Piloting Smartphone Application to Improve Mother's Knowledge of Proper Neonatal Care in Indonesia

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Abstract

BACKGROUND: The first of 0–28 days presents a crucial stage in infant health and well-being. In Indonesia, it is estimated that 60–80% of all newborn deaths occur within the first 6 days of life. Antenatal education regarding neonatal care is needed in this setting.

AIM: This study aims to pilot an Android-based smartphone application (app) to assess effectiveness in improving pregnant Indonesian women's knowledge about neonatal care.

METHODS: A quasi-experimental study conducted from November 2019 to January 2020 with 31 participants in each of the experimental and control groups (n = 62). Participants were pregnant women in the third trimester who obtained antenatal care (ANC) at the Community Health Center in Banguntapan 1 in Yogyakarta, Indonesia. Participants completed a structured questionnaire and were given the "My Baby Care" (MBC) app. Data collection occurred 3 times in the form of (1) pre-intervention activities and training on use of the MBC app; (2) follow-up activities using WhatsApp groups during the intervention; and (3) post-intervention data collection was conducted through Google Forms questionnaire. Data were analyzed using paired t-tests to compare pre- and post-intervention groups, and independent sample t-tests to compare participants' knowledge status between the two groups.

RESULTS: Participants were on average 28.7 years old in the experimental group and 29.9 years old in the control group. The majority had a high school level education, were not currently working, got married over the age of 20, and had more than two children. Before the intervention, there was no significant difference in neonatal care knowledge of the participants between the experimental and control groups. We found that health education delivered through the smartphone app was effective in increasing participants' knowledge about neonatal care (MD = 4.354, p = 0.030).

CONCLUSION: The use of an Android-based smartphone app was found to be effective in increasing mother's knowledge about proper neonatal care. Digital strategies are innovative and should be considered for the implementation of health education in ANC programs in Indonesia and beyond.

Introduction

Poor perinatal health outcomes, such as premature birth and low birth weight (LBW), remain a global concern today. Babies born, prematurely, and/or with LBW are often faced with serious health risks that can be fatal. The first 24–72 h of extrauterine life are especially critical [1]. According to the World Health Organization (WHO), 15 million babies or one in 10 are born prematurely every year and this number continues to rise. The current global prevalence of LBW is 15.5%, which equates to 20 million babies being born with LBW annualy, 96.5% of which occurs in developing countries. Indonesia heavily contributes to the annual number of global neonatal deaths due to complications associated with LBW. In 2020, around 1/3 of worldwide infant deaths occurred on the day of birth, and almost ¾ occurred during the 1st week of life [2]. In Indonesia, of all reported infants deaths, around 80% occur within the first 6 days, 21% occur within 29 days to 11 months, and 10% occur within 12–59 months. Importantly, in Indonesia, the most common cause of neonatal death is LBW [2].

Neonates are particularly vulnerable to experiencing poor health outcomes due to physiological changes to organ systems that occur during extrauterine adaptation time period [3]. Neonates require proper neonatal care from those around them during this adaptation period [4]. Neonatal care broadly refers to care carried out by health workers and families to maintain a neonate's good health and prevent health issues from arising [5], [6]. Optimal neonatal care involves the family, especially the mother, and it is, therefore, fundamental that education on best neonatal care practices be accessible [5], [7].

Lack of maternal knowledge regarding newborn care practices has a significant impact on neonatal mortality and morbidity [8]. A study conducted in Pakistan found that the average mother's knowledge of neonatal care was a score of 5.48 out of 11.00 [9]. About 57% of the participants in this previous study demonstrated adequate knowledge about skin to skin care; 55% knew the right timing for a newborn's first bath; 54.6% demonstrated accurate knowledge about early initiation of breastfeeding; 57.6% had knowledge of acceptable pre-lacteal foods; and 55.6% of participants answered correctly when asked about giving colostrum to babies. Among the same study population, only 1.4% of participants were informed of correct umbilical cord care, although 73.4% knew that breastfeeding should be given on demand; and 51.0% knew the ideal duration of exclusive breastfeeding. Overall, this recent study helped to determine that certain aspects of neonatal care are still widely misunderstood by mothers such that education beginning during antenatal care (ANC) visits and over the course of the pregnancy should be made accessible to all mothers before the birth of their newborn.

Community Health Centers serve as some of the most important public health service facilities in Indonesia. These centers serve multiple functions, including fostering community participation in the health sector and carrying out comprehensive, integrated and sustainable community activities [6]. The Community Health Center is expected to aid in monitoring the implementation of health-care practices so as to have a positive impact on public health in the communities in which they are located [10]. One of the principle missions of the Community Health Center is to provide education to pregnant women during the ANC period as set forth by the Ministry of Health of the Republic of Indonesia [6].

Educational media help mothers to better understand the material provided to them. Educational media can include audio-visual, printed, web-based, and mobile-based media. The display of images or videos has been shown to enhance the learning process compared to using only written media [11], [12]. Fortunately, the development and ubiquity of technology today makes it possible to combine several types of educational media to be accessed from one source. Smartphones in particular can serve as a medium for educational media combining images, audio-visuals, and writing [9], [13].

Several studies have the benefits smartphone use for educational purposes [12]. For example, Kim *et al.* found that smartphone use was effective for increasing knowledge and alertness of pregnant women increased risk of having a preterm birth [13]. In addition to its ubiquity, smartphones can be used virtually anywhere and at any time for learning (sometimes referred to as mobile learning or m-learning) [14]. Information and Communication Technology survey data in Indonesia 2017 show that 65.09% of Indonesian women have used smartphones [15]. Despite this, there is relatively limited literature on the use of Android-based smartphone applications (apps) for neonatal care education.

According to the International Data Corporation, Android holds 82.8% of the worldwide market share, while iOS only holds 13.9%. In Indonesia, as of January 2020, there were more Android-based smartphone users than iOS-based iPhone users, therefore making Android the more appropriate choice for the present intervention. In Partnership with the Banguntapan 1 Community Health Center, Bantul Regency, Yogyakarta Province, and the Indonesian Ministry of Health, the presents study was conducted to examine the effectiveness of using an Android-based smartphone app as an educational medium for improving pregnant women's knowledge about proper neonatal care.

Methods

Study design

The present study used a quasi-experimental design with non-equivalent experimental and control groups to determine the effectiveness of the intervention in the experimental group compared to the control group. The experimental group received education using the My Baby Care (MBC) app on an Android-based smartphone and the control group received a booklet as the alternative educational medium.

Study sample

This research was conducted in a rural area, namely, at the Banguntapan 1 Community Health Center, which is located in Bantul Regency, Yogyakarta Special Region Province. The study population included pregnant women who received ANC at the Banguntapan Community Health Center 1. A diagram of the selection of research participants is found in Figure 1. Inclusion criteria were: (1) Being in the third trimester of pregnancy, (2) undergoing ANC at the Banguntapan Community Health center 1, (3) having access to an Android-based smartphone, and (4) being willing to participate. Exclusion criteria were: (1) Having a smartphone that is incompatible with the Android operating system and (2) already having received education from health workers about neonatal care.

We used the Lwanga and Lameshow sample size determination formula, with a degree of confidence of 95% and margin of error of 5%. From a total population of t4 women, a sample of 62 participants was obtained [16]. Participants were then divided into either the experimental group (n = 31) or the control group (n = 31) using the purposive sampling technique. In this context, participants from Potorono Village and
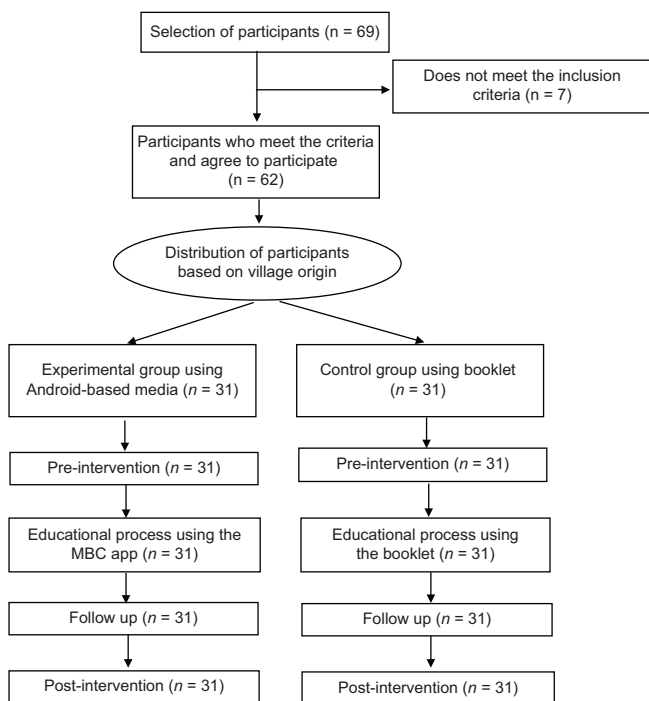
Figure 1: Flow diagram of participants for the experimental and control groups

Baturetno Village made up the experimental group; while participants from Banguntapan Village and Jambi Village made up the control group.

Questionnaire instrument

Data were collected using a structured neonatal care knowledge questionnaire developed by previous researchers and administrated through Google Forms. The questionnaire includes questions regarding basic neonatal care such as eye, hair, ear, skin, umbilical cord, and genital care, as well as bathing, diaper changing, breastfeeding babies, and giving immunizations. There are a total of 20 statements, 13 favorable and 7 unfavorable, for which scoring relies on the Guttman scale. Each correct answer earns 5 points, while each wrong answer earns 0 points. The higher the score, the higher the knowledge level of the respondent. This questionnaire was originally developed for use in the *Primipara Mother's Knowledge of Baby Care in Situmeang Habinsaran, Sipoholon* study, and was been found to have acceptable content validity (0.631) and reliability (0.681) [17].

App development

In the present study, the experimental group downloaded and installed an Android-based smartphone app that contains content regarding neonatal care in the form of text, images, and videos. The control group was given printed booklets with similar educational content to the app.

The MBC app used in the present study was developed by the present research team which included a pediatric nurse practitioner and academic faculty members in the fields of pediatric nursing science and information systems. The app was programmed using the ADDIE model. ADDIE is an acronym for "Analyze, Design, Develop, Implement, and Evaluate" [18], [19]. The app development stages were follows: (1) Analyze in the form of identifying the desired target uses of the app, as well as information needs and non-functional requirements; (2) design in terms of the process of translating requirements identified from the analysis stage into the design of the app using use case diagrams, activity diagrams, and flowcharts; (3) development of the app based on the Massachusetts Institute of Technology (MIT) app inventor from the MIT; (4) implementation where participants in the experimental group use the app; and (5) evaluation where participants in the experimental group complete a questionnaire on their knowledge of neonatal care following use of the app. The MBC app consists primarily of video tutorials and materials accompanied by pictures and written steps.

Data collection

Data collection was carried out twice, namely, at pre-intervention and post-intervention, and consisted of completing a Google Forms questionnaire sent through WhatsApp each time. On the 1st day after the pre-intervention time point, participants in the experimental group were then trained to download, install, and use the MBC app. After the download and installation process, participants were free to access content without relying on working internet. In contrast, participants in the control group were given a booklet which was explained. The educational material in the booklet was the same as that presented in the MBC app.

On the 2nd day, follow-up activities were conducted through WhatsApp group chats among the experimental group and included: (1) Helping participants if they had difficulties during the educational activities; (2) ensuring that participants had studied all the educational materials; (3) providing motivation to mothers; and (4) ensuring that mothers obtain information about neonatal care only from the instruments provided. In the control group, follow-up activities were conducted through WhatsApp group chats to ensure mothers used the booklet only, and no other media. Use of the MBC app lasted approximately 45 min and research participants were given the opportunity to study the content at least 2 times, namely, on the 1st day and the 2nd day at follow-up (Figure 1).

On the 3rd day, post-intervention data collection was conducted through Google Forms questionnaire. Participants were again provided with instructions so as to limit any issues from arising while completing the questionnaire (Figure 1).

Data analysis

Data were then analyzed to obtain descriptive data about the characteristics of participants in both groups. Comparison of participants characteristics between the two groups was carried out using an independent samples t-test or one-way ANOVA for continuous data, and a Chi-square test for categorical data. Paired t-tests were performed to compare the pre- and post-intervention data collected in each group, and an independent samples t-test was used to compare assessed maternal knowledge between the two groups.

Ethical approval

This research was reviewed and approved by the Ethics Committee of the Faculty of Health Sciences, Alma Ata University on December 2, 2019 (number: KE/AA/XI/1002/EC/2019). Participants were given an explanation of the purpose and course of the research, and if they agreed to participate, they then signed the written consent form. During the consent process, it was explained that the participant's personal information would be kept confidential, that no side effects would be intentionally caused by participating, and that the participant was able to withdraw from the study at any time.

Results

Among our sample, the average age of participants was 28.7 in the experimental group and 29.9 in the control group. The majority of participants had attained a high school level education, were not currently employed, had been married over the age of 20, and had more than two children at the time of the study. There was no significant difference between the two groups regarding age, education, occupation, age at marriage, and parity status (Table 1). Further,

Table 1: Demographic data of the experimental group and control group

Variables	Experimental group (n = 31)		Control group (n = 31)		p
	n	%	n	%	
Age (mean, SD)	28.7	6.21	29.9	6.19	0.107
>35	5	16	9	29	
20–35	25	81	22	71	
<20	1	3	0	0	
Educations					0.518
College	12	39	8	26	
Senior high school	15	48	20	65	
Junior high school	4	13	2	6	
Elementary school	0	0	1	3	
Professions					0.736
Currently works	13	42	11	35	
Does not work	18	58	20	65	
Age of marriage					0.759
>20	25	81	29	94	
<20	6	19	2	6	
Parity status					0.255
>2	13	42	20	65	
1	6	19	5	16	
None	12	39	6	19	

Table 2: Participants' knowledge homogeneity test pre-intervention

Variables	Experimental group (n = 31)		Control group (n = 31)		t	p
	Mean	SD	Mean	SD		
Knowledge of neonatal care	73.54	7.65	76.61	8.10	0.131	0.948

no significant difference was detected between the two groups regarding neonatal care knowledge of participants as baseline based on the pre-intervention questionnaire (Table 2).

The average knowledge score of participants in the experimental was 73.55 (SD = 7.65) at the pre-intervention time point and 82.74 (SD = 7.83) at the post-intervention time point. The results of the paired t-test analysis demonstrated that using an Android-based smartphone app as an educational medium significantly increased participants' knowledge (p = 0.000; Table 3). For comparison, participants in the control group had an average knowledge score of 76.61 (SD = 8.10) pre-intervention and 78.38 (SD = 7.57) post-intervention, with the results of the paired t-test being significant (p = 0.025). Although this demonstrates that the use of the booklet in the control group also significantly increased participants' knowledge, there was a higher average increase in knowledge among the experimental group compared to the control group.

Table 3: Change in participants' knowledge

Variables	Pre-intervention		Post-intervention		p
	Mean	SD	Mean	SD	
Knowledge					
Experimental group	73.55	7.65	82.74	7.83	0.000
Control group	76.61	8.10	78.38	7.57	0.025

An independent samples t-test was conducted to compare the knowledge of the participants in the experimental group and the control group post-intervention. We found a significant difference in knowledge between the two groups and determined that the use of smartphone app was more effective for increasing knowledge compared to the booklet (p = 0.030; mean difference = 4.354) (Table 4).

Table 4: Difference in knowledge post-intervention

Variables	Experimental group (n = 31)		Control group (n = 31)		Mean difference	p
	Mean	SD	Mean	SD		
Knowledge of neonatal care	82.74	7.83	78.38	7.57	4.35	0.030

Discussion

The present study sought to pilot an Android-based smartphone app as an educational medium for increasing Indonesian pregnant mothers' knowledge about neonatal care. Use of the smartphone app was compared to a more traditional printed booklet used by Community Health Centers to provide education.

Data analyses demonstrated that although both the smartphone app and booklet were effective in increasing mother's knowledge, the average increase in knowledge was significantly higher among the experimental group compared to the control group.

Health education involves a conscious and planned process to increase knowledge and develop one's life skills toward living a healthy lifestyle [12]. The media through which health education is delivered can influence this process [20]. Importantly, health education that contains mixed media in the form of text, videos, and images can aid in a person's learning process [21]. In digital era, many health app have been developed as educational media. Research from Ratnasari found a pre-pregnancy education app design that can replace flipcharts or leaflets for counseling health care workers. This app facilitates and increases knowledge about pre-pregnancy [22].

In line with the present study, the benefits of using educational media can also be seen from the results of research conducted by Jiao *et al.* on psychoeducation using web-based media. In this 2019 study, Jiao *et al.* found that web-based media increased maternal self-efficacy and reduced the incidence of postnatal depression compared to the control group given traditional psychoeducation [23]. More study about health education using slide was more effective to improve the level of breast cancer knowledge for students [24].

In addition, our results are in line with research conducted by Kim *et al.* which found that providing education through smartphones increased awareness about risk factors for premature birth among pregnant women, and led to an increase in the number of visits to health-care facilities for consultation with health workers [13]. The use of android media for health education for pregnant women also shows an influence on the motivation of pregnant women in caring for babies [25]. The use of smartphones as an educational medium has various advantages, including ease of use, appealing design, and the ability to use it at any time and in any location [26].

Based on the results of the present study coupled with previous research, the authors believe that software-based educational media stimulate thoughts, feelings, and interests that can make the learning process more appealing. With the current technological advancements, it is possible to provide educational content in the form of mixed media presented through smartphone apps. We found that our MBC increased mother's knowledge about neonatal care, and we hypothesized that increased knowledge would be increased mothers' confidence in caring for her baby. In turn, we can work toward global improvements in neonatal care and health, especially given the ubiquity of mobile technology.

One limitation worth noting was that there was a lack of monitoring of participant's use of the MBC app during the present study. Monitoring was only carried out through text messages sent in WhatsApp group chats. There is possibility for bias due to not knowing whether mothers used the app as intended. The use of purposive sampling method and the quasi-design of the study are considered because of the groups were not significant different at baseline for support.

Conclusion

Smartphones should be considered an important tool for delivering neonatal education due to the ease and convenience of use compared to traditional print methods. The use of smartphones may make the learning process more appealing for mothers and can help to overcame typical challenges such as physical distance to local Community Health Center services. Future research should assess the effectiveness of smartphone apps like the MBC app on a larger scale. It is our hope that technology can be developed and enhanced to assist in the process of implementing health promotion for neonatal care by Community Health Centers in Indonesia and similar settings.

Acknowledgments

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