

Application of mobile health to improve self-care among pregnant women: A literature review

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Abstract: The advent of Information and Communication Technology (ICT) in the area of healthcare has led to introduction of novel services named Mobile Health (MHealth) while focuses on use of smart, mobile technologies in providing medical and healthcare services with high accessibility and low cost regardless of time or place. Mhealth has significantly affected various areas of healthcare including health of pregnant women and newborns. The aim of the current study is to investigate the advantages of using mhealth for self-care among pregnant women. This review is done using various scientific databases including Scopus, PubMed, Web of Science and Google Scholar to retrieve related literature. Investigating the current literature showed that the majority of applications for this technology focused on weight control for pregnant women, education and information regarding pre and postnatal care, reminders, evaluation of services and need assessment. Given the widespread use of smartphones among people, ease of access and use as well as portability of this technology, it is possible to use mhealth to improve healthcare services in various medical fields including healthcare during pregnancy. Use of smart, mobile tools in providing healthcare services for women, especially during pregnancy, can improve service speed, provide suitable and cost-effective solutions and reduce occurrence of malpractice. Pregnant women require sufficient media and health literacy in order to use mhealth services. They also need to be familiar with novel technologies and receive constant and suitable education.

Keyword: Mobile health; Smartphones; Self-care; Pregnant women

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1. Introduction

Information and communication technologies (ICT) is nowadays an inseparable part of human life and has affected various aspects of our world (1). These technologies have caused various upheavals in economic activities, banking and money transactions, libraries and digital collections (2). Healthcare institutions are not exempt from these changes and have used these

technologies for nearly four decades (3-6). Today, we can say that information and communication technologies are an inseparable part of healthcare systems (7).

Technology in healthcare system offers numerous advantages including improved care quality, increased efficiency, reduced costs and reduction of malpractice cases and international access to health-related information. This has offered new opportunities for healthcare professionals and has led to creation of a new concept called Electronic Health (EHealth) (8-12). Ehealth includes health information and services which are transferred and published through the use of ICT (13-

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18). This concept consists of various parts including health knowledge management, electronic health records (EHR), tele-health, virtual healthcare and other activities. One of the areas of electronic health which has received increased attention in recent years is Mobile Health (MHealth) (6, 18-19) which includes the use of mobile phones, Personal Digital Assistants (PDAs), patient monitoring equipment and other related information and communication technologies in order to offer medical information and services (20-24).

MHealth has resulted in an upheaval in traditional method of healthcare by providing patients with novel facilities to improve their health through self-care and remote monitoring by healthcare professionals. Mhealth also helps in offering health and medical care for people in remote and inaccessible areas and people with disabilities, especially those who require constant health monitoring such as diabetic and M.S. patients and pregnant women (1,4,25-26). One of the important and widespread parts of mhealth is smartphones. The Global System for Mobile Communications (GSMA) intelligence reports that the number of mobile phone users has exceeded 5 billion users in 2017. This means that more than two thirds of people on earth have access to mobile phones (27). This technology enables people to access health information regardless of their geographical location and is especially useful for providing health and medical care and self-care in low and medium-income countries. Furthermore, use of mobile phone technology offers a cost-effective, efficient and accessible method of healthcare for rural and remote locations which suffer from lack of health and medical professionals and is therefore used with increased frequency (28-30). Mhealth has affected various areas of health and medicine including healthcare for pregnant women and newborn children. Portable Smart Devices provide new opportunities for providing effective health and medical care and self-care for pregnant women. Increased use of this technology has improved the quality of pre and postnatal care and has reduced mortality of infants and mothers significantly (23-31). In recent years, portable smart devices and their capabilities in providing access to text and voice communication, multimedia content, internet and smartphone applications have seen increased use in providing healthcare and medical assistance and providing information for patients and pregnant women. The use of smartphone applications can be especially effective during pregnancy for controlling weight, blood sugar, blood pressure and physical activities during pregnancy(32-34). Given the fact that knowledge of pregnant women plays an important role in the health of

mothers and infants and given the special circumstances of pregnant women during the last trimester of pregnancy and difficulty of travel to health centers, pregnant women can be supported with suitable care in a timely manner through mhealth. As a result, the aim of this review is to investigate the applications of mhealth for self-care of pregnant women (22).

2. Method

In order to conduct the present review article, the articles published between 2012 and 2017 were studied. In order to access to the related scientific documentation, electronic search was conducted on the PubMed, Science Direct, InterScience, ProQuest and Google Scholar databases. At first, 90 articles were found and 35 papers were considered to cover the objectives of this study after the preliminary study and 20 of them were selected after reading their full texts. The criteria for entering the reviewed articles include its relation to registry, publishing between 2001-2017, publication in English, and (4) the availability of the full text of the articles. In addition, those papers which were not translated into English, presented at conferences, had only their abstracts available and published only on websites were excluded. In order to evaluate the quality of the collected articles, the researchers reviewed the articles in terms of title, abstract, introduction, method, results, discussion, and references.

3. Result

One of the applications of mhealth during pregnancy is weight control. Studies in this regard had focused on exercise (physical activities) and nutrition (diet) using SMS (Short Text Message) and mobile phone applications in pregnant women. The results of these studies show improvements in physical activities and facilitating healthy diet using short message services (35-37) and also showed a lack of relevant applications for mobile phones regarding following up on weight increase and healthy diet (35). One of the other applications of mhealth is education and increasing the knowledge of women regarding care activities during and after pregnancy using text and voice messages and mobile phone applications. The sample studies in this regard indicate a significant increase in the knowledge of pregnant women using these mhealth services (38-39). Smartphone applications including mobile medical clinic have been successful in providing a model for education and prevention of sexually transmitted diseases (40). Another application called Mobile Midwife (MM) has also been successful in providing automatic educational voice messages regarding care activities during and after

Table 1: Characteristics of reviewed studies on application of health for pregnant women and pregnancy healthcare

Area	year	Article title	Application	Results
Weight control	2017	Mobilizing mhealth for Moms: a Review of Mobile Apps for Tracking Gestational Weight Gain (38)	Investigating mobile applications focused on follow-up of weight control, healthy diet and physical activity during pregnancy	Lack of suitable applications for weight control during pregnancy
	2017	Dose and timing of text messages for increasing physical activity among pregnant women: a randomized controlled trial (50)	Investigating the most effective timing and volume of text messages for improving physical activity during pregnancy	Lack of short text message strategy for improving physical activity in pregnant women
	2015	Development and design of an intervention to improve physical activity in pregnant women using Text4baby (36)	Use of free short message services and determination of suitable message volume for improving physical activity in pregnant women	Improvement in physical activity of pregnant women using SMS
	2017	Evaluation of smart phone nutrition and physical activity application to provide lifestyle advice to pregnancy women: the SNAPP randomized trial (34)	Investigating the effect of a mobile phone application along with face-to-face consultation for facilitating healthy diet and physical activity among pregnant women	Lack of significant effects from mobile phone application on improving diet and physical activity
	2017	A mobile health intervention promoting healthy gestational weight gain for women entering pregnancy at a high body mass index: the txt4two pilot randomized controlled trial (37)	Determining the possibility and effectiveness of mobile health applications pm healthy diet, physical activity and weight gain of pregnant women	Effectiveness of mobile health intervention

pregnancy for women (28). The results of studies in this regard indicate the effectiveness of mhealth services for common cares for diabetes during pregnancy as well as preventing the transfer of Human Immunodeficiency Virus (HIV) from mothers to infants (33,41). Offering reminders is another application of health and many of the investigated studies had emphasized the use of educational text messages and health applications for reminding pregnant women about medical and healthcare activities during and after pregnancy. The results of these studies indicate the usefulness of text messages for increasing the frequency of visits to health centers by pregnant women and improving care activities during and after pregnancy (42-43). MM mhealth application also played an important role in offering reminders regarding Antenatal Care (ANC) for pregnant women (44). The last application of mhealth for pregnant women is regarding the evaluation of health care services and need assessment. In this regard, several studies had investigated the application of smartphones in women and pregnancy medicine. The results of these studies indicated the effectiveness of PANDA and Commcare mobile applications in improving the quality of ANC services and showed a high acceptance rate for these applications among pregnant women (45-46). The results also indicated that mother and infant care had

improved as a result of design and implementation of communication systems based on mobile phones (47). The studies which were entered to our review can be seen in table 1.

4. Conclusion

Nowadays, ICT have affected all aspects of our lives and have created a large upheaval in the field of medicine and healthcare. Automatization of clinical services, self-care and remote consultation, improved medical care for rural and remote locations, reduced cost of medical services, providing the best healthcare quality at the shortest possible time and electronic education are among the uses of these technologies in medicine. Given the significant increase in use of smartphones among general public, their accessibility and ease-of-use and their use as a powerful platform for various applications; they can be used to improve healthcare services through the use of text messages and mhealth applications in various areas of medicine including women and pregnancy care.

Mhealth services, especially smartphones, play an important role in improving health outcomes for mothers and infants and provide suitable solutions for improving

Table 1: Characteristics of reviewed studies on application of health for pregnant women and pregnancy healthcare (continue...)

Area	year	Article title	Application	Results
Education	2017	Implementing and sustaining a mobile medical clinic for prenatal care and sexually transmitted infection prevention in rural Mysore, India (42)	Performing general per-childbirth care, education and prevention of STDs using mobile medical clinic application	Mobile medical clinic application provides a successful, applicable and acceptable model
	2014	Antenatal health promotion via short message service at a Midwife Obstetrics Unit in South Africa: a mixed methods study (39)	Improving awareness of health situation before childbirth and knowledge regarding pregnancy care using short text messages to pregnant women	Text messages provide suitable motivation for seeking medical care
	2017	Mobile Technology for Community Health in Ghana: what happens when technical functionality threatens the effectiveness of digital health programs? (28)	Providing a health platform using mobile technology in two parts: Client data application allowing healthcare providers to digitalize and track pregnant women and infants Mobile midwife: Educational voice messages sent automatically to pregnant women during pregnancy	Women have a higher probability of listening to voice messages during pregnancy compared to after pregnancy
	2016	Pregnancy, exercise and nutrition research study with smart phone app support (pears) study protocol of a randomized controlled trial (33)	Investigating the effect of a “healthy lifestyle package” based on smartphone technology compared to usual care activities on prevalence of diabetes in pregnant women with above average weight	Recommending the investigated software package as an effective method
	2014	Babywijzer: An Application to Support Women During their Pregnancy (40)	Investigating a mobile health intervention in pregnant women which allows them to directly seek answers to their questions regarding pregnancy and receive recommendations based on available evidence	The positive effect of the intervention on knowledge, awareness, confidence and satisfaction of pregnant women
	2016	Acceptability and feasibility of mHealth and community-based directly observed antiretroviral therapy to prevent mother-to-child HIV transmission in south African pregnant women under Option B+: an exploratory study (43)	Investigating the acceptance rate and need assessment of mobile health/short message services (SMS) for anti-retroviral treatment (ART) and prevention of HIV transfer from mothers to infants	Mobile health provides a suitable intervention for accepting ART
	2014	A study to assess the feasibility of Text Messaging Service in delivering maternal and child healthcare messages in a rural area of Tamil Nadu, India (41)	Evaluating text message services as an applicable method for improving knowledge and health education related to mother and infant healthcare	Significant improvement of knowledge in pregnant women using text messages

the quality of pre and postnatal care and reducing mother and infant mortality. As a result of these services, pregnant women in low-income countries and those with poor and hard access to advanced medical care institutes can use relatively low-cost, effective and efficient mhealth services such as text messages and freeware health applications and seek consultation from healthcare

professionals and get health solutions.

In order to make effective and efficient use of mhealth services, pregnant women require suitable levels of health and media literacy; should be familiar with novel technologies and receive proper and constant training and education. Workshops and educational classes, seminars, and use of educational radio and TV programs

Table 1: Characteristics of reviewed studies on application of health for pregnant women and pregnancy healthcare (continue...)

Area	year	Article title	Application	Results
Reminder	2012	Mobile phones as a health communication tool to improve skilled attendance at delivery in Zanzibar: a cluster-randomized controlled trial (44)	Evaluating the use of SMS for providing reminders from healthcare providers to pregnant women and providing messages regarding pre and postnatal care	Increased presence of women in medical centers
	2014	Mobile phones improve antenatal care attendance in Zanzibar: a cluster randomized controlled trial (45)	Evaluation of mobile phone and text message intervention effectiveness for improving the use of prenatal care and scheduling of interventions during pregnancy	Improved presence of women in prenatal care
	2015	Learning the ABCs of pregnancy and newborn care through mobile technology (46)	Evaluating the role of Mobile Midwife application in offering orderly reminders of prescheduled ANC care for pregnant women	Confident toward MM application in pregnant women and increasing use trend
Service evaluation and need assessment	2017	Usability and feasibility of a mobile health system to provide comprehensive antenatal care in low-income countries: PANDA mHealth pilot study in Madagascar (47)	Evaluating the usability and feasibility of PANDA mobile health application for providing high quality ANC to pregnant women based on recommendations by WHO	High acceptance of this application among pregnant women and providing a promising method for improving ANC
	2016	Are Pregnant and Postpartum Women Interested in Health- Related Apps? Implications for the Prevention of Perinatal Depression (51)	Evaluating the use of internet and information technology among women with pre and postnatal depression	The majority of pregnant women access internet through smartphones, computers or both
	2012	Designing and implementing an innovative SMS-based alert system (RapidSMS-MCH) to monitor pregnancy and reduce maternal and child deaths in Rwanda (49)	Describing design and implementation requirements for a mobile phone-based communication system for improving supervision during pregnancy and decreasing mother and infant mortality	Improvements in care for mothers and infants through implementation of communication systems based on mobile phones and SMS
	2015	Assessment of the Quality of Antenatal Care Services Provided by Health Workers Using a Mobile Phone Decision Support Application in Northern Nigeria: A Pre/Post-Intervention Study (48)	Evaluating the effectiveness of “CommCare” mobile application on quality of ANC services provided by healthcare providers	Positive effect of CommCare on quality of ANC services
	2014	Toll free mobile communication: overcoming barriers in maternal and neonatal emergencies in Rural Bangladesh (52)	Evaluating the quality of free mobile health intervention for pregnant women during pregnancy and after childbirth	Fast provision of services and creating motivation in women and healthcare providers for use of mobile phones

may be helpful for this matter.
The use of mhealth services faces limitations and problems, especially in low-income and developing

countries. These limitations include infrastructural limitations such as low speed and high cost of internet, lack of proper understanding for use of these

technologies, lack of proper supervision and concerns related to users' privacy. Therefore, we suggest cooperation between governments, technicians, non-government organizations, universities, and related institutions in order to improve the quality of health services provided to users, to improve the quality of health systems, and overcoming the aforementioned limitations.

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6. Conflict of interest

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