Systematic Review

Effectiveness of the Telemedicine Approach on Maternal Health Practices among Pregnant Women in Rural Areas

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Abstract

Objectives: To systematically evaluate the current evidence on the effectiveness of the telemedicine approach on maternal practices in rural communities. The author hopes that this study offers a breakthrough to draw a solid conclusion regarding the feasibility of implementing telemedicine to improve maternal health in rural areas of Indonesia.

Methods: A systematic literature search was performed using international databases, such as Cochrane, PubMed, EBSCOhost, Science Direct, Scopus, and Google Scholar, published from 2012 to August 31, 2022. Risk of bias assessment was conducted using the Cochrane Risk of Bias tools 2.0 for randomized controlled trials and converted to the AHRQ standards.

Results: This study included five randomized controlled trials from different countries, namely India, Ethiopia, and Kenya. Telehealth interventions, delivered using mobile applications, phone calls, or short text messaging, improved the number of ANC visits, safe childbirth in hospitals or by skilled staff, exclusive breastfeeding, and immunization compliance, with a significant difference compared to the control group that received no intervention ($p<0.05$). Nevertheless, considering the already widely used mobile phone technologies in rural settings, it is now clear that the telehealth approach should be scaled up and implemented in clinical settings.

Conclusion: Telehealth-based intervention is a promising approach to promote better maternal health practices among pregnant mothers in rural and low-resources settings. This approach has been proved to successfully made a significant difference in terms of antenatal care visits and safe childbirth practice.

Keywords: Maternal health practices, pregnant women, rural areas, systematic review, telemedicine.

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INTRODUCTION

In Indonesia, maternal mortality in rural areas has been a significant issue for decades. According to data from the Riset Kesehatan Dasar (Riskesdas) by the Ministry of Health, Republic of Indonesia, in 2018, there remains a substantial disparity in antenatal care coverage between provinces, with the lowest in Papua (66.8%) and the highest in Central Java (99.0%).[1] In certain rural areas of Indonesia, including West Papua, Papua, and East Nusa Tenggara, maternal mortality rates have been alarmingly high, with figures reaching 565, 343, and 316 per 100,000 live births, respectively, according to data from the Long Form Sensus Penduduk 2020 by Badan Pusat Statistik. These rates are significantly higher than the national average of 189 per 100,000 live births.[2] The most critical factors contributing to maternal mortality are maternal education and rural residence, with odds ratios of 5.74 and 4.65, respectively.[3] It occurs in women undergoing regular antenatal care at midwives without a risk factor analysis recorded.[4] Therefore, novel solutions are urgently required, especially in rural areas.

The significant cognitive, structural, and financial barriers have made access to healthcare facilities in rural areas nearly impossible. The failure of the educational function among

healthcare workers has a massive impact on maternal and infant mortality rates. This is due to the fact that pregnant mothers need much more careful treatment and proper education by the healthcare workers. However, in rural areas, only half of the pregnant mothers receive at least four antenatal care (ANC) visits. Moreover, the rate of safe delivery in hospitals by skilled nurses and midwives remains relatively low. This condition leads to various complications during and after pregnancy and childbirth, resulting in a high mortality rate.[5,6]

With advancements in health technology, especially telemedicine, it is now possible to connect patients with professional healthcare workers in a much more effective and efficient manner. According to the International Telecommunication Union, there were over seven billion mobile phone users worldwide in 2015, and over 90% of the population in low-to middle-income countries had access to mobile phone.[7] Through the telehealth approach, healthcare can be delivered using mobile applications, phone calls, or short text messaging. Recent studies conducted in India, Kenya, and Ethiopia have shown that telehealth approaches have significantly improved maternal health through routine education and reminders to maintain good health among pregnant women.[8,9] These countries have similar socioeconomic backgrounds to Indonesia; therefore, they may represent conditions similar to those in Indonesia.

However, most review studies conducted to date have not reported and analyzed outcomes in rural areas alone, with most studies combining the results in urban and rural communities. Through this systematic review, the author focused on the effectiveness of the telehealth approach on maternal practices in rural communities. The author hopes that this study offers a breakthrough in drawing a solid conclusion regarding the feasibility of implementing telehealth to improve maternal health in rural areas of Indonesia, especially in West Papua, Papua, and East Nusa Tenggara.

METHODS

The study was conducted in accordance with the Cochrane Handbook 6.2 and is reported based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guideline.[10]

A Literature search was performed in databases including Cochrane, PubMed, EBSCOhost, Science Direct, Scopus, and Google Scholar for studies that implemented a telehealth-based approach to maternal health education from 2012 to August 31, 2022, with the detailed keywords for each database, as shown in **Table 1**. Furthermore, an advance search strategy was used whenever appropriate to narrow the search process.

Table 1. Table of Keywords for Literature search

Database	Keywords
PubMed	(("telemedicine"[MeSH Terms] OR telemedicine[Text Word]) AND ("gravidity"[MeSH Terms] OR pregnant women[Text Word]) AND (("health"[MeSH Terms] OR health[Text Word]) AND ("knowledge"[MeSH Terms] OR knowledge[Text Word])) AND ("Rural Population "[Mesh])
Scopus	TITLE-ABS-KEY ((telemedicine OR telehealth OR ehealth OR e-health OR health OR m-health) AND (pregnancy OR pregnant or prenatal or antenatal or perinatal or maternal) AND (maternal health knowledge) AND (rural areas of rural communities more rural patients or rural population or remote))
Cochrane	(("telemedicine"[MeSH Terms] OR telemedicine[Text Word]) AND ("gravidity"[MeSH Terms] OR pregnant women[Text Word]) AND (("health"[MeSH Terms] OR health[Text Word]) AND ("knowledge"[MeSH Terms] OR knowledge[Text Word])) AND ("Rural Population "[Mesh])
EBSCOhost	(telemedicine OR telehealth OR ehealth OR e-health OR health OR m-health) AND (pregnancy OR pregnant or prenatal or antenatal or perinatal or maternal) AND (maternal health knowledge) AND (rural areas of rural communities more rural patients or rural population or remote)
ScienceDirect	(telemedicine OR telehealth OR ehealth OR e-health OR health OR m-health) AND (pregnancy OR pregnant or prenatal or antenatal or perinatal or maternal) AND (maternal health knowledge) AND (rural areas of rural communities more rural patients or rural population or remote)
Google Scholar	(telemedicine OR telehealth OR ehealth OR e-health OR health OR m-health) AND (pregnancy OR pregnant or prenatal or antenatal or perinatal or maternal) AND (maternal health knowledge) AND (rural areas of rural communities more rural patients or rural population or remote)

The inclusion criteria were as follows: type of study, randomized controlled trial; population, pregnant mothers who have access to mobile phones and reside in rural areas; intervention, maternal education through telehealth approaches; and outcomes, maternal knowledge and practices. The exclusion criteria were set as follows: unsuitable study design; incomplete result data; inability to retrieve full-text articles; no control group; and languages other than English.

In this systematic review, the author carefully reported the key findings and key information from each included study. The following data were extracted: author and time of publication; characteristics of the study, including study design and location; population of the study by number and mean age, intervention, program characteristics, and results, detailed in the indicators, pre- and post-intervention values, and significance levels (p-values).

The quality of each study was assessed using the Cochrane Risk of Bias 2.0 for randomized controlled trials. This tool consists of five domains: risk of bias due to the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcomes, and bias in selecting the reported result. Subsequently, the overall quality of the study was determined based on the Agency for Healthcare Research and Quality (AHRQ) standards.

RESULTS

A flowchart of the literature search is shown in **Figure 1**. The initial search returned 289 records from all databases. 244 records were further screened by titles and abstracts, and 101 articles were excluded. Unrelated articles, comments, reviews, letters, and duplicates were excluded. Subsequently, 36 articles were assessed by accessing their full text. Nineteen studies were excluded because of qualitative outcomes, eight studies were irretrievable full texts, and four studies were in languages other than English or Indonesian. Finally, five studies were included in the analysis. A summary of the bias assessment is provided in **Appendix 1**. In summary, we found that all studies included in this review were of good quality in terms of the AHRQ standards. Therefore, all the studies included in this review had a low risk of bias.

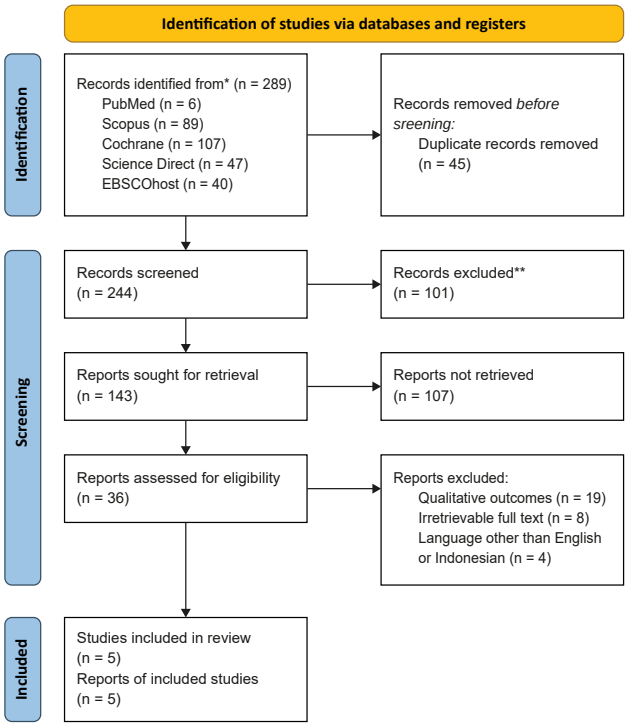

Figure 1. Literature search strategy diagram

All five studies included were randomized controlled trials that were conducted in rural areas among low-to-middle income countries, namely India, Ethiopia, and Kenya. These studies were conducted over multiple years from 2014 to 2020. Among the included studies, the participants were pregnant mothers without gestational age limitations residing in rural areas. Patients included in the studies had access to mobile phones with adequate internet connection. The intervention includes a telehealth-based approach to maternal education programs, including ANC, nutrition, and immunization for infants, and a safe delivery process. In contrast, the control group received only routine ANC sessions, without any telehealth intervention. The outcomes measured were the number of ANC visits during pregnancy, place of delivery, breastfeeding practice, and immunization status related to pregnancy. In **Table 2**, the characteristics of the included studies are presented and in **Table 3** the study results are showed.

Table 2. Study characteristics

Author; year	Study design	Location	Population	Number of participants (Mean age ± SD)	Intervention	Control	Duration of intervention
Bangal et al[11], 2017	RCT	Ahmednagar, India	Pregnant women voluntarily coming for antenatal visit at Rural Medical College, Loni, Ahmednagar	Intervention: 200; age not available Control: 200; age not available	Healthcare workers perform regular mobile phone calls to mothers to remind for next visit schedule, in addition to SMS text messaging about important education of ANC and its aspects.	Routine ANC care without mobile phone calls and SMS	1 year
Murthy et al[12], 2020	Pseudo RCT	Mumbai, India	Pregnant women from two wards (F North and M East).	Intervention: 1,113; 25 (3.9) y Control: 402; 24 (4.1) y	A mobile application program named mMITRA deliver one hundred and forty-five audio messages.	No intervention	1 year
Atnafu et al[13], 2017	RCT	Abeshge, Ethiopia	Pregnant mothers from three woredas, namely Ezha, Abeshge, and Sodo	Intervention: 1,073; age not available Control: 1,080; age not available	SMS text messaging–based mobile phone reminder intervention about ANC and delivery services.	No intervention	13 months
Unger et al[14], 2018	RCT	Nairobi, Kenya	Pregnant women at the Mathare North Health Centre (MCH).	Intervention: 100; 23 (20 -26) y Control: 99; 24 (21 -26) y	SMS text messaging automatedly sent to participants including topic such as ANC, pregnancy complications, family planning, infant health, infant immunization, and visit reminders.	Routine ANC without SMS text messaging	24 weeks
Fedha et al[15], 2014	RCT	Njoro, Kenya	Pregnant women with gestation age between 12-36 weeks	Intervention: 191; age not available Control: 206; age not available	Mobile phone reminders and updates on pregnancy condition every fortnightly, including ANC and pregnancy advices.	Routine care with no mobile reminders or supports	Until 6 weeks post-delivery

*Significant results. Abbreviations: ANC: antenatal care.

Table 3. Key study outcomes

Author; year of publication	Study outcomes			
	Indicators	Intervention	Control	Significance *(P-value)*
Bangal et al[11], 2017	ANC visits 6 or more (%)	24	24	<0.0001
	Delivery at hospital (%)	91.5	91.5	N/A
	Tetanus toxoid immunization (%)	97.29	97.29	<0.0002
Murthy et al[12], 2020	ANC visits 3 or more (Intervention/control)	1.508 (0.797–2.853)		0.207
	Delivered in hospital (Intervention/control)	2.543 (1.488–4.348)		0.0001*
	Delivery by skilled birth attendant at home deliveries (Intervention/control)	0.457 (0.229–0.913)		0.027*
	Mother fed colostrum to the baby	1.269 (0.898–1.794)		0.177
Atnafu et al[13], 2017	ANC visits 4 or more (%)	Baseline: 15.80 Post intervention: 31.50	Baseline: 24.48 Post intervention: 23.27	0.0001*
	Delivered in hospital (%)	Baseline: 49.30 Post intervention: 64.18	Baseline: 27.20 Post intervention: 41.54	0.0001*
Unger et al[14], 2018	Exclusive breastfeeding practice	0.62 (0.51-0.72)	0.41 (0.31-0.51)	0.005 *
	Postpartum contraceptive use	0.83 (0.75-0.90)	0.77 (0.69-0.85)	0.33
Fedha et al[15], 2014	ANC visits 4 or more (%)	96.4	82.4	0.002*
	Delivery in hospital (%)	88.0	72.8	<0.001*
	Number of participants taking iron supplements (%)	91.6	87.4	0.170
	Tetanus toxoid immunization (%)	100	99.7	0.534

*Significant results. Abbreviations: ANC: antenatal care.

Antenatal Care Visits

The impact of the telehealth approach in terms of ANC visits was consistently reported to be superior to the control group in four studies. Study by Bangal et al reported that the number of ANC visits of 6 or more in the intervention group was 24%, while in the control group was 7% with significant p-values ($p<0.0001$).[11] Study by Atnafu et al and Fedha et al showed that the ANC visits 4 or more in the intervention group significantly improved ($p=0.0001$ and $p=0.002$, respectively).[13,15] However, study by Murthy et al reported that the ANC visits was not significantly different between intervention and control group ($p=0.207$).[12]

Safe Delivery

The location of delivery is one of the most important factors for safe delivery. The telehealth approach was proven to have a beneficial outcome to ensure that delivery was done in a hospital by a skilled birth attendant in a sterile environment. Three studies by Murthy et al., Atnafu et al., and Fedha et al. reported that mothers given telehealth interventions were most likely to deliver their babies in the hospital ($p<0.0001$).[12,13,15] This finding was consistent in each study and showed superiority of telehealth compared to the control group. One study by Bangal et al also reported that overall percentage of women delivered in hospitals were higher in the telehealth intervention group than control group, however the significance value was not showed in the study.[11]

Breastfeeding Practice, Postpartum Contraception, and Immunization Compliance

Other outcomes reported by the included studies were the impact of the telehealth approach on breastfeeding practices, postpartum contraception, and immunization compliance. Studies reported that mothers who received telehealth intervention were most likely compliant with exclusive breastfeeding of their baby compared to the control group, which was not given any intervention.[12,14] A significant difference ($p=0.005$), while insignificant results.

Postpartum contraception with no significant differences were found. In the study, both 1-way and 2-way SMS approaches increased early uptake of contraception by 16 weeks postpartum, though this was not statistically significant when correcting for multiple comparisons.[14]

Finally, immunization compliance was assessed and reported the compliance to tetanus toxoid immunization found significant results ($p<0.0002$), while study no significant differences ($p=0.534$).[11,15]

DISCUSSION

Technology development in rural areas has increased greatly since the start of the modernization era.[16] In fact, the International Telecommunication Union launched the results from their survey that there were already over 7 billion people who had access to mobile phones in 2015, with its benefits in rural communities reaching 90% of the population.[7] Telemedicine, which combined healthcare with technologies, has helped human health in various ways, from prevention and education to home monitoring of specific conditions. Moreover, its role in assisting pregnant women from routine monitoring and check up to various maternal health education are also crucial.[16]

In this study, the telehealth approach focuses on several topics related to maternal health practices. These approaches consist of reminders and educational content that cover several subtopics such as pregnancy nutritional need, vitamin and mineral supplementation, ANC reminders, birth preparedness, mental health during pregnancy, and exclusive breastfeeding practices. Moreover, other studies also included education about basic immunization needs in pregnancy to prevent dangerous infections during pregnancy. Telehealth approach was delivered by several means, namely phone calls, mobile application, and short message services (SMS) according to the available technology and the competence of the population in each study.[14]

According to the World Health Organization recommendation, there are several practices that is required for pregnant mothers, such as nutritional needs, maternal and fetal assessment, preventive measures, intervention for physiological symptoms, and antenatal care visits.[17] The included studies measured the number of ANC visits during the whole pregnancy period, safe delivery in hospital or by skilled professionals, exclusive breastfeeding, and immunization compliance.[18]

WHO guidelines suggest that antenatal care visits should ideally be performed in 13 visits, specifically once a month for the first 7 months, twice a month for the next month, and once a week for the last gestational month until delivery. Meanwhile, the minimum requirement recommended by the WHO is four contacts or visits to reduce the risk of perinatal mortality and promote a positive mother's pregnancy experience.[19] In our included studies, ANC visits of more than four were reported.[11,13,15] They reported that telehealth interventions, specifically through routine reminders of the next ANC visits, could significantly improve the practice of ANC visits among pregnant mothers

The next health practice measured was safe delivery. Safe delivery requires several factors, such as the presentation of professional staff, continuous monitoring of the mother and fetal condition, administration of antibiotic therapy, and other interventions when appropriate.[20] WHO guideline suggest that delivery should only be performed under the supervision of professional healthcare workers, including midwives. The studies included in this review reported that after telehealth intervention in terms of education on safe childbirth, the number of pregnant mothers who delivered their babies in the hospital increased in contrast to the control group. There is significant difference of the number of deliveries in hospital ($p<0.0001$) and deliveries by skilled staffs ($p=0.027$).[12]

This systematic review has several strengths and limitations. First, it provides evidence regarding the effectiveness of a telehealth-based approach to maternal health practices among pregnant mothers in rural areas. Second, the author compared data from the included studies to provide insight into the importance of telehealth-based approaches. However, the author also identified limitations of the study, the included studies showed high heterogeneity in the included subjects of various gestational age.

CONCLUSION

Telehealth-based intervention is a promising approach to promote better maternal health practices among pregnant mothers in rural and low-resources settings. This approach has been proved to successfully made a significant difference in terms of antenatal care visits and safe childbirth practice.

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