

REVIEW

Barriers and facilitators to the implementation of cell phone interventions to improve the use of family planning services among women in Sub-Saharan Africa: A systematic review

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ABSTRACT

Background: Mobile health (mHealth) interventions are being tested to improve contraceptive uptake in Sub-Saharan Africa (SSA). However, few attempts have systematically reviewed the mHealth programs to enhance family planning (FP) services among women in SSA. At the same time, more than half of low-income countries' population have a cell phone. This review identifies and highlights facilitators and barriers to implementing cell phone interventions designed to target women FP services.

Methods: Databases including PubMed, CINAHL, Epistemonikos, Embase, and Global Health were systematically searched for studies from January 1, 2010, to December 31, 2020, to identify various mHealth interventions used to improve the use of FP services among women in SSA. Two authors independently selected eligible publications based on inclusion/exclusion criteria, assessed study quality and extracted data using a pre-defined data extraction sheet. In addition, a content analysis was conducted using a validated extraction grid with a pre-established categorization of barriers and facilitators.

Results: The search strategy led to 8,188 potentially relevant papers, of which 16 met the inclusion criteria. Most included studies evaluated the impact of mHealth interventions on FP services, access ($n = 9$), and use of FP outcomes ($n = 6$). At the same time, only one article was interested in implementing a mHealth intervention. The most-reported cell phone use was for women reproductive health education, contraceptive knowledge and use. Barriers and facilitators of the use of mhealth were categorized into three main outcomes: behavioral outcomes, data collection and reporting, and health outcomes. mHealth interventions addressed barriers to provider prejudice, stigmatization, discrimination, lack of privacy, and confidentiality. The studies also identified barriers to uptake of mHealth interventions for FP services, including decreased technological literacy and lower linguistic competency.

Conclusions: The review provides detailed information about implementing mobile phones at different healthcare system levels to improve FP service outcomes. Barriers to uptake mHealth interventions must be adequately addressed to increase the potential use of mobile phones to improve access to Sexual and Reproductive Health (SRH) awareness and FP services.

Key Words: Cell phone, mHealth, Women, Sub-Saharan Africa, Systematic review, Facilitators, Barriers

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1. INTRODUCTION

Improving access to family planning (FP) information can be a strategy to improve service utilization and prevent adverse pregnancy outcomes and unsafe abortions among adult women of reproductive age, reduce the risk of maternal mortality, and promote the realization of reproductive rights.^[1-3] Indeed, lack of knowledge about appropriate FP methods, fear of side effects, myths and misconceptions about contraception are well-known barriers to FP services.^[4,4] In addition, low utilization of FP services in well-attended maternal and child health (MCH) centers and clinics may be related to a lack of provider time and FP counseling opportunities.^[5,6] Thus, new approaches to providing comprehensive, client-centered FP counselling that addresses individual and structural barriers^[7,8] are essential to increasing reproductive-age FP service utilization among adult women.

Sub-Saharan Africa is, geographically, the area of the continent of Africa that lies south of the Sahara. Geopolitically, in addition to the African countries and territories situated entirely in that specified region, the term may also include policies that only have part of their territory located in that region, per the United Nations (UN). In Sub-Saharan Africa (SSA), several factors prevent women from accessing and utilizing family planning services. It is estimated that approximately 200 million women in the developing world desire birth spacing (recommended at 24 months between births), delayed birth, or a limited number of pregnancies.^[9] The high rates of unmet need for family planning and contraception can lead to high fertility rates and maternal mortality due to unsafe abortions and pregnancy in young girls. Due to the World Health Organization's Millennium Development Goals (MDGs) 4 and 5, to reduce infant and maternal mortality by two-thirds and three-quarters, respectively, awareness of family planning and reproductive health services in the developing world is increasing. International funding has helped support family planning service access in sub-Saharan Africa for approximately 50% of the couples seeking it. However, several barriers still prevent the remaining couples from accessing services.^[10] eHealth is defined as healthcare practices supported by electronic processes and communications. It includes (mHealth), defined as the practice of medicine and public health supported by mobile devices such as cell phones, patient monitoring devices, personal digital assistants and other wireless devices.^[11,12] mHealth technologies have shown benefits in a variety of Sexual and Reproductive Health (SRH) settings in resource-limited settings.^[13,14] Many low- and middle-resource countries with limited Internet or publishing resources have achieved an effective cell phone infiltration rate.^[8,15,16] According to the 2018 International Telecommunication Union (ITU) report, the total

number of cell phone subscribers worldwide has reached 5 billion.^[17] Due to the increasing dependence on cell phone technology and the decreasing costs of mobile phones, this number will grow in the coming years and exceed the world population.^[18-20] In low-income countries (LICPs), the cell phone infiltration rate has been over 90%.^[21] A survey was conducted in 24 developing countries to assess cell phone ownership. The survey report found that more than half of the countries' populations have a cell phone. In addition, a median of 78% of cell phone users in 24 countries uses short messages (SMS), making it the most popular method of communication.^[22,23]

Furthermore, cell phone owners were more likely to use modern contraceptives than non-owners.^[24-26] mHealth technology can help overcome provider bias, stigma, discrimination, fear of rejection, lack of privacy and confidentiality, and embarrassment in seeking SRH education and services on sensitive topics, cost issues, and transportation challenges by providing safe, accurate, cost-effective, timely and tailored FP services to women.^[8,15] Sexual and reproductive health programs in SSA using mobile health are mainly based on behavior change communication, sharing FP knowledge through SMS,^[15,27] either within a general population or for a target audience of adolescents,^[28-30] resulting in increased use of these services.

As a platform, mHealth has offered educational information about SRH and FP service providers.^[31] In addition, individuals can quickly, conveniently, and confidentially search for FP information and related resources instead of visiting a clinic or health care provider for the same information.^[32,33] Several interventions have been implemented to assess whether mHealth technologies could help reduce unmet contraceptive needs in SSA by increasing the use of FP services.^[5,29,34-47]

In recent years, there has been increased research on the potential of mHealth for women's SRH services in SSA. However, little evidence exists on cell phone interventions to improve women's use of FP services in SSA. mHealth interventions addressing maternal health in low-income countries have been previously studied. In the literature search, 370 articles were found. They evaluated the full text of 57 studies and included 19 in the review. These studies showed promise for mHealth for maternal health; however, most evidence came from low- to moderate-quality studies.^[48-50] A systematic review by Feroz and colleagues assessed the use of mobile phones to improve young people SRH in low and middle-income countries.^[8,15] The review provides detailed information about mobile phones' implementation at different healthcare system levels for enhancing young people's

SRH outcomes. Still, there is a lack of literature on women of reproductive age. Another review by Gahungu et al. summarized 79 studies in a systematic review of the literature, which focused on unmet needs for modern FP methods among postpartum women in SSA.^[51,52] The unmet need for postpartum FP among women in sub-Saharan Africa is associated with sociodemographic and health system determinants. However, there is a need to emphasize the use of modern contraceptive methods through effective interventions.^[52,53] These three reviews included evidence regarding the use of mHealth to improve young people's SRH and women in postpartum. However, very little is known regarding the potential barriers and facilitators for the uptake of mobile phone interventions to improve women's use of FP services. This systematic review aimed to highlight potential barriers and facilitators for the uptake of cell phone interventions to improve FP services among women in SSA. Thus, developing and implementing a cell phone FP intervention for adult women of reproductive age will inform the future use of mHealth to deliver FP programs in SSA.

We present the following article by the PRISMA reporting checklist (see supplementary file via https://www.prisma-statement.org//documents/PRISMA_2020).

2. METHODS

This systematic review examines barriers and facilitators to implementing mobile phone interventions to improve FP services use among women in SSA. Additionally, this review will help the research community make decisions regarding new methodologies and mobile phone interventions to encourage women of childbearing age to seek FP information and services.

The review protocol was registered in the International Prospective Register for Systematic Reviews (PROSPERO)

CRD42020220669 on December 14, 2020.

2.1 Information sources and search strategy

An electronic systematic literature search was carried out to explore mobile phone technology's role in improving women use of FP services, particularly in SSA. Although there are many databases on this pertinent topic, we searched five electronic databases, including PubMed, CINAHL, Epistemonikos, Embase, and Global Health. These databases were explored using a detailed search strategy. Additionally, grey literature (non-published, internal, or non-reviewed papers, repositories) was also examined as an essential source for mobile phone evaluations. The reference list of included records was also appraised to identify relevant articles. The search strategy included five categories of keywords: mHealth, Women, SSA, Facilitators and Barriers. These keywords should appear in conjunction with the title or abstract of the article. For example, to refer to m-Health, articles either had to include the term "mhealth" (and its alternative formulations) or include both the terms "health" and one of the following search terms or their variants: mobile phone, smartphone, mobile application, mobile app, cellular phone, mobile device, mobile technology, SMS, or text message. To refer to women, we used the following search terms: female, young adult, women of childbearing age, and women of reproductive age. To refer to SSA, we used the following search terms: Africa South of the Sahara, Sub-Saharan Africa, Africa Central, Africa Eastern, Africa Southern, Africa Western. Finally, we searched the following themes related to barriers: availability of electricity, availability of mobile phone, phone cost, literacy, inadequate information on implementation costs; and facilitators: use of mobile phone, Adequate information on implementation, political stability and support, social acceptability (see Table 1).

Table 1. Search strategy into MEDLINE/PubMed

<p>"Women" [MeSH] OR "Female" [MeSH] OR "Young Adult" [MeSH] OR "Women of Childbearing Age" OR "Women of Reproductive Age" AND "Cell Phone*" [MeSH] OR "Health Communication*" [MeSH] OR "Mobile Applications" [MeSH] OR "Text Messaging*" [MeSH] OR "Telephone" [MeSH] OR "Text Messaging" [MeSH] OR "Communications Media" [MeSH] OR "Smartphone" [MeSH] OR "Cellphone" OR "Telecommunications" [MeSH] OR "Telemedicine*" [MeSH] OR "mHealth" OR "Reminder Systems*" [MeSH] OR "Texting" OR "Mobile Phone" OR "Wireless Technology" [MeSH] OR "Medical Informatics" [MeSH] OR "Mobile technology" AND "Contraception Behavior*" [MeSH] OR "Natural Family Planning Methods*" [MeSH] OR "Family Planning" OR "Family Planning Services" [MeSH] OR "Natural Family Planning Methods" [MeSH] OR "Contraception" [MeSH] OR "Birth Intervals" [MeSH] OR "Contraceptive counseling" OR "Decision aid" OR "Sex Education*" [MeSH] OR "Behavior change communication" OR "Pregnancy, Unplanned" [MeSH] OR "Contraceptive Effectiveness" [MeSH] OR "Pregnancy, Unwanted" [MeSH] AND "Africa South of the Sahara" [MeSH] OR "Sub-Saharan Africa" OR "Africa, Central" [MeSH] OR "Africa, Eastern" [MeSH] OR "Africa, Southern" [MeSH] OR "Africa, Western" [MeSH]</p>

Duplicate citations across databases were identified and excluded using Zotero, and a manual revision was done for verification. We only included the most recent publication if a study was reported in more than one publication and presented the same data. However, all were included if new data were presented in multiple publications describing the same study.

2.2 Eligibility criteria

We included studies with an abstract in English or French. The studies had to be based on an empirical design, includ-

ing qualitative, quantitative or mixed-methods. The articles should clearly state the data collection process, research methods, and measurement tools. We excluded publications presenting editorials, comments, position papers, and unstructured observations. We included conference proceedings as long as they presented all relevant data. Studies provided data on women’s barriers and facilitators to use mHealth in their results or discussion sections. We excluded studies that focused on studies involving groups of women, men, and girls under the age of 15 years and over 45 years (see Table 2).

Table 2. Inclusion and exclusion criteria

Attribute	Inclusion criteria	Exclusion criteria
Population	Women aged 18-45 years to which mobile phone interventions were delivered to improve their use of family planning services outcomes	Studies involving groups of women, men, and girls under 18 years and over 45 years
Intervention	Studies will be included that have involved mobile phone intervention to improve the use of family planning services	Studies involving other ICT interventions, ART compliance reminders, physical mobile clinics, and teleconsultations
Comparison	No mobile phone (all other interventions other than mobile telephony)	Not applicable
Outcomes	Health Outcomes, behavioral outcomes, Awareness, Reproductive Health/Education, Reproductive Health/Trends, Sexual Behavior, Abortion, Sexual Health Rights.	Studies with other outcomes such as demonstrating skilled birth attendants, emergency care, quality of life, immunization coverage, the cost-effectiveness of the intervention, child development, and others
Setting	Studies conducted in Sub-Saharan Africa	Studies conducted elsewhere
Study designs	Randomized and non-randomized controlled trials, pre-and post-test designs, non-experiment observational (cross-sectional, case-series, case studies), and qualitative papers	Commentaries, editorials, symposium proceedings, and systematic reviews
Language	Studies available in the English and French language as authors are proficient in this language	Studies which were not available in an English or French translation
Time period	Studies published between January 2010 to December 2020 as the field of mobile phone emerged over the last decade	Studies published before January 2010 and after December 2020

2.3 Data extraction

Two authors independently extracted data from each study that fulfilled the inclusion criteria using a standard form. Study characteristics (name of the first author, year of publication, the country where the study was conducted, study design, sampling approach, participating characteristics) and key findings related to factors associated with the use of FP services by women were extracted. Any factors associated with using FP services were listed, and the results of multivariate statistical tests for association (odds ratio) were noted. The results of bivariate analyses were noted for studies where a multivariate statistical test was not done. When the measure of association in multivariate analysis was not significant and not reported by authors, the factor was not considered in the

synthesis.

2.4 Studies selection

A citation management system (Zotero) was used to manage the records exported from electronic databases.^[54] A pre-defined screening form was developed to ensure the reliability of screening articles among the two reviewers (BA and KSS), and pilot testing was conducted per the eligibility criteria. After reviewing the studies, both reviewers (BA and KSS) described outcome measures to verify the articles’ relevance. Each reviewer provided strong justifications for excluding studies. In a consensus meeting, a third reviewer (PN) resolved disagreements between the two reviewers and decided whether the study met the eligibility criteria for inclusion.

Titles, abstract first screened all studies, and full text to progressively eliminate studies not meeting the inclusion criteria. Database searches identified a total of 8,188 studies initially. After de-duplication, 8,020 potentially relevant titles were included for title or abstract screening. Next, full texts of the remaining 52 studies were reviewed to determine if they ful-

filled the inclusion criteria. Finally, 16 studies were selected and used for this review.^[5,29,34-47] The Preferred Reporting Items for Systematic Reviews and Metaanalyses (PRISMA) flow diagram was used to report the study selection process (see Figure 1).

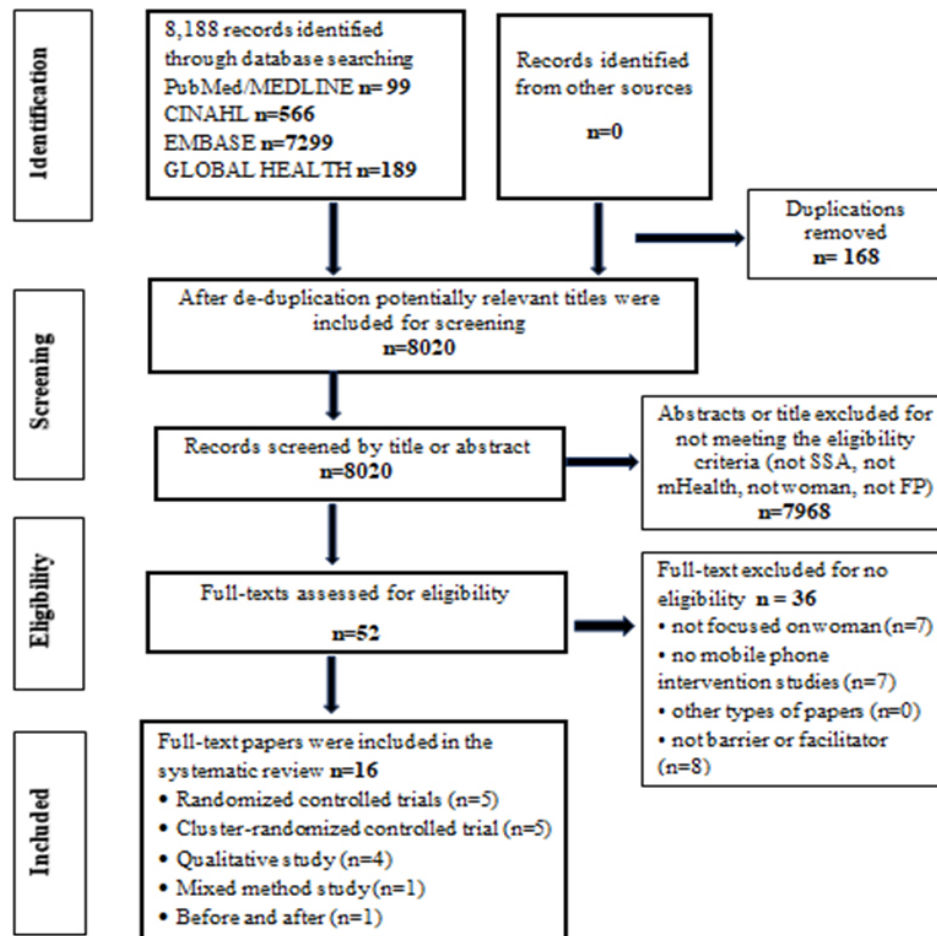


Figure 1. PRISMA flow diagram for database search of studies

2.5 Quality assessment of included studies

We used the mixed methods appraisal tool (MMAT) 2018 version to assess the methodological quality of the included studies. The MMAT is a critical appraisal tool for qualitative, quantitative and mixed methods studies. It allows the appraisal of five methodological quality categories: qualitative research, randomized controlled trials, non-randomized studies, quantitative descriptive studies, and mixed methods studies.^[55,56] The tool is divided into two parts. First, the tool was suited for this review as it was specifically developed for quality appraisal in systematic reviews involving qualitative, quantitative and mixed methods designs. Qualitative and quantitative sections have four criteria each, and studies are scored by dividing the number of criteria met by

four to arrive at a value ranging from 25% to 100%. For mixed-method studies, we adapted the MMAT by assessing each segment separately and selecting the lowest quality rating. The MMAT is a unique tool that can be used to appraise the quality of different study designs. Also, by limiting to core criteria, the MMAT can provide a more efficient appraisal.^[55,56] Articles were not excluded based on the MMAT score; the purpose was to examine and gain insight into the rigor of existing research in this field.

2.6 Data synthesis and analysis

The reviewers identified sections of the publications that presented a relevant barrier or facilitator to using mHealth for the women to improve their use of FP services. In addition,

the authors coded each facilitator and barrier according to the Consolidated Framework for Implementation Research (CFIR), a conceptual framework created to guide the systematic assessment of factors that influence the implementation and effectiveness of interventions.^[57,58] The CFIR comprises five major domains: intervention characteristics, outer setting, inner setting, characteristics of the individuals involved, and implementation process. Eight constructs were identified related to the intervention (e.g., evidence strength and quality), four constructs were identified about the outer setting (e.g., patient needs and resources), and 12 constructs were identified related to the inner setting (e.g., culture, leadership engagement), five constructs were identified related to individual characteristics, and eight constructs were identified related to the process (e.g., plan, evaluate, and reflect). We used domain 4 (individuals involved), domain 2 (outer setting) and domain 1 (intervention characteristics) in our study. The CFIR provides a pragmatic structure for approaching complex, interacting, multi-level, and transient states of constructs in the real world by embracing, consolidating, and unifying key constructs from published implementation theories.^[58,59]

Two authors collaborated to produce one consolidated document containing all relevant codes by resolving disagreements between their original data extraction documents. Then, a third author was involved in resolving any conflicts. The two authors agreed roughly 70% about extracting barriers and facilitators for each article and 75% about the coding. Finally, all barriers and facilitators were grouped inductively to facilitate the creation of broad themes.

3. RESULTS

3.1 Included studies

Our search identified 8,188 papers. We removed 168 duplicates and screened 8,020 titles and abstracts, of which 7,968 were excluded after initial screening. Full texts of 52 studies were assessed; 36 were excluded, and 16 were included in this review. The study selection flow diagram is presented in Figure 1.

3.2 Characteristics of included studies

Of the 16 papers, ten (10) described programs in Kenya,^[5,28,35–38,41,43,44,46] 2 in Malawi,^[45,47] and 1 each in Ghana,^[29] Uganda,^[39] Nigeria,^[40] Tanzania.^[42] Each paper reported different outcomes and/or study periods. Nine papers reported interventions targeting couples, four on interventions targeting Postpartum women, three targeted users; one sex worker; and one on interventions targeting students. Three papers were graded low quality, 4 moderate, and 9 high. Eight papers described reported on randomized controlled

trials (RCTs), whereas five reported on a cross-sectional qualitative study. One study used a before and after design with no control group, and two used a pilot study. Sample sizes ranged from 12 to 7,397, limiting comparability.

The largest proportion of papers was classified as high quality. Of the 9 high-quality papers, 4 reported on RCTs, 2 reported on cluster-randomized control trials, one reported before and after studies, and two reported on Cross-sectional data. The four moderate-quality papers reported on a qualitative study, and 1 was a Pilot study on the general public. The remaining three low-quality papers: one reported on RCTs, one pilot study (quantitative and qualitative data) and one reported on Cluster-randomized controlled trial (see Table 3).

Most included studies evaluated the impact of mHealth interventions on FP services, access (n = 9), and use of FP outcomes (n = 6). At the same time, only one article was interested in implementing a mHealth intervention.

3.3 Overview of mHealth using factors

In total, 64 elements were identified as barriers to or facilitators for mHealth use and were classified in the CFIR domains and constructs from the extraction grid. 41 (64.06%) of these elements were classified as facilitators for mHealth adoption and 23 (35.94%) as barriers. The reported frequency of the barriers and facilitators and their alignment to the CFIR constructs are shown in Table 4.

3.4 Individuals involved in the implementation

Individual factors represented 31 (48.44%) of the extracted elements. There were twice as many facilitators as barriers in this category (41 and 23, respectively). The most common factor identified was outcome expectancy (n = 12).^[5,29,34–36,38–41,44,45] Most women valued mHealth and described it as useful in helping to dispel myths and misconceptions, setting realistic expectations about potential side effects of FP and maintaining confidentiality. Indeed, mobile health could be considered a cost-effective tool for improving family planning knowledge.^[5,28,29,35,38–41,44] However, some pointed out that mHealth alone did not improve contraceptive knowledge and modern contraception among women.^[28,36,45] Familiarity and ability with mHealth are considerable skill limitations in low-literacy settings, especially regarding the recruitment and induction of women (n = 4).^[1,28,36,40] Awareness of mHealth (n = 2)^[1,38] was perceived either as a facilitator or a barrier, dependent on other factors, such as familiarity, ability with mHealth and technologies in general.

Autonomy and agreement with mHealth (Welcoming/resistant) were also mentioned three times.^[5,36,38,40] In addition, one comment underlined that future adaptations

of the tool should address the limitations connected with the number and length of program calls.^[40] Finally, familiarity with technologies in general,^[5] voluntary ownership,^[5] experience,^[5] and beliefs in one's competence to use mHealth^[40] were other factors identified in this category.

3.5 Outer setting

Outer Setting represented eleven elements identified in the review (17.19%). Eight of the factors extracted were facilitators, and three were barriers. Women and health professional interaction (n = 5)^[29,37,40,41,44] were underlined more often than other factors. Professionals believed that mHealth, especially in the case of smartphones, SMS dialogue with a nurse about FP could reduce misperceptions and stimulate communication within couples, thereby improving contraceptive access and continuation.^[29,37,40,41,44] Other factors related to women were applicability to the patients' characteristics,^[28,40] women's attitudes and preferences towards mHealth^[35,47] and other factors associated with women.^[36,47]

3.6 Characteristics of the intervention

A total of 22 elements (34.37%) pertain to the category "Characteristics of the Intervention," with five identified as barriers and 17 as facilitators. The most recurrent factor was perceived usefulness, with ten extracted elements.^[5,28,29,38-43,45] It was seen as a facilitator for mHealth adoption. Perceived usefulness is defined as an individual's perception that the utilization of a particular mobile device will be advantageous in an organizational setting over a current practice.^[60] Satisfaction about content available (completeness) was another frequently mentioned factor (n = 4).^[5,35,40,44] Satisfaction with the content available is defined by personalized, complete, relevant, easy-to-understand and secure information content.^[61] Therefore, it was important for the women to perceive messages' usefulness and content completeness in their living environment; otherwise, there would be less incentive to use them. Content appropriate for the users (relevance) was also mentioned three times^[36,44,46] and was perceived mainly as facilitators.

Table 3. Characteristics of articles included in the systematic review (N = 16)

Authors	Country	Target of Intervention	Goal	Duration	Intervention	Design	Quality
Johnson et al., 2017	Kenya	Consumers	Knowledge and use of contraception	September 2013-May 2014	The m4RH service: via text message -13,629 Consumers	RCT	High
Jones and al, 2020	Kenya	Women	Care-seeking behavior and uptake of family planning	November 2017 and concluded in March	Postpartum Checklist (PPC) messages. General Postnatal Care messages Family Planning messages	RCT with four study arms.	High
Rubee Dev et al., 2019	Kenya	Postpartum women and FP providers	Acceptability and feasibility of the iMACC mobile decision aid	Six weeks	Interactive Mobile Application for Contraceptive Choice [iMACC]: self-administration; combines images and text in a heuristic approach	A cross-sectional qualitative study	High
Lee et al., 2019	Kenya	Female respondents	Exposure to family planning messages through mHealth and contraceptive knowledge and use	May and September 2015.	mHealth exposure was defined as having received family planning messages through a mobile phone via text or e-mail in the last 12 months	Before and after with no control group	High
Harrington et al., 2019	Kenya	Postpartum women	2-way short message service (SMS) with a nurse on postpartum contraceptive	July 19 and December 6, 2016	Health education: contraceptive information via text messaging (Mobile WACH XY)	Unblinded RCT	High
Rokicki et al., 2017	Ghana	Female students	Text-messaging programs to improve reproductive health	3-month follow-up; 15-month follow-up	An interactive mobile phone quiz on reproductive health knowledge at 3 and 15 months. Unidirectional intervention sent participants text messages with reproductive health information. Interactive intervention engaged adolescents in text-messaging reproductive health quizzes	Cluster-RCT	High
Ampt et al., 2020	Kenya	Sex workers	The mHealth to reduce the incidence of unintended pregnancy a mobile phone application	Sept 14, 2016, and May 16, 2017	WHISPER message content focused on the promotion of contraception	Cluster-RCT	Low
Nuwamanya et al., 2020	Uganda	Students	(APP) to increase access to SRH information, goods, and services	Oct 23rd, 2018, to 13th November 2018	Participants were granted access to an MPA over six months.	RCT	Low
Babalola et al., 2019	Nigeria	Women	Exposure to the digital tool on contraceptive ideation and use	March 7, 2017, to June 5, 2017	The Smart Client digital health tool was designed to be delivered via mobile phone and included 17 pre-recorded calls: 1 welcome call, 13 regular program calls, and 3 quiz calls interspersed.	A cluster-randomized control trial	High

(Table continued on page 46)

Table 3. (continued.)

Authors	Country	Target of Intervention	Goal	Duration	Intervention	Design	Quality
Harrington et al., 2019	Kenya	men and Women	SMS to facilitate postpartum FP counseling	April to June 2016	A theoretical framework for SMS development: SMS messages based on behavioral theory and experience	Focus group discussions (FGD) among men (n = 35) and among pregnant/postpartum women (n = 15)	Moderate
L'Engle et al., 2013	Tanzania	General public	The feasibility, reach and potential behavioral impact of providing automated family planning information	September 2010 through June 2011	Every m4RH user logged by the system was sent a series of four questions via text message.	Pilot study (2870 unique users accessed m4RH)	Moderate
Shelus et al., 2017	Kenya	Female app users	CycleBeads app brings the experience of the new users to family planning	May and September 2015	The Cycle Beads app, a digital platform to support women using the Standard Days Method, is the first mHealth app marketed in Kenya to offer an evidence-based family planning method exclusively via mobile phone.	A three-month pilot study (quantitative and qualitative data from 185 female app users.)	Low
Unger et al., 2018	Kenya	Postpartum women	Short message service (SMS) communication on contraceptive use	August 2013 and April 2014	Women were to receive 1-way SMS versus 2-way SMS with a nurse versus control.	3-arm, unblinded RCT	High
Hu et al., 2020	low-middle-income countries	Mothers	Received SMS-based family planning communication and use of modern contraception		Mothers receiving SMS regarding family planning, as well as the association between receiving SMS with modern contraceptive use, and utilisation of essential maternal health services	Cross-sectional data 94,675 mothers (15–49 years)	High
Vahdat et al., 2013	Kenya	Users	The m4RH access and potential behavioral impact of providing contraception information	January 2010 to June 2011	Automatic logging of all queries to the m4RH system; demographic and behavior change questions and telephone interviews with a subset of m4RH users.	The structured interview	Moderate
Laidlaw et al., 2017	Malawi	Stage 1: representing men, women, leadership, elderly and male and female youth; Stage 2: male adults, female adults, male youth and female youth	Implementing an mHealth intervention	Stage 1: secondary analysis of village profiles in 2013/14. Stage 2: intervention development in 2015.	mHealth education intervention, an mHealth messaging service, which will provide health information to the community	Two-stage qualitative study	Moderate

Other factors related to mHealth characteristics were perceived ease of use,^[1] cost issues,^[36] and cell phone accuracy^[36] (all of them extracted one time). Cost issues, perceived ease of use and cell phone accuracy were seen exclusively as barriers to the use of mHealth. Indeed, women were worried about the cost of mobile technology and smartphone applications were perceived as barriers to mHealth use. Additionally, women were worried about literacy and lack of familiarity with smartphones or tablets. They suggested the inclusion of interactive multimedia such as audio or videos to optimize the tool's effectiveness. Other factors were identified in this category.^[5,40]

4. DISCUSSION

4.1 Summary of findings

This systematic review is the first to assess factors influencing the implementation of mhealth interventions toward increasing the use of FP services in SSA. Other systematic reviews have examined mHealth in FP interventions, but few included studies from SSA. Additionally, three of the 16 studies in the present review were not assessed in previous systematic reviews. Therefore, findings from the current systematic review reveal new information about the role that mHealth has in improving the use of FP services in SSA. The

mHealth solutions identified in this systematic review mainly aimed to improve FP related SRH education, services and behavioral outcomes for women.

Out of the 16 studies included, three reported improvements in FP behavioral outcomes among women who received the intervention compared with controls.^[35,38,40] Concerning mHealth, two of the three studies used text messages,^[35,38] while the other used voice messages and telephone counseling, which included information about the nearest family planning service provider.^[40] Thus, one common trait that the three studies shared was interactive communication to deliver tailored intervention content to participants. Other commonalities were motivational messages^[35,38] and the involvement of a male partner in the intervention.^[40]

Seven of the 16 studies found improvements in FP outcomes, the full extent that cell phones contributed to progress in the use of FP services among participants cannot be determined. Certain types of mHealth features may be more advantageous to effect change in the use of contraceptives. For example, Seohyun and colleagues found that mHealth alone was limited in improving contraceptive knowledge and use in their study. However, using four other channels, mHealth led to intended outcomes.^[36] When to Hu et al., receiving SMS

on FP does not affect modern contraceptive use. However, a significant increase in the odds of availing health facility delivery services among those receiving SMS about family planning is notified.^[45] This review found that text message-based health interventions are feasible and acceptable for improving women's reproductive health information and access to contraceptives.^[28, 37, 39]

The categorization of the studies in various mHealth applications showed that the most substantial evidence exists on client education and behavior change communication mHealth application. These findings are similar to the other reviews, suggesting that mobile phone approaches, including texting, have been explored much by various studies. It provides a feasible and potential efficacious medium for increasing reproductive and sexual health education.^[1, 29, 43, 46]

4.2 Comparison with existing literature

Based on our analysis, the most reported use of cell phones was health outcomes, including women repro-

ductive health education, contraceptive knowledge and use,^[28, 35–37, 39, 41, 44, 45] followed by data collection and reporting,^[1, 29, 42, 43, 46, 47] and behavioral outcomes.^[35, 38, 40] The grouping of cell phone and FP studies by outcome showed that the most substantial evidence exists on women's reproductive health education, contraceptive knowledge and use. These findings are aligned with other reviews, suggesting that cell phone approaches, including texting, have been explored much by various studies. It provides a feasible and potentially efficacious medium for increasing education on FP and sexual health levels.^[7, 62] However, these studies are primarily conducted in developed countries than in SSA. Thus, a complete understanding of cell phones' role in improving women's use of FP services is required to strengthen the evidence base in SSA. More studies are needed to refine the current work with a larger body of evidence and establish how best to integrate it with the published existing framework.

Table 4. Frequency of barriers and facilitators identified from included items

CFIR domains and constructs	Barriers (N)	Facilitators (N)	Total
Domain 4: Individuals involved in the implementation	15	16	31
Awareness of the existence of mHealth	1	1	2
Familiarity, ability with mHealth	4	1	5
Familiarity with technologies in general	1	-	1
Risk-benefit assessment (perception)	2	-	2
Autonomy	2	1	3
Outcome expectancy	3	9	12
Agreement with mHealth (Welcoming/resistant)	1	2	3
Belief in one's competence to use mHealth	-	1	1
Voluntary ownership	-	1	1
Experience	1	-	1
Domain 2: Outer Setting	3	8	11
Women's attitudes and preferences towards mHealth	-	2	2
Women and health professional interaction	-	5	5
Applicability to the characteristics of women	2	-	2
Other factors associated with women	1	1	2
Domain 1: Characteristics of the Intervention	5	17	22
Design and technical concerns	2	-	2
Perceived usefulness	-	10	10
Perceived ease of use	1	-	1
Satisfaction about the content available (completeness)	-	4	4
Content appropriate for the users (relevance)	-	3	3
Cost issues	1	-	1
Cell phone accuracy	1	-	1
Total	23	41	64

The International Conference on Population and Development set men's involvement in FP as a priority area.^[63] Harrington and coll.^[41] conducted four focus groups (FGD) among men (n = 35) and two among pregnant/postpartum women (n = 15) in western Kenya. This component may have contributed to improving FP decision-making and couple communication. For example, Tao and coll.^[64] found that the male partner's involvement in FP decision-making improved family planning knowledge and contraceptive continuation. Prior research suggests that male partners' involvement is advantageous for FP and the uptake of contraceptive methods. However, future research is warranted to assess whether the type of male partners differs (e.g., sexual/romantic relationship, family, friend) and the amount and frequency of their involvement toward achieving these outcomes.

Two studies included in this review reported using a behavioral change theory.^[1,37] One used the Integrated Behavioral Model,^[1] and the other study used the Theory of Planned Behavior.^[37] They are similar derivative theories of general behavioral prediction, with the most important determinant being motivation or intention as the interventions targeted. A systematic review by Cho and coll.^[65] examined the use of theories in mHealth behavior change interventions conducted in the LMICs and found that about one-third (5 of 14) of their included studies were based on a behavioral change theory. Well-tested behavioral change theories help guide FP interventions and programs.^[65,66] However, cell phone effectiveness in FP interventions in SSA remains inconclusive. Future research using behavioral change theory for contraception uptake is warranted and needed to help identify which intervention components (cell phone and behavior change) work best for FP.

4.3 Importance for research and practice

The review has provided an understanding of how cell phone solutions targeting women help address issues of "provider's prejudice, stigmatization, lack privacy and confidentiality, cost prohibitions, and transportation challenges."^[1,42,46] Simultaneously, the review has highlighted the barriers to uptake mHealth solutions for FP services, including poor technological literacy, insufficient network coverage, lower linguistic competency, high cost of service, and socio-cultural beliefs and expectations not favoring the use of mHealth.^[1,29] Additionally, larger-scale and more rigorous studies are needed to assess external validity across SSA settings to guide health-sector resource investments into these technologies. Finally, future research should explore new areas of mHealth interventions, such as healthcare providers' training, supervision and quality improvement for health workers. Despite these research needs, mHealth has significant potential

to alter the landscape for using FP services in SSA and is worthy of attention and support. This opens a window to examine the issue from a broader perspective and explore the most important technology implementation challenges.

4.4 Limitations

This systematic review has its strengths and weaknesses. To ensure a comprehensive search strategy, we used a literature search strategy adding specific terms for the three components we were interested in studying (mobile phone and women and SSA) and used explicit inclusion and exclusion criteria. In addition, although we included only papers published in peer-reviewed journals to improve the review's quality, this may have resulted in the omission of outside reports from nonprofit organizations, white or grey literature, or papers published in technology journals. Another limitation is that we only included articles published in English and French. Finally, it is worth noting that there is program overlap among some of the reports included in this review.

Also, we used a theoretical framework (CFIR) for classifying elements identified as barriers and facilitators to mHealth use from the studies included in this review. As such, we relabelled some of the original factors for them to fit within our conceptual framework. We acknowledge that using other theoretical frameworks or models could have uncovered different dimensions of the use of mHealth. However, we think that the framework used is comprehensive and well suited to present use factors of mHealth perceived by women of reproductive age as it is based on extensive theoretical and empirical research.

5. CONCLUSION

The review provides insights for the research community and public health professionals in making decisions regarding innovative, engaging and effective mobile phone interventions to improve FP services outcomes among women. The findings from this systematic review provide a common ground, making it possible to understand better the challenges and opportunities related to mHealth utilization by women of reproductive age. While some of the barriers and facilitators to mHealth use are similar to those identified in systematic reviews about other ICT applications, this review has enabled us to identify factors specific to mHealth.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

AUTHORS' CONTRIBUTIONS

BA conceived and designed the study. BA drafted the manuscript and is the guarantor of the systematic review. BA, KSS, PN developed the search strings, searched the studies, selected the studies, extracted data, and synthesized. BA, KSS, PN, BN, PY extensively reviewed the manuscript.

All authors read, provided feedback, and approved the final version of the manuscript.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that they have no competing interests.

REFERENCES

- [1] Rubee Dev, Woods NF, Unger JA, et al. Acceptability, feasibility and utility of a Mobile health family planning decision aid for postpartum women in Kenya. *Reprod Health*. 2019; 16(1): 97. PMID:31286989. <https://doi.org/10.1186/s12978-019-0767-9>
- [2] Harrington EK, McCoy EE, Drake AL, et al. Engaging men in an mHealth approach to support postpartum family planning among couples in Kenya: a qualitative study. *Reprod Health*. 2019; 16. PMID:30744697. <https://doi.org/10.1186/s12978-019-0669-x>
- [3] Velonjara J, Crouthamel B, O'Malley G, et al. Motherhood increases support for family planning among Kenyan adolescents. *Sex Reprod Healthc*. 2018; 16: 124-31. PMID:29804756. <https://doi.org/10.1016/j.srhc.2018.03.002>
- [4] Achwoka D, Pintye J, McGrath CJ, et al. Uptake and correlates of contraception among postpartum women in Kenya: results from a national cross-sectional survey. *Contraception*. 2018; 97(3): 227-35. PMID:29031815. <https://doi.org/10.1016/j.contraception.2017.10.001>
- [5] Rubee D, Woods NF, Unger JA, et al. Acceptability, feasibility and utility of a Mobile health family planning decision aid for postpartum women in Kenya. *Reprod Health*. 2019; 16(1): 97. PMID:31286989. <https://doi.org/10.1186/s12978-019-0767-9>
- [6] Lopez LM, Grey TW, Chen M, et al. Strategies for improving postpartum contraceptive use: evidence from non-randomized studies. In: *The Cochrane Collaboration, éditeur. Cochrane Database of Systematic Reviews*. Chichester, UK: John Wiley & Sons, Ltd; 2014. CD011298 p. <https://doi.org/10.1002/14651858.CD011298.pub2>
- [7] Feroz AS, Ali NA, Khoja A, et al. Using mobile phones to improve young people sexual and reproductive health in low and middle-income countries: a systematic review to identify barriers, facilitators, and range of mHealth solutions. *Reprod Health*. 2021; 18(1): 9. PMID:33453723. <https://doi.org/10.1186/s12978-020-01059-7>
- [8] Mwaisaka J, Gonsalves L, Thiongo M, et al. Young People's Experiences Using an On-Demand Mobile Health Sexual and Reproductive Health Text Message Intervention in Kenya: Qualitative Study. *JMIR MHealth UHealth*. 2021; 9(1): e19109. PMID:33448930. <https://doi.org/10.2196/19109>
- [9] Haile A, Fantahun M. Demand for long acting and permanent contraceptive methods and associated factors among family planning service users, Batu town, Central Ethiopia. *Ethiop Med J*. 2012; 50(1): 31-42.
- [10] Mathe JK, Kasonia KK, Maliro AK. Barriers to Adoption of Family Planning among Women in Eastern Democratic Republic of Congo. *Afr J Reprod Health*. 2011; 15(1): 69-77.
- [11] Adibi S. *Mobile Health: A Technology Road Map*. Cham: Springer International Publishing; 2015. PMID:26503114. <https://doi.org/10.1007/978-3-319-12817-7>
- [12] Kay M, Santos J, Takane M. *mHealth: new horizons for health through mobile technologies*. Geneva: World Health Organization; 2011. Available from: http://www.who.int/goe/publications/goe_mhealth_web.pdf
- [13] Odeny TA, Bukusi EA, Cohen CR, et al. Texting improves testing: a randomized trial of two-way SMS to increase postpartum prevention of mother-to-child transmission retention and infant HIV testing. *AIDS*. 2014; 28(15): 2307-12. PMID:25313586. <https://doi.org/10.1097/QAD.0000000000000409>
- [14] Smith C, Gold J, Ngo TD, et al. Mobile phone-based interventions for improving contraception use. *Cochrane Fertility Regulation Group. Cochrane Database Syst Rev*. 2015. <https://doi.org/10.1002/14651858.CD011159.pub2>
- [15] Feroz A, Abrejo F, Ali SA, et al. Using mobile phones to improve young people's sexual and reproductive health in low- and middle-income countries: a systematic review protocol to identify barriers, facilitators and reported interventions. *Syst Rev*. 2019; 8(1): 117. PMID:31103044. <https://doi.org/10.1186/s13643-019-1033-5>
- [16] Feroz AS, Ali NA, Khoja A, et al. Using mobile phones to improve young people sexual and reproductive health in low and middle-income countries: a systematic review to identify barriers, facilitators, and range of mHealth solutions. *Reprod Health*. 2021; 18(1): 9. PMID:33453723. <https://doi.org/10.1186/s12978-020-01059-7>
- [17] Wiffen P. Change blindness. *Eur J Hosp Pharm*. 2018; 25(3): 117. PMID:31157003. <https://doi.org/10.1136/ejpharm-2018-001587>
- [18] Gunther E, CONSORT-EHEALTH Group. CONSORT-EHEALTH: Improving and Standardizing Evaluation Reports of Web-based and Mobile Health Interventions. *J Med Internet Res*. 2011; 13(4): e126. PMID:22209829. <https://doi.org/10.2196/jmir.1923>
- [19] van der Kleij RMJJ, Kasteleyn MJ, Meijer E, et al. SERIES: eHealth in primary care. Part 1: Concepts, conditions and challenges. *Eur J Gen Pract*. 2019; 25(4): 179-89. PMID:31597502. <https://doi.org/10.1080/13814788.2019.1658190>
- [20] Wallis L, Blessing P, Dalwai M, et al. Integrating mHealth at point of care in low- and middle-income settings: the system perspective. *Glob Health Action*. 2017; 10(sup3): 1327686. PMID:28838302. <https://doi.org/10.1080/16549716.2017.1327686>
- [21] Bergström DA. *mHealth: can mobile technology improve health in low- and middleincome countries*. UCL PUBLIC POLICY. 2015; 3. Available from: http://www.who.int/goe/publications/goe_mhealth_web.pdf
- [22] Greenleaf AR, Ahmed S, Moreau C, et al. Cell phone ownership and modern contraceptive use in Burkina Faso: implications for research and interventions using mobile technology. *Contraception*. 2019; 99(3): 170-4. PMID:30468721. <https://doi.org/10.1016/j.contraception.2018.11.006>

- [23] Wike R, Oates R. Cell Phones Nearly Ubiquitous in Many Countries. Wash DC Pew Res Cent. 2014; 43. Available from: <https://www.yumpu.com/en/document/download/36820465/32735-0aeeb-8ecb9-255c7-3a17f-8b722-fef45-80571>
- [24] Greenleaf AR, Gadiaga A, Choi Y, et al. Automated and Interviewer-Administered Mobile Phone Surveys in Burkina Faso: Sociodemographic Differences Among Female Mobile Phone Survey Respondents and Nonrespondents. *JMIR MHealth UHealth*. 2020; 8(7): e17891. PMID:32673250. <https://doi.org/10.2196/17891>
- [25] Greenleaf AR, Gadiaga A, Guiella G, et al. Comparability of modern contraceptive use estimates between a face-to-face survey and a cellphone survey among women in Burkina Faso. *PLoS One*. 2020; 15(5): e0231819. PMID:32401773. <https://doi.org/10.1371/journal.pone.0231819>
- [26] Jadhav A, Weis J. Mobile phone ownership, text messages, and contraceptive use: is there a digital revolution in family planning? *Contraception*. 2020; 101(2): 97-105. PMID:31782990. <https://doi.org/10.1016/j.contraception.2019.10.004>
- [27] Ippoliti NB, L'Engle K. Meet us on the phone: mobile phone programs for adolescent sexual and reproductive health in low-to-middle income countries. *Reprod Health*. 2017; 14(1): 11. PMID:28095855. <https://doi.org/10.1186/s12978-016-0276-z>
- [28] Johnson D, Juras R, Riley P, et al. A randomized controlled trial of the impact of a family planning mHealth service on knowledge and use of contraception. *Contraception*. 2017; 95(1): 90-7. PMID:27421767. <https://doi.org/10.1016/j.contraception.2016.07.009>
- [29] Rokicki S, Fink G. Assessing the reach and effectiveness of mHealth: evidence from a reproductive health program for adolescent girls in Ghana. *BMC Public Health*. 2017; 17(1): 969. PMID:29262823. <https://doi.org/10.1186/s12889-017-4939-7>
- [30] Vahdat HL, L'engle KL, Plourde KF, et al. There are some questions you may not ask in a clinic: providing contraception information to young people in Kenya using SMS. *Int J Gynecol Obstet*. 2013; 123: e2-6. PMID:24012514. <https://doi.org/10.1016/j.ijgo.2013.07.009>
- [31] Fantom N, Serajuddin U. The World Bank's Classification of Countries by Income. World Bank, Washington, DC; 2016. <https://doi.org/10.1596/1813-9450-7528>
- [32] Von Elm E, Altman DG, Egger M, et al. Declaración de la Iniciativa STROBE (Strengthening the Reporting of Observational studies in Epidemiology): directrices para la comunicación de estudios observacionales. *Gac Sanit*. 2008; 22(2): 144-50. PMID:18420014. <https://doi.org/10.1157/13119325>
- [33] von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: Guidelines for Reporting Observational Studies. *PLoS Med*. 2007; 4(10): e296. PMID:17941714. <https://doi.org/10.1371/journal.pmed.0040296>
- [34] Johnson D, Juras R, Riley P, et al. A randomized controlled trial of the impact of a family planning mHealth service on knowledge and use of contraception. *Contraception*. 2017; 95(1): 90-7. PMID:27421767. <https://doi.org/10.1016/j.contraception.2016.07.009>
- [35] Jones RM, Kimenju G, Subbiah S, et al. A Short Message Service (SMS) increases postpartum care-seeking behavior and uptake of family planning of mothers in peri-urban public facilities in Kenya. *PLoS One*. 2020; 15(9): e0239213. PMID:32997684. <https://doi.org/10.1371/journal.pone.0239213>
- [36] Lee S, Begley CE, Morgan R, et al. Addition of mHealth (mobile health) for family planning support in Kenya: disparities in access to mobile phones and associations with contraceptive knowledge and use. *Int Health*. 2019; 11(6): 463-71. PMID:30576546. <https://doi.org/10.1093/inthealth/ihy092>
- [37] Harrington EK, Drake AL, Matemo D, et al. An mHealth SMS intervention on Postpartum Contraceptive Use Among Women and Couples in Kenya: A Randomized Controlled Trial. *Am J Public Health*. 2019; 109(6): 934-41. PMID:31067089. <https://doi.org/10.2105/AJPH.2019.305051>
- [38] Ampt FH, Lim MSC, Agius PA, et al. Effect of a mobile phone intervention for female sex workers on unintended pregnancy in Kenya (WHISPER or SHOUT): a cluster-randomised controlled trial. *Lancet Glob Health*. 2020; 8(12): e1534-45. [https://doi.org/10.1016/S2214-109X\(20\)30389-2](https://doi.org/10.1016/S2214-109X(20)30389-2)
- [39] Nuwamanya E, Nalwanga R, Nuwasiima A, et al. Effectiveness of a mobile phone application to increase access to sexual and reproductive health information, goods, and services among university students in Uganda: a randomized controlled trial. *Contracept Reprod Med*. 2020; 5(1). PMID:33292724. <https://doi.org/10.1186/s40834-020-00134-5>
- [40] Babalola S, Loehr C, Oyenubi O, et al. Efficacy of a Digital Health Tool on Contraceptive Ideation and Use in Nigeria: Results of a Cluster-Randomized Control Trial. *Glob Health Sci Pract*. 2019; 7(2): 273-88. PMID:31249023. <https://doi.org/10.9745/GHSP-D-19-00066>
- [41] Harrington EK, McCoy EE, Drake AL, et al. Engaging men in an mHealth approach to support postpartum family planning among couples in Kenya: a qualitative study. *Reprod Health*. 2019; 16(1): 17. PMID:30744697. <https://doi.org/10.1186/s12978-019-0669-x>
- [42] L'Engle KL, Vahdat HL, Ndakidemi E, et al. Evaluating feasibility, reach and potential impact of a text message family planning information service in Tanzania. *Contraception*. 2013; 87(2): 251-6. PMID:22935322. <https://doi.org/10.1016/j.contraception.2012.07.009>
- [43] Shelus V, Ashcroft N, Burgess S, et al. Preventing Pregnancy in Kenya Through Distribution and Use of the CycleBeads Mobile Application. *Int Perspect Sex Reprod Health*. 2017; 43(3): 131-41. PMID:29553474. <https://doi.org/10.1363/43e4617>
- [44] Unger JA, Ronen K, Perrier T, et al. Short message service communication improves exclusive breastfeeding and early postpartum contraception in a low- to middle-income country setting: a randomised trial. *BJOG Int J Obstet Gynaecol*. 2018; 125(12): 1620-9. PMID:29924912. <https://doi.org/10.1111/1471-0528.15337>
- [45] Hu Y, Huang R, Ghose B, et al. SMS-based family planning communication and its association with modern contraception and maternal healthcare use in selected low-middle-income countries. *BMC Med Inform Decis Mak*. 2020; 20(1): 218. PMID:32912201. <https://doi.org/10.1186/s12911-020-01228-5>
- [46] Vahdat HL, L'Engle KL, Plourde KF, et al. There are some questions you may not ask in a clinic: providing contraception information to young people in Kenya using SMS. *Int J Gynaecol Obstet*. 2013; 123 Suppl 1: e2-6. PMID:24012514. <https://doi.org/10.1016/j.ijgo.2013.07.009>
- [47] Laidlaw R, Dixon D, Morse T, et al. Using participatory methods to design an mHealth intervention for a low income country, a case study in Chikwawa, Malawi. *BMC Med Inform Decis Mak*. 2017; 17(1): 98. PMID:28679428. <https://doi.org/10.1186/s12911-017-0485-6>
- [48] Sondaal SFV, Browne JL, Amoakoh-Coleman M, et al. Assessing the Effect of mHealth Interventions in Improving Maternal and Neonatal Care in Low- and Middle-Income Countries: A Systematic Review. *PLoS One*. 2016; 11(5): e0154664. PMID:27144393. <https://doi.org/10.1371/journal.pone.0154664>

- [49] Colaci D, Chaudhri S, Vasani A. mHealth Interventions in Low-Income Countries to Address Maternal Health: A Systematic Review. *Ann Glob Health*. 2017; 82(5): 922. PMID:28283147. <https://doi.org/10.1016/j.aogh.2016.09.001>
- [50] Ilizumbi O, Abejirinde IOO, Dieleman M, et al. Targeting strategies of mHealth interventions for maternal health in low and middle-income countries: a systematic review protocol. *BMJ Open*. 2018; 8(2). PMID:29478019. <https://doi.org/10.1136/bmjopen-2017-019345>
- [51] Ahinkorah BO, Ameyaw EK, Seidu AA. Socio-economic and demographic predictors of unmet need for contraception among young women in sub-Saharan Africa: evidence from cross-sectional surveys. *Reprod Health*. 2020; 17(1): 163. PMID:33097088. <https://doi.org/10.1186/s12978-020-01018-2>
- [52] Gahungu J, Vahdaninia M, Regmi PR. The unmet needs for modern family planning methods among postpartum women in Sub-Saharan Africa: a systematic review of the literature. *Reprod Health*. 2021; 18(1): 35. PMID:33568180. <https://doi.org/10.1186/s12978-021-01089-9>
- [53] Teshale AB. Factors associated with unmet need for family planning in sub-Saharan Africa: A multilevel multinomial logistic regression analysis. Navaneetham K, éditeur. *PLOS ONE*. 2022; 17(2): e0263885. PMID:35143584. <https://doi.org/10.1371/journal.pone.0263885>
- [54] Zotero. Manuel d'utilisation de Zotero Version 0.2.5. 2020; 22. Available from: https://www.unige.ch/lettres/index.php/download_file/view/863/279/
- [55] Hong Q, Pluye P, Fabregues S, et al. Mixed Methods Appraisal Tool (MMAT), version 2018. *Can Intellect Prop Off Can*. 2018; 11. Available from: <http://mixedmethodsappraisaltoolpublic.pbworks.com/>
- [56] Hong QN, Fabregues S, Bartlett G, et al. The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Educ Inf*. 2018; 34(4): 285-91. <https://doi.org/10.3233/EFI-180221>
- [57] Damschroder LJ, Aron DC, Keith RE, et al. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci*. 2009; 4(1): 50. PMID:19664226. <https://doi.org/10.1186/1748-5908-4-50>
- [58] Wienert J, Zeeb H. Implementing Health Apps for Digital Public Health - An Implementation Science Approach Adopting the Consolidated Framework for Implementation Research. *Front Public Health*. 2021; 9: 610237. PMID:34026702. <https://doi.org/10.3389/fpubh.2021.610237>
- [59] Damschroder LJ, Reardon CM, Opra Widerquist MA, et al. Conceptualizing outcomes for use with the Consolidated Framework for Implementation Research (CFIR): the CFIR Outcomes Addendum. *Implement Sci*. 2022; 17(1): 7. PMID:35065675. <https://doi.org/10.1186/s13012-021-01181-5>
- [60] Davis FD. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Q*. 1989; 13(3): 319. <https://doi.org/10.2307/249008>
- [61] DeLone WH, McLean ER. The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. *J Manag Inf Syst*. 2003; 19(4): 9-30. <https://doi.org/10.1080/07421222.2003.11045748>
- [62] Badawy SM, Kuhns LM. Texting and Mobile Phone App Interventions for Improving Adherence to Preventive Behavior in Adolescents: A Systematic Review. *JMIR MHealth UHealth*. 2017; 5(4): e50. PMID:28428157. <https://doi.org/10.2196/mhealth.6837>
- [63] United Nations. Report of the International Conference on Population and Development: Cairo, 5-13 September 1994. New York: United Nations; 1995. 193 p.
- [64] Tao AR, Onono M, Baum S, et al. Providers' perspectives on male involvement in family planning in the context of a cluster-randomized controlled trial evaluating integrating family planning into HIV care in Nyanza Province, Kenya. *AIDS Care - Psychol Socio-Med Asp AIDS/HIV*. 2015; 27(1): 31-7. PMID:25329436. <https://doi.org/10.1080/09540121.2014.954982>
- [65] Cho YM, Lee S, Islam SMS, et al. Theories Applied to m-Health Interventions for Behavior Change in Low- and Middle-Income Countries: A Systematic Review. *Telemed J E-Health Off J Am Telemed Assoc*. 2018; 24(10): 727-41. PMID:29437546. <https://doi.org/10.1089/tmj.2017.0249>
- [66] Webb TL, Joseph J, Yardley L, et al. Using the internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *J Med Internet Res*. 2010; 12(1): e4. PMID:20164043. <https://doi.org/10.2196/jmir.1376>