ISSN: 03875547
Volume 46, Issue 01, January, 2023

Mobile Health Intervention for Contraceptive Initiation in Reproductive Aged Women A Systematic Review and Meta-Analysis

Eka Rusdianto Gunardi[1], Omo Abdul Madjid[1], Costan Tryono Parulian Rumapea[1], Nur Fitri Fadila[1]

Obstetrics and Gynecology Department Cipto Mangunkusumo General Hospital Indonesia[1]

Keywords:
Contraception, Family Planning, Meta-analysis, mHealth

ABSTRACT

Knowledge regarding contraceptive use is a major factor in family planning decisions. Lately, mHealth has gained traction due to increasing technological literacy and the COVID-19 pandemic. This meta-analysis aims to study whether mHealth intervention could improve contraceptive use in reproductive-age women. We conducted a systematic literature search from Pubmed, Embase, and clinicaltrials.gov for relevant articles. Critical analysis was done using the Cochrane Risk of Bias for Clinical trial. Meta-analysis was conducted using random effects model. 12 relevant studies were included in the systematic review and meta-analysis. mHealth Intervention significantly improves contraceptive use (OR: 1.53, 95%CI: 1.16 – 2.01; p=0.003). Subgroup analysis shows that mHealth intervention is more effective in Low-Middle income countries compared to high-income countries. Additionally, app-based intervention is more effective compared to text-based or phone-based intervention. mHealth intervention is effective in improving contraceptive use in reproductive-age women.

1. INTRODUCTION

Family planning is one of the *Safe Motherhood Initiative* pillars that stands together with antenatal care, clean and safe delivery, and essential obstetric care. Family planning reduces the number of high-risk pregnancies which include teenage (too young) or advanced maternal age, multiparity, and frequent pregnancy. Moreover, family planning reduces unwanted pregnancies which in turn reduces the family's physical, mental, and economic burden [1].

Effective contraception is a vital key to family planning. Studies found that contraceptive use significantly reduces maternal mortality [2] and increases the life maternal quality [3]. Adequate contraceptive use could decrease maternal mortality to 44% [2]. However, contraceptive use in low-middle income countries was found inadequate. Given the growing use of contraceptives, In 2010, studies found that there were 146 billion women, especially in developing countries, had an unmet need for contraception [4].

The widespread use of smartphones in the medical field has been g. rowing alongside technological

advancement as well as the pandemic COVID-19. A study showed that utilization of mobile phones had an impact on one's lifestyle and perception of health issues [5]. A mobile phone-based utilization in the medical field is called mobile health (m-health). Mobile health uses short message service (SMS), telephone, and application as tools.

Mobile health is an alternative educational method for a patient. A medical officer would conventionally educate their patients within a limited amount of time. However, the presence of mobile health offers a great range of communication methods through a readily accessible platform and media for instance telemedicine, health articles, and video [5].

Studies showed that m-Health could increase the knowledge as well as the use of contraception both in developed and developing countries [6], [7]. M-health is found to have helped reduce maternal and child mortality, optimize their health such as an increase in weight, lessen the risk of anemia, and mother's quality of life [9]. However, several studies stated contrarily [10], [11]. M-health is reported to have a relatively high maintenance cost [12]. This raises a question about the effectiveness and efficiency of m-health in increasing the number of contraceptive uses, especially in developing countries with limited resources. This systematic and meta-analysis study aims to assess mobile health intervention for contraceptive initiation in reproductive-aged women.

2. Methods

The systematic literature study was done using two databases: Medline and Embase on the use of m-health in improving contraceptive use. A manual literature search of meta-analyses and articles was done to increase the sensitivity of the search. Inclusion criteria include randomized or non-randomized clinical trials which included reproductive-aged women, the intervention of m-health in the form of SMS, telephone, or an application, and an outcome of contraceptive use. The relevant articles are screened by two independent researchers. The selected articles are screened by their abstracts followed by the full paper. The selected articles were then discussed by the two researchers.

2.1 Analysis and Data Extraction

Data extraction was done by data extraction form. Data extracted consist of authors, year of research, the place of the research, research population, type of intervention, and the use of contraception. Critical analysis was done using the Revised Cochrane Risk-of-bias tool for a randomized trial. The risk of bias is classified as low, medium, and high. Meta-analysis was done using Review Manager version 5 (Cochrane Collaborative).

Due to the significant mode of intervention, meta-analysis was done using a random-effect model. In addition to that, subgroup analysis was done to determine if there was a difference in effect size on each type of intervention (App-base, phone-base, or text-based) and to assess whether m-health has a more significant effect in low- income and developing countries than that in developed countries.

3. Results

A total of 305 articles were extracted. Following data deduplication, 292 articles were screened. A total of 32 articles were screened for full text. Excluded studies are one study comparing two types of m-health intervention with no control group, 17 studies that didn't include the relevant outcome of contraceptive use, and 2 studies that were review articles. The remaining 12 relevant articles were then analyzed and went through the data extraction process.

Seven studies showed there was no significant relationship between the use of m-health and contraceptive use [10], [11], [13- 16]. However, four studies showed a significant relationship between the use of m-health and contraceptive use [7], [17- 19]. One study found that the use of m-health reduced contraceptive use [20].

The pooling sample collected a total of 8,164 samples from 12 studies. Meta-analysis studies showed the use of m-health increases contraceptive use in reproductive-aged women (OR: 1.53; 95%CI: 1.16 – 2.01; p=0.003). However, there is a significant heterogenicity presented in the study (I2 = 81%). Meta-analysis results are presented in pictures 1, 2, and 3.

There are two subgroups included in the study. The first one is a subgroup analysis comparing low-middle income countries and high-income countries and another subgroup analyses intervention methods (SMS, phone, or application).

M-health intervention has a more significant effect on low-middle income countries compared to high-income countries (OR: 1.92; 95%CI: 1.25 – 2.92 vs OR: 1.31; 95%CI: 0.93 – 1.85). However, the results are not statistically significant (p = 0.17). Subgroup analysis showed intervention by application is more effective than that of SMS or by phone. (OR: 1.92; 95%CI: 1.25 – 2.92 vs OR: 1.38; 95%CI: 0.93 – 2.06). In addition to that, the application-based group showed low heterogenicity. (I^2 = 10.2%).

4. Discussion

Systematic and meta-analysis studies showed that m-health utilization increases contraceptive- use in reproductive-aged women. However, heterogenicity in this study was found to be high. According to subgroup analysis, this is due to the different intervention methods. Heterogenicity in the application-based subgroup was, however, found to be low.

Two studies are reporting a significant relationship between the m-health application and contraceptive use. [18], [19] used an interactive game-based application concerning contraception. A study by [18] used an interactive application in the form of video and reminders to get to nearby contraception clinics.

These studies showed that application-based m-health intervention proved to be effective. Similar results were found to have different an aspect in changing one's lifestyle [21].

But, there is still heterogeneity in the text message and phone-based research (residual heterogeneity).

After the heterogeneity analysis is done, no study significantly gave a high heterogenicity effect, so further analysis is required to find out the heterogenicity source that was done by [22]. It was also shown that in m-Health phone-based interventions, there was no significant effect using contraceptives. The Meta-analysis report also showed high heterogeneity.

In the phone-based research, [7] used drama episodes that were delivered via a mobile phone. The result of the research shows that there are significant differences in contraceptive use between intervention groups and control. This matter shows that the interactive component may be more influential towards the external use of contraceptives than the concept of the intervention. However, because there is only one interactive phone-based research, it can't be analyzed whether the interactive factors further enhance the success of the program compared to the form of intervention.

One of the obstacles that often occurs is the high dropout rate on the subject of research. [7] reported that the

dropout rate for the intervention group (44.9%) is higher than the control group (33.5%). However, [18] reported that the dropout rate of both groups is the same between the control and the intervention group.

The high dropout rate is often reported by app-based mobile health research. There are several factors associated with a low dropout rate, including low status of health of the subject so the subject has a willingness to change, higher health literacy, higher education, and a subject who's accustomed to the use of the application [23].

Besides high dropout rates, the m-Health implementation requires a lot of money. Starting from the cost of developing, and maintaining the application, leasing a server, and maintaining an m-Health program. In return, this makes it a paid application, thus creating a barrier to the users [24].

In addition, regulations are required regarding the data and safety of patients that are using the application. Data security is one of the ethical issues that are often raised, especially in the fields of technology and health. Clear regulations and data are needed to address these ethical issues [24].

There are several things to note in the interpretation of the results of this meta-analysis. Firstly, the use of contraceptives is closely related to the level of education of the patient. The use of mobile phones themselves, without m-Health intervention, is associated with contraceptive use compared to women who do not have mobile phones [25]. This means that the population of subjects who can use m-Health uses more contraceptives, thereby reducing the effect size of the m-Health intervention itself.

In addition, most of the studies were conducted in the United States, so the population in this study cannot be generalized to other populations. There are a few research that was done in low-income countries like Tajikistan and Nigeria [7], [26]. However, there is only a few research done in low-income countries. Due to differences in resources and socioeconomic levels. The research was shown to prove that a few obstacles in the implementation of the m-Health in low-income countries include: Difficulties in using technology, infrastructure, costs, human resources as well as tools and materials [27].

There are a few shortcomings in this systematic literature and meta-analysis. First, the researcher did not find the grey literature. This might lead to a relatively high publication bias. However, the results of the funnel plot showed a low publication bias. Second, the source of heterogeneity in some research results has not been explained, so more research is required with standardized interventions to determine the effect of the m-Health intervention on contraceptive use. Third, there is no analysis of contraceptive knowledge outcomes before and after the intervention, so it is not known whether there is a relationship between the levels of contraceptive use.

5. Summary

m-Health interventions, especially application-based m-Health, can increase the use of contraception in women with reproductive health. Thereby, contributing to the success of family planning programs and reducing high-risk pregnancies. However, several factors may interfere the implementation of mobile health, such as high dropout rates, barriers to resources, costs, and technologies that need to be addressed to increase the effectiveness of the mobile health intervention.

6. References

[1] Brown W, Ahmed S, Roche N, Sonneveldt E, Darmstadt GL. Impact of family planning programs in reducing high-risk births due to younger and older maternal age, short birth intervals, and high parity.

Seminars in Perinatology. 2015;39(5):338-44.

[2] Ahmed S, Li Q, Liu L, Tsui AO. Maternal deaths averted by contraceptive use: an analysis of 172 countries. The Lancet. 2012;380(9837):111-25.

[3] Williams SL, Parisi SM, Hess R, Schwarz EB. Associations between recent contraceptive use and quality of life among women. Contraception. 2012;85(3):282-7.

[4] Alkema L, Kantorova V, Menozzi C, Biddlecom A. National, regional, and global rates and trends in contraceptive prevalence and unmet need for family planning between 1990 and 2015: a systematic and comprehensive analysis. The Lancet. 2013;381(9878):1642-52.

[5] Free C, Phillips G, Galli L, Watson L, Felix L, Edwards P, et al. The Effectiveness of Mobile-Health Technology-Based Health Behaviour Change or Disease Management Interventions for Health Care Consumers: A Systematic Review. PLOS Medicine. 2013;10(1):e1001362.

[6] Tebb KP, Rodriguez F, Pollack LM, Trieu SL, Hwang L, Puffer M, et al. Assessing the effectiveness of a patient-centered computer-based clinic intervention, Health-E You/Salud iTu, to reduce health disparities in unintended pregnancies among Hispanic adolescents: study protocol for a cluster randomized control trial. BMJ Open. 2018;8(1):e018201.

[7] Babalola S, Loehr C, Oyenubi O, Akiode A, Mobley A. 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.

[8] Martínez-Fernández A, Lobos-Medina I, Díaz-Molina CA, Chen-Cruz MF, Prieto-Egido I. TulaSalud: An m-health system for maternal and infant mortality reduction in Guatemala. Journal of Telemedicine and Telecare. 2015;21(5):283-91.

[9] Paulsamy P, Easwaran V, Ashraf R, Alshahrani SH, Venkatesan K, Qureshi AA, et al. Association of Maternal Observation and Motivation (MOM) Program with m-Health Support on Maternal and Newborn Health. Healthcare. 2021;9(12):1629.

[10] Chernick LS, Stockwell MS, Wu M, Castaño PM, Schnall R, Westhoff CL, et al. Texting to Increase Contraceptive Initiation Among Adolescents in the Emergency Department. J Adolesc Health. 2017;61(6):786-90.

[11] Gilliam ML, Martins SL, Bartlett E, Mistretta SQ, Holl JL. Development and testing of an iOS waiting room "app" for contraceptive counseling in a Title X family planning clinic. Am J Obstet Gynecol. 2014;211(5):481.e1-8.

[12] Scale Matters: A Cost-Outcome Analysis of an m-Health Intervention in Malawi. Telemedicine and e-Health. 2016;22(4):317-24.

[13] Gold J, Aitken CK, Dixon HG, Lim MS, Gouillou M, Spelman T, et al. A randomised controlled trial using mobile advertising to promote safer sex and sun safety to young people. Health Educ Res. 2011;26(5):782-94.

[14] Harrington EK, Drake AL, Matemo D, Ronen K, Osoti AO, John-Stewart G, 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.

[15] Hebert LE, Hill BJ, Quinn M, Holl JL, Whitaker AK, Gilliam ML. Mobile contraceptive application use in a clinical setting in addition to standard contraceptive counseling: A randomized controlled trial. Contraception. 2018;98(4):281-7.

[16] McCarthy O, Leurent B, Edwards P, Tokhirov R, Free C. A randomised controlled trial of an intervention delivered by app instant messaging to increase the acceptability of effective contraception among young people in Tajikistan: study protocol. BMJ Open. 2017;7(9):e017606.

[17] Leight J, Hensly C, Chissano M, Safran E, Ali L, Dustan D, et al. The effects of text reminders on the use of family planning services: evidence from a randomised controlled trial in urban Mozambique. BMJ Glob Health. 2022;7(4).

[18] Manlove J, Cook E, Whitfield B, Johnson M, Martínez-García G, Garrido M. Short-Term Impacts of Pulse: An App-Based Teen Pregnancy Prevention Program for Black and Latinx Women. J Adolesc Health. 2020;66(2):224-32.

[19] Tebb KP, Rodriguez F, Pollack LM, Adams S, Rico R, Renteria R, et al. Improving contraceptive use among Latina adolescents: A cluster-randomized controlled trial evaluating an mHealth application, Health-E You/Salud iTu. Contraception. 2021;104(3):246-53.

[20] Rinehart DJ, Leslie S, Durfee MJ, Stowell M, Cox-Martin M, Thomas-Gale T, et al. Acceptability and Efficacy of a Sexual Health Texting Intervention Designed to Support Adolescent Females. Acad Pediatr. 2020;20(4):475-84.

[21] Kelli HM, Witbrodt B, Shah A. THE FUTURE OF MOBILE HEALTH APPLICATIONS AND DEVICES IN CARDIOVASCULAR HEALTH. Euro Med J Innov. 2017;2017:92-7.

[22] Zulu EM, Sukwa T. Impact of mHealth on contraceptive use among women and men of reproductive age in low- and middle-income countries: a systematic review and meta-analysis. Trop Med Int Health. 2020;25(10):1182-97.

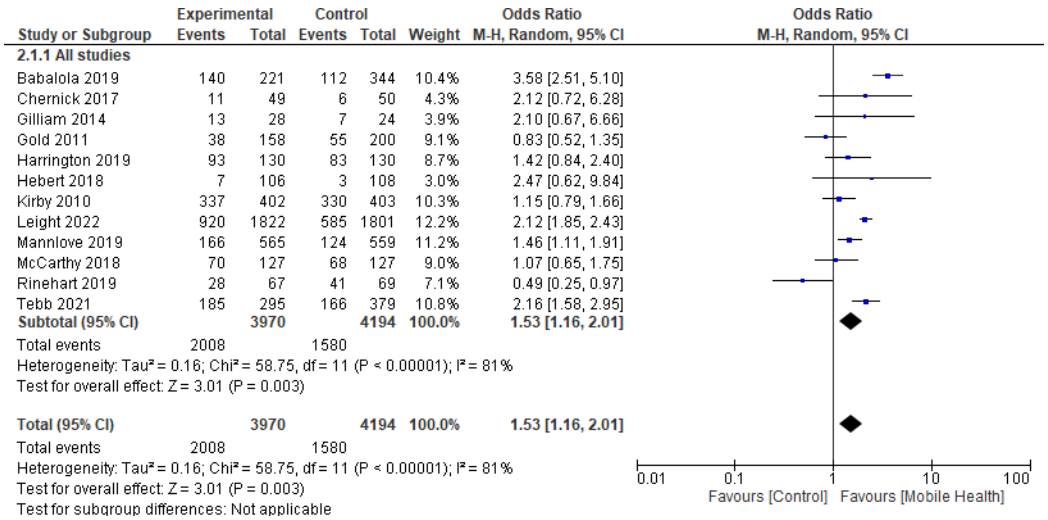
[23] Meyerowitz-Katz G, Ravi S, Arnolda L, Feng X, Maberly G, Astell-Burt T. Rates of Attrition and Dropout in App-Based Interventions for Chronic Disease: Systematic Review and Meta-Analysis. J Med Internet Res. 2020;22(9):e20283.

[24] Weinstein RS, Lopez AM, Joseph BA, Erps KA, Holcomb M, Barker GP, et al. Telemedicine, Telehealth, and Mobile Health Applications That Work: Opportunities and Barriers. The American Journal of Medicine. 2014;127(3):183-7.

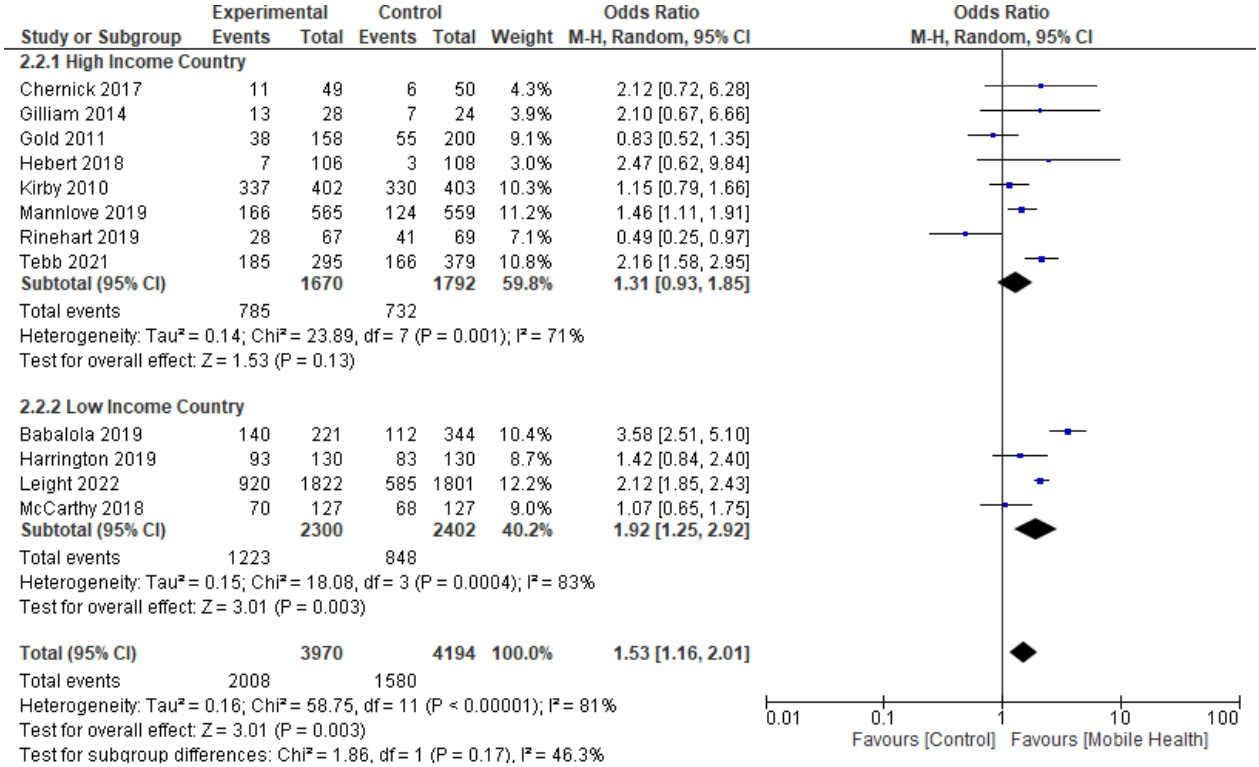
[25] Greenleaf AR, Ahmed S, Moreau C, Guiella G, Choi Y. Cell phone ownership and modern contraceptive use in Burkina Faso: implications for research and interventions using mobile technology. Contraception. 2019;99(3):170-4.

[26] McCarthy O, Ahamed I, Kulaeva F, Tokhirov R, Saibov S, Vandewiele M, et al. A randomized controlled trial of an intervention delivered by mobile phone app instant messaging to increase the acceptability of effective contraception among young people in Tajikistan. Reprod Health. 2018;15(1):28.

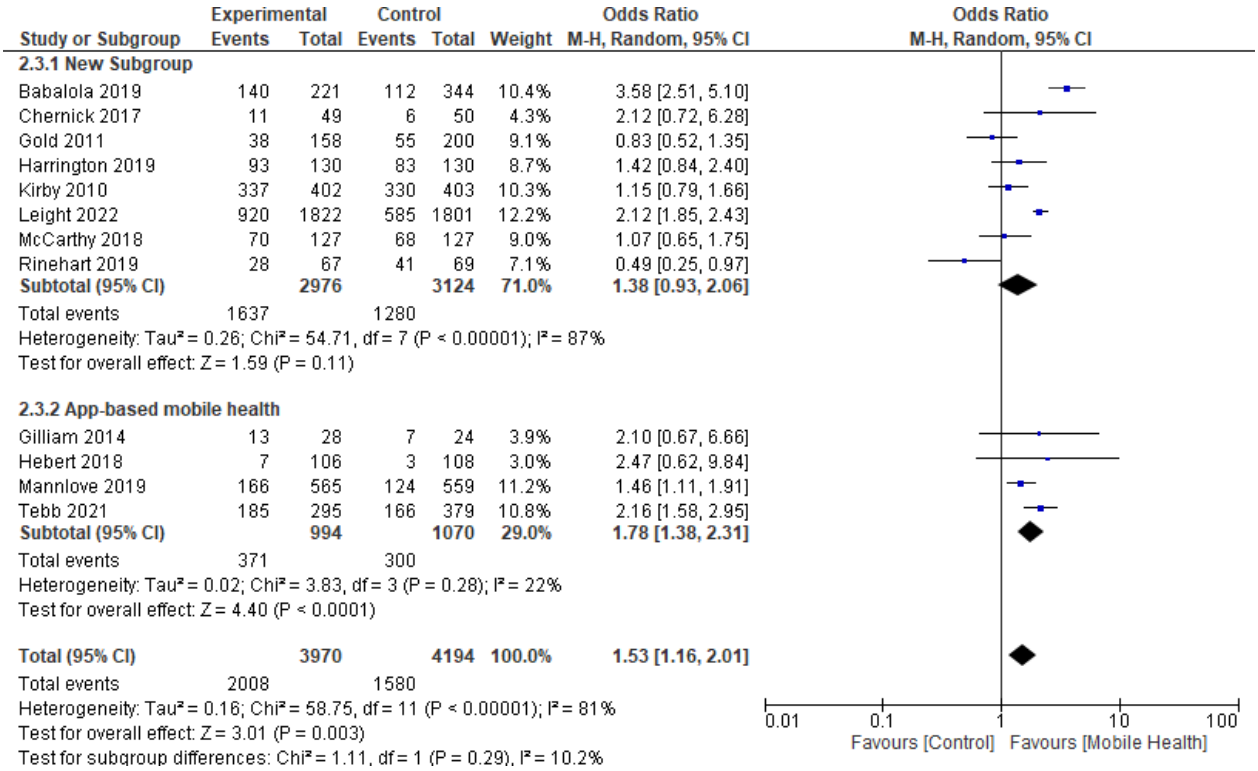
[27] Kruse C, Betancourt J, Ortiz S, Valdes Luna SM, Bamrah IK, Segovia N. Barriers to the Use of Mobile Health in Improving Health Outcomes in Developing Countries: Systematic Review. J Med Internet Res. 2019;21(10):e13263.



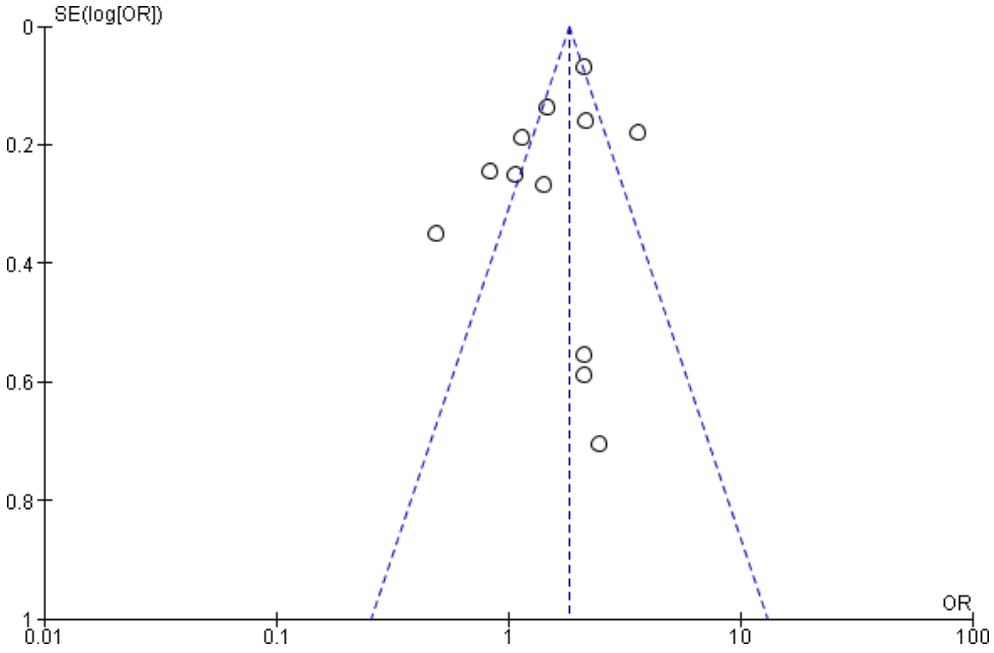
Picture 1. Forest plot for the whole studies



Picture 2. Forest plot for subgroup analysis in low and high income countries



Picture 3. Forest plot for subgroup analysis in the usage of application, phone and SMS based mobile health



Picture 4. Funnel plot

Table 1. Summary of the systemic and meta-analysis studies

hor	Year	Place of research	Population	Intervention method	Follow-up time	Result

	2019	Nigeria	Women with the age of 18-35 not using non-barrier contraception and owning a mobile phone	*SmartClient,a drama-based education platform regarding contraception. This is done using a mobile phone*	6 weeks	Case group (63.6%) s higher rate of contrace use than that of co (32.7%)
	2017	United States of America	Women with the age of 14-19 and are sexually active	3-months long of unidirectional SMS advocating the the use of contraception	3 months	Contraception initiation b in 6/50 subjects (12%) 11/49 (22.4%) in case control group respectivel
	2014	United States of America	Women with the age of 15-29 presenting herself to family planning clinics	Application-based focusing in long-term contraception information	1 months	Increased rate contraceptive utilization 7.1% to 32.1%
	2010	Australia	Women with the age of 16-29 and are currently using mobile phone	A SMS -based approach to promote healthy sexual activity	4 months	Case group uses condom than that of control group
	2019	Kenya	Women with the age of more than 14 years old or are currently pregnant more than 28 weeks and are able to read and reply to a text	A SMS-based approach containing education and call to action responding to a change of family planning method	6 months	In the 6-months of partum time , effe contraception are observ women who received the (69.9%) than that of co group 57.4%
	2018	United States of America	Women with the age of 15-29 coming for a contraception inquiry and are sexually active at least in less than 6 months' time	Application-based educational platfrom containing information of methods of contraceptions, their effectivity and respective side-effects	3 months	There is significant differ between long-contraceptopm and co group (p>0.05)
y et al	2010	United States of Americ	Sexually active women who wishes to use oral contraception	Daily SMS containing 6 dimensional knowledge regarding oral contraception	6 months	82% subjects contraception during the sexual activity than tha control group (84%)
	2021	Mozambique	Reproductive-age women interacting with volunteer workers	SMS-based approach to promote family planning program	4 weeks	Women who rece reminders (SMS) visited clinic more frequently that of control group
	2019	United States of America	Black and Hispanic women with the age of 18-20 who were not pregnant and not trying to conceive	*Pulse application designedto deliver information regarding reproductive and sexual health*	6 weeks	Case group had 7.6 % risk in doing sexual act persen without hormona well as long-contraception

2018	Tajikistan	Subjects with the age 16 – 24 who owns Android mobile phone, living in Tajikistan and are able to give an informed consent	A SMS containing contraception education to influence and promote the usage of contraception, and to support their free will in their reproductive health decision-making.	4 months	No significant differenc the use of effe contraception in both of groups. (66% and 64 case and control g respectively, adjusted 1.21, 95%CI 0.80 – p=0.36)
2019	United States of America	Women in the age of 13-18	*Texts for Sexual Health Education and Empowerment* (t4she) is a a group of text messages focusing on *modifiable* factors in understanding and deciding methods of contraception	3 months	In 3 months time, subjects in the t4she g uses contrace prescription than that control 45%
2021	United States of America	Hispanic women with the age of 14-18 and are sexually active	Mobile app providing information on contraception methods	3 months	Increases in non-ba contraceptive use baseline (29% interventio 30% controls) to 3 mo (63% vs. 45%; OR = 95% CI 1.04–10.36, p = and 6 months (63% vs. OR = 5.54, 95% CI 1 18.06, p = 0.005)