Reseacrh Article

The Effectiveness of the Roni App in Enhancing the Resilience of Tuberculosis Patients

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ABSTRACT

Tuberculosis (TB) remains a significant global health burden, requiring not only adherence to treatment regimens but also robust psychological resilience for successful recovery. This study evaluated the efficacy of the Roni application, a novel technology-based intervention designed to enhance resilience among TB patients. Employing a quasi-experimental design, 60 TB patients were randomized into an intervention group (n=30) and a control group (n=30). The intervention group utilized the Roni application for one month, while Patients in the control group received standard care. Resilience was assessed at baseline and post-intervention using the Brief Resilience Coping Scale (BRCS). Results demonstrated a statistically significant improvement in resilience scores among participants in the intervention group compared to the control group ($p < 0.05$). The Roni application, by providing tailored educational resources, motivational support, and opportunities for emotional processing, appears to effectively enhance resilience in TB patients. These findings align with theoretical frameworks of stress adaptation and self-efficacy. This study contributes to the growing body of evidence supporting the potential of technology-based interventions to address the psychosocial needs of TB patients and improve treatment outcomes. Future research should investigate the long-term sustainability of these effects and explore the generalizability of this intervention across diverse populations.

INTRODUCTION

Tuberculosis (TB) remains one of the deadliest infectious diseases in the world [1], [2], [3]. According to data from the World Health Organization (WHO), millions of people are affected by TB every year, and treatment is often time-consuming and requires strict adherence [4], [5]. Indonesia is ranked as the country with the second-highest TB burden globally. In 2021, the TB incidence rate was 354 per 100.000 populations [5], [6]. Indonesia reports a higher prevalence of multidrug-resistant tuberculosis (MDR-TB) among previously treated patients, with rates (52.5%) significantly surpassing the global average of 17.7% [7]. The prevalence of tuberculosis varies significantly across Indonesia, with Sumatera and other islands experiencing higher rates than the Java-Bali region [8]. In Padang City, the capital of West Sumatra Province, the rates of pulmonary tuberculosis, treatment dropout, recurrence, and multidrug-resistant tuberculosis have increased by 2022 to 69%, 3%, and 69%, respectively [9].

In the treatment process, patients often face a variety of psychological distress (e.g., stress, anxiety, and uncertainty), social challenges, and socioeconomic disparities, which can affect their resilience to survive treatment until completion [10], [11], [12]. In line with a study in Ukraine, barriers to tuberculosis treatment adherence include psychological distress, unsupportive interactions with providers, financial costs, and a high pill burden [13]. Therefore, efforts to improve patient resilience are crucial to ensure the success of TB therapy. In the digital era, information technology provides a great opportunity to support patient health [14], [15].

Previous research has shown the benefits of technology-based applications in improving the quality of life and resilience of patients with chronic diseases [16], [17]. A recent systematic review found that digital health interventions, such as SMS text messages and medication reminders, have the potential to improve TB treatment adherence and encourage disease management among individuals and healthcare professionals [18], [19] reported that the mHealth app targeting breast cancer patients showed promising findings, promoting weight loss, improving quality of life, and reducing stress. Although the mHealth app is promising, some existing apps have shortcomings in terms of information quality and functionality [20]. Therefore, further development is required to ensure that this application meets the needs of all patients, including children and vulnerable populations.

Despite current interventions, psychological and socio-economic factors continue to challenge TB treatment adherence. This study introduces the Roni App, which is designed to provide education, motivation, and support to patients facing challenges in TB treatment. According to the theory of stress adaptation and coping, this app is an essential tool for helping individuals develop effective coping mechanisms [21]. While existing mHealth applications offer medication reminders and emotional support, few provide a comprehensive resilience-building program tailored to the unique challenges faced by TB patients, an area the Roni App aims to innovate in

Although mHealth applications for TB treatment adherence exist, holistic solutions that aim to strengthen patient resilience by providing personalized support and educational resources are scarce. This study aimed to evaluate the effectiveness of the Roni App, a novel digital intervention designed to address this gap.

METHOD

This study employed a quasi-experimental design, with a non-equivalent control group. Participants were recruited from three public health canters (Alai, Pauh, and Ambacang) in Padang City, Indonesia, between May and August 2024.

The study population comprised all patients with active tuberculosis (TB) patients registered at public health centers during the study period. The inclusion criteria were as follows: (1) a confirmed diagnosis of TB by a physician, (2) willingness to participate in the study for the entire duration, and (3) the ability to use a mobile phone and the Roni application. The exclusion criteria were as follows: (1) severe comorbidities that could significantly impact resilience, and (2) withdrawal from the study before completion. A purposive sampling technique was used to select 60 participants divided equally between the intervention and control groups.

The intervention group received access to and guidance on using the Roni application, which was designed to enhance resilience in patients with TB. The Roni app has three mainstay features, namely education, concordance, and compliance (Figure 1). Patients in the control group received standard care. The participants in both groups received the intervention for the next month.
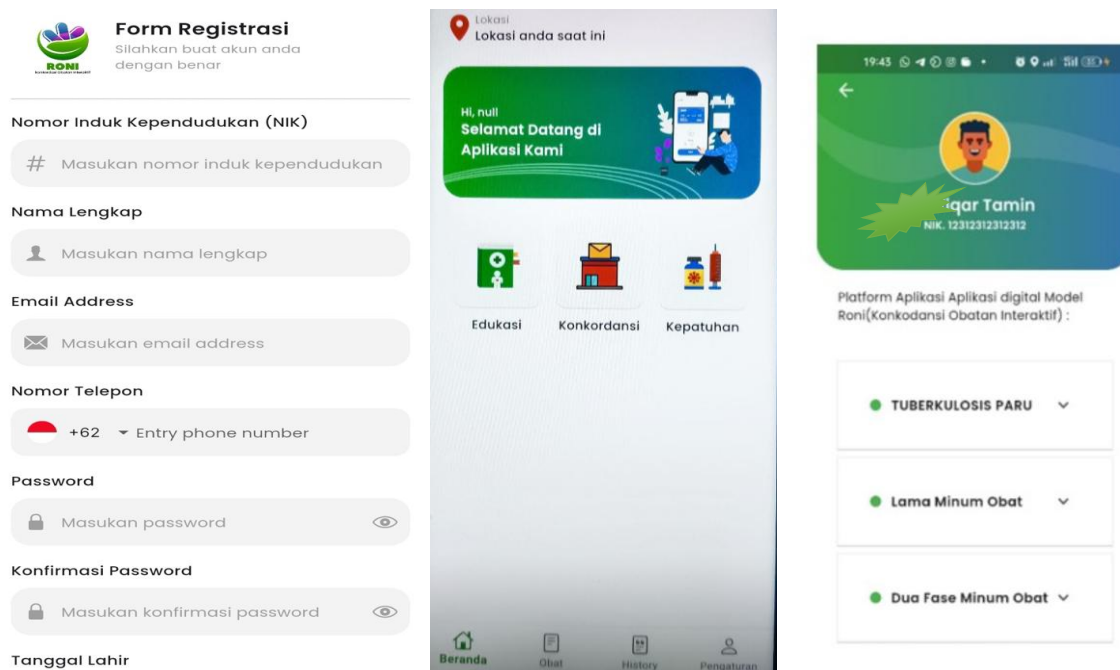

Figure 1. the Roni app

Resilience levels were assessed using the Brief Resilience Coping Scale (BRCS) instrument developed by [22] at baseline and at the end of the intervention period, which was tested for validity and reliability. The BRCS consists of four items (partnership, knowledge, shared decision making, and support) that assess how individuals perceive their ability to cope with adversity or bounce back from difficult situations. It measures resilience in terms of how well a person can recover from setbacks or stressors such as the challenges associated with tuberculosis (TB). Each item in the BRCS is rated on a Likert scale ranging from 1 to 5. After administering the questionnaire, the scores for each of the 4 items were summed. The total score ranges from 4 to 20. Higher scores indicated higher resilience, while lower scores indicated lower resilience. Interpretation of scores: 1) High resilience: A total score closer to 20 indicates that the individual is likely to cope well with stress and adversity. 2) Moderate resilience: A score of approximately 12–15 suggests moderate resilience, meaning that the person may manage some stress, but might face challenges when stressors are significant. 3) Low resilience: a score closer to 4–8 suggests that a person may struggle with recovery from stress and adversity. Data were collected through face-to-face interviews conducted by trained research assistants. We used statistical software to analyze the data, employing the Mann–Whitney test to compare resilience scores before and after the intervention across both groups.

This study was approved by the Research Ethics Committee of the Medicine Faculty of Andalas University (permit number 53/UN.16.2/KEP-FK/2024). All participants were given a full explanation of the study and provided written informed consent prior to participation. The privacy and confidentiality of patient data were guaranteed in accordance with the principles of research ethics.

RESULTS AND DISCUSSION

This section presents the demographic characteristics of the participants and the outcomes of the Roni app intervention. Many participants in both groups were over 35 years of age. Males constituted more than half of the study population. Regarding education, a higher proportion of participants in the control group had completed Senior High School than those in the intervention group. Most participants had attained high school education. Notably, a portion of the participants in both groups was not employed (Table 1).

Table 1. Demographic characteristics of respondents (N=60)

Characteristics Respondent	Intervention Groups		Control Group	
	f	%	f	%
Age (year)				
≤ 35	14	46,6	10	33,3
> 35	16	53,4	20	66,7
Gender				
Male	17	56,7	17	56,7
Female	13	43,3	13	43,3
Educational Level				
Junior High School	10	33,3	8	26,7
Senior High School	12	40,0	18	60,0

Characteristics Respondent	Intervention Groups		Control Group	
University	8	26,7	4	13,3
Occupational				
Government employee	-	0	3	10,0
Laborer	8	26,7	4	13,3
Teacher	1	3,3	-	0
Housewife	7	23,3	7	23,3
Not employed	10	33,3	13	43,3
Privat sector	3	10,0	3	10,0
Other	1	3,3	-	0

The implementation of the RONI application was carried out in three stages: pre-test, implementation, and post-test.

Table 2. Differences in Pre-test and Post-test Resilience in the Control Group

Resilience	$\overline{X} \pm SE$	Me	SD	Min- Max	α_3	p
Pre-test	22,97 (22,08-23,85) ± 0,43	23,5	2,371	17-28	-0,374	0,83
Post-test	22,97 (22,19-23,74) ± 0,38	23	2,076	19-27	-0,151	

Based on Table 2, the data suggest that there was no significant change in resilience scores within the control group from pre-to post-test. The results of the analysis showed a p value of 0.83 (p > 0.05), indicating that there was no statistically significant difference between pre-test and post-test resilience scores in the control group.

Table 3. Differences in Pre-test and Post-test Resilience in the Intervention Group

Resilience	$\overline{X} \pm SE$	Me	SD	Min- Max	α_3	p
Pre-test	11,6 (11,05-12,15) ± 0,27	11,5	1,476	9-14	-0,003	0,001
Post-test	21,87 (21,18-22,56) ± 0,34	22	1,852	19-26	0,209	

Table 3 shows that the data strongly suggests that the intervention had a positive and statistically significant impact on the resilience scores of the participants. The mean resilience score increased substantially from pre-to post-intervention, indicating an improvement in resilience levels within the intervention group. The mean resilience in the intervention group at the post-test was higher than that in the pre-test. The results of the analysis showed p < 0.05, which means that there is a significant influence of the RONI app on the resilience of patients with TB.

Differences in resilience after being given the Roni app using The Mann-Whitney test because the data were not normally distributed. This is shown in Table 4.

Table 4. Differences in Pre-test and Post-test Resilience in the Intervention and Control Groups

Group	N	Mean (SD) Pre-Test	Mean (SD) Post-Test	Δ Mean (Post - Pre)	p-value
Intervention	30	50.3 (±10.5)	70.8 (±9.3)	20.5	< 0.001
Control	30	51.0 (±9.8)	55.2 (±10.1)	4.2	

Table 4 shows that the intervention group experienced an increase in the average resilience score by 20.5 points after the intervention. A p-value of 0.001 indicated that this increase was statistically significant. This means that the Roni app intervention was effective in increasing the resilience of patients with TB.

DISCUSSION

The results showed that the use of the Roni application significantly increased the resilience of tuberculosis patients. This increase was seen in the comparison of pre- and post-test resilience scores in the intervention group ($p < 0.05$), while the control group did not show significant changes. These findings suggest that the application of Roni can be an effective tool for improving patient resilience, which is crucial for supporting the tuberculosis treatment process.

Theoretically, resilience is an individual's ability to adapt to stress and challenges, including in the context of chronic diseases, such as tuberculosis. According to stress adaptation theory, technology-based support can provide a more structured coping mechanism and help patients manage their emotions better [21]. In this study, Roni's application appeared to act as a medium to support the patient's adaptation process to emotional and physical challenges due to tuberculosis, in line with this theory.

The results of this study are in line with those of previous studies, which stated that technology-based interventions can improve resilience in patients with chronic diseases. For example, A research by Qin et al. (2022) showed that mobile health apps can improve quality of life, self-efficacy, and alleviate anxiety, depression, and stress in adult cancer survivors [23]. A similar thing was also reported by Luo et al. (2021) found that mobile apps that provide health education and emotional support can improve the resilience of patients with cancer [24]. Another study by Lin et al. (2023) also showed that the mobile app for gynaecologic cancer support (MGCS) programs has shown success in supporting gynaecologic cancer patients receiving chemotherapy, improving their quality of life, and reducing uncertainty about the disease. App-based technology helps improve the quality of life of patients with chronic lung disease [25]. This strengthens the effectiveness of the Roni application as a supporting tool for increasing the resilience of patients with TB.

However, there are also studies that show different results. For example, a study by Kelley et al. (2021) revealed that mobile apps do not have a significant impact on the resilience of cancer patients, citing a lack of personalization in the app's features [26]. This is contrary to the results of our study, which showed

that the personalization features of the Roni app, such as customized reminders and relevant educational materials, contributed significantly to improved patient resilience. These differences may be due to variations in the context of the disease, the design of the app, and the level of support provided. The study demonstrates the importance of ensuring that the app is designed to meet the specific needs of the patient, which includes both technical and emotional aspects.

Notwithstanding the positive outcomes of this study, several limitations should be considered. Extraneous variables, such as familial support or the pre-existing psychological state of the patient, may have influenced the results yet were not fully controlled for. The duration of the intervention, limited to one month, provides an initial assessment of the efficacy of the application; however, the long-term effects remain undetermined.

CONCLUSION

The use of the Roni application significantly enhanced the resilience of tuberculosis patients. The Roni application functions as an efficacious support tool to assist patients with TB in addressing emotional distress and challenges encountered during the treatment process. Further research involving larger sample sizes and extended intervention durations is necessary to evaluate long-term effects. A more comprehensive evaluation of the features of the Roni application that contribute most substantially to improving resilience can serve as a foundation for future application development.

AUTHOR CONTRIBUTIONS

RP wrote the manuscript with support from AF; FY; and AB. All authors discussed the results and contributed to the final manuscript.

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