

Research Paper

EFFECTIVENESS OF MHEALTH INTERVENTION IN ACCESSING HEALTHCARE FACILITIES

A STUDY ON WOMEN IN RURAL BANGLADESH

Authors

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Co-Founder & Executive Director, Dnet
&
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About Dnet

Dnet (Development Research Network) is a not-for-profit research institution in Bangladesh, established in 2001. Dnet's vision is a society where information and knowledge facilitate all stakeholders' participation in the generation of wealth and its equitable distribution for poverty alleviation. Its mission is to become a premier organization in Bangladesh and beyond by undertaking research and various action programs in the areas where information and knowledge can contribute to poverty alleviation, economic growth, and peace.

During the initial years of activities, Dnet's main focus was research on information and communication technology (ICT) for development. Dnet's in-depth research in the area of ICTs for poverty alleviation has drawn the attention of stakeholders not only in Bangladesh but also across the globe.

Dnet empowers individuals and communities through collaborative solutions. We transcend service provision, acting as a catalyst for positive change. Rigorous research fuels our impactful programs, designed by experts for lasting impact. We promote human-centric technology and offer business solutions, all focused on building a just and sustainable future.



Table of Contents

1. Introduction	1
2. A Short Review of m-health Industry in Bangladesh	2
3. Research Objectives	6
4. Significance of the Study	7
5. Literature Review	7
6. Conceptual Framework	11
7. Methodology	13
7.1 Sampling	13
7.2 Data Collection Strategies	13
8. Discussion on Findings	13
8.1 Age Distribution and Type of Receiving Services	14
8.2 Level of Education and Understanding mHealth Content	14
8.3 Ownership and Frequency of Mobile Phone Use and Reading or Listening mHealth Content	15
8.4 Facility Visit After First Reminder	16
8.5 Distance of Home from Facility Centers	17
8.6 Influence of Social Barriers and Restrictions on Visiting Facility Centers	18
8.7 Influence of mHealth Contents on Facility Visits from the Perspective of Beneficiaries	19
8.8 Influence of mHealth Contents Type on Facility Visits	19
8.9 Evaluating the Effectiveness of mHealth Intervention in Accessing Healthcare Facilities	20
9. Policy Recommendations	23
10. Conclusion	24
11. References	25



List of Tables

<i>Table 1: mHealth or eHealth Initiatives in Bangladesh</i>	3
<i>Table 2: Objectives and Hypotheses of The Present Study</i>	6
<i>Table 3: Relationship Between Level of Education and mHealth Content Understanding</i>	14
<i>Table 4: Relationship Between Owning a Mobile Phone and Reading or Listening to mHealth Content</i>	15
<i>Table 5: Relationship Between Frequency of Using a Mobile Phone and Reading or Listening mHealth Content</i>	16
<i>Table 6: Relationship Between Reading or Listening mHealth Content (First Reminder) and Facility Visit After First Reminder</i>	16
<i>Table 7: Relationship Between Understanding mHealth Content (First Reminder) and Facility Visit After First Reminder</i>	17
<i>Table 8: Distance of Home from Facility Centers</i>	17
<i>Table 9: Relationship Between Socio-cultural Norms and Beliefs Influence and Facility Visit</i>	18
<i>Table 10: Influence of mHealth Contents on Facility Visits from the Perspective of Beneficiaries</i>	19
<i>Table 11: mHealth Content Types and Number of Visits After the First Reminder</i>	20
<i>Table 12: Multivariate Analysis Evaluating the Effectiveness of mHealth Intervention in Accessing Healthcare Facilities</i>	20

List of Figures

<i>Figure 1: A Brief Discussion on mHealth Journey in Bangladesh</i>	4
<i>Figure 2: Conceptual Framework</i>	12

1. Introduction

Bangladesh has achieved success in providing maternal healthcare facilities. The maternal mortality rate in Bangladesh decreased by 70.5% from 2010 to 2021 (WHO, 2015; BBS, 2022). About 70% of deliveries are assisted by skilled birth providers¹ (NIPORT and ICF, 2023). Despite the progress coverage of key evidence-based interventions remains unacceptably low, with only 41% of pregnant women attending four or more antenatal care (ANC) visits² (NIPORT and ICF, 2023). This trend is 22% lower among women in rural areas (35%) than in urban areas (57%) (Ibid). It is also evident that 17.8% babies were delivered by unskilled birth attendants in rural areas (65.2%) which was 17% less than in urban areas (82.2%) (Ibid). About 55% of mothers and 56% of babies receive postnatal care by medically trained providers within two days of birth (Ibid). Under the age of 5 years, still, 24% of children are stunted, 22% are underweight, and 11% are wasted (Ibid). As of 2022, the infant mortality rate is 25% per 1000 live births (which is 3% more than in 2021) and the neonatal mortality rate is 17% per 1000 live births (which is 1% more than in 2021) (BBS, 2023). Post-neonatal mortality is also high. Because it has increased by 2% compared to 2021 to 8% per 1000 live births (Ibid).

Thus, improvements are necessary to ensure access to, availability of, demand for, and utilization of qualified maternal care during pregnancy, delivery, and postpartum (MoHFW, 2017). Rural women are mainly deprived of receiving quality maternal healthcare facilities. Level of awareness, lack of sources of health-related information, education, non-availability of sources of proper healthcare facilities, social prejudices, socio-economic characteristics etc. are major contributing factors that may hinder rural women from accessing proper maternal healthcare facilities.

However, there is room for improvement in the situation. At present, using mobile phones in various aspects of daily life activity is becoming a common practice. Statistics of BTRC show that the total number of mobile phone subscribers in Bangladesh reached 190.36 million at the end of November 2023³ and it is increasing at a high rate consequently almost every household owns a mobile phone (Krishna et al., 2014). The number of mobile internet users was 118.96 million at the end of November 2023⁴. So about 62.9% of mobile users use mobile internet. In this respect, the mobile phone can play a crucial factor in spreading mobile-based facilities.

In an overpopulated country like Bangladesh, it is difficult for the government to provide all the people with proper healthcare facilities. In this case, mobile phones are being used to get access to healthcare facilities as a much more comfortable and acceptable communication channel. The

¹ The 4th Health Nutrition and Population Sector Program (HPNSP) aims to reach 65% coverage by 2023.

² The 4th Health Nutrition and Population Sector Program (HPNSP) aims to reach 50% coverage by 2022.

³ <https://www.amtob.org.bd/home/industrystatics>

⁴ Ibid



concept of mobile health (mHealth) communication has its roots in the rapid growth of mobile technology in recent years. A team of 54 Researchers at Johns Hopkins University has extended the Bangladesh model through a mCare initiative that schedules prenatal care visits for expectant mothers, helps during childbirth, and checks in after childbirth to assist with any health issues (Christen, 2012).

2. A Short Review of mHealth Industry in Bangladesh

Access to mobile phones is an important factor in getting access to mHealth services. According to the information of the Bangladesh Bureau of Statistics-BBS (2023), the proportion of mobile phone users is 97.9% at the household level. From 2013 to 2023, the percentage of mobile phone users at the household level increased by 10.2%. However, urban areas (99.4%) predominate over rural areas (97.9%) in the proportion of using mobile phones. At the individual level, the percentage of mobile users is 90.5%, with a predominance in urban areas (92.7%) compared to rural areas (89.8%). However, from 2013 to 2023, the percentage of mobile phone users at the household level increased by 8.2%. It is also mentionable that though the percentage of individuals who use mobile phones increased in 2023, the proportion of individuals owning a mobile phone is only 63.8% (urban 72.3% and rural 60.9%). Regarding gender-wise mobile phone users at the individual level, BBS (2023) showed that about 93.2% of males used mobile phones whereas only 87.8% of females used mobile phones. In the case of owning a mobile phone, 21% of male mobile phone users did not own any mobile phone which was 11.5% higher among the female mobile phone users. From this discussion three factors can be identified in mobile phone usage, firstly rural backwardness, secondly, gender disparity, and thirdly lack of mobile phone ownership. The existence of certain cultural and traditional backward beliefs or norms, lack of education, and digital skills can create gender inequality or gender gap in mobile phone access at the individual level. On the other hand, infrastructural constraints, inadequate mobile network coverage, and lack of technological resources are more likely to pave the way for the decline in the number of female mobile phone users.

These factors may contribute to keeping mHealth services at the infancy level in Bangladesh. But the benefits of mHealth services, albeit at a small scale, have opened up opportunities to ensure quality healthcare for underprivileged rural populations (Khatun et al. 2014). Some common mHealth or eHealth initiatives in Bangladesh are given in the next page.

Table 1: mHealth or eHealth Initiatives in Bangladesh

Managed by	Information
Public	DGHS District Health Information System Version 2 (DHIS-2), DGHS Office Attendance Monitoring System (OAMS), DGHS Telemedicine, DGHS Mobile Phone Health Service (MPHS).
Private (for profit)	Medinova Telemedicine, eClinic24 (Chakaria Project) by TRCL, LifeChord ⁵ AMCARE by TRCL, Health services for expatriates in Singapore by TRCL, Breast Cancer Finding via mobile by Amader Gram, JBFH Telemedicine, Friendship by mPower, MHSBC by mPower, Grameenphone Health Line, Banglalink, Airtel, City Cell, Robi, TeleTalk etc
NGOs	CRP Telemedicine, infoLADY by Dnet, Aponjon (MAMA Bangladesh) by Dnet, BRAC m-health etc.

Source: Ahmed et al. 2014²; Alam 2018

⁵ <https://lifechord.com.bd/>

*Figure 1: A Brief Discussion on mHealth Journey in Bangladesh*

In 1998, the telemedicine project was launched by Swinfen Charitable (Vassallo et al. 2001).

In 1998, the Bangladesh Ministry of Health and Family Welfare (MoHFW) initiated e-health for the first time (ibid).

In 1999, the privately owned Telemedicine Reference Center Limited (TRCL) was established and introduced the first-ever method of accessing healthcare through mobile phones (Ahmed et al. 2014²).

In 2002, Bangladesh adopted a national policy on ICT that sought to build a nationwide ICT infrastructure including health by 2006 (MHFW, 2008).

In 2005, Grameen Telecom (GTC) in partnership with the Diabetic Association of Bangladesh (DAB) deployed telemedicine administration, giving patients at Faridpur General Hospital access to specialist doctors of their choice in Dhaka (Khan et al., 2021).

In 2006, Grameenphone launched the first telephone medical advice line in collaboration with the Telemedicine Reference Centre (TRCL) (Alam, 2018)

In 2007, Medinova Hospital started started telemedicine service (Alam, 2018).

In 2009, the Ministry of Health launched mHealth in each sub-district hospital and district hospital by establishing a local call center to provide medical advice to service seekers on a 24/7 basis (Ahmed et al. 2014¹).

In 2009, TRCL in collaboration with Diabetic Association of Bangladesh (DAB) established AMCARE (Alam, 2018).

In 2010, Pregnancy Care Advice through SMS was launched to achieve the milestones of MDG h and 5 (DGHS, 2011).



In September 2011, the Aponjon (Power of Health in Every Mother's Hand), the largest mHealth service in South Asia service was launched in 13 locations of four districts in Bangladesh with about 1500 subscribers on a pilot basis by Dnet. It is a mobile phone based mhealth service for expecting and new mothers in Bangladesh under the auspices of the Mobile Alliance for Maternal Action (MAMA). Aponjon services are operated under the program agreement between the governments of the USA and Bangladesh. In August 2012, The national-scale operation of Aponjon started. Dnet became the first agency in the world to implement a mHealth initiative on a national level, where a private-sector-led sustainable business model was proactively promoted. Aponjon has more than 2.2 million customers across the country at this stage. Aponjon's target audience was new and expectant mothers along with children up to 5 years old. Aponjon offered health information through websites, mobile apps, mobile texts, and voice message channels. It also offered a 24/7 counseling line service, where subscribers could consult with a medical doctor when needed. In 2018, after the donor funding concluded, the project continued on its own. Aponjon was rebranded as LifeChord. To make the venture more sustainable, Dnet built proprietary software to eliminate third-party dependency and created new sales channels for additional sources of revenue.

In 2011, JiVita, a project of Johns Hopkins University was launched (Alam, 2018).

In 2011, the telemedicine service was officially launched at the National Digital Innovation Fair (Health bulletin, 2013).

In 2012, ten more telemedicine centers were launched in 10 different hospitals (ibid).

In 2013, another ten new telemedicine centers were opened in 10 different hospitals (ibid).

In 2015, the 'Info Sarkar' project was launched under the Information and Communications Technology (ICT) division (Alam, 2018).

In 2018, Dnet implemented the Mamoni-Maternal and Newborn Care Strengthening Project (MaMoni-MNCSP), including a mHealth-based SMS and OBD reminder system. USAID commissioned this project. This project was implemented in different districts of Bangladesh to attain its objective via 4 technological components: mHealth, a facilitated referral transport model, OpenMRS+-based queue management and reporting system, and a KIOSK-based client feedback mechanism.

Source: Developed by Researchers

3. Research Objectives

The main objective of this study is to investigate the effectiveness of mHealth intervention in accessing healthcare facilities by women in rural Bangladesh. This study includes some specific objectives. The table below presents the objectives of this study along with the research hypothesis.

Table 2: Objectives and Hypotheses of The Present Study

Type of Objective	Objective	Hypothesis
Board	<i>- to investigate the effectiveness of mHealth intervention in accessing healthcare facilities by women in rural Bangladesh.</i>	<i>The mHealth intervention plays an effective role in accessing health-care facilities by women in rural Bangladesh</i>
Specific	<i>i - to understand the role of the education level of the mHealth service seekers to understand the understanding of mHealth content;</i>	<i>Education level of the mHealth service seekers influences the understanding of mHealth content in rural Bangladesh</i>
	<i>ii - to depict ownership status and frequency of mobile phone use to access mHealth contents;</i>	<i>Ownership and frequency of mobile phone use positively influence the adoption of mHealth contents</i>
	<i>iii - to realize how the first reminder influences facility visits;</i>	<i>The first reminder influences the facility visits of the respondents</i>
	<i>iv - to observe how comprehension of mHealth contents influences facility visits</i>	<i>Understanding of the mHealth contents influences the facility visits</i>
	<i>v - to explore how the distance between service seekers and facility centers influences the frequency of visits to the facility centers;</i>	<i>Distance from the respondent's house from the facility centers influences the frequency of visiting the facility centers</i>
	<i>vi - to observe the influence of social barriers and restrictions on facility visits;</i>	<i>Socio-cultural norms and beliefs influence visiting facility centers</i>
	<i>vii - to measure the comparative effectiveness of SMS mHealth content and OBD mHealth content to motivate women to visit the facility after the first reminder.</i>	<i>Both types of mHealth content (SMS and OBD) are similarly effective in motivating women to visit the facility center after the first reminder</i>



4. Significance of the Study

Digital health, as a viable solution to ensure safe pregnancy and improve pregnancy outcomes (Lee et al., 2016), includes eHealth, mHealth, telehealth, health information technology, and telemedicine. In Bangladesh, mHealth service is still in the infancy stage and requires extensive research on the user adoption process, especially considering users of mobile or smartphones. However, very few or no studies consider the adoption of mHealth services concerning tech adoption in developing countries. Therefore, factors that influence the adoption of mHealth services must be investigated - a population that is most favorably placed in the adoption of innovations and technology. It is also important to consider the education level, gender, age, and social influence issues in mHealth adoption because these factors still exist in developing countries.

There are now over 7.7 billion mobile phone users worldwide, with a significant proportion of these users located in developing countries (WHO, 2018). This presents a unique opportunity for healthcare providers to use mobile technology to reach and serve populations that may otherwise have limited access to health services. This study will be a resource for healthcare providers as well as concerned departments of the government to understand the scope, issues, and potential of disseminating mHealth services among marginalized rural women in Bangladesh.

5. Literature Review

mHealth communication is a broad term that refers to the use of mobile devices and telecommunication technologies for health purposes (WHO, 2020). It is a medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices (WHO, 2011). With the widespread adoption of mobile devices and internet connectivity, mHealth communication has emerged as a promising tool for delivering healthcare services, especially in low- and middle-income countries where access to traditional healthcare services is often limited (WHO, 2018). It has the potential to overcome barriers such as geographical distance, lack of information, and inadequate health services (WHO, 2020).

In recent years, there has been a growing body of research exploring the potential benefits and limitations of mHealth communication. Several studies have shown that mHealth communication can improve health outcomes by providing timely, relevant, and accessible information to individuals and communities (Nwankwo et al., 2016; Tiwari et al., 2015). For example, one study found that a mobile phone-based health information and support program for pregnant women led to increased uptake of prenatal care and improved birth outcomes (Nwankwo et al., 2016). Another study found that a mobile phone-based disease surveillance and response system improved the accuracy and speed of disease reporting, leading to more effective disease control and prevention efforts (Tiwari et al., 2015). In the context of pregnancy and childbirth, mHealth



communication has been used to improve maternal and newborn health outcomes by providing timely and accurate information, reminders, and support (Liu et al., 2019).

In addition to these benefits, mHealth communication also has the potential to address some of the key challenges facing the healthcare sector, such as the shortage of healthcare workers, the high cost of healthcare services, and the limited reach of traditional healthcare systems (WHO, 2018).

By leveraging mobile technology, mHealth communication can help extend the reach of healthcare services, improve access to health information, and reduce the costs associated with healthcare delivery (Ibid).

mHealth communication technologies are becoming increasingly popular for their potential to improve healthcare delivery and patient outcomes. Rulisa et al. (2018) showed that mHealth communication has been successfully implemented in various healthcare settings, including maternal and child health, mental health, chronic disease management, and emergency response. In these settings, mHealth communication technologies have been used to support remote monitoring, provide health information and education, and improve patient-provider communication. Their review also revealed that mHealth communication can improve health outcomes by increasing access to care, improving health behaviors, and enhancing patient engagement and empowerment.

One of the key applications of mHealth communication in maternal and newborn health is the delivery of health information and

education to expectant mothers (Sicignano et al., 2018; Yeboakuma et al., 2017).

Telemedicine service is another example of mHealth communication interventions aimed at improving maternal and newborn health in remote areas, where access to healthcare services may be limited (Rulisa et al., 2018) which can increase the uptake of prenatal care and improve birth outcomes (Liu et al., 2019). In line with this, Das et al. (2016) also suggested that mobile phone-based reminders increased the utilization of prenatal care services by 50%. Another study in India showed that text message reminders improved the utilization of institutional deliveries by 26% (Rao et al., 2017). These findings suggest that mHealth communication can play a critical role in improving the health outcomes of pregnant women and newborns.

In maternal and child health, mHealth communication has been used to improve access to care for women during pregnancy and childbirth. For example, a study by Dangour et al. (2013) found that mHealth communication programs in low- and middle-income countries significantly improved access to care for pregnant women and reduced the incidence of maternal and neonatal mortality. It can help increase the uptake of preventive health services such as antenatal care by providing timely and accessible information to pregnant women.

Similarly, mHealth communication has been used to improve access to care for patients with chronic diseases. Qiu et al. (2017) opined that mHealth communication technologies, such as mobile health apps and text message reminders, were effective in improving medication



adherence and health outcomes for patients with chronic conditions such as diabetes and cardiovascular disease. Additionally, mHealth communication technologies, such as telemedicine, can provide remote access to care for individuals in remote or underserved areas (Ibid).

Another important aspect of mHealth communication is its ability to increase patient engagement and adherence to recommended care. By providing expectant mothers with information and support, mHealth communication can help mothers feel more involved in their own care and more committed to following recommended health practices. This can lead to improved health outcomes for mothers and newborns, as well as reduced health costs and improved health system efficiency (Chib and Vreeman, 2017).

Overall, the literature suggests that mHealth communication has the potential to improve access to care and health outcomes, particularly in low- and middle-income countries where healthcare infrastructure is limited (Rulisa et al., 2018; Dangour et al., 2013; Qiu et al., 2017). mHealth communication is increasingly being recognized as a valuable tool for improving maternal and newborn health outcomes. mHealth communication technologies can support prenatal care, maternal health education, and postpartum care, helping to ensure that mothers and newborns receive the care they need. Additionally, mHealth communication can improve patient engagement and adherence to recommended care, reducing the risk of maternal and newborn morbidity and mortality (Owens et al., 2016; Chib and Vreeman, 2017; Yeboakuma et al., 2017).

The healthcare system in Bangladesh is facing major challenges of accessibility and affordability, which has resulted in low utilization, quality, and equity of healthcare services. However, there have been significant improvements in several health indicators in recent years. The country's high population density and rapid urbanization make it challenging to provide universal healthcare. mHealth has been promoted as a cost-effective and equitable alternative to traditional healthcare services in Bangladesh.

To address this situation, the importance of mHealth communication in rural areas of Bangladesh cannot be overstated. In these regions, mothers and newborns face numerous obstacles when it comes to accessing healthcare services. These barriers include a lack of healthcare professionals, limited healthcare infrastructure, and geographical challenges that make it difficult to reach medical facilities.

The journey towards mHealth integration in Bangladesh started around 2001 with the Telemedicine Reference Center Limited (TRCL) using mobile phones for healthcare provision (Krishna et al., 2014). In 2016, TRCL partnered with Grameenphone to launch the mobile phone-based call center Health Line: 789 (Haque, 2014). Many other initiatives, both public and private, have since been established in Bangladesh, including the Mobile Alliance for Maternal Action (MAMA) program initiated by Dnet in 2010. The MAMA program supports the MaMoni initiative, which uses SMS technology linked with the electronic health record system eMIS to deliver SMS reminders to women about their upcoming maternal and child health (MNC) appointments



(Krishna et al., 2009). mHealth communication provides a solution to these challenges by utilizing mobile devices and technology to deliver health information, support remote monitoring, and provide telemedicine services. This helps to make healthcare more accessible to the rural populations in Bangladesh, improving their chances of receiving the care they need (Gustafsson et al., 2016).

The Digital Bangladesh initiative launched by the government has influenced a range of programs aimed at improving citizens' health status and access to health services through the use of modern communication technologies. The government, NGOs, and private sector organizations have been exploring the application of eHealth and mHealth services, including health information dissemination, notifications, and reminders for health services (Ahmed et al., 2014). The Bangladeshi government initiated sending health-related text messages to all mobile phone subscribers as part of health awareness campaigns such as the National Immunization Day (NID) campaign. The government has also sent voice messages to mobile subscribers in rural areas to increase the utilization of community clinic health services for primary healthcare (Free et al., 2013). The mHealth intervention in Bangladesh involves the use of pre-determined, customized SMS messages for pregnant women based on their ANC care needs. The messages are relevant to pregnancy, delivery, and postnatal care and are chosen from a pool of messages based on the stage of pregnancy/postpartum period. The SMS intervention is designed to ensure repeat visits to the eMIS platform for ANC visits and facility-based deliveries, as well as reminders for upcoming checkup dates and postnatal care (Ahmed et al., 2014).

However, while mHealth communication has the potential to improve access to care and health outcomes, some challenges must be addressed. For example, privacy and security concerns, cost, and limited infrastructure in some areas may limit the implementation and effectiveness of mHealth communication interventions (Rulisa et al., 2018).

Despite the potential benefits of mHealth communication, delivering these services in rural areas of Bangladesh can be challenging. One of the main challenges is a lack of connectivity and access to mobile technology, as many rural populations have limited access to the internet and mobile networks. Additionally, a lack of technical knowledge and digital literacy among rural populations can pose barriers to the adoption and use of mHealth communication services. There may also be cultural, social, and economic barriers that limit the uptake of mHealth communication services in rural areas (Gustafsson et al., 2016; Karim et al., 2018).

Another challenge is ensuring that mHealth communication services are relevant and responsive to the needs of rural populations. This requires a deep understanding of local health needs and challenges, as well as the development of culturally appropriate and locally relevant content. It is also important to ensure that mHealth communication services are accessible, user-friendly, and affordable for rural populations (Gustafsson et al., 2016).

Moreover, there are also infrastructure and logistical challenges in delivering mHealth communication services to rural areas in Bangladesh. This includes a lack of healthcare facilities and resources, such as electricity and

reliable transportation, which can hinder the delivery and implementation of mHealth communication interventions. There may also be a lack of trained healthcare providers, such as midwives and community health workers, who can effectively deliver mHealth communication services (Karim et al., 2018).

In conclusion, mHealth communication interventions offer a promising approach to improving maternal and newborn health outcomes. Through the delivery of health information and education, remote monitoring and support, and increased patient engagement, mHealth communication can help to ensure that mothers and newborns receive the care they need to stay healthy. Delivering mHealth communication services in rural areas in Bangladesh requires a comprehensive and integrated approach that takes into account the unique challenges and needs of rural populations. Addressing these challenges and ensuring the relevance, accessibility, and affordability of mHealth communication services can help to improve maternal and newborn health outcomes in rural areas of Bangladesh.

6. Conceptual Framework

The main objective of this study is to understand the role of mHealth interventions in accessing healthcare facilities for rural women in a developing country like Bangladesh. Several studies have investigated the effectiveness of mHealth communication in improving healthcare outcomes, particularly in rural areas, where access to healthcare services is often limited (Philbin et al., 2019). However, several factors along with SMS and/or OBD-based mHealth facilities can impact the effectiveness of mHealth communication among rural populations.

Socioeconomic Status

The socioeconomic status of rural populations is a key factor in the effectiveness of mHealth communication (Hampshire et al., 2016). Low-income rural populations are more likely to face barriers to healthcare access, including lack of transportation, distance from the household, time constraints, and limited healthcare infrastructure (Liao et al., 2012)). These barriers can impact the uptake of mHealth communication interventions, particularly if they require additional time or resources.

Digital Accessibility and Literacy

Digital accessibility, and the ability to use digital technologies effectively, are other important factors in the effectiveness of mHealth communication among rural populations (Estacio et al., 2019). Rural populations, particularly older adults, may have lower levels of digital literacy compared to urban populations (Estacio et al., 2019). This can impact the ability of rural

populations to use mHealth communication tools effectively, leading to lower uptake and engagement with these interventions.

Satisfaction and Trust in Healthcare

Satisfaction and trust in healthcare providers are significant factors in the effectiveness of mHealth communication among rural populations (Su and Fan, 2011). Rural populations may have lower levels of trust in healthcare providers compared to urban populations, due to a variety of factors, including lack of access to healthcare services and negative experiences with healthcare providers (Aboumatar and Cooper, 2013). This can impact the uptake of mHealth communication interventions, as rural populations may be less likely to trust the advice and recommendations provided through these channels.

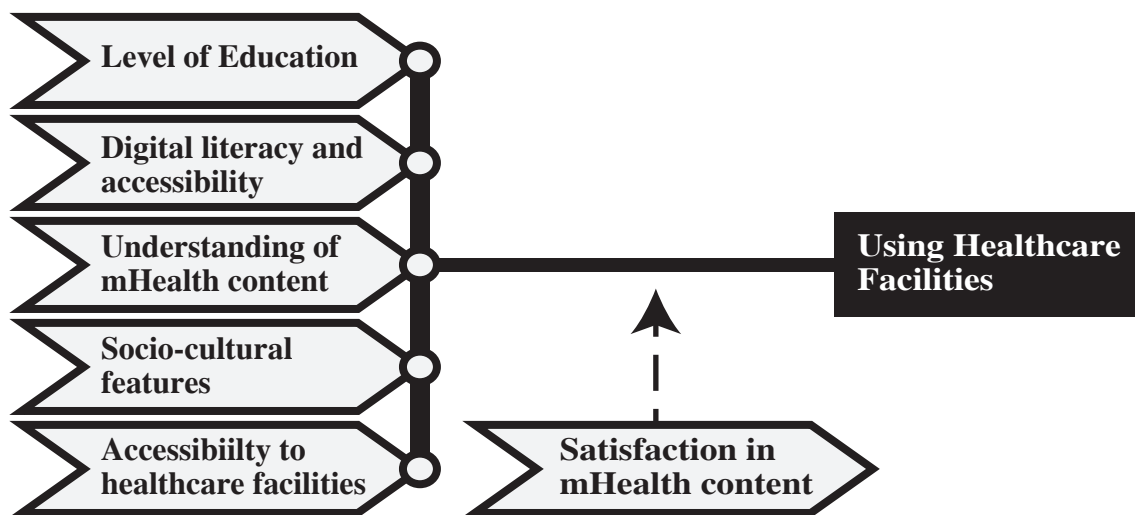
Socio-Cultural Beliefs and Practices

The cultural relevance of mHealth communication interventions is another important factor in their effectiveness among rural populations (Aboumatar and Cooper, 2013). Rural populations may have unique cultural beliefs and practices that impact their healthcare-seeking behaviors (Farmer et al., 2012). Interventions that are not culturally relevant may be less effective in engaging and motivating rural populations to adopt healthier behaviors.

Accessibility to Healthcare Facilities

The availability and quality of digital infrastructure, including internet connectivity and mobile phone coverage, is another important factor in the effectiveness of mHealth communication among rural populations (Haenssger, 2018). Rural areas may have limited access to digital infrastructure, which can impact the ability of rural populations to access and use mHealth communication tools effectively.

Figure: 02 Conceptual Framework



Source: Developed by Researchers

7. Methodology

This study uses the cross-sectional study design to collect data from a sample of individuals at a single point in time. This design is suitable for capturing a snapshot of the current situation and understanding the relationships between variables at that moment. In the context of this study, the cross-sectional study design was used to collect data on the key factors influencing the effectiveness of mobile phone-based short message reminders among pregnant women in a rural district of Bangladesh.

In this study, data was collected through a phone survey, which involved conducting a one-to-one survey over the phone. The phone survey is a convenient and cost-effective way to reach a large number of participants in a short amount of time. The participants in this study were pregnant women in a rural district of Bangladesh who had received mobile phone-based short message reminders for pregnancy check-ups and child delivery.

7.1 Sampling

The study was conducted on rural pregnant women who received mHealth SMS and OBD reminders in the Habiganj district of Bangladesh. Pregnant mothers from the Habiganj district who received SMS and OBD messages were selected for the survey.

However, since the population size is more than 200,000. Following a simple random sampling technique for a finite population⁶, this study found a sample size of ≈ 384.43 . Since the

sample size must be a whole number, we round up to get an adjusted sample size of 385. But to address non-response problems or missing answers **this study took a sample size of 395 respondents**. Among these respondents, 66.3% (262) were pregnant women, and 33.7% (133) women already delivered their babies.

7.2 Data Collection Strategies

The data collection process involved training of enumerators, respondent selection, database screening, and conducting the telephonic survey. Enumerators were well-versed in ethical considerations to ensure the validity and reliability of the data collected and to protect the rights and welfare of participants. Ethical issues were involved in obtaining informed consent from the respondents, maintaining the confidentiality of the participants' information, ethical consideration, and safeguarding policy. The enumerators were trained on the measures taken to ensure the security of the data, including encryption, and secure storage. The enumerators were trained on identifying and managing risks and the steps taken to minimize these risks, including the potential for emotional distress and harm to the participants.

8. Discussion on Findings

The mHealth intervention provides a potentially highly effective approach to global public health for geographic reach through increasingly widespread access and marginal cost on mobile phones. (Neff and Fry, 2009; Free et al., 2013). It is important to consider whether mHealth is accessible, especially for

⁶The adjusted sample size formula for a finite population size is $n_{adj} = n / (1 + (n-1)/N)$. Substituting the values into the formula for this study, we get: $n_{adj} = 385 / (1 + (385-1)/200000)$ $n_{adj} \approx 384.43$

marginalized populations who are challenged to reach existing methods and who already have poorer health status than their counterparts (Patrick et al., 2008; Ngaruiya et al., 2019). Considering that this study first concentrated on the demographic information of the respondents.

8.1 Age Distribution and Type of Receiving Services

The age distribution of the study shows that the mean age of the respondents was 26.3 years. However, the age distribution of the respondents reflects the existence of child marriage with more than 6.1% of the respondents. Of the respondents included in the study, 54.2% received mHealth SMS services and 45.8% received mHealth OBD services. Respondents who are victims of child marriage prefer SMS services over OBD services.

8.2 Level of Education and Understanding mHealth Content

The education level of the respondents shows that most of the respondents received a high school education. The proportion of higher secondary passers was higher among SMS service users. But the majority of OBD service recipients have a primary school education. This reveals that education level may be a determining factor in receiving SMS or OBD services. The *Hypothesis-01* of this study is that the “*Education level of the mHealth service seekers influences the understanding of mHealth content*”. To examine this hypothesis this study performs a chi-square independence test.

Table 3: Relationship Between Level of Education and mHealth Content Understanding

Highest Education Level	Status of Understanding mHealth Content				All Samples	
	Not Able		Able		Freq.	Percent
	Freq.	Percent	Freq.	Percent		
HSC	17	23.6	111	28.1	128	32.4
SSC	7	9.7	55	13.9	62	15.7
High School	3	4.2	77	19.5	80	20.2
Primary	45	62.5	80	20.3	125	31.7
Total	72	18.2	323	81.8	395	100
Pearson chi-square coefficient (χ^2)						41.841
p-value						0.000

The chi-square independence test shows that women’s status of understanding mHealth content was found to have a strong association with their level of education. This association was highly statistically significant at the 1% level of confidence; $\chi^2(3) = 41.841, p\text{-value} = 0.000$.

8.3 Ownership and Frequency of Mobile Phone Use and Reading or Listening mHealth Content

Studies show that ownership of mobile phones by women or their households matters to seek mHealth services, more likely to utilize maternal and newborn health services (Nie et al., 2016; LeFevre et al., 2020; Olamoyegun, 2020). Considering the importance of having ownership of a mobile phone, this study found that most of the respondents owned a mobile phone. About 27.59% reported that their husband owned the phone and 5.32% reported that another family member owned the phone. Women’s ownership of mobile phones is about 1.5% higher for SMS service receivers than for OBD service receivers.

The *Hypothesis-02* of this study is that “*Ownership and frequency of mobile phone use positively influence the adoption of mHealth contents*”. Although all respondents included in this study had access to a mobile phone in different ways, ownership is a status that allows someone to use their own resources more freely. To understand whether owning a mobile phone is related to reading or listening to mHealth content, this study performed a chi-square test of independence.

Table 4: Relationship Between Owning a Mobile Phone and Reading or Listening to mHealth Content

Status of Ownership of A Mobile Phone	Status of mHealth Content Read or Listened				All Samples	
	Did Not Read or Listen		Read or Listened		Freq.	Percent
	Freq.	Percent	Freq.	Percent		
Not Owned	25	6.3	105	26.6	130	32.9
Owned	25	6.3	240	60.8	265	67.1
Total	50	12.7	345	87.3	395	100
Pearson chi-square coefficient (χ^2)					7.571	
p-value					0.006	

The table shows the relationship between the ownership of a mobile phone and the frequency of reading or listening to mHealth content. The Pearson chi-square test of independence indicates that there is a statistically significant association between these two variables; $\chi^2 (1) = 7.571, p = 0.006$. This suggests that the ownership of a mobile phone is related to the tendency to read or listen to mHealth content.



Table 5: Relationship Between Frequency of Using a Mobile Phone and Reading or Listening mHealth Content

Status of mHealth Content Read or Listened	Frequency of Usage of Mobile Phone Daily						Total	
	Once		Twice		Several Times a Day			
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Did Not Read or Listen	20	5.1	5	1.3	25	6.3	50	12.7
Read or Listened	80	20.2	25	6.3	240	60.8	345	87.3
Total	100	25.3	30	7.6	265	67.1	395	100
Pearson chi-square coefficient (χ^2)							7.803	
<i>p-value</i>							0.020	

The chi-square test of independence was performed to assess if there is a statistically significant association between the status of mHealth content read or listened to and the frequency of usage of mobile phones daily. The result of this test shows that the *p-value* is 0.020, which is less than the commonly used alpha level of 0.05. Therefore, it can be concluded that there is evidence of a statistically significant association between using mobile phones daily and the tendency to read or listen to mHealth content.

8.4 Facility Visit After First Reminder

This study found that more than half (50.1%) of the respondents received facility service after the first reminder of the mHealth service. They visited these facility service centers on an average of more than two times after the first reminder. The *Hypothesis-03* of this study involves that “*the first reminder influences the facility visits of the respondents*”. To understand this association this study performs a chi-square independence test.

Table 6: Relationship Between Reading or Listening mHealth Content (First Reminder) and Facility Visit After First Reminder

Status of Facility Visit After First Reminder	Status of mHealth Content Read or Listened				All Samples	
	Did Not Read or Listen		Read or Listened			
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Did not go to the facility	37	9.4	160	40.5	197	49.9
Went to facility	13	3.3	185	46.8	198	50.1
Total	50	12.7	345	87.3	395	100
Pearson chi-square coefficient (χ^2)					13.329	
<i>p-value</i>					0.000	

The chi-square test of association shows that the reading or listening mHealth content (first reminder) was found to influence the respondents to facility visit after the first reminder. This association was highly statistically significant at 1% level of confidence, $\chi^2 (1) = 13.329, p = 0.000$.

The *Hypothesis-04* of this study includes that “*Understanding of the mHealth contents influences the facility visits*”. To understand this association this study performs a chi-square independence test.

Table 7: Relationship Between Understanding mHealth Content (First Reminder) and Facility Visit After First Reminder

Status of Facility Visit After First Reminder	Status of mHealth Content Read or Listened				All Samples	
	Not Able		Able		Freq.	Percent
	Freq.	Percent	Freq.	Percent		
Did not go to the facility	54	13.7	143	36.2	197	49.9
Went to facility	18	4.6	180	45.6	198	50.1
Total	72	18.2	323	81.8	395	100
Pearson chi-square coefficient (χ^2)						22.236
p-value						0.000

The chi-square test of association shows that there is an association between understanding mHealth content at the first reminder and visiting facility centers after the first reminder. This association was highly statistically significant at the 1% level of confidence, $\chi^2(1) = 22.236$, $p = 0.000$. However, the above two tables reveal that receiving mHealth contents (first reminder) as well as understanding these contents influence women or respondents to visit the facility centers.

8.5 Distance of Home from Facility Centers

The *Hypothesis-05* of this study includes that “*Distance from respondent’s home from the facility centers influences the frequency of visiting the facility centers*”. Side by side accessing mHealth contents, this study also concentrates on the distance of home from the nearest convenience center and the frequency of visiting the facility centers. To calculate that this study conducts a mean equality F-test with the frequency of visits to the facility and distance from home.

Table 8: Distance of Home from Facility Centers

Distance from House (km)	Number of Visits to the Facility	
	Mean	Std. dev.
< 1	1.9	1.3
1-3	0.3	0.8
4-6	1.0	1.3
> 6	0.2	0.7
Total	1.2	1.4
Mean Equality F-test		26.67
p-value		0.000

As per the above table, the frequency of visiting the facility centers was the highest among the respondents who lived less than one km from the nearest facility centers. On the other hand, the average frequency of visits to facility centers decreases as the distance increases. This reveals that respondents' interest in taking mHealth content benefits decreases as the distance from the house increases. This could be due to the fact that distance from the house to the facility centers includes some intrinsic factors like cost, time, transportation facility, security, family restrictions etc. These factors are highly likely to affect the tendency of visiting facility centers. However, the F-test for equality of means indicated that the mean number of visits to the facility centers was highly statistically significantly different from the variation in distance from the respondents' homes.

8.6 Influence of Social Barriers and Restrictions on Visiting Facility Centers

Hypothesis-06 of this study includes that “*Social barriers and restrictions influence visiting facility centers*”. Sometimes socio-cultural norms and beliefs impede human freedom and aspiration. To understand this situation, this study performs a Chi-square test of independence.

Table 9: Relationship Between Socio-cultural Norms and Beliefs Influence and Facility Visit

Restrictions in Accessing Facility-Based Care	Status of Facility Visit After First Reminder				All Samples	
	Did Not Go to the Facility		Went to Facility		Freq.	Percent
	Freq.	Percent	Freq.	Percent		
Restriction exist	98	24.8	53	13.4	151	38.2
No restriction	99	25.1	145	36.7	244	61.8
Total	197	49.9	198	50.1	395	100
Pearson Chi-square Coefficient (χ^2)						22.08
<i>p-value</i>						0.000

The chi-square test of independence shows that there is a strong association between restrictions in accessing facility-based care and the status of facility visits after the first reminder. This association was statistically significant at the 1% level of confidence; $\chi^2 (1) = 22.08, p = 0.000$. It reveals that lack of freedom in accessing facility-based care influences visiting facility centers. These results also reveal the inferior position of women at the household level in terms of decision-making about the freedom to seek health services.

8.7 Influence of mHealth Contents on Facility Visits from the Perspective of Beneficiaries

This study also concentrated on the respondents’ views regarding the influence of mHealth content to motivate them to go to healthcare centers. To validate their comment regarding the provision of mHealth content, this study also includes their tendency to visit and receive health services from the facility centers.

Table 10: Influence of mHealth Contents on Facility Visits from the Perspective of Beneficiaries

Do You Think That mHealth Content has Influenced You to Go to the Facility Centers?	Number of Visits to the Facility Center After First Reminder		
	Percent	Mean	Std. dev.
Agreed	51.4	2.33	1.0
Did Not Agree	48.6	0.09	0.5
Total	100	1.2	1.4
Independent t-test			28.190
<i>p-value</i>			0.000

The above table shows that more than half of the respondents think that mHealth content has influenced them to go to the facility centers. Considering their number of visits to the facility centers after the first reminder, it was found that the respondents who agreed on this question visited more than two times after getting the first reminder which was 26 times higher than their counterparts. The independent t-test shows that this difference was highly statistically significant at the 1% level of confidence; $t(393) = 28.190$, $p\text{-value} = 0.000$. This validates that mHealth content has influenced them to go to the facility centers.

8.8 Influence of mHealth Contents Type on Facility Visits

The mHealth contents include two different types of services; SMS and OBD. This section focuses on the influence of mHealth content types on facility visits to understand the relative effectiveness of mHealth content types. *Hypothesis-07* of this study includes that “**Both types of mHealth contents (SMS and OBD) are similarly effective in motivating women to visit the facility center after the first reminder**”. To test this hypothesis, an independent t-test is performed including the variables type of mHealth contents and the number of facility visits after the first reminder.

Table 11: mHealth Content Types and Number of Visits After the First Reminder

Type of mHealth Content	Number of Visits to the Facility Center After First Reminder	
	Mean	Std. dev.
OBD	1.2	0.1
SMS	1.1	0.1
Total	1.2	0.1
Independent t-test		0.436
<i>p-value</i>		<i>0.663</i>

The above table shows that there is no statistically significant difference between the two types of mHealth contents (SMS and OBD) in visiting the facility center after the first reminder; $t(393) = 0.436, p\text{-value} = 0.663$. This also reveals that two types of mHealth content are similarly effective in motivating women to visit the facility center after the first reminder.

8.9 Evaluating the Effectiveness of mHealth Intervention in Accessing Healthcare Facilities

The descriptive discussion and the hypothesis testing results preliminarily reveal that the mHealth intervention has a positive influence on accessing healthcare facilities for the rural women of Bangladesh. To understand it more profoundly and scientifically, this study performs a multiple regression which is a statistical technique that can be used to analyze the relationship between a single dependent variable and several independent variables. This study considers the frequency of visiting and receiving healthcare facilities from the facility centers as the dependent variable and includes several independent variables including accessing mHealth contents.

Table 12: Multivariate Analysis Evaluating the Effectiveness of mHealth Intervention in Accessing Healthcare Facilities

Dependent Variable	Frequency of visiting and receiving healthcare facilities after the first reminder		
Independent Variables	Coefficient	Std. err.	<i>p-value</i>
Age	0.006	0.011	<i>0.575</i>
Highest level of education (Primary)	0.097	0.137	<i>0.482</i>
Ownership of mobile phone (Owned)	0.337***	0.136	<i>0.013</i>
Distance from house to healthcare facilities (Less than One km)	0.922***	0.136	<i>0.000</i>
Restrictions in Accessing Facility-based Care (Restrictions exist)	- 0.354***	0.125	<i>0.005</i>
Type of mHealth content (SMS)	- 0.030	0.122	<i>0.806</i>
Satisfaction with mHealth contents and services (Satisfied)	0.631***	0.137	<i>0.000</i>
Status of mHealth Content Read or Listened (Read or Listened)	0.619***	0.190	<i>0.001</i>
Constant	- 0.354	0.375	<i>0.346</i>
R-squared	0.247		
N	395		



Overall, the results showed the utility of the predictive model was significant, $F(8, 386) = 15.85$, $R^2 = 0.25$, $p < 0.000$. R^2 is a statistical measure that represents the goodness of fit of a regression model. Since R^2 is a proportion, it is always a number between 0 and 1. The ideal value for r-square is 1. In social science research, an R-squared that is between 10% - 50% (0.10 and 0.50) is acceptable only when some or most of the explanatory variables are statistically significant (Ozili, 2023). More specifically, an r-square value of .12 or below indicates low, between .13 to .25 values indicates medium, and .26 or above and above values indicate high effect size in social science research (Cohen, 1992). Considering the type of the present study it is found that all of the predictors explain a moderate amount of the variance between the variables (25%). In this model, each coefficient is the difference from the average.

The multiple regression shows that the age of the respondents was found to be positively correlated with the frequency of visiting and receiving healthcare facilities, but it was not statistically significant. Respondents who completed primary level education were more likely to visit and receive health care benefits than respondents who completed higher level education, but it was not statistically significant. Respondents who own mobile phones are almost 0.34% more likely to visit and receive healthcare facilities after the first reminder than respondents who do not own and this was highly statistically significant at the 1% level of confidence. This may be due to the fact that if a woman has her own mobile phone, she can enjoy the freedom to manage it for her necessary purposes which can accelerate her

tendency to visit health facility centers by increasing her access to mHealth content.

With respect to visiting and receiving healthcare facilities after the first reminder, distance from the service seekers' houses to healthcare facilities was found to play a crucial role. This study found that the propensity to visit and receive healthcare facilities was more than 0.92% for respondents living within one kilometer of a health center compared to those living in remote areas more than one kilometer from the health center and this was highly statistically significant.

In Bangladesh, socio-cultural issues greatly affect women's ability to fulfill their aspirations. This study also found that respondents who faced restrictions from their families were less likely to visit healthcare facilities than those who did not. This association was highly statistically significant at the 1% level of confidence. Considering the main focus of this study on mHealth content, this study found that respondents who received mHealth SMS services were less likely to visit healthcare facilities after their first reminder than those who received mHealth OBD services. This reveals that both types of mHealth content are equally effective in motivating women to visit the facility center after the first reminder. However, this association was not statistically significant. In this study, beneficiaries' satisfaction with the provision of mHealth services such as service delivery time, and appropriateness of the information provided by mHealth services were included to measure beneficiaries' satisfaction levels. Multiple regression showed that mHealth beneficiaries who were satisfied with mHealth content were more



likely to visit and receive healthcare facilities after the first reminder and this was statistically significant at the 1% level of confidence.

The main hypothesis of this study was that *“the mHealth intervention plays an effective role in accessing healthcare facilities for rural women in Bangladesh”*. The regression result found that the ability to read and listen to mHealth content had a positive relationship with the frequency of visiting and receiving healthcare facilities after the first reminder compared to respondents who were not able to read or listen to mHealth content and this was found highly statistically significant 1% level of confidence. More specifically, the respondents who are able to read or/and listen to mHealth contents were 0.62% more frequently visiting and receiving healthcare facilities after the first reminder.

If we compare the five statistically significant variables, we find that the standardized beta coefficient is higher for the variable less than 1 km distance from the house to healthcare centers (the standardized beta coefficient is 0.314) followed by satisfaction with mHealth contents and services (standardized beta coefficient is 0.215), ability to read and listen to mHealth content (standardized beta coefficient is 0.150), and self-ownership of mobile phone (standardized beta coefficient is 0.116). This reveals that the higher standard beta coefficient illustrates the variable less than 1 km distance from the house to healthcare centers has more explanatory power in the model than the other significant variables.



9. Policy Recommendations

Based on the research findings, this study suggests the following recommendations;

1. Although the government of Bangladesh has given importance to women's education and Bangladesh has achieved considerable progress in this regard, there is a need to strengthen the promotion and motivation process of women's education at the rural level in public and private initiatives.
2. Prevention of child marriage needs to be strengthened.
3. Various campaign activities can be conducted at the public and private levels to highlight the importance of women's mobility and technology connectivity in rural households.
4. mHealth service-providing organizations may prioritize OBD over SMS in providing mHealth facilities. In this case, they can check the opinion of the beneficiary beforehand. Then mHealth intervention can be more effective.
5. Health care providers should relocate their facility points considering the distance to the target group's homes, infrastructure conditions, and consultation with the local population.



10. Conclusion

The study aimed to investigate the effectiveness of mHealth intervention in accessing healthcare facilities of women in rural Bangladesh. Six hypotheses were tested, and the results indicated that ownership and frequency of mobile phone use, education, understanding of the received contents, and socio-cultural norms and beliefs were all significant factors influencing the adoption of mHealth intervention and visits to healthcare facilities. The inferential analysis of this study shows that women's ability to read and/or listen to mHealth content, ownership of mobile phone, distance from house to healthcare facilities, socio-cultural restrictions, and satisfaction with mHealth contents and services were significant positive predictors of accessing healthcare facilities of women in rural Bangladesh. Overall, based on the findings it is beyond doubt that mHealth interventions are playing an effective role in accessing healthcare facilities for women in rural Bangladesh.

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