Does a phone text message improve focused antenatal care visit and skill birth attendance in low and middle income countries? A systematic review and meta-analysis of randomized clinical trials

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Abstract

Background: Background: Missed appointments are a major cause of inefficiency in healthcare delivery. MHealth has been projected as a possible solution to support women during pregnancy, birth and puerperium period, to increase the uptake of essential maternal services.

Objective: This systematic review and meta-analysis study was aimed to determine the effectiveness of phone text messaging on Focused Antenatal Care (FANC) visits and skilled birth attendance in Low and Middle Income Countries (LMICs).

Methods: We searched a broad body of literature from electronic databases–Cochrane review, PsycINFO, PubMed and Google Scholar to offer comprehensive evidence on the role of phone text messaging on FANC visits and skilled birth attendance. We extracted data from only randomized clinical trials (RCTs). Meta-analyses were conducted using random-effects models with inverse variance method in Review Manager (RevMan) computer software. Qualities of the included studies were determined by GRADEpro, and risk of bias was assessed using Cochrane Collaboration risk of bias tool.

Results: Result: Of the 1,224 non-duplicated articles screened, only 7 RCT studies met eligibility criteria and included in this synthesis. On aggregate, there were statistically significant associations in experimental group in that pregnant mothers who received text messaging had a 74% increase in FANC visits (OR = 2.74 (95% CI: 1.41, 5.32) and 82% in skilled birth attendance (OR = 1.82 (95% CI: 1.33, 2.49). The overall qualities of included studies were moderate, and had low risk of bias.

Conclusions: Conclusion: Phone text messaging has positive effects for the uptake of FANC visits and skill birth attendance in LMICs. A short messaging service targeting pregnant woman is an invaluable, affordable intervention to improve maternal healthcare seeking behaviors.

ClinicalTrial: Not applicable

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Abstract

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variance method in Review Manager (RevMan) computer software. Qualities of the included studies were determined by GRADEpro, and risk of bias was assessed using Cochrane Collaboration risk of bias tool.
Result: Of the 1,224 non-duplicated articles screened, only 7 RCT studies met eligibility criteria and included in this synthesis. On aggregate, there were statistically significant associations in experimental group in that pregnant mothers who received text messaging had a 74% increase in FANC visits (OR = 2.74 (95% CI: 1.41, 5.32) and 82% in skilled birth attendance (OR = 1.82 (95% CI: 1.33, 2.49). The overall qualities of included studies were moderate, and had low risk of bias.
Conclusion: Phone text messaging has positive effects for the uptake of FANC visits and skill birth attendance in LMICs. A short messaging service targeting pregnant woman is an invaluable, affordable intervention to improve maternal healthcare seeking behaviors.

Plain english summary

Missed appointments are a major cause of inefficiency in healthcare delivery. *MHealth* has been projected as a possible solution to support women during pregnancy, birth and puerperium period, to increase the uptake of essential maternal services. This study was determine the impact of phone text messaging on FANC visits and skilled birth attendance in LMICs.
A broad range of databases published between 2008–2017–Cochrane, CINAHAL, PsycINFO, PubMed, Web of Science and Google scholar–were used to search relevant literature**.** Based on *a priori* set criteria, only 7 RCTs relevant to this study were systematically reviewed. Two reviewers separately extracted the required information from the relevant articles. Meta-analyses were conducted using random-effects models with inverse variance method in Review Manager (RevMan) computer software.
On aggregate, there were statistically significant associations in experimental groups in that pregnant mothers who received text messaging had a 74% increase in FANC visits (OR = 2.74 (95% CI: 1.41, 5.32) and 82% in skilled birth attendance (OR = 1.82 (95% CI: 1.33, 2.49). The overall qualities of included studies were moderate, and had low risk of bias.
In conclusion; Phone text messaging has positive effects for the uptake of FANC visits and skill birth attendance in LMICs.
Keywords: *MHealth* , phone text messaging, FANC, LMICs, systematic review and meta-analysis

Background

Despite ongoing efforts to improve maternal and child health in developing countries, mortality rates still remain high, with 1 in 160 lifetime risk of maternal mortality in developing regions as compared to 1 in 3,700 for women living in developed regions [1]. Limited access to preventive maternal health services, poor administration, limited logistic and technical ability, insufficient financial assets and scarcity of skilled health personnel's are some of the reasons for this disparity [2].
The three essential interventions with proven role to reduce maternal mortality include antenatal care (ANC) (during pregnancy), skilled birth attendances during Intrapartum (labour and delivery) and the postpartum periods (follow-up after delivery) [3]. Indeed, studies in Tanzania and Ethiopia have confirmed the capacity of focused ANC (FANC) and postnatal care (PNC) provision to mitigate maternal mortality [5-7]. Data from Demographic and Health Surveys (DHS), however, reported that two-thirds of women deliver without skilled birth attendance, only 13% having received a postnatal check-up within 48 hours in 23 African countries [4]. In addition, only nearly half pregnant women, in low and middle-income countries (LMICs), attend the World Health Organization (WHO) recommended level of at least four ANC visits (i.e., FANC) [8].
On the other hand, there is a rapid increase in mobile phone coverage in developing countries

bringing up a new unprecedented opportunities for broadcasting health information to large population at a low price [10-12]. Nonetheless, missed appointments are a major cause of inefficiency in healthcare delivery. The field of mHealth, or mobile health, has been projected as a possible solution to many of the problems in LMICs in tackling workforce scarcity and health education opacity, as well as, *mHealth* has been implemented for record keeping or data recording in general [13].

One of the vital areas tackled by *mHealth* interventions is the support of women during pregnancy, birth and puerperium period to reduce maternal and child mortality [15]. Prior studies including one systematic review have revealed that text messaging may be capable and effective tool to provide support, offer messages and remind appointments to women during prenatal and postpartum periods [16-19]. Nonetheless, to our knowledge, none of these studies explored a meta-analysis to confirm the impact of *mHealth* on FANC visits and skill birth attendance. Thus, the evidence base is still unclear and inconclusive. This systematic review and meta-analysis was aimed to determine the effectiveness of phone text message on FANC visits and skilled birth attendance in LMICs.

Methods

Search methods for identification of studies

A broad range of databases published between 2008–2017–Cochrane, CINAHAL, PsycINFO, PubMed, Web of Science and Google scholar–were used to search relevant literature**.** The search was extended to high quality studies by retrieving from the reference lists of included studies. The search strategy used the combination of the following keyterms: “mHealth” “mobile phone*”,”SMS”, “text message”, “telemedicine*”, AND “pregnancy”, “maternal health”, “prenatal Care” AND “LMICs”. Searches were done by two reviewers (FW and GD) independently and any conflicts were resolved by discussion, and third author (HM) was consulted whenever appropriate.

Types of studies

To come up with robust evidence, we considered studies with only randomized controlled comparison groups that determined the role of phone text messaging for pregnant mothers. We excluded before and after interventions and other types of observational study designs.

Types of participants

All pregnant women in LMICs who attended ANC visit(s) in all settings (i.e. primary care settings (services in primary health care), outpatient settings (outpatient clinics), community settings (public health services) and hospital settings).

Types of interventions

Interventions that use SMS (text messaging) as reminders for a scheduled health appointment(s) were included. We excluded appointment reminders provided for other services, for example, for socialization purposes.

Types of outcome measures

Primary outcome: the effect of mobile phone texting message service on FANC visits.

Secondary outcome: the effect of mobile phone texting message service on the skilled birth attendance. Primary and secondary outcomes were considered based on their natural order (i.e., FANC visits for pregnancy, and then for delivery).

Data extraction

The data extraction format was constructed and pilot-tested with a subset of eligible studies, and then summarized using a table. Two reviewers (FW, GD) separately extracted the required information from the relevant articles. Further information was request from primary authors through email (whenever indicated). Discrepancies were resolved by consensus, whenever appropriate. The following study characteristics were extracted: author’s name, year of publication, country of study, participant characteristics, study design, types of interventions and main findings. For dichotomous data, we extracted the number of participants with outcome of interest and total sample size.

Quality of evidence

The overall quality of evidence was evaluated using the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) methods [20]. GRADE profiler was used to compute the evidence profile and categorize the quality of evidence. The quality of evidence was classified as: (1) high quality (further research is extremely unlikely to change the credibility of the pooled results); (2) moderate quality (further research is likely to influence the credibility of pooled results and may change the estimate); (3) low quality (further research is extremely likely to influence the credibility of pooled results and likely to change the estimate); and (4) very low quality (the pooled results have extreme uncertainty) [20].

Assessment of risk of bias

Two authors (FW, GD) evaluated the risk of bias of the included studies using Cochrane Collaboration tool. Methodological quality of each study was appraised by retrieving information on five components related to the design, execution and reporting of randomized trials: randomization technique, allocation concealment, blinding, manner of handling withdrawals and comparability of randomized groups, with respect to baseline characteristics [21]. Studies were considered to have a low risk of bias when all key aspects were assessed and found to be at low risk for bias [21]. Consistent discussion was in place to settle any controversial idea, or a third author was used as a mediator.

Data synthesis and analysis

The characteristics of the 7 included RCTs were summarized and presented in a descriptive table. The extracted data were entered in to Microsoft Excel spreadsheet and then exported to REVMAN version 5.3 software for meta-analysis. Pooled effects odds ratio (OR) and its corresponding 95% confidence interval (CI) was estimated by using the inverse-variance method of random-effects model [22]. Funnel plot and egger test were used to test for publication bias. Heterogeneity between studies was assessed by calculating the I^2 statistic and its corresponding 95% CI using RevMan version 5.3 [23]. To verify the results, two researchers independently computed main statistical analysis and checked for consistency.

Results

Characteristics of the included studies

The search strategy identified 1,453 articles. Of these, 1,119 articles and 229 articles were excluded due to irrelevant topics and duplication, respectively. Thirty-three full text articles were further screened. Of these, 26 were excluded for 7 articles were systematic reviews on other related topics [24-30], 14 were non-controlled clinical trials [31-44], and 5 RCTs reported different outcomes of interest [45-49]. Based on *a priori* set criteria, only 7 RCTs relevant to this study were systematically reviewed (Figure 1). A Meta analysis was done from 4RCTs that specifically determined the effect of phone text messaging on FANC visits and skill birth attendance. Three of the remaining RCT studies those that did not reported quantitative data and just only described the findings qualitatively, were included and narrated to augment the pooled estimates (Table 1).

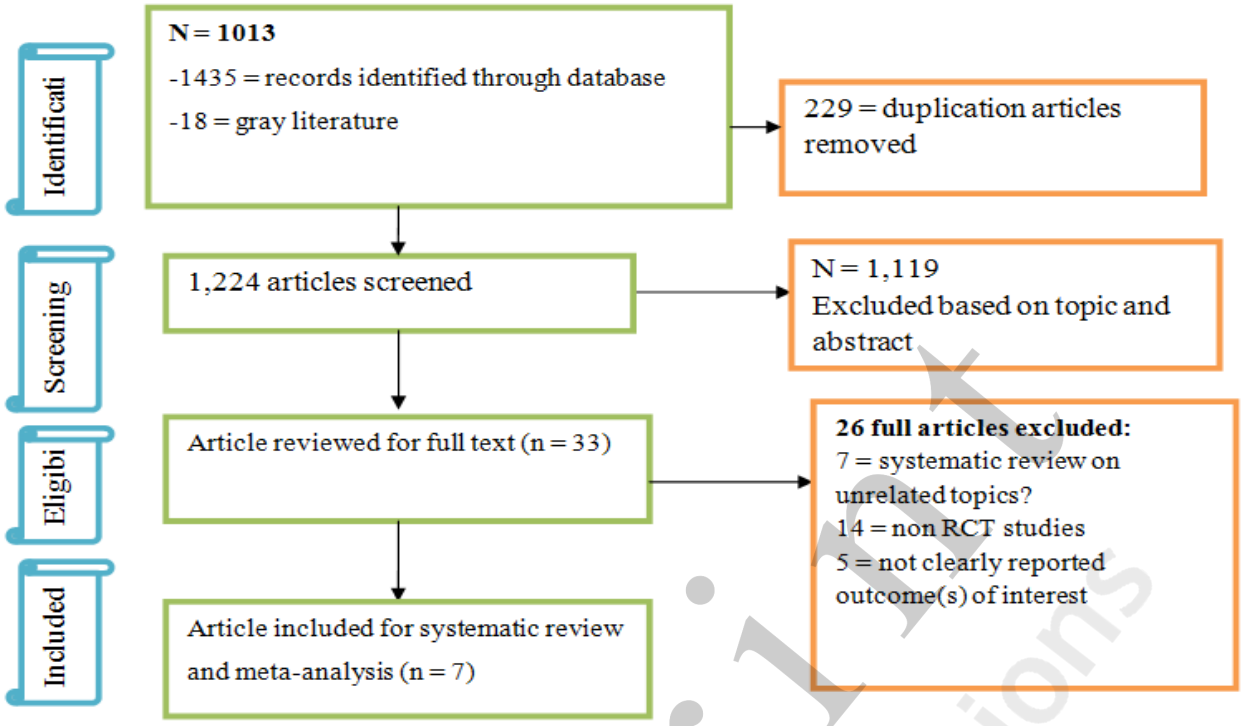

Figure 1: Flow chart describing selection of studies for a systematic review and meta-analysis of the effect of phone text messaging on FANC visits and skilled birth attendance among pregnant women in LMICs.

Table 1: Descriptive review of RCT relevant studies on the effect of phone text messaging on pregnant women's health care services uptake.

Authors	**Country**	**participants**	***Mhealth* Interventions**		**outcome**	**Main Finding**
			Experimental group	**Control Group**		
Jareethum et al. 2008[53]		Pregnant women / Size: Intervention: 32, Control: 29	text messaging: twice weekly	routine ANC and advice	Maternal satisfaction	Satisfaction scores of antenatal and perinatal periods were significantly higher in the study group compared to the control
Lund et al.,2012[51]	Zanzibar:	Intervension;1311 Control; 1239	Mobile phone text-message and voucher component.	routine ANC and advice	Primary outcome: skilled attendance at delivery	The mobile phone intervention significantly Increased skilled delivery attendance among pregnant women.
T.Fedha,2014[54]	Kenya	Intervension:191	reminded every fortnightly of the	Allowed to continue with	Primary outcome :	mobile telephone service for

		Control: 206	next visit to the clinic and given advice on pregnancy updates and advice	routine clinics with no mobile advice or updates support	FANC Secondary outcome: skill birth attendance	pregnant mother enhance maternal health care ANC visits and skill birth attendance
Lau et al. 2014[55]	South Africa	Size: Intervention: 102, Control: 104	text messaging: staggered according to the week of pregnancy	routine ANC and advice	To compare the control and intervention group's knowledge	No statistically significant difference in score in any of the 9 questions between the intervention and control
Lund et al.,2014[52]	Zanzibar:	Intervension;1311 Control; 1239	Mobile phone text-message and voucher component.	routine ANC and advice	Primary outcome: FANC visits -secondary outcome: tetanus vaccination, other preventive services for malaria, etc.	In the Intervention group 44% of the women received four or more antenatal care visits versus 31% in the control group.
Atnafu, 2017[56][28]		Size; Intervention: 1,080, Control : 1,080	SMS based mobile phone intervention in most of the selected MCH service indicators	No phone text messaging	role of mobile phone SMS MCH outcomes	The proportion of mothers receiving more than four ANC visits increased significantly in both intervention woredas.
Bangal VB et al.2017[50]	India	Intervention: 200 Control: 200	Mobile phone calls, as reminders about next visit and text messages (SMS)	Control group: women received routine ANC and advice as per hospital protocol.	percentage of pregnant women coming for FANC, percentage of institutional delivery and postnatal check-ups.	Mobile phone intervention significantly increased the percentage of women receiving the recommended four antenatal visits and received

						preventive health services.

Characteristics of the included studies

RCTs at clinic- and community-levels on phone text message service for pregnant mothers were included. Studies those explicitly addressed the effect of *mHealth* interventions on FANC visits and skilled birth attendance, and reported that the mobile phone interventions increase FANC visits (> 4 visits) and skilled birth attendance at delivery were conducted in India *[50]*, Zanzibar [51, 52] and Kenya [27]. Study done by Asfaw, a community-based randomized controlled trial, reported that the proportion of mothers receiving phone text message were more likely to receive FANC as compared to no interventions group. The range of study participates (intervention group) was from 32 [53] to 1311 [51]. Study characteristics and primary outcomes of reviewed articles were summarized in **Table 1** finally; a meta-analysis was done using 3 RCTs studies.

Pooled effect of phone text messaging on FANC

Three out of the 7 included studies assessed the impact of phone text messaging on FANC visits (as a primary outcome), and the other 3 included studies assessed the impact of phone text messaging on skilled birth attendance at delivery (as a secondary outcome). A total of 3,345 participants were included in the meta-analysis (Figure 2). On aggregate, there were statistically significant associations in experimental groups in that pregnant mothers who received text messaging had a 74% increase in FANC visits (OR = 2.74 (95% CI: 1.41, 5.32) and 82% in skilled birth attendance (OR = 1.82 (95% CI: 1.33, 2.49). The overall qualities of included studies were moderate, and had low risk of bias (Figures 3 and 4).

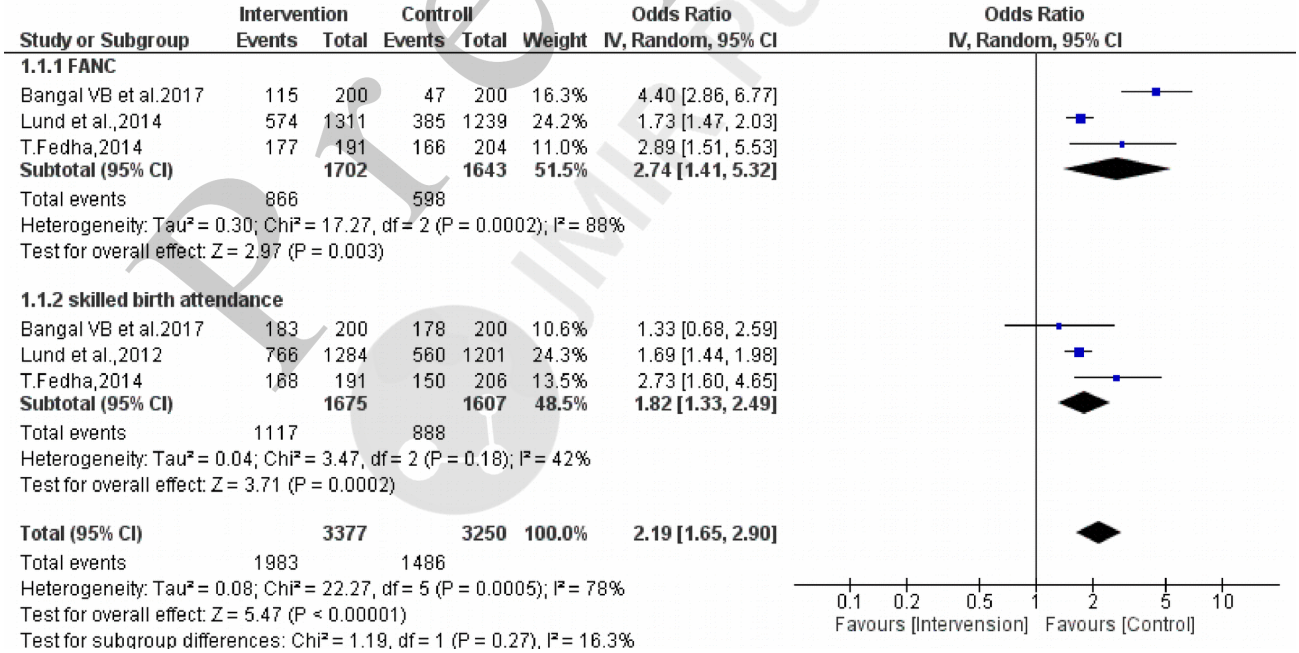

Figure 2: Forest plot of the 7 RCT studies that quantitatively assessed the effect of mobile phone messaging on maternal healthcare services uptake during pregnancy and at birth.

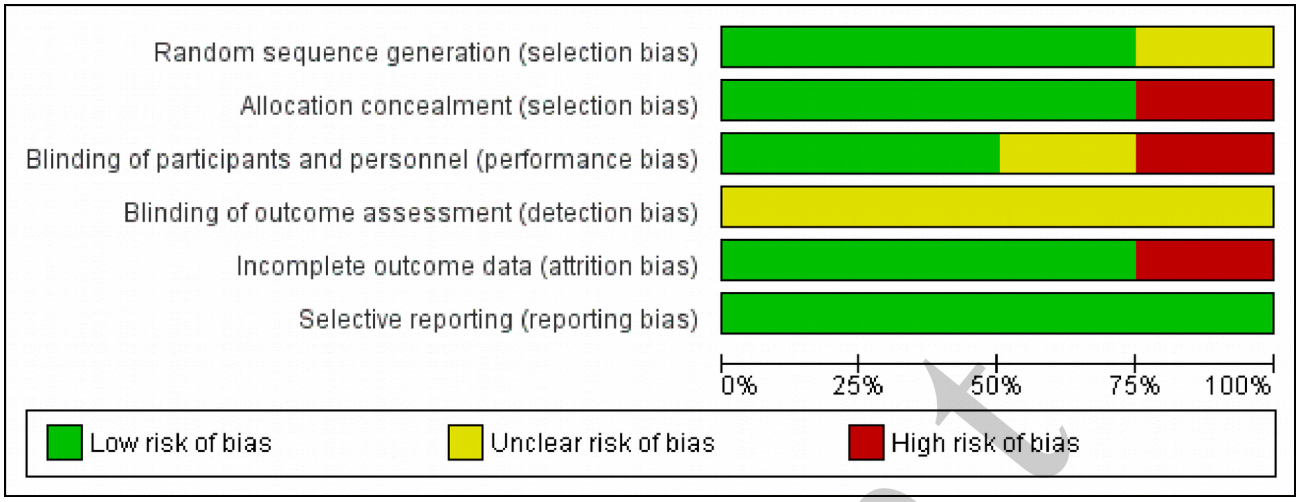

Figure 3: Risk of bias graph: review authors' judgments about each risk of bias item presented as percentages across all included studies.

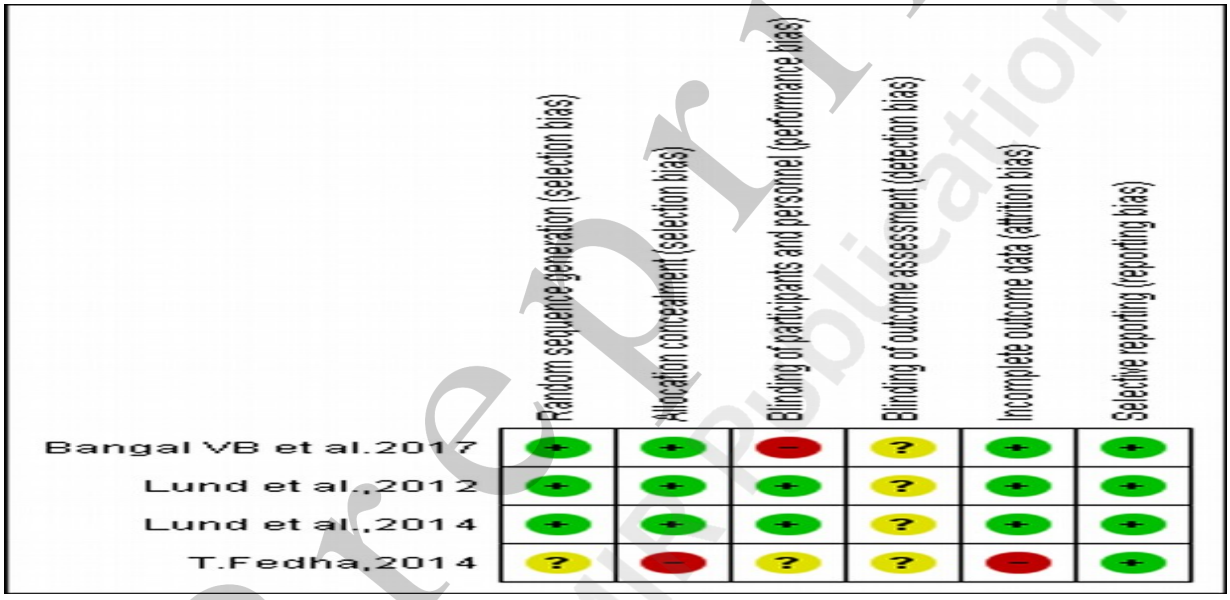

Figure 4: Risk of bias summary: review authors' judgments about each risk of bias item for each included study.

Quality of evidence

Evidence on the level of quality was evaluated by using GRADE pro criteria, which gave as a moderate level of quality **(**Table 2**).**

Table 2: GRADEpro level of quality evidences assessment

Certainty assessment							№ of patients		Effect		Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	phone text messaging	no interventions	Relative (95% CI)	Absolute (95% CI)	
FANC visit (assessed with: OR)											

Certainty assessment							№ of patients		Effect		Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	phone text messaging	no interventions	Relative (95% CI)	Absolute (95% CI)	
3	Randomized trials	not serious	not serious	serious	not serious	none	866/1702 (50.9%)	598/1643 (36.4%)	**OR --** (1.41 to 5.35)	**-- per 1,000** (from 83 more to 390 more)	⨁⨁⨁◯ **MODERATE**
Skilled birth Attendance(assessed with: OR)											
3	Randomized trials	not serious	not serious	serious	not serious	none	947/1675 (56.5%)	731/1607 (45.5%)	**OR --** (0.80 to 2.78)	**-- per 1,000** (from 55 fewer to 244 more)	⨁⨁⨁◯ **MODERATE**

CI: Confidence interval; **OR:** Odds ratio

Discussion

Mobile phone services, especially in certain population groups such as teenage girls and pregnant women in remote areas, have facilitated access to some healthcare services. That said, SMS messaging has used as an appointment reminder and provides basic health information [57] throughout pregnancy and perinatal period. This meta-analysis detected a statistically significant improvement for FANC visits among pregnant mothers who had received text messaging as compared to their counterparts. This finding is in keeping with a systematic review done in Ethiopia that also showed that *mHealth* tools are handy to influence maternal and child health services utilization by enhancing ANC/PNC attendances and delivery in health institutions [24]. Another systematic review done by Feroz (2017) [26] that reported *mHealth* interventions, particularly those delivered through SMS, were associated with improved utilization of preventive maternal healthcare services including uptake of recommended ANC and PNC services. This study also detected a significant difference between intervention and control groups of pregnant mothers who received text messaging and the likelihood of attending delivery by skilled health personnel as compared to those who did not receive text messaging. Consistently, a systematic review done by Colaci (2017) reported that phone text offered an opportunity to enhance acceptability of prenatal and obstetric care including skilled birth attendance [25]. This is because phone text messaging interventions (e.g., reminders, feedback, etc.) can improve self-efficacy, enhance provision of social support and create peer-to-peer networks. It may also improve health-seeking behaviors [58, 59].

Although few studies [53, 55, 56] were not included in the meta-analysis because of unclear evidence and inconsistent results, those studies vigorously assessed and reported that *mHealth* intervention can enhance client behavioral change and mental satisfaction. This could increase the intake of maternal healthcare services such as ANC, skilled birth attendance at delivery and PNC.

Interestingly, the quality of evidence was moderate, suggesting the observed effect was close to true effect, and that there was non-significant publication bias. The present study differs from the previous studies in that the eligible criteria were more rigorous, emphasizing only on randomized controlled trials, a meta-analysis, and included a quality assessment of the included literature.

Overall, the findings were robust and point the integration of *mHealth* interventions into the existing healthcare delivery system to mitigate maternal and child mortality through increasing the uptake of essential health services.
Nonetheless, some of important limitations included the inclusion of studies published only in English (language bias) and exclusion of studies from high income countries may compromise representativeness.

Conclusion

Phone text messaging was significantly associated with FANC visits and skilled birth attendance. Phone text messaging has positive effects for the uptake of FANC visits and skill birth attendance in LMICs. SMS targeting pregnant women is an invaluable, affordable intervention to improve maternal healthcare seeking behaviors.

List of Abrevassion

FANC	Focused Antenatal Care
LMICs	Low and Middle Income Countries
PNC	Postnatal Care
RCT	Randomized Clinical Trial
SMS	Short Message Service
WHO	World Health Organization

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and material

PRISMA checklist

Competing interests

The authors have declared that they have no competing interests.

Funding

Not applicable.

Authors' contribution

FW: conception of the research idea, study design, data collection, analysis and interpretation, and manuscript write-up. GD,AA,HM and AAA: data analysis and interpretation and supervision. All authors have read and approved the final manuscript.

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Supplementary Files

Figures

Figure 1. Flow chart describing selection of studies for a systematic review and meta-analysis of the effect of phone text messaging on FANC visits and skilled birth attendance among pregnant women in LMICs.

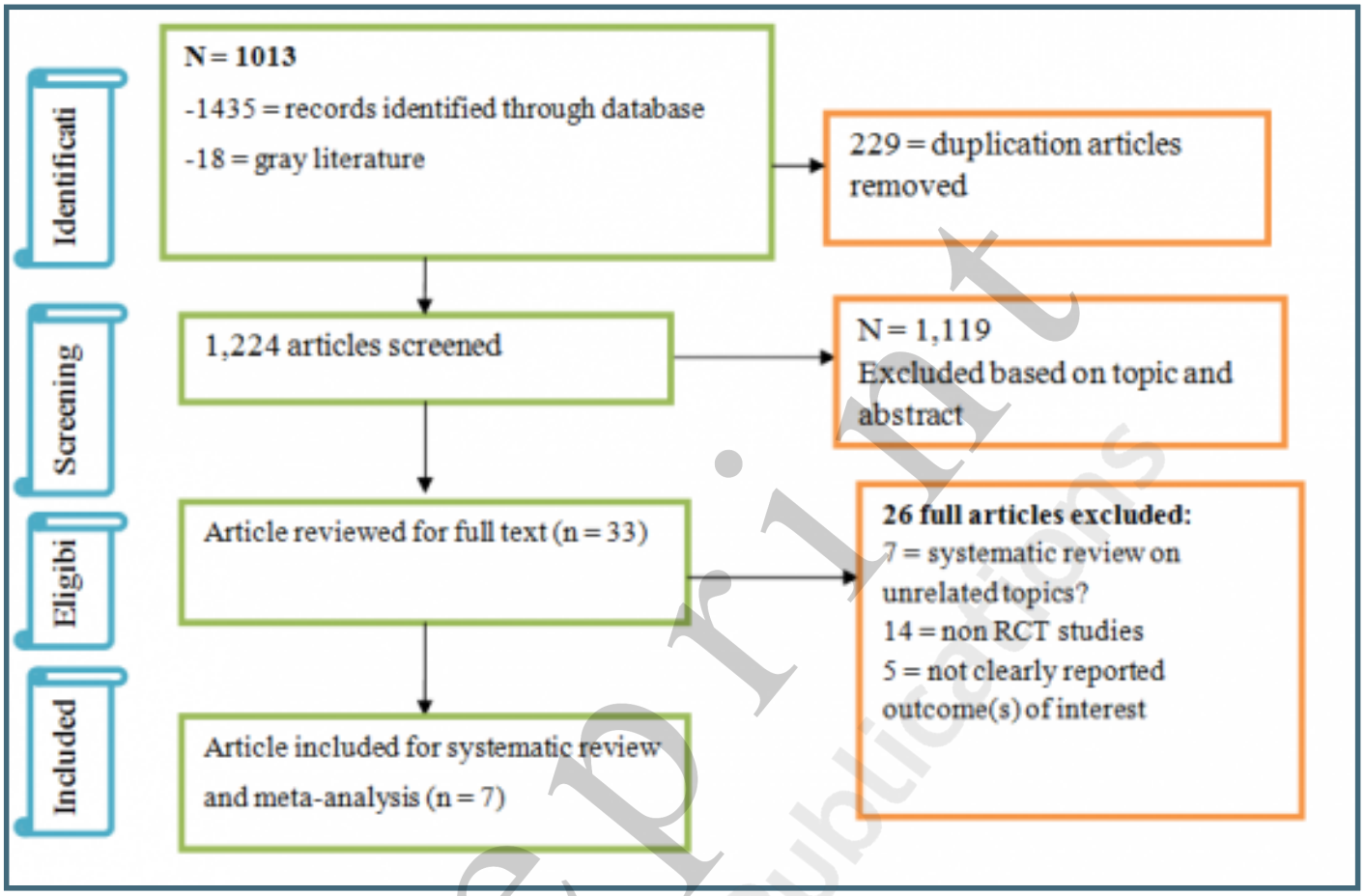

Figure 2. Forest plot of the 7 RCT studies that quantitatively assessed the effect of mobile phone messaging on maternal healthcare services uptake during pregnancy and at birth.

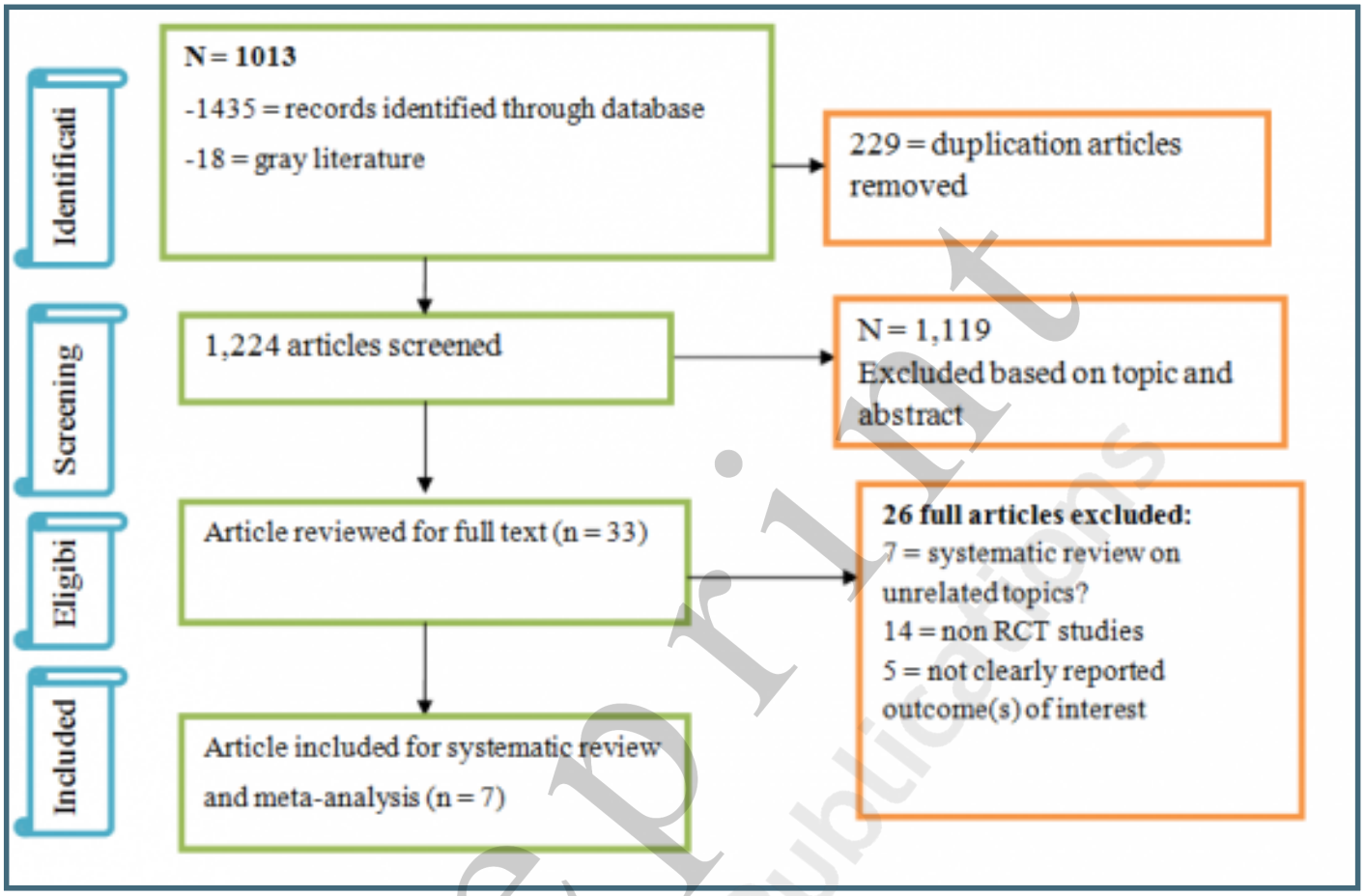

Figure 3. Risk of bias graph: review authors' judgments about each risk of bias item presented as percentages across all included studies.

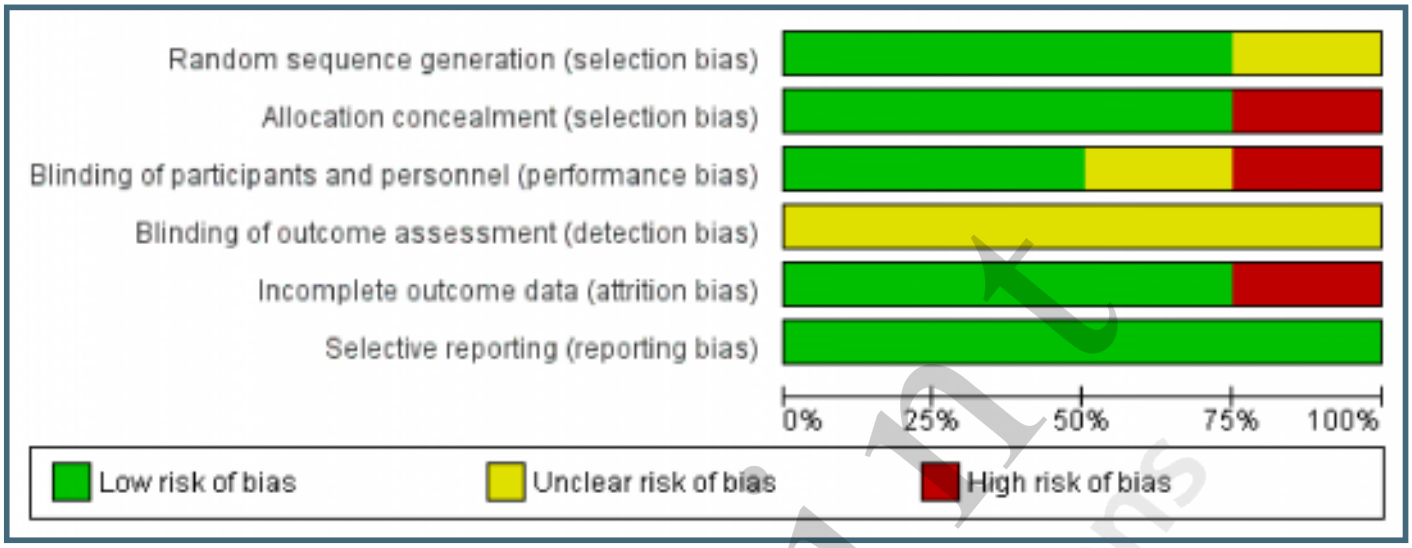

Figure 4. Risk of bias summary: review authors' judgments about each risk of bias item for each included study.