Original Research

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SDMPH
SOCIETY FOR DISASTER MEDICINE & PUBLIC HEALTH

The Effects of a Disaster Preparedness app on Community Knowledge and Intentional Behavior in Hurricane Risk Areas

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Abstract

Objective: With the advancement of technology, disaster preparedness related to hurricane hazards can be taught through an app. This study aimed to examine the effect of using an android-based disaster preparedness app on community knowledge and intentional behavior in hurricane risk areas.

Methods: A quasi-experimental study was conducted from October to November, 2020 and a total of 80 respondents were recruited using cluster sampling. The treatment group was given the intervention in the form of the disaster preparedness app for 2 weeks. Meanwhile, the control group received home visits and conventional education about hurricane disasters twice throughout the same period. We then used a Wilcoxon Signed Rank test to analyze the pre-test and post-test and a Mann-Whitney U test to compare between treatment and control groups.

Results: After the implementation of the SiBen app, we found a statistically significant difference in knowledge between treatment and control groups ($P < 0.003$) and intentional behavior between treatment and control groups ($P < 0.001$).

Conclusion: The findings indicate that the disaster preparedness app was an effective educational program able to improve the knowledge and intentional behavior among community members in a hurricane risk area.

Introduction

Indonesia is a country at a high risk of various disasters.[1] The types of disasters that often occur in Indonesia include earthquakes, landslides, floods, volcanic eruptions, tsunamis, and hurricanes.[2] Given these conditions, Indonesia must be prepared for and alert to disaster conditions. The Government of Indonesia must strive to maximize its disaster preparedness at the community level. However, this is a limitation because the consideration of the cultural factors, region, layman's knowledge about disaster management, and community behavior result in different reactions to disaster situations and conditions.[3,4] The efforts undertaken to maximize the level of disaster preparedness in the community need to be considered.

The disasters occur almost every year in Indonesia with an intensity that ranges from mild to severe.[5] Many disasters such as landslides and earthquakes have an impact in the form of tsunami events that result in a lot of victims. In 2004, Sumatra experienced a tsunami that caused the death of 283106 victims.[2] Indonesia also experiences hurricanes, between 2015 and 2018, 1285 rural areas were disrupted by hurricanes on the island of Sumatra.[6] Also, throughout the year 2021, there have been 210 hurricanes in Indonesia so far.[7]

Strengthening public education and awareness as part of disaster risk reduction is needed.[8] It is important to minimize the impact of hurricane disasters by preparing human resources to maximize their prevention, mitigation, and preparedness skills,[9] this can be improved by increasing the level of knowledge and intentional behavior.[10,11] Knowledge about disaster preparedness and mitigation has an important role in reducing the high risks present due to the impact of hurricane disasters that should be taught early on.[12–14] Readiness is a sign that a community is willing to take any action to help when a disaster occurs. This is influenced by the behavioral intention to behave in a certain way.[15,16] Having sufficient skills and knowledge about disasters is 1 indicator that a community is ready to respond to disasters.[17]

Along with the increasing development of technology, an increasing level of knowledge and changing behavior can be stimulated using application-based technology.[13] The previous research has stated that an application that provides disaster-related information could be a means to facilitate the learning process and to increase the knowledge held about disaster mitigation.[18,19] In this study, we developed an Android-based application including games that can
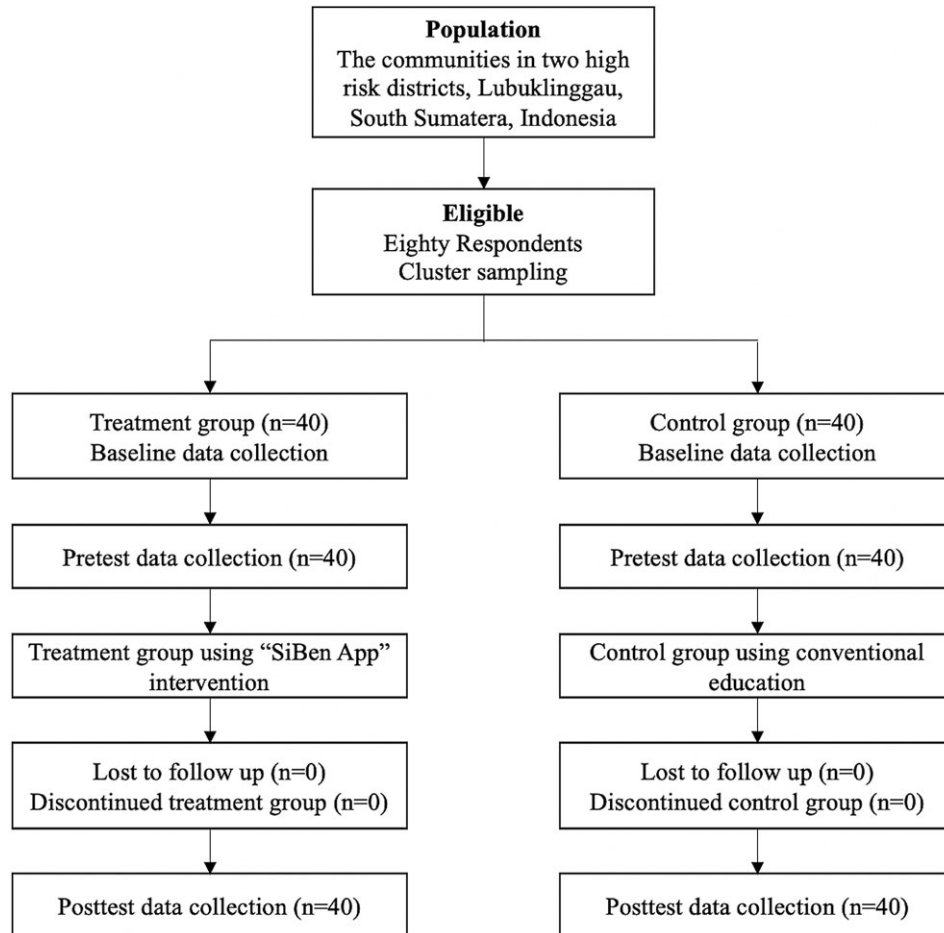
Figure 1. Sample Diagram.

provide information related to hurricanes, before and after disasters, as well as interactive games that show whether the person's intended disaster management actions are appropriate or not. This app has the potential to be an innovation that all ages can use.

The occurrence of hurricanes in Indonesia is significant and they need more attention. This can be done by increasing the community preparedness in the areas at risk of hurricanes. Our study aimed to determine the effect of the Android-based disaster preparedness app 'Siaga Bencana (SiBen).' This will be to examine the effect of disaster alerts on the knowledge and intentional behavior among the communities in hurricane risk areas.

Methods

Study design

A quasi-experimental study design consisting of a 2-group pre- and post-test design was used to examine the effectiveness of the disaster preparedness app.

Setting and sample

The population consisted of the communities in 2 hurricane-prone high-risk districts in Lubuklinggau, South Sumatra, Indonesia. The sampling technique used was random sampling with a cluster sampling pattern (area sampling) taken in areas that were affected by hurricanes in 2 districts. Then, we used a sample size calculation

based on effect size with an alpha of 0.05 and an Effect Size (ES) of 0.24. We obtained a total sample of 80 respondents who participated in the study. Then, we divided the 2 districts into treatment groups and control groups with 40 respondents in each group (Figure 1). The inclusion criteria were respondents aged 18 - 40 years old who have a smartphone with an Android operating system and could read. They also had to live in areas affected by hurricanes and be able to operate a smartphone. The respondents who did not follow through with the study until the end were excluded.

Instrument knowledge

The questionnaire was used to measure the knowledge about how to respond to a hurricane disaster. It was adapted from the National Disaster Mitigation Agency (NDMA) of Lubuklinggau City and consisted of 15 items with a range value between 0 and 100. The questionnaire also used multiple choice questions and consisted of 6 indicators: (1) the definition of a hurricane, (2) when a hurricane usually occur, (3) what to do before, during and after a hurricane, (4) dangerous areas during a hurricane, (5) who the priority to help is, and (6) how to ask for help. The Cronbach's alpha value was 0.84.

Intentional behavior

The questionnaire aimed to evaluate the behavior of the community to intentionally respond to a hurricane disaster. This

Table 1. Respondents' characteristics

Characteristic	Categories	Treatment Group (n = 40)		Control group (n = 40)		Total	
		n	%	n	%	n	%
Age	18 - 30	28	70	30	75	58	72.5
	31 - 40	12	30	10	25	22	27.5
Gender	Male	22	55	20	50	42	52.5
	Female	18	45	20	50	38	47.5
Education levels	High School	30	75	22	55	52	65
	Bachelor	10	25	18	45	28	35
Occupation	No	17	42.5	12	30	29	36.2
	Employees	12	30	12	30	24	30
	Civil Servant	3	7.5	5	12.5	8	10
	Entrepreneur	8	20	11	27.5	19	23.8

questionnaire was based on Ajzen's theory of the planned behavior (TBP) in relation to the behavioral intention.[20] When developing the TBP questionnaire, there were 3 main factors, namely: (1) the attitude towards the behavior, (2) the subjective norm, (3) self-efficacy. The questionnaire used a Likert scale (ranging from "Strongly disagree" to "strongly agree") and consisted of 10 items with a value range between 10 and 50. The indicators of the questionnaire were: (1) taking an action to minimize the impact of a hurricane, (2) reporting the signs of a hurricane, (3) having the courage to act when a hurricane occurs, (4) being willing to help unknown people, (5) being willing to help people of the opposite sex. The Cronbach's alpha value was 0.82.

Disaster preparedness app

The SiBen app is an Android-based educational and simulation application developed by 1 of the researchers. The minimum requirement for running the application was an Android operating system version 5 with a minimum of 60 MB of free space. The application contained education about hurricanes including the definition, signs, and how to respond before, during and after a hit. Additionally, there was a simulation of what happens when a hurricane occurs, as if you were in a place where a hurricane is occurring and what you would do. If you do the right thing in the simulation, you are saved, but if you do something wrong, you will not survive. A disaster expert from the NDMA verified the content validity of the module.

Data collection

The data was collected from October to November, 2020. The intervention was conducted by all researchers who were divided into 2 groups (3 in the treatment and 2 in control groups) and helped by 2 research assistants for data collection. In addition, the research purpose and procedure were known to all the researchers and research assistants. All of the participants were given information on the purpose and stages of the study, and they were asked to fill in an informed consent form. Before the intervention was given, both groups were given a questionnaire as a pre-test. In the treatment group we conducted 3 meetings and installed the SiBen app on their mobile phones. During the first meeting, we explained the information about the tools and guidance when using the app. The next meeting was a simulation using the app. We gave the respondents an example of how to use the SiBen app and provide an opportunity for a question and answer session.

In the last meeting, respondents were asked to play the simulation game once a day while a reminder was sent out by researchers via a mobile messenger. The technical intervention was performed over 3 meetings across 2 weeks. Meanwhile, in the control group, they were given conventional education about the hurricane over 2 meetings. The first meeting provided general information about hurricane while the last meeting had the researchers simulating how to save lives in a hurricane. At the end of week 2, both groups took part in the post-test (Figure 1).

Data analysis

The data was analyzed using the Statistical Package for the Social Sciences (SPSS) 25 software (IBM Corp., Armonk, NY). The respondents' characteristics in both the treatment and control groups were analyzed by assessing the distribution of the frequency and percentage. The analysis of the features and variables in this study was performed following a homogeneity test done using Levene's test. The reliability of the instruments was analyzed using the Cronbach's α parameter. We used Cohen's d coefficient to analyze the effect size using standardized mean difference to identify if the size of the effect the app had was small, medium, large, or huge.[21] Furthermore, the effectiveness of the Android-based disaster preparedness application was analyzed using non-parametric test. We then used a Wilcoxon Signed Rank test to analyze between pre-test and post-test, and a Mann-Whitney U test to compare between treatment and control groups. The significance level was considered at $P < 0.05$.

Results

We found out that most of the 80 respondents were between the ages of 18 - 30 years old in both groups. Most of the respondents were male in the treatment group. The level of the respondent's education was predominantly that of high school in both groups. Most of the respondents did not have an occupation in either the treatment or control groups (Table 1).

Table 2 displays the analysis of the effectiveness of the Android-based disaster preparedness app in relation to community knowledge and intentional behavior in hurricane risk areas. Based on the Cohen's d coefficient, we found that the app has a medium effect on knowledge (d = 0.70) and has a huge effect on intentional behavior (d = 2.07). For the knowledge variable, the differences between treatment and control groups were statistically significant

Table 2. Analysis of the effect of android-based disaster preparedness app on community knowledge and intentional behavior in hurricane risk areas

Group	Pre-test Min ± Max	Pre-test M ± SD	Post-test Min ± Max	Post-test M ± SD	Difference Min ± Max	Difference M ± SD	Cohen's d coefficient	*P*[a]	*P*[b]
Knowledge									
Treatment	40 ± 73.33	60.33 ± 7.69	73.33 ± 100	89.00 ± 7.32	6.67 ± 46.67	28.66 ± 0.36	0.71	< 0.001**	0.003**
Control	46.67 ± 73.33	60.66 ± 7.66	73.33 ± 100	83.66 ± 8.26	13.33 ± 40	23.00 ± 0.59		< 0.001**	
Intentional behavior									
Treatment	27 ± 36	31.70 ± 2.07	40 ± 50	46.87 ± 2.93	8 ± 22	15.17 ± 0.85	2.07	< 0.001**	< 0.001**
Control	27 ± 36	31.47 ± 2.58	33 ± 45	39.95 ± 2.19	4 ± 15	8.47 ± 0.38		< 0.001**	

[a]Wilcoxon Signed Rank Test.
[b]Mann-Whitney U Test; **$P < 0.05$.

($P < 0.003$). However, when viewed according to the difference in mean values, the treatment group showed a higher value than the control group. This also occurred for the intentional behavior variable. We also found the differences on intentional behavior between treatment and control groups were statistically significant ($P < 0.001$).

Discussion

In this study, the importance of knowledge and intentional behavior to improve the preparedness for natural disasters hurricanes in the territory of Indonesia has been explained. This study shows that increasing the knowledge capacity and intentional behavior of the population can be done by developing Android-based technology such as educational games.

The level of knowledge in both groups showed a significant change. This can be caused by the intervention of the SiBen app. It should be carried out each day by playing educational games that are based on the preparedness for tornadoes. To improve the quality of education, the quality of the materials available must also be improved, including how the materials are delivered. Using applications can be an effective tool for disaster education as it displays the disaster information interactively.[22] Learning using an application as a learning media can also improve an individual's critical thinking, creative thinking, and problem-solving skills.[22]

Learning processes that are carried out repeatedly, such as playing disaster simulation games on the SiBen app can increase the memory retention of hurricane disaster management. Previous research has also shown that memory retention gets better if the learning process is carried out repeatedly and continuously, this means that it can be retained for a longer period of time.[23,24] Interactive learning, such as the use of media games can generate interest and facilitate learning.[25] Also, the good use of visuals, as well as games that pose challenges can improve the process of understanding materials quickly and with ease.[26,27] This is very appropriate when applied to the learning process of hurricane disaster preparedness.

In addition, this study also showed a significant change in intentional behavior after being given the intervention using the SiBen app. Changes in behavior can occur along with an increase in knowledge. The previous research shows that knowledge is 1 factor that has a very close relationship with behavior change.[28,29] Providing the SiBen app intervention can result in interrelated benefits such as increasing the public's level of knowledge accompanied by behavioral changes to help the population be more aware

of and have a better sense of preparedness when it comes to hurricane disasters.

The gaps in this research can be seen in each group in relation to the observed variables that have a significant relationship. When viewed according to the mean value, it is clear that the SiBen app can increase the level of knowledge and induce significant behavioral changes. This is in accordance with the research showing that the brain finds it easier to process information by engaging with certain forms of media as part of the learning process than conventional education.[30,31] The main purpose of this application is to help the community test their ability to deal with certain incidents, to evaluate the ability and readiness of certain groups to work together and respond to emergencies, and to discuss the roles, responsibilities, and anticipated activities, including plans, policies, and procedures that disaster management. Perry (2004) stated that after the simulation, there was an increase in the knowledge and response of the civilian participants to disasters.[32]

Strengths and limitations

This study provides solutions and an alternative learning media using the SiBen App. The app is focused on evidence-based cases in connection to the occurrence of hurricanes displayed in the form of educative games. However, the distribution of the SiBen App in disaster risk areas can be hampered due to the lack of facilities and the lack of ability to use smartphones that caused the sample limitation. Areas with a high risk of disaster, usually rural areas, are also where the ability and exposure of the population to smartphones requires special assistance. In addition, specific behavioral changes in this study have not been presented. This means that further research over a longer period of time is needed to obtain information on more specific behavior changes.

Conclusion

This study shows that the Disaster Preparedness app (SiBen app) intervention can significantly increase the level of knowledge and change people's behavior to allow them to be more responsive to hurricane disasters. For this reason, the SiBen app can be an exciting solution as a learning medium about hurricane disaster management for the community, the government, and health workers. Furthermore, research that can describe changes in behavior in connection to natural disaster preparedness needs further observation.

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