the most frequently diagnosed condition in people aged 60 years and over¹³.

Handling cases of this disease does not seem easy because diseases in the elderly are generally degenerative, chronic, multi-diagnosed diseases, the treatment of which requires a long time and high costs, so it will be a very heavy burden for society and the government, including the National Health Insurance Program (JKN). Therefore, elderly health care should prioritize promotion and prevention

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with the support of quality curative and rehabilitative services¹⁴. One of the programs developed to overcome the problem of elderly people with hypertension is *self-management intervention*. According to Green, Jaser, Park & Whittemore, *self-management* is the active management of an individual in managing the chronic illness they suffer, in collaboration with family members and doctors or other health workers¹⁵.

Self-management in chronic patients is a very important strategy because it is not only the treatment that the patient needs, but also the interventions that are acceptable and can make the patient able to manage their condition. Intervention with the use of self-care management strategies is key to adequate blood pressure control and reduction of cardiovascular events. *Self management* in chronic conditions includes; an individual's ability to manage symptoms, medication, physical, psychosocial conditions and lifestyle changes that can improve their quality of life¹⁶.

The development of mobile health (*mHealth*) applications can lower the costs of health care delivery and improve the quality of health care as well as change behavior to strengthen prevention and treatment of reported cases, all of which can improve health outcomes in the long term. One of the main aims of using mobile technology in the health sector is to improve the quality and access of health services¹⁷. The use of mobile healthcare is becoming increasingly popular in the self-care of chronic diseases such as hypertension.

Many studies have been conducted to evaluate the effectiveness of *self-management interventions* based on digital technology such as *smartphones* in various community health centers throughout the world. In a *systematic review* by McLean *et al.*, (2016), they synthesized evidence on the use of *interactive digital interventions* (IDIs) around the world to support self-management of adult HT patients and looked at the impact of controlling and reducing blood pressure (BP). The study found evidence that digital interventions are interactive can significantly reduce systolic blood pressure (TDS) by 3.74 mmHg and diastolic blood pressure (TDD) by 2.37 mmHg¹⁸. Li *et al.*, (2019), also found that *mHealth-based self-management interventions* were a feasible and efficient program to help middle-aged and elderly HT patients in Chinese communities to lower their BP and improve their self-management¹⁹.

BP control for elderly with hypertension may require interventions and strategies that can help improve their BP monitoring skills independently at home and increase the knowledge of elderly with HT in managing their disease in an easy and accessible manner. One way is to develop digital-based *self-management interventions*. According to WHO Digital technologies, such as wireless technology have the potential to revolutionize how populations interact with national health services. Digital health, especially *mHealth*, has been proven to improve the quality and coverage of care, increase access to health service information and skills, and encourage positive changes in health behavior to prevent the onset of acute and chronic diseases²⁰⁻²¹.

METHOD

This research uses research and development methods or known as *Research And Development* (R&D). Research and development methods are research methods used to produce certain products and test the effectiveness of these products. The research and development method (*Research and Development*) is focused on 2 stages, namely the *preliminary stage* and the *formative evaluation stage*, which includes *self evaluation*, *prototyping* (*expert reviews*, *one-to-one*, and *small group*) and *field tests*²²⁻²⁴. After the application product instrument was agreed upon, validity testing and application evaluation was then carried out with 3 *experts* consisting of 2 IT experts and 1 epidemiologist. Data were collected using a questionnaire consisting of 10 questions with 5 assessment aspects, namely the *self-instructional aspect*, *self-contained*

aspect, *stand alone aspect*, *adaptive aspect*, and *friendly aspect*. The application test research subjects were elderly people with HT, men and women who were able to use Android *smartphones*, with a one-on-one trial sample of 3 elderly people and a small group trial of 12 elderly people. The average age range is 62 years. Data was collected using the TAM questionnaire which consists of 13 questions with 4 assessment aspects, namely the convenience aspect, usefulness aspect, trust aspect, and user intention aspect. There are 4 answer choices on a Likert scale ranging from strongly agree to strongly disagree. The data was processed with the help of MS.Excel through analysis of the average value of respondents' answers for each aspect of measurement²⁵. To ensure ethical considerations for this research, research ethics approval is required from Hasanuddin University Makassar Health Research Ethics Committee with Number: 2986/UN4.14.1/TP.01.02/2023.

Table 1. Expert Validation Test Results.

| Elements of assessment | Rating result | Percentage and eligibility criteria |
|--------------------------------|---------------|-------------------------------------|
| Attractive design/appearance | Good | 86.6% is very decent |
| Layout (layout) | Good | |
| Clarity of image display | Very good | |
| Easy to apply | Good | |
| Loading speed | Very good | |
| RAM usage (memory usage) | Good | |
| Theme display and menu options | Good | |
| Ease of guidance | Good | |
| Color composition | Very good | |
| Feature compatibility | Very good | |
| Application size | Good | |
| Splash screen | Good | |

Source: Primary Data

Table 2. Media and Material Appropriateness Validation Test Results.

| Assessment aspect | Mean | |
|------------------------|-------------|--------------------|
| | IT Expert | NCD epidemiologist |
| Self-instructional | 5 | 5 |
| Self-contained | 5 | 4.5 |
| Stand alone | 4 | 5 |
| Adaptive | 5 | 4 |
| User friendly | 5 | 5 |
| Eligibility percentage | 98 | 96 |
| Eligibility criteria | Very worthy | Very worthy |

Source: Primary Data

Table 3. Results of SMH Application Trials on Individuals (one person).

| Evaluation | Mean (minimum-maximum) | | |
|------------------------|------------------------|--------------|--------------|
| | Respondent 1 | Respondent 2 | Respondent 3 |
| Convenience aspect | 3.25 (3-4) | 3.50 (3-4) | 4.00 (3-4) |
| Aspect of usefulness | 3.33 (3-4) | 4.00 (3-4) | 3.00 (3-4) |
| Trust aspect | 4.00 (3-4) | 3.67 (3-4) | 3.67 (3-4) |
| Aspects of user intent | 3.33 (3-4) | 3.00 (3-4) | 4.00 (3-4) |

Table 4. Small Group Application Trial Results (n=12).

| Aspect | Mean | Minimum | Maximum |
|---------------------------|------|---------|---------|
| Perceived Ease-To-Use | 3.52 | 3 | 4 |
| Perceived Usefulness | 3.53 | 3 | 4 |
| Trust | 3.69 | 3 | 4 |
| Intention-To-Use Behavior | 3.64 | 3 | 4 |

Source: Primary Data

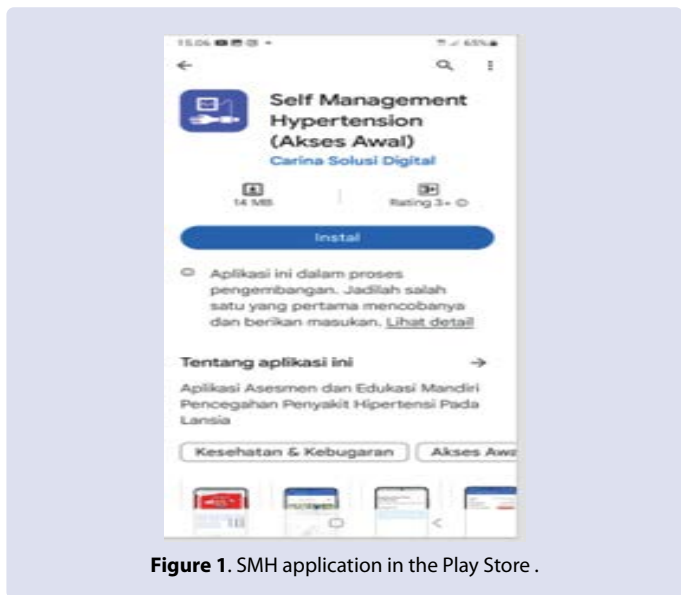


Figure 1. SMH application in the Play Store .



Figure 4. Display of SMH application features



Figure 2. Create an account in the application.

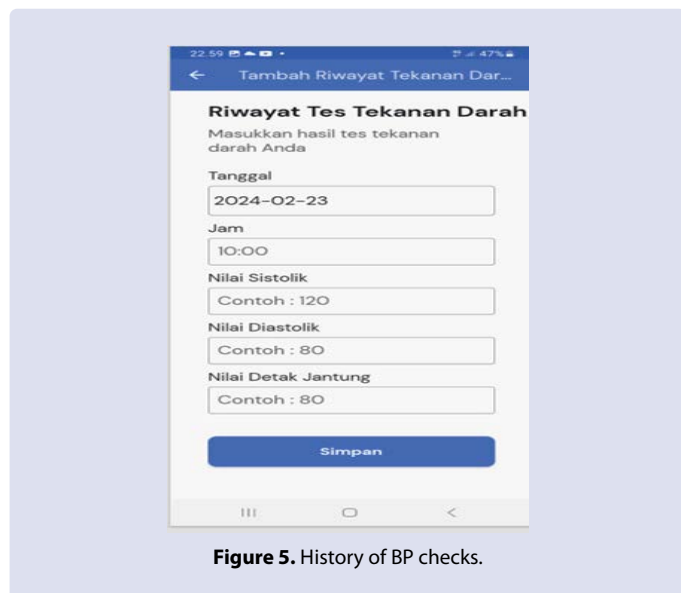


Figure 5. History of BP checks.

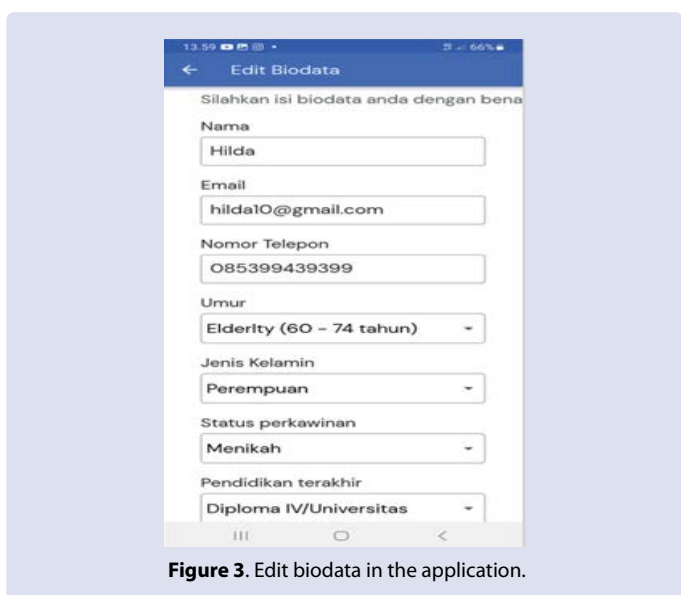


Figure 3. Edit biodata in the application.

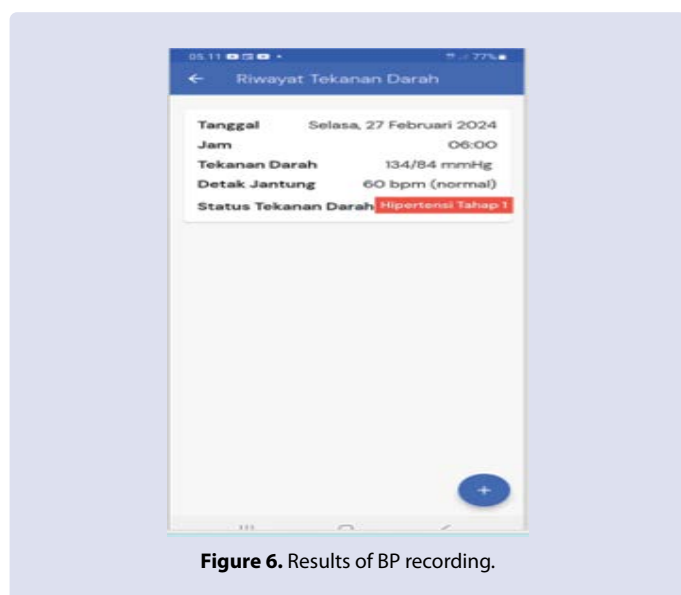


Figure 6. Results of BP recording.

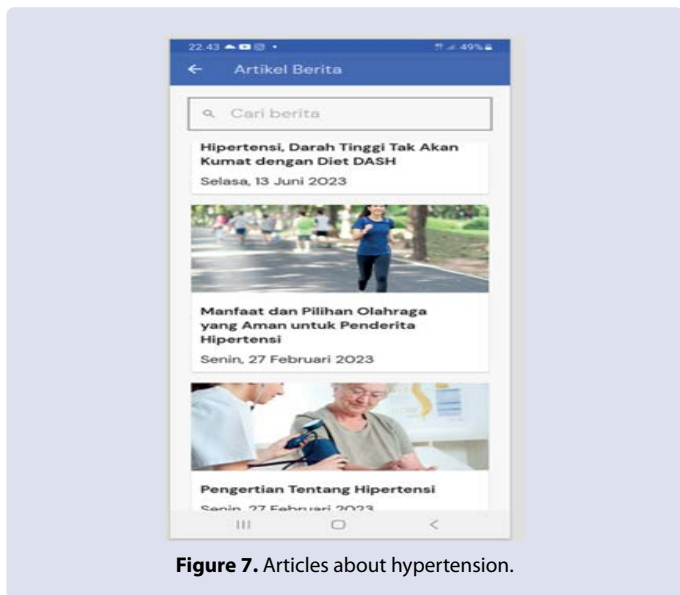


Figure 7. Articles about hypertension.

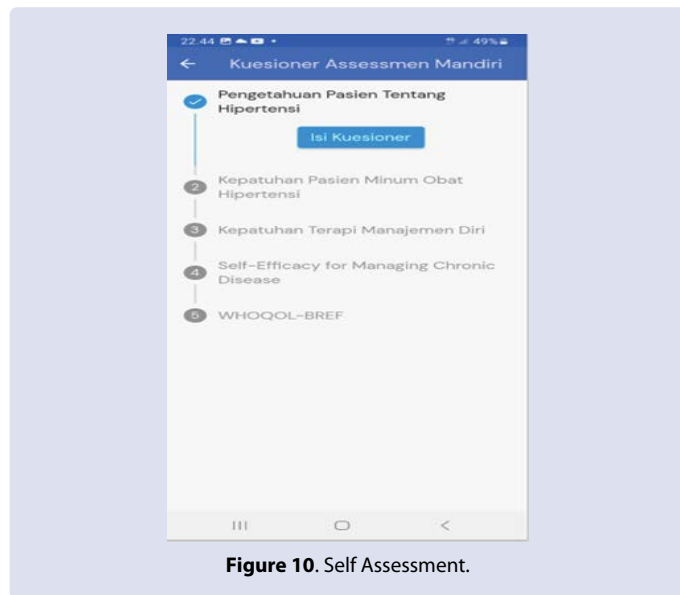


Figure 10. Self Assessment.

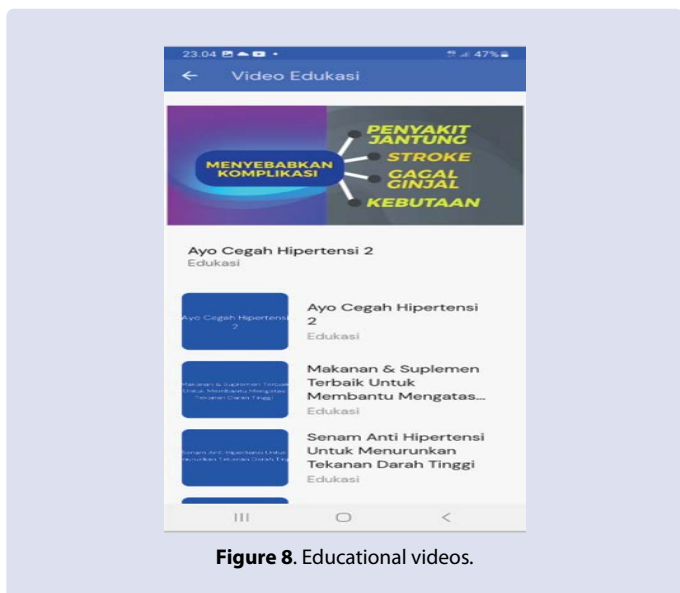


Figure 8. Educational videos.

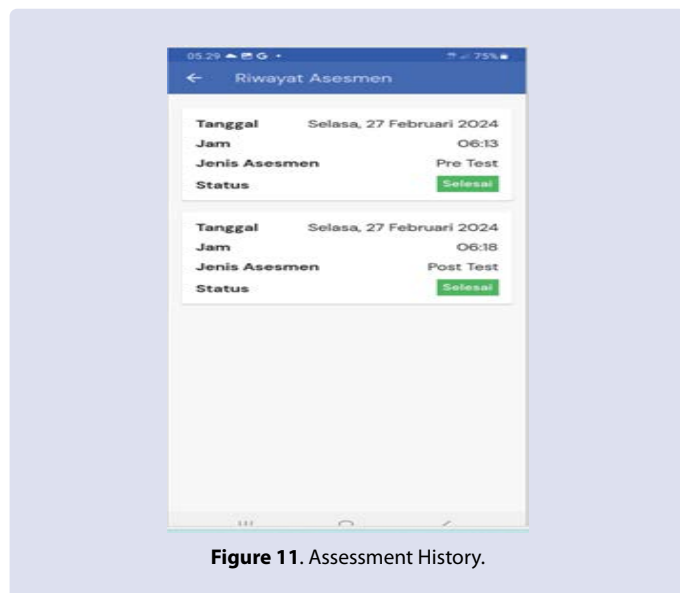


Figure 11. Assessment History.

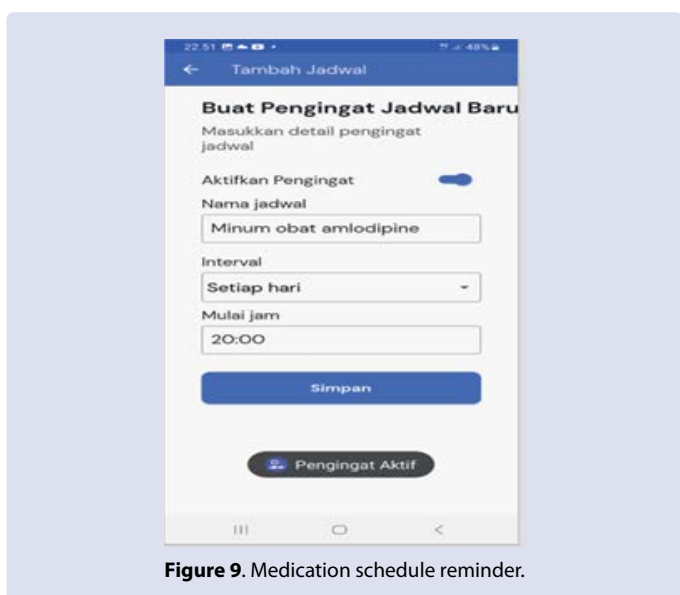


Figure 9. Medication schedule reminder.

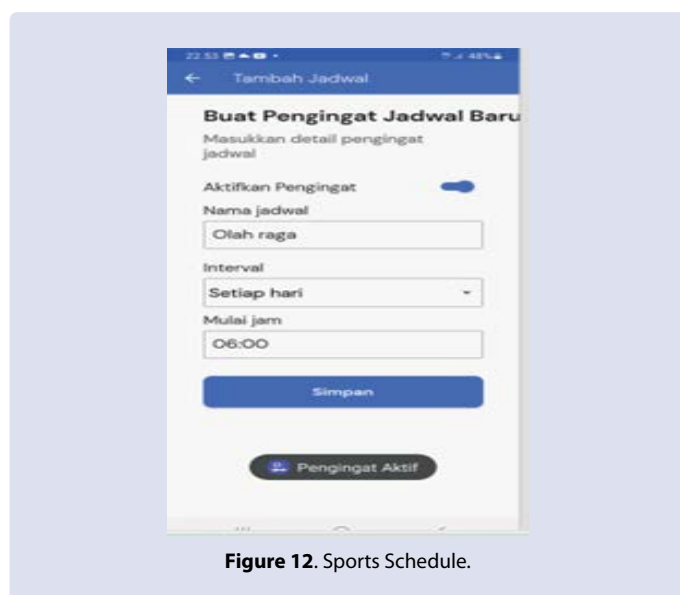


Figure 12. Sports Schedule.

RESULTS AND DISCUSSION

Before creating a *prototype* application design model, we explored potential problems and collected data through observations and interviews with 15 elderly people with HT who were visiting the community health center, to explore the elderly's knowledge about HT and the elderly's understanding of self-management of HT, as well as the use of technology in everyday life. Apart from that, we also conducted observations and interviews with community health center officers who were responsible for treating HT disease, such as posbindu managers at 3 community health centers in Makassar City, namely at Antang Community Health Center, Mangasa Health Center, and Malimongan Baru Health Center. These observations and interviews are one of the bases for making *prototypes*.

Based on the results of observations and interviews conducted with several elderly people with HT, the following things were found:

- a. Most elderly people do not understand the causes, symptoms and impacts of HT disease, and do not understand how to properly manage HT disease, to control BP.
- b. Of the several elderly people we interviewed, none of them took antihypertensive medication regularly, because they often forgot, they didn't take medication if their blood pressure had dropped, they were afraid to take medication because of side effects, they believed in taking traditional medicine, they didn't take medication if they had a supply. the medicine has run out.
- c. Most elderly people also do not understand how to better self-management, such as not limiting their consumption of salt and fat. Regarding physical activity, a small number of elderly people do exercise once a week in the prolanis program at the health center, and the majority never exercise (elderly people assume that by doing housework they are already exercising).
- d. Most of the elderly are lazy to come to Posbindu, because they don't get antihypertensive medication, and the elderly are lazy to queue at the community health center, and for other reasons there is no one to accompany them and they don't have time.
- e. Most elderly people use technology in their daily lives. From our observations, all the elderly people we observed actively use *smartphones* with several applications in them such as WhatsApp, Facebook, mobile JKN, Satusihat, Taspen, YouTube and so on. However, there is a lack of interest among elderly people in finding out about managing HT disease through this technology, but according to most elderly people, if there was an application that could be accessed, such as mobile JKN, we would really be very happy, because we could get a lot of information just by pressing the application.

Meanwhile, based on observations of activities at posbindu and interviews with several community health center officers, the following things were found:

- a. There are still many elderly people who are lazy about going to posbindu, let alone going to the puskesmas, on the grounds that there is no one to accompany them, they don't have time because they are busy taking care of the household and grandchildren at home.
- b. Posbindu or elderly posyandu activities are only carried out once a month in each RW, so they cannot provide comprehensive education because the puskesmas area is very large, and there are not many puskesmas officers. So officers cannot reach all areas.
- c. There is no public awareness of routine health control, especially elderly hypertensive patients.

d. Prolanis activities are held once a week, in the form of an exercise club specifically for hypertension and diabetes patients. But the small number of elderly patients who come usually only come to exercise and check their blood pressure and blood sugar.

e. Health cadres do not play much of a role in assisting community health center officers

Self Management Hypertension (SMH) Application Prototype Design

Based on literature studies and *user needs*, we have developed a *prototype of the SMH* application. The SMH application can be downloaded/installed on the Google Play Store using an Android *smartphone* for free. The main function of this application is to educate patients in managing HT disease, to monitor blood pressure independently and as a medication reminder. There are several features in the SMH application that can educate patients in the form of articles/news or educational videos that contain comprehensive knowledge about HT, and HT management, as well as medication reminder features such as medication schedules, exercise schedules, history of recording pressure measurement results. blood independently.

After the application is downloaded/installed on the Google Play Store, the user first creates an account by filling in the biodata contained in the application menu such as name, email, telephone number, age, gender, marital status, highest level of education, and monthly income. Create a personal profile and password that can be changed at any time.

The initial appearance of the application after the patient has registered, there are various menus that can be opened, such as the Blood Pressure Menu, which functions to record the results of blood pressure measurements independently at home. If the blood pressure results are recorded every day and then saved, a blood pressure history display will appear, so that the patient can see the results, with high results the patient can control or modify his lifestyle by regularly doing physical activity, reducing consumption of salt and fried foods and so on. so on which can control TD. The Schedule Menu functions as a reminder or note for patients regarding medication compliance, doctor visit schedule reminders, exercise schedule reminders, and other activity schedule reminders. The *Pre Test* and *Post Test* menus function to measure the patient's level of knowledge about HT and self-management in managing HT disease before and after education or self-management during the intervention process. The Assessment History Menu functions to view the results of filling in the *pre* and *post test questionnaires*. Application Guide menu as a guide for using the SMH application.

Before opening the educational article/news feature or in the form of educational videos that contain comprehensive knowledge about hypertension and hypertension management, patients should fill out the *pre-test questionnaire* in the self-assessment feature first to measure the patient's level of knowledge before receiving education from articles and videos. that education. The function of filling out the *pre* and *post test* self-assessment questionnaire is very useful to see whether there is an increase in knowledge and an increase in lifestyle modifications after receiving the SMH application-based intervention. There are 5 measurement variables in the self-assessment, namely patient knowledge about hypertension, patient compliance with taking antihypertensive medication, compliance with self-management therapy with lifestyle modifications, self-efficacy for managing chronic disease (hypertension) and quality of life for elderly hypertensive patients. In the application there is also a schedule feature, reminders for taking antihypertensive medication, reminders for exercise schedules and other activity schedules.

Expert Validation Trial And Application Testing

The most widely used and influential model for testing or acceptance of information technology is the TAM model. *The Technology Acceptance Model* was first introduced by Davis in 1986 to explain application usage behavior²⁶.

Expert Validation

After the application is finished, it continues with an expert validation test, namely expert assessment in the field of Information Technology (*Information and Technology/IT*) and media eligibility criteria (content expert). Validation was carried out by 3 (three) experts consisting of 2 (two) IT experts, with expertise in *software engineering and artificial intelligence*, and 1 (one) expert in the field of epidemiology of non-communicable diseases (PTM). The results of the validation test can be seen in the table below:

The validation results from IT experts show that the application is very suitable for use with several revised components, namely instructions for using the application, clarity of flow and output from the application. This was remedied by creating an application usage guidebook containing instructions and objectives for using the SMH application.

The application was tested by asking about 5 (five) aspects related to the content of the application, namely *Self instructional, Self contained, Stand alone, Adaptive, and User friendly*. This aspect is measured using 5 answer choices starting from number 1 indicating strongly disagree and number 5 indicating strongly agree with this aspect of the SMH application. Validation results show that the SMH application has appropriate content and is suitable for elderly patients with HT in improving better self-management and control of BP.

Application Trial

Before the application is used, the application is first tested twice, namely a one-on-one trial and a small group trial using the TAM instrument which aims to evaluate the general level of user acceptance of the SMH application.

a. One-on-One Trial

Carried out on 3 (three) elderly people with HT who had almost the same characteristics. The results of the one-on-one trial show a picture of individual acceptance of the SMH application as follows:

The SMH application was tested on individuals (one-on-one trials) on 3 elderly people with HT using the TAM questionnaire with 4 assessment aspects, namely *Perceived Ease-To-Use*, *Perceived Usefulness*, *Trust*. (Aspect of trust), and *Intention-To-Use Behavior* (Aspect of user intention). The assessment of these 4 aspects is measured using 4 answer choices, starting from number 1 strongly disagree (STS) to number 4 strongly agree (SS)²⁵⁻²⁶.

The results of one-on-one trials show that the ease of application aspect is in the range of 3.25-4.00, the usefulness aspect is in the range of 3.00-4.00, the trust aspect is in the range of 3.67-4.00 and the user intention aspect is in the range of 3.00-4.00. It can be concluded that the three respondents agree to strongly agree that the SMH application is easy to use, very useful, the level of trust in the SMH application is very good, so that individuals intend to use the SMH application. The conclusion obtained is that individuals show good acceptance of the SMH application

b. Small Group Trials

Small group testing is carried out using 6-12 subjects²¹. In this study, a small group trial was conducted on 12 elderly people with HT. An overview of SMH application acceptance in groups is as follows:

Small group trials show an average ease aspect of 3.52, which means that the average respondent agrees that the SMH application is easy to use, an average usefulness aspect value of 3.53, which means that the average respondent agrees that the SMH application is useful and has usability, the average value of the trust aspect is 3.69, which means that on average respondents have confidence in the SMH application regarding the content in the application. The average user intention aspect is 3.64, which means that the average respondent intends to use the SMH application as a medium for education and self-management for elderly people with HT. So it can be interpreted that the SMH application is easy to use, very useful and reliable, thereby increasing the intention of elderly people with HT to use the SMH application for self-management in controlling BP and as an educational medium.

DISCUSSION

The development of the SMH application *prototype* which was designed as a solution to problems occurring in the field. Based on the results of interviews and observations in the field, it was found that the elderly's knowledge about HT was limited. This is due to the elderly's lack of interest in finding out about HT disease. In line with research by Kebede, Taddese and Girma²⁷, the results showed that 74.8% of elderly HT patients in East Africa did not know much about HT disease. In a similar study by Twum²⁸, although all HT patients were aware of the risks posed by several factors, such as consuming foods high in saturated fat and lack of exercise, 76% of adults with HT did not have adequate knowledge about their HT condition. In addition, the results of Murphy *et al's* research showed that patients were not confident in carrying out self-care and did not know how to change their lifestyle, due to the patient's lack of literacy about HT²⁹. The many problems faced by elderly people with HT are related to poor management of HT disease, such as being lazy to control BP, not maintaining a healthy diet, not doing physical activity and low compliance with taking medication, caused by the lack of awareness among the elderly, which is influenced by habitual factors. In families who like salty, sweet and fried foods, besides that, they are more confident in traditional medicine on the assumption that it does not have side effects that can cause kidney disease. In line with the results of Dworakowska's research, it was found that more than 50% of HT patients did not make changes to their diet or physical activity, citing its disruptive nature, dependence on people closest to them, lack of will and strong involvement from the family³⁰. In this study, the role of health workers in providing education to elderly HT patients was not effective, because the working area of the puskesmas was very large so that health service education was not carried out well, there was no provision of medicines for HT patients at posbindu, so patients were reluctant to come to visit, as well as to the community health center, patients are lazy to queue and no one delivers them. Likewise with the results of Hussein's research, the main obstacles for patients to get education are at the health facility level, such as long waiting times, insufficient medicines, high drug costs, busy doctors due to the large number of patients, poor education and counseling, patient interaction. with poor service providers, and drug shortages³¹. The majority of patients in Murphy *et al's* study, said HT patients did not receive enough information from health care providers, often having difficulty getting counseling or social support, thus preventing them from engaging in activities necessary to manage their condition²⁹.

In recent years, many people have become interested in a new approach to population health management known as *mobile health (mHealth)*. Digital technology has become an important component in the provision of medical and public health services³². This research proves that elderly people with HT actively use technology (*smartphones*) in daily life, and intend to use applications to manage their health. Likewise, in Still *et al's* (2018) research, elderly people with HT reported that they have *smartphones* and use them to communicate,

search, obtain information sharing, manage time, and participate in entertainment. Elderly people with HT complain that they do not receive enough information or training to use this technology for self-management of HT disease and independent control of BP¹³.

mHealth application development can lower the costs of health care delivery and improve the quality of health care as well as change behavior to strengthen prevention and treatment of reported cases, all of which can improve health outcomes in the long term. One of the main aims of using mobile technology in the health sector is to improve the quality and access of health services¹⁷. Furthermore, we developed the SMH application as a means of self-management for elderly HT patients in an effort to better control BP and as one of the needs of elderly HT patients to receive education about self-management of their disease. This is in line with Bengtsson's research, emphasizing that professional health services need to understand the needs and circumstances of each patient, to support patient self-management, so it is necessary to develop self-management and reporting systems via mobile phones³³, as well as research by Still *et al*, saying there is a need to develop a self-management intervention for HT patients integrated with technology, which can help improve the quality of BP control¹³.

McBride (2020), developed a *smartphone application* called BP Journal. The app is commercially available on the Google Play Store and serves as a companion app for clinically validated home blood pressure tracking. This application has two main functions, namely: monitoring BP independently and providing reminders for medication³⁴. Meanwhile, the SMH application that we developed is also available on the Google Play Store, and can be downloaded for free. The SMH application has various features with their respective functions and uses Indonesian, but there is something new about our research, namely that there is a self-assessment feature to measure the level of knowledge and self-management of elderly patients in managing HT disease. This *pre* and *post test* assessment is to see changes in behavior after receiving application-based educational intervention. There is the potential that more independent, knowledgeable and active patients, through the use of interactive mobile systems, will promote better HT treatment outcomes³⁵.

After testing the SMH application, it can be interpreted that the SMH application is easy to use, very useful and reliable, thereby increasing the intention of elderly people with HT to use the SMH application. This is in line with research by Lim *et al* (2023), who also tested the feasibility and usability of personalized *mHealth applications for breast cancer patients*. The application received an average feasibility test score of 75.8% and a usability score of 80.2%, most patients thought that this application was useful and effective as a means of health education. As many as 94% of patients intend to use and are willing to recommend it. Therefore, *mHealth applications* can help breast cancer patients manage their disease and promote better health behaviors³⁶.

CONCLUSION

The SMH application has appropriate content and is suitable for elderly patients with hypertension in improving better self-management and control of blood pressure, is easy to use, very useful and reliable so as to increase the intention of elderly people with hypertension to use the SMH application as a medium of education and information in improving self management.

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