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Quick Response Code:

Website: www.jehp.net
DOI: 10.4103/jehp.jehp_108_23

Effectiveness of daily educational message on pregnancy anemia prevention behavior and knowledge: A pilot randomized controlled trial

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Abstract:

BACKGROUND: Distance education and mobile health (mHealth) usage are yet to be researched widely, particularly in terms of anemia prevention in Indonesian pregnant women. This study aimed to analyze the daily educational messages' effectiveness on anemia prevention behavior and knowledge, in pregnant women in Surakarta City, Indonesia.

MATERIALS AND METHODS: This pilot randomized controlled trial was conducted in two Primary Healthcare Centers in Surakarta in April-September 2022. The target population was pregnant women who conducted Antenatal Care at Primary healthcare Center. The sample was put into two randomized groups consisting of pregnant women in the first and second trimesters: intervention and control. This study included a total of 44 participants. The intervention was a daily educational message sent through WhatsApp for seven weeks. Measurement of anemia prevention knowledge, anemia prevention diet, and Iron and Folic Acid (IFA) tablet consumption was collected at the baseline and follow-up.

RESULTS: The intervention resulted in a significant difference (P value .003) in mean IFA tablet consumption (last 42 days), which was higher in the intervention group (39.54 ± 3.94) than in the control group (34.86 ± 8.13). It has a significant effect on knowledge (P value .007) as well. However, no significant difference in the anemia prevention diet between groups at the end of the intervention.

CONCLUSIONS: The daily educational message improves pregnant women's knowledge and IFA tablet consumption. Conducting a full-scale randomized controlled trial is feasible to confirm the effectiveness of daily educational messages as a pregnant anemia prevention program, considering the needed improvements.

Keywords:

Anemia prevention, daily educational message, knowledge, mobile health, pregnant women

Introduction

The most prevalent cause of women's anemia is iron deficiency (about 20%). It is the cause of about 50% of anemia in pregnant women.^[1] Anemia during pregnancy increases maternal and child mortality and morbidity.^[2,3] World Health Organization (WHO) estimates show that

anemia during pregnancy was linked to 40% of deaths in mothers in developing countries.^[4] Pregnant Indonesian women with anemia were found to have a high prevalence of 48.9% in 2018.^[5]

The WHO's recommendation for the prevention of anemia in pregnant women is to focus on education about nutrition and

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How to cite this article: Arifah I, Pambarep TS, Khoiriyah L, Kusumaningrum TA, Werdani KE, Ngadiyono NP. Effectiveness of daily educational message on pregnancy anemia prevention behavior and knowledge: A pilot randomized controlled trial. *J Edu Health Promot* 2023;12:296.

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Received: 23-01-2023
 Accepted: 08-04-2023
 Published: 31-08-2023

healthy food consumption.^[6] WHO recommends routinely giving Iron and Folic Acid (IFA) supplementation to women experiencing pregnancy to prevent anemia.^[4] Policies in Indonesia for preventing pregnant women from developing anemia have been implemented to meet the target, namely, the coverage of giving at least 90 tablets of IFA supplements, which is more than 95%. However, many pregnant women who get IFA tablets do not regularly consume them. Data show that the percentage of pregnant women who consume iron tablets from all pregnant women who claim to receive iron tablets is only 38.1%.^[5] Research shows many pregnant women do not comply with appropriate eating recommendations to prevent anemia.^[7,8]

Previous research has proven that various educational interventions for anemia prevent anemia during pregnancy.^[9-11] A systematic review of anemia prevention recommends that further interventions be directed using technology and distance education.^[10] WHO defines mobile health (mHealth) as the use of mobile phone technologies in supporting health and health-related efforts.^[12] The results of a systematic study on the use of mHealth to boost health in mothers and children show evidence of mHealth interventions' effectiveness when implemented in developing countries. Most mHealth interventions send short message service, voice messages, and use applications.^[13] Previous research recommend using digital technology to provide text alerts daily to remind drinking IFA through electronic devices.^[7] The previous study shows that short message interventions are more suitable for repetitive behavior interventions such as Antenatal Care (ANC) visits.^[13-15]

However, conditions with complex circumstances require beyond simple reminders and consider the client's beliefs, emotions, and environmental barriers to medical advice adherence.^[16,17] Therefore, this intervention uses daily educational messages in visual form to increase knowledge and adherence to iron tablet consumption. The short message provided in motivational, persuasive, and informational form toward anemia prevention. This has the potential to increase anemia prevention behavior to prevent anemia. In addition, the use of social media is a potential medium for education. A randomized controlled trial study in India found that using social media to prevent anemia in women of childbearing age showed the benefits of involving many participants and could increase knowledge about anemia prevention.^[18] Therefore, this study intends to analyze the effectiveness of daily educational messages on pregnancy anemia prevention behavior and knowledge in pregnant women in Surakarta City, Central Java Province, Indonesia.

Materials and Methods

Study design and setting

This study was a two-arm, parallel, pilot randomized controlled trial, single-blinded study. This study was conducted in two Healthcare Centers in Surakarta City, Central Java Province, Indonesia, between April and September 2022.

Study participants and sampling

Anemia in Indonesian pregnant women is prevalent, as per Indonesian Policy, the IFA supplementation was provided to all pregnant women regardless of the anemia status and gestational age. All Indonesian pregnant women should be given at least 90 IFA tablets starting from their first ANC. Therefore, this study's participants were pregnant women in the first and second trimesters to maximize the chance of the women finishing the study before their labor due date. Pregnant women who did the ANC at the Sangkrah and Kratonan Primary Healthcare Center (Puskesmas), Surakarta City were considered eligible if they were at 8-26 weeks gestational age at the time of the recruitment period, had an android-based smartphone, were active WhatsApp users, and are willing to include in the study. The exclusion criteria included the condition of extreme gestational complications such as hypertension, preeclampsia, and cardiovascular disease. To sort out the eligible participants, a simple random sampling technique was used. Participants were recruited from Primary Healthcare Centers, namely Puskesmas Sangkrah and Kratonan in Surakarta City. The research team cooperates with the health provider in the recruitment period to offer for joining this study to several randomly listed participants during their ANC visits to the health centers. The participant recruitment period was April-May 2022. The minimum sample was counted using the Continuous Response Variables formula with a power of 80% and significance level of 95%. Using the previous effect size of the pictorial handbook education toward anemia knowledge outcome of 2.7,^[11] the minimum sample was 20 per group. Counting for anticipated drop-out, this study adds 10% of respondents per group. A total of 44 pregnant women participated in this study. As seen in Figure 1, all the eligible participants were allocated randomly to one of the two groups by a randomization list with a block size of 4. We used a website-based dynamic allocation to conduct the randomization.

Intervention and control

The intervention group (n = 22) received daily educational and reminder messages through WhatsApp through personal chat. The short message delivered in visual graphics consists of two sentences. The first sentence contains educational content about the prevention of anemia in pregnancy. The last sentence

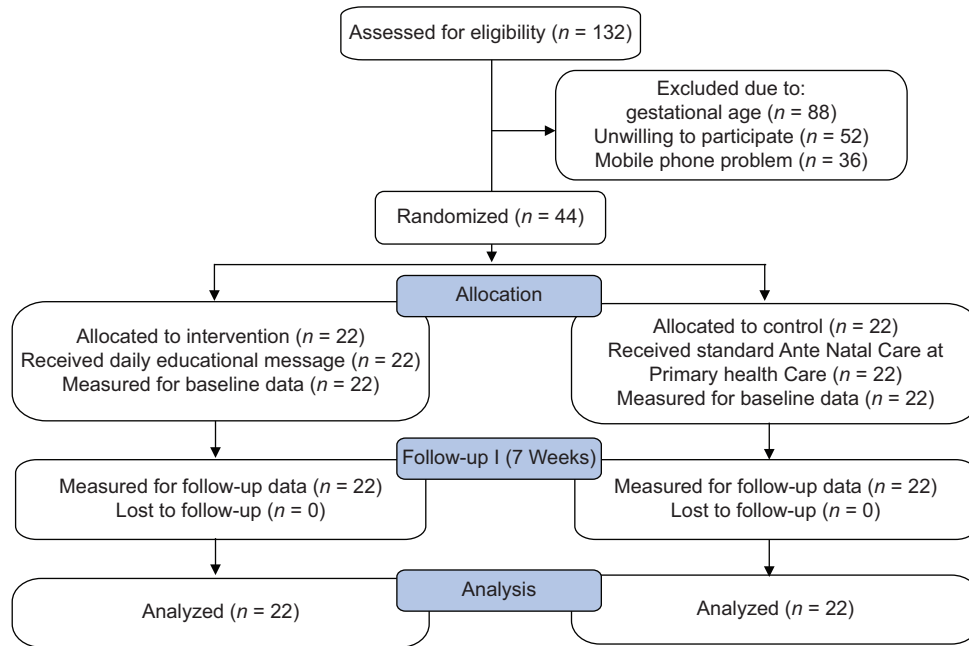


Figure 1: Respondents' flow chart

is a supportive, persuasive, or motivational message to do anemia prevention behaviors. This visual message design was tailored as per the Capability, Opportunity, Motivation, Behaviour (COM-B) model that includes changing perception and motivation beyond a simple reminder in designing behavioral change.^[19] This visual message was given with no additional message sent to the respondents. Each day participants in the intervention group received one visual message about how anemia prevention and a motivational message related to the message topics. The topic message was classified into four topics namely the definition of anemia, the benefits of anemia prevention, the impact of pregnancy anemia on infants and pregnant women, and advice about IFA consumption and diet suggestion to prevent anemia in pregnancy. In total, the intervention group received different 23 messages daily in 46 days of the intervention. The control group (n = 22) received standard ANC and health information from the health centers. The group allocation was not blinded, as this does not apply to the study design. The investigators analyzing the data were unaware of the group assignment.

At the baseline, respondents were measured about their anemia prevention knowledge, consumption of anemia prevention diet, IFA tablets consumption, and Hemoglobin level (anemia status). As detailed in Figure 1, participants were assessed for the follow-up measurement at the end of the seven weeks of the intervention for their anemia prevention knowledge, diet, and the number of weekly IFA tablet consumption.

Ethical consideration

This trial was started after approval of clinical trial registration on the Iranian Registry of Clinical Trials (IRCT20220320054334N1) and received approval from the Health Research Ethics Committee, Faculty of Medicine, Muhammadiyah Surakarta University (4208/B.2/KEPK-FKUMS/IV/2022) on April 2022.

Data collection tools and technique

Respondents' and their husbands' sociodemographic characteristics such as age, education, occupation, and income were assessed using characteristics questionnaires. Pregnancy characteristics such as gestation age, anemia status, and the number of children were obtained from a medical record written in the Maternal and Child Health Book owned by each respondent.

The anemia prevention-related knowledge was assessed using questionnaires consisting of 20 items about anemia's definition, its impact on children, prevention of anemia during pregnancy, and food containing a high source of iron (Fe). Correct answers received a score of 1 and otherwise scored 0. Scores could range between 0 and 20 points. The higher scores reflected higher knowledge levels. The knowledge questionnaire had a Cronbach's alpha of 0.735.

Anemia prevention diet questionnaires consist of 11 items about high-source Fe food, Fe food enhancers, and Fe food inhibitors consumption on a Likert scale of 1-4. The maximum total score was 44. The Cronbach's

alpha for the diet questionnaire was 0.701. IFA tablets consumption was assessed using two questions asking “how frequent IFA tablets did you consume in this last week?” and “how many IFA tablets did you consume in this last week?”. This question was asked at the end of every week in the intervention period. IFA consumption was assessed twice in the last week of the seven-week follow-up and IFA tablet consumption during the seven weeks of the intervention period. The Cronbach’s alpha for the IFA consumption questionnaire was 0.984.

Data collection using self-administered online questionnaires on Google Form, distributed using WhatsApp. Data were collected from May to September 2022. Preintervention and postintervention data were collected over the course of 12 weeks.

Statistical analysis

Data analysis was performed using the STATA program. A Chi-squared test was deployed to compare the baselines of the respondents’ and their husbands’ sociodemographics (age, education, occupation, and income) and pregnancy characteristics (gestation age, anemia status, and the number of children) between the intervention and control groups. Normality data were evaluated using Kolmogorov-Smirnov test. Paired sample *t*-test was deployed to compare baseline and postintervention anemia prevention diet data within groups. Within groups, Wilcoxon signed rank test was used to compare anemia prevention knowledge and IFA tablet consumption data.

Meanwhile, the Analysis of Covariance was performed by comparing the anemia prevention diet and IFA tablets consumption of the two groups by controlling the anemia status of the pregnant woman. Mann-Whitney test was deployed to compare the two groups’ anemia prevention knowledge. The test used a *P* value <.05 level of significance.

Results

About 132 respondents were assessed for eligibility and invited to join the study. Of the total, 44 pregnant women participated in the trial and finished the intervention period. Tables 1 and 2 inform about detailed characteristics of respondents, including age, the number of children, anemia status, gestation age, education and working status, husbands’ age, education, and working status. As shown in Tables 1 and 2, most respondents were working mothers, in a healthy age period to pregnant, and were not anemic. These characteristics data were taken in the baseline period of the study. There were no significant differences among the characteristics of respondents in the intervention and control groups unless the number of children. The higher proportion

Table 1: Distribution of intervention group and control group’s characteristic at baseline

Variables	Study Group				P
	Intervention		Control		
	n	%	n	%	
Age					0.548
20-25	8	36.36	9	40.91	
26-30	8	36.36	9	40.91	
31-35	4	18.18	1	4.55	
>35	2	9.09	3	13.64	
Mean age	28.04		27.31		
Working status					0.517
Yes	8	63.64	6	72.73	
No	14	36.36	16	27.27	
Education level					0.805
Basic education	6	27.27	5	22.73	
Senior High school	13	59.09	15	68.18	
Higher education	3	13.64	2	9.09	
Husband work					0.946
Private sector employee	14	63.64	15	68.18	
Entrepreneur	1	4.55	1	4.55	
Casual laborer	7	31.82	6	27.27	
Husband education					0.441
Basic education	6	27.27	4	18.18	
Senior High school	12	54.55	16	72.73	
Higher education	4	18.18	2	9.09	

Table 2: Distribution of intervention group and control group’s gravidity and parity characteristic at baseline

Variables	Study Group				P
	Intervention		Control		
	n	%	n	%	
Anemia status					0.635
Yes	2	9.09	3	13.64	
No	20	91.01	19	86.36	
Gestation Age					0.365
Trimesters 1	9	40.91	12	54.55	
Trimester 2	13	59.09	10	45.45	
Number of children					0.033
0	6	27.27	12	54.55	
1	9	40.91	7	31.82	
2	7	31.82	1	4.55	
3	0	0	2	9.09	

of the respondents who were pregnant with their first child were in the control group. This means that the overall distribution of respondents’ characteristics in the intervention and control groups is relatively homogeneous.

Table 3 informs comparison effect of daily message reminders on anemia prevention knowledge and diet and IFA tablets consumption between groups and within groups. It can be seen that there was no significant difference in anemia prevention diet consumption and IFA tablet consumption (last seven days) after the intervention. However, there were significant

Table 3: Comparison of pretest and posttest data of anemia prevention knowledge and diet, and IFA tablets consumption in intervention and control groups

Variables	Groups	n	Pre-test Mean±SD	Post-test Mean±SD	P	Post-test Mean difference	P
Anemia Prevention Knowledge	Intervention	22	15.32±4.70	18±1.51	0.008 ^a	2.10	0.007 ^b
	Control	22	16±3.96	15.90±3.10	0.818		
Anemia Prevention Diet	Intervention	22	31±4.38	31±3.55	1.000	0.05	0.731
	Control	22	29.77±5.44	30.5±2.52	.561		
IFA tablets Consumption (last seven days)	Intervention	22	5.72±1.38	6.45±1.01	0.233	0.05	0.268
	Control	22	5.72±1.83	6.5±1.43	0.108		
IFA tablets Consumption (last 42 days)	Intervention	22		39.54±3.94		4.68	0.003 ^{b,*}
	Control	22		34.86±8.13			

^a $P < 0.05$ significant change preintervention and postintervention; ^b $P < 0.05$ significant difference of postintervention measurement between control and intervention group; *Statistical test used Analysis of Covariance by adjusting for the anemia status and the pretest score of IFA tablets consumption (last seven days), F value for between-subject effects is 9.37 and F for within-subject effects is 17.09

differences in knowledge mean scores before and after intervention (P value .008). The results showed that the knowledge score between intervention and control groups after the intervention was statistically significant with 2.1 points of mean difference (P value = .007). Moreover, after the intervention, mean IFA tablet consumption for the last 42 days was significantly different between the two groups. The mean IFA tablet consumption in the intervention group was higher than in the control group, which was 39.54 ± 3.94 and 34.86 ± 8.13 , respectively. After adjusting for anemia status and IFA tablet consumption (last seven days) at the baseline, the results show a significant difference in IFA tablet consumption between the two groups, with a mean difference of 4.68 (P value .003).

Discussion

This study provides an intervention which was a daily reminder message that is beyond simple reminders. It did give not only a reminder but also an educational message that included a motivational message to prevent anemia, information about anemia and the consequences to the child, and supportive message that gives a sense of capability of the women to avoid pregnancy anemia. This intervention has proven to increase participants' knowledge and adherence to IFA tablet consumption. Yet, this intervention did not significantly affect the anemia-prevention diet consumption of the participants. These results support previous studies about message reminder intervention through advanced technologies and social media that proved to increase medical compliance in various health conditions and populations such as adolescents and young adults, adults, and the elderly.^[20-22]

This study suggests that routine educational messages provided to participants facilitate the increase of knowledge. These results were similar to a previous study suggesting that the program that included packages of health information, which was carried out

routinely, was an effective method of intervention to educate pregnant women with anemia. Educational brochures, informational messages, and reminders were provided in that study using WhatsApp media, which increased respondents' average knowledge.^[23] While in this study, short educational messages were provided daily, in a systematic order of educational material and fascinating design that resulted in an increased understanding of anemia, the health consequences to child nutrition status, and how to prevent it. A previous study found that attractive and coherent health messages attract the attention of the recipient of the message.^[24] Digital health messages via WhatsApp give benefits such as the health content stored on the gadget so that it can be viewed repeatedly.^[25] The short message was easily remembered and likely triggered the participants to seek additional information from other sources if necessary. The previous study about health campaigns showed that short messages that the content match target needs more excite the participants in reading health messages.^[26]

Daily educational message intervention has been proven effective in increasing participants' IFA tablet consumption as well. This intervention's message design was similar to the COM-B model that includes Capacity, Opportunity, and Motivation in designing behavioral change.^[19] Previous studies found that intervention design with the COM-B model facilitates behavioral change.^[20] A study in young adults with chronic diseases using text messaging in the COM-B model found that intervention can maintain medication adherence for more extended than a simple message reminder.^[20] Other research also shows that pregnant women with high knowledge about anemia, as a result of educational intervention, will be more obedient in taking Fe tablets.^[27] Education increases pregnant women's knowledge about consuming IFA tablets and minimizing the side effects. Mostly, pregnant women do not take IFA tablets because they feel nauseous or forget.^[28] Motivational messages and health consequences for the child provided to the participants in this study induce their adherence to

IFA tablet intakes. The previous research suggests that motivational health messages are needed to increase a person's self-motivation and ability to behave.^[29] This explains how daily educational message intervention affects IFA consumption. Adopting this intervention into practice must consider how long the period of the reminder program is not viewed as intrusive from the patient's perspective and as excessive additional work from the health workers' perspective.^[30] The potential approach was that WhatsApp service is integrated into the health system and that served as a prevention and monitoring program for maternal anemia in health facilities.^[7]

Interestingly, the daily educational message did not affect the anemia prevention diet consumption of the participants. Although this educational message includes motivational and persuasion messages as in the COM-B model, these strategies were probably inherently educational compared to skill-building because participants did not have the opportunity to receive feedback on their progress with the choice of their diet. A scoping review of the effectiveness of the nutritional intervention behavior change program on nutritional outcome shows that enablement strategies, including enhanced social support and restructuring the social or physical environment, were less frequently used as a strategy for behavior change programs, yet that strategy had good effectiveness.^[31] An enablement strategy is needed to facilitate individual new behavior to be established. Besides, an anemia prevention diet includes animal protein sources rich in iron. Women who can provide various animal-source food likely come from at least a middle-income or wealthy household, as indicated in a previous study that wealthy families were significantly more likely to have better dietary diversity scores.^[32] To improve dietary diversity from animal-source food needs beyond simple education message intervention. It also needs instrumental support such as cash transfer and another enablement strategy as a specific intervention design for stunting prevention through increased consumption of animal-source foods and diet diversity.^[33,34] Further study is needed to design package intervention of education and instrumental support in improving maternal diet and preventing anemia.

However, the strength of this pilot study included a randomized and controlled design. This finding adds to the growing literature on evidence-based mHealth approaches in preventing anemia in pregnant women in developing countries. However, this study had limitations as well. We depended solely on self-reporting weekly IFA tablet intake to measure IFA tablet consumption. The pregnant women were not observed when taking the IFA supplements, meaning a response

bias could have been present because compliance was not observed. This pilot study also used a small number of samples; therefore, statistical inferences are not definitive. Nonetheless, this pilot study demonstrates significant preliminary findings and issues to tackle for conducting a full-scale trial of anemia prevention programs in future studies.

Conclusion

This pilot randomized controlled trial suggests that a daily educational message intervention increased participants' knowledge and adherence to IFA tablet consumption. This finding adds to the growing literature on evidence-based mHealth approaches in preventing anemia in pregnant women. However, there was no significant difference in anemia prevention diet consumption after the intervention. Conducting a full-scale randomized controlled trial is feasible to confirm the effectiveness of daily educational messages in preventing anemia in pregnancy, considering the improvements needed.

Acknowledgments

The authors express their appreciation to all participants and health workers at Sangkrah and Kratonan Primary Healthcare Center for supporting this study.

Financial support and sponsorship

The authors were given financial support for the study, a tri dharma integration grant from Universitas Muhammadiyah Surakarta (953/A.3-III/FIK/IV/2022).

Conflicts of interest

There are no conflicts of interest.

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