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Meta Analysis

Meta-Analysis: The Effectiveness of Using mHealth to Improve Antenatal Care

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ABSTRACT

Background: One of the innovations in technology in health that can be used is mHealth. The use of technology such as mHealth allows for the dissemination of information to pregnant women in an effort to improve antenatal care. This study aims to determine the effectiveness of using mHealth on antenatal care.
Subjects and Method: This was a systematic review and meta-analysis study using PICO, Population: Pregnant women, Intervention: Using mHealth, Comparison: Not using mHealth/ standard services, Outcome: ANC visits. The articles used in this study came from 6 databases including Pubmed, ScienceDirect, Google Scholar, BMJ, Springer link, Sage, and Core. The keywords of the article are, Telemedicine OR Mobile Health OR Health Mobile OR Telehealth OR mHealth OR eHealth AND Short Message AND Quality Improvement OR Quality Improvement OR Quality Improvements OR Quality Improvements AND Prenatal Care OR Prenatal Care OR Antenatal Care OR Antenatal Care. The articles included in this study are complete articles, RCT study designs for 2012-2022.
Results: There are 8 RCT articles from 3 continents, including Africa (Kenya, Ethiopia, Zanzibar), Asia (India), America (Peru, Brazil). It was found that using mHealth could increase ANC visits by 1.32 times compared to not using mHealth (RR=1.32; 95% CI=1.10 to 1.59; p=0.003).
Conclusion: effective use of mHealth to improve antenatal care.

Keywords: mHealth, pregnant women, ANC.

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BACKGROUND

WHO defines mHealth as a practical medical and public health media supported by mobile devices such as smartphones, patient monitoring devices, personal digital assistants (PDAs) and other wireless devices (WHO, 2011). One of the innovations in technology in health that can be used is mHealth. The use of technology such as mHealth allows for the dissemination of information to pregnant women in an effort to improve antenatal care (Cormick et al., 2012; Evans et al., 2012). Lagging quality of antenatal care where coverage of antenatal care is retarded is greatest in low-income countries, where 86.6% of women access care but only 53.8% receive services for blood pressure monitoring, urine and blood tests. WHO has emphasized quality versus quantity through a focused antenatal care model and recommends at least four antenatal care visits for uncomplicated preg-

nancies with the first visit starting before 16 weeks of gestation (Villar et al., 2001). In addition, the quality of counseling is still found to be lower in some countries (Arsenault et al., 2018).

Improving the quality and coverage of antenatal care can be started by increasing the knowledge and awareness of pregnant women regarding the need to monitor health during pregnancy. Based on several studies, the low level of antenatal care is due to the low knowledge and attitudes of pregnant women. Access of pregnant women to get counseling from health workers is still low. Utilization of mHealth can increase knowledge about pregnancy care, influence attitudes and changes in behavior of pregnant women. This can improve the health of mothers and children because it can be used to find information related to perceived complaints and their handling (Parker et al., 2012). This study aims to determine the effectiveness of using mHealth on antenatal care.

SUBJECTS AND METHOD

1. Study Design

This research was conducted using a systematic review and meta-analysis study design. The articles used in this study came from various sources. Article searches were conducted through search engines with the databases "Pubmed", "Science Direct", "Google Scholar", "BMJ", "Springer link", "Sage", and "Core". This research started from April 2022 and is the result of searching for data from previous studies. The articles used were articles published from 2012 to 2022. The selection of articles was carried out using the PRISMA flow chart. The keywords used to search for articles were as follows "Telemedicine" OR "Mobile Health " OR "Health Mobile" OR "Telehealth" OR "mHealth" OR "eHealth" AND "Short Message" AND "Quality Improvement" OR "Quality Improvement" OR "Impovements Quality" OR "Quality Improvements" AND "Prenatal Care" OR "Prenatal Care" OR "Antenatal Care" OR "Antenatal Care" and other terms combined with the Boolen operators AND and OR.

2. Inclusion Criteria

The inclusion criteria in this study were articles must be full text using a Randomized Control Trial (RCT) study design. The article contains the use of mobile phone-based technology with the results of antenatal visits (either alone or in collaboration).

3. Exclusion Criteria

The criteria for this research are articles published in languages other than English and Indonesian before 2012.

4. Operational Definition of Variables

The search for articles was carried out by considering the feasibility determined using the PICO model. Population: Pregnant Women, Intervention: mHealth, Compare: standard service or without using mHealth, Outcome: ANC visit.

mHealth is defined as a mobile computing system, health sensor device, and communication technology for health services.

Antenatal care is defined as a service aimed at maintaining health during pregnancy that is beneficial through accurate and consistent observation of principles that are important in maternal and child health.

5. Instrument

The research was guided using the PRISMA flow chart and the quality of the articles was tested with Critical Appraisal Tools obtained from CEBM University of Oxford 2014.

6. Data Analysis

Research data were analyzed using the Review Manager application (RevMan 5.3). Forest plots and funnel plots were used to compare the size of the relationship and the heterogeneity of the data. The fixed effect model is used for homogeneous data, while

the random effect model is used for heterogeneity between studies.

RESULTS

Figure 1 shows a step-by-step diagram of a meta-analysis related to the effectiveness of using mHealth to improve antenatal care. The article search process is carried out through several journal databases including: "Pubmed", "ScienceDirect", "Google Scholar", "BMJ", "Springer link", and "Core". The review process for linking articles can be seen in the PRISMA flow chart Figure 1.

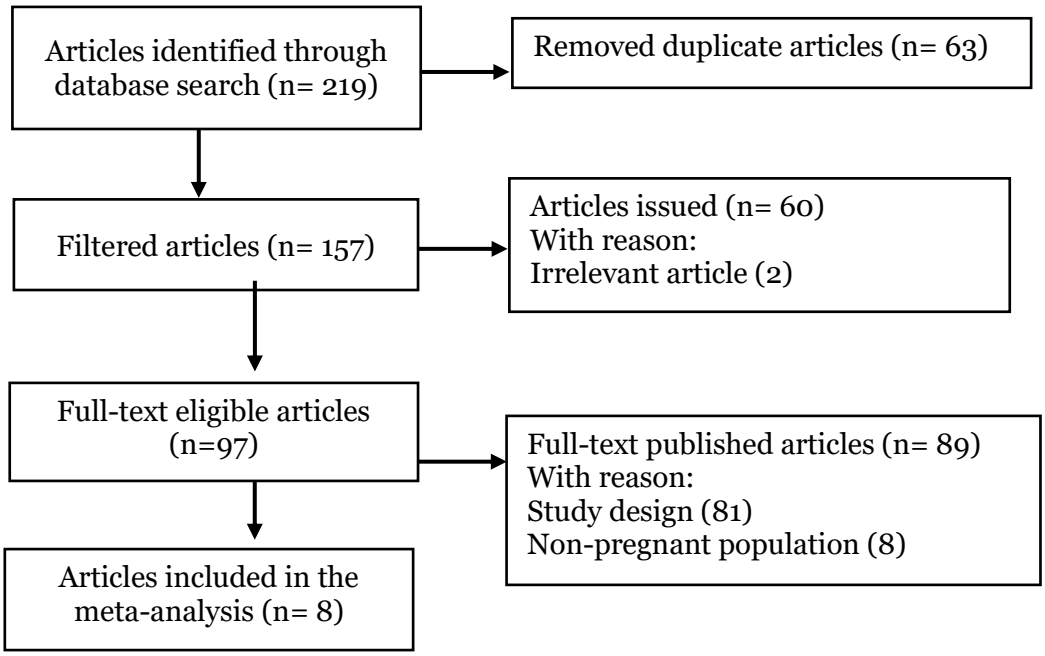

Figure 1. PRISMA Flow Diagram

Research related to the effectiveness of using mHealth to improve ANC services found 97 articles from the initial search process which resulted in 219 articles, after the process of deleting published articles that were eligible to be included in meta-analysis research. To combine this qualitative data using a meta-analysis of 8 articles.

It can be seen in Figure 2 which shows a map of the distribution of the research conducted. Research related to the effectiveness of using mHealth consists of 8 articles. From the 8 articles found, it can be concluded that the research articles were obtained from 3 continents, including the African continent (Kenya, Ethiopia, Zanzibar), the Asian continent (India), the Americas (Peru, Brazil).

Question items are shown with the following results:

1. Does the research address clearly focused statements/ problems?
2. Is the Randomized Controlled Trial research method appropriate to answer the research question?
3. Were there enough subjects in the study to establish that the findings did not occur by chance?
4. Were subjects randomly allocated to the experimental and control groups? If not, could this be biased?
5. Were inclusion/exclusion criteria used?
6. Were the two groups comparable at the start of the study?
7. Were objective and unbiased outcome

criteria used?
8. Are objective and validated measurement methods used in measuring the results? If not, were results assessed by someone who was not aware of the group assignment (ie was the assessment blinded)?
9. Is effect size practically relevant?
10. How precise is the estimate of the effect? Is there a confidence interval?
11. Could there be confounding factors that have not been taken into account?
12. Are the results applicable to your research?

Figure 2. Research Distribution Map

The forest plot in Figure 3 shows that mHealth is effective in increasing the use of ANC services in pregnant women. Pregnant women who received mHealth were 1.32 times more likely to use ANC services than did not receive mHealth and the effect was statistically significant (RR= 1.32; 95% CI= 1.10 to 1.59; p=0.003). The forest plot also shows a high heterogeneity of effect estimates between the primary studies in this meta-analysis with I^2=99%. Thus, the estimated average mHealth effect of all primary studies in this meta-analysis was carried out using a random effects model approach.

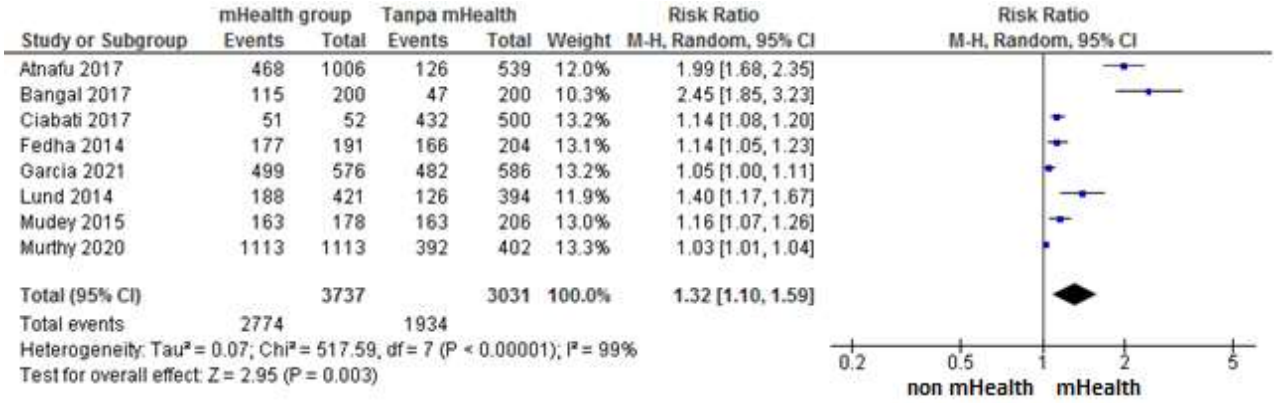

Figure 3. Forest plot of the effectiveness of using mHealth on ANC service improvement

The funnel plot in Figure 4 shows the asymmetric distribution of the estimated effect on the right and left of the average vertical line of the estimated effect. The distribution of effect estimates is more to the left of the vertical line than to the right, which indicates that there is publication bias. Because the distribution tends to the right of the same direction as the diamond shape, the average estimated effect in Figure 4.3, the publication bias overestimates the true mHealth effect (over estimate).

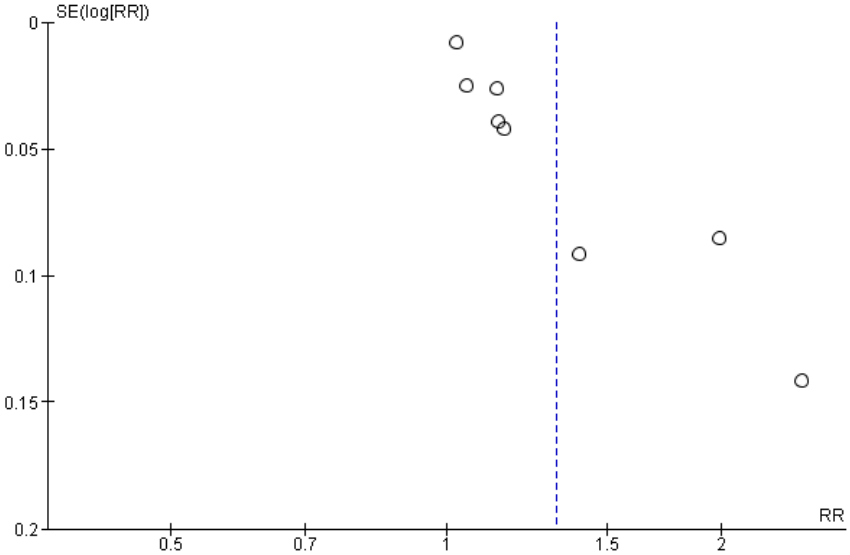

Figure 3 Funnel plots the effectiveness of using mHealth against ANC service improvement

Table 2. Research Quality Assessment with Critical Appraisal Checklist for Randomized Controlled Trial

No	Study							
	Fedha et al. (2014)	Lund et al. (2014)	Bangal et al. (2017)	Garcia et al. (2021)	Murthy et al. (2017)	Ciabati et al. (2015)	Mudey et al. (2015)	Atnafu et al. (2017)
1	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2
3	2	2	2	2	2	2	2	2
4	2	2	2	2	2	2	2	2
5	2	2	2	2	2	2	2	2
6	1	1	2	1	0	0	1	0
7	2	2	2	2	2	2	2	2
8	2	2	2	2	2	2	2	2
9	2	2	2	2	2	2	2	2
10	2	2	2	2	2	2	2	2
11	2	2	2	2	2	2	2	2
12	2	2	2	2	2	2	2	2
Total	23	23	24	23	22	22	23	22

Note: 2 Yes, 1: Hesitant, 0: No

Table 1. Description of the baseline data entered into the meta-analysis baseline

Author (Year)	Country	Study Design	P Populatian	I Intervention	C Comparison	O Outcome	RR (CI 95%)	
							mHealth	Without mHealth
Atnafu et al. (2017)	Ethiopia	RCT	Community-based Pregnant Women (Intervention= 1080; Control= 1080)	Message via SMS based on mobile phone reminder	No SMS text messages	ANC visits, SBA, and delivery facilities	468	126
Bangal et al. (2017)	India	RCT	Pregnant women (intervention=200; control=200)	Call via mobile phone¸remind next visit and SMS on important aspects of ANC on a regular basis	ANC routine standard service	ANC visits to pregnant women and consumption of iron tablets, TT immunization for childbirth and PNC	115	47
Ciabati et al. (2017)	Brazil	RCT	Pregnant women (intervention = 770; control 440)	The PRENACEL group received messages that were arranged once a week with health education and health promotion related to pregnancy and childbirth and the availability of questions via SMS messages.	ANC routine standard service	ANC, tetanus vaccination, influenza vaccination, and other preventive services	51	432
Fedha et al. (2014)	Kenya	RCT	Pregnant Women (intervention= 191; control= 206)	Mobile phone-based reminders, nightly updates and advice of the next clinic visit and advice giving in pregnancy.	Routine ANC without using mobile advice or support	Antenatal visits, SBA, other outcomes of labor	177	166
Garcia et al. (2021)	Peru	RCT	Pregnant Women (intervention=576; control=586)	SMS messages based on gestational age and other specific pathology based on EMR, ANC appointment reminders and health education messages	Routine ANC	ANC visits, eating habits, fulfillment of iron / folic acid.	499	482
Lund et al. (2014)	Zanzibar	RCT	Pregnant women (intervention 1311; control: 1239)	Mobile phone-based SMS messages (2 times a week and cellphone vouchers; health education and reminders	Routine ANC	ANC visits, tetanus vaccine, and other preventive services	188	126
Mudey et al. (2015)	India	RCT	Pregnant Women (Intervention=178; Control 206)	Reminder via SMS	Standard service	ANC visits and adherence to iron therapy	163	178
Murthy et al. (2020)	India	RCT	Pregnant women (Intervention=1516; control=500)	Audio messages include mMitra call packages based on gestational age containing relevant content such as nutrition, folic acid/iron supplementation, ANC reminders, anemia, bed rest during pregnancy, blood tests, HIV tests for pregnancy danger signs, sanitation and hygiene preparation for childbirth, breastfeeding practices and sex.	Standard service without mobile phone	Anc visits, anemia, knowledge of pregnancy services, and increasing the habit of seeking health workers	1113	392

DISCUSSION

Systematic studies and meta-analyses of studies show mHealth can increase ANC visits. This study discusses ANC visits can improve the quality of ANC services. This is in accordance with the results of research from Oliveira-Ciabati et al., (2017) which showed that text messages via SMS addressed to pregnant women could increase the number of ANC visits and this effect was more pronounced in women who received more education. With this text message, pregnant women get comprehensive health-related education and also get reminders to make the next ANC visit according to the time set by health workers. The mHealth intervention contributes to the improvement of ANC and skilled birth services among pregnant women in low and middle-income countries (Rahman et al., 2022).

Other studies suggest that exposure to voicemail services has the potential to increase access and users to routine and high-risk pregnancies. Women who are exposed to messages via mobile phones are increasing the adoption of practices in hospitals and health facilities that can have a positive impact on maternal and child health. The mHealth intervention also contributes to behavioral change for maternal and child health (Murthy et al., 2020). According to Garcia et al. (2021), pregnant women who received SMS messages were 6% more likely to make more than 6 ANC visits and 25% more likely to attend visits on time. The adoption of a cellular telephone system at the community level can contribute to improving emergency obstetric and neonatal care.

SMS reminder programs can encourage adherence to iron supplementation. Adherence to supplementation was greater in the group that received SMS reminders than the group that did not receive reminder messages (Khorshid et al., 2014). Even simple mobile phone interventions can increase antenatal visits to four or more visits as recommended in national and international guidelines. There is also a tendency to get tetanus vaccination, malaria prevention treatment at gestational age where pregnant women make the last antenatal visit and antepartum referral although the results are not statistically significant (Lund et al., 2014).

According to the results above, mHealth is effective in improving the quality of health services based on antenatal visits. With timely antenatal visits, pregnant women get health screenings such as blood tests, giving tetanus vaccine, monitoring iron and folic acid intake during pregnancy. The drawback of this study is the bias in terms of language because the articles used are English articles. The publication bias is shown by the funnel plot results and the search bias is due to using only six databases.

AUTHOR CONTRIBUTION

Mayriyana Kartikasari is the main researcher who chooses the topic, searches for and collects data and processes the research data. Didik Tamtomo and Bhisma Murti assisted in providing input and direction related to writing and the ongoing research process.

FUNDING AND SPONSORSHIP

This study is self-funded.

CONFLICT OF INTERESTS

There is no conflict of interest in this study.

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