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mHealth for Self-Management in Pregnancy: Perceptions of Women in Low-Resource Settings

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Abstract

Mobile health (mHealth) has shown to be effective for self-management. While most studies point to mHealth as a tool to support healthcare in low-resource settings, it is not clear how women in low-resource settings perceive mHealth for self-management during pregnancy. The purpose of this study was to investigate the perceptions of women in low-resource settings on the use of mHealth for self-management during pregnancy. Semi-structured interviews were conducted with ten women in low-resource settings who owned mobile phones, understood English and were above eighteen years of age. The interviews were analysed and several themes emerged after analysing the findings from interviews: awareness of mHealth for self-management, perceived benefits, barriers to adoption, improving adoption and the preferred approach for mHealth in low-resource settings. The findings of this study extended existing knowledge on the perception, design considerations, challenges and methods for improving adoption in terms of using mHealth technologies for self-management during pregnancy. The findings of this study provide researchers, mHealth app designers and developers, healthcare providers and practitioners with information on how to improve the design of mHealth solutions and interventions for women in low-resource settings to support self-management during pregnancy.

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1. Introduction

Self-management in healthcare facilitates patients in managing their health[1]. Digital health technologies such as mobile phones have been used for healthcare management and monitoring[2]. The use of mobile technologies in healthcare has not only improved care but also reduced the cost of receiving care, especially in low-resource settings[3]. The United Nation's Sustainable Development Goal (SDG) 3 highlights "good health and wellbeing" as one of the major targets[4]. The specific goal relating to maternal health states[4]:

"By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births."

The World Health Organisation reports that 99% of maternal deaths occur in under developed countries.[5] This could be as a result of the shortage of skilled medical specialists in these settings and other complications that occur during pregnancy[6].

Nigeria is a lower-middle-income country in sub-Saharan Africa, with a population of approximately 200 million[7]. The maternal mortality rate in Nigeria is currently at 917 per 100, 000 births, which ranks Nigeria as the fourth country with the highest mortality rate in the world[34]. Maternal mortality is higher in the northern regions of Nigeria compared to the southern regions[8]. This can be attributed to various factors such as the dearth of healthcare facilities in the local areas and, as a result, the majority of the women do not give birth in a health facility[9,10]. Furthermore, 70% of maternal deaths in Nigerian rural communities are caused by "infection, haemorrhage, obstructed labour, unsafe abortion and hypertensive disease of pregnancy"[11] which could be avoided if symptoms can be detected early and managed.

In rural communities within Nigeria, there is a major challenge in terms of health facilities and resources which include a shortage of hospitals and clinics in these communities, and inadequate medical personnel[12]. For example, pregnant women in rural areas prefer to give birth at home due to distance from their respective villages to the nearest health facility[13]. Other reasons include the cost of maternal healthcare service, poor information dissemination, illiteracy among pregnant women, and ill-treatment of expecting mothers in health facilities[13]. However, the findings of a recent study suggest that women in northern Nigerian rural communities have access to mobile phones during pregnancy[14].

mHealth can be used as a self-management tool to support patients in monitoring and managing their health at distant locations, hence, promoting good health. The current literature suggests that Information and Communication Technologies (ICTs) can help developing countries in reducing maternal mortality and that there are existing information systems for maternal healthcare[15]. Findings from the literature have explained the various mobile apps which may be used for maternal education to support antenatal women who are socially disadvantaged[16]. There exist mHealth self-management apps for maternal health[17], however, it is important to understand the perspectives of women in low-resource settings towards the use of mHealth tools for self-management. The purpose of this study was to investigate the perceptions of women in low-resource settings on the use of mHealth tools for self-management. The findings could provide a new perspective on the use of mobile technologies for self-management during pregnancy in low-resource settings. The findings of this study provide researchers, mHealth app designers and developers, healthcare providers and practitioners with information on how to improve the design of mHealth solutions and interventions for women in low-resource settings to support self-management during pregnancy.

This paper is structured as follows: Related work is presented; then, the methodology and results are presented. Next, the discussion of the findings, conclusion and future work are presented.

2. Related Work

In a health system, there are specific standards that should be met. Goldstuck states that a "health system which does not meet the accepted norms can be called a low-resource setting"[18]. On the other hand, the term low-resource settings in relation to healthcare also indicate the lack of or limited resources to provide the necessary healthcare services within a specific geographic location. These resources could range from healthcare practitioners, healthcare facilities, medication and resources needed to provide care. In areas where there is a lack of healthcare resources, they can be described as low-resource settings[19, 12]. For example, in rural communities within Nigeria, there is a major challenge in terms of health facilities and resources which include a shortage of hospitals and clinics in these communities, and inadequate medical personnel[12].

mHealth has been defined by different authors, for example, Iyawa et al.[20] define mHealth as "the use of any mobile device including mobile phones, smartphones, mobile or phone-based sensors for providing and receiving healthcare services such as healthcare monitoring, diagnosis, management and prediction of diseases". The World Health Organisation[21] also defines mHealth as a "technology that is used to provide healthcare-related services via the use of mobile communication technologies such as PDAs, cell phones and tablets computers." These definitions suggest that mobile technologies can be included in the provision of healthcare services.

The focus of mHealth in this paper includes any type of mobile technology such as mobile phones, mobile applications, or text messaging in healthcare; however, for rural areas. mHealth has the potential to improve the level of service, provide productivity gains as well as reduce the cost of healthcare service delivery[22]. mHealth plays an important role in facilitating communication, accessing and updating information within the healthcare sector, therefore, the use of mHealth has great potential for patients and providers in the healthcare environment[23].

Mobile phone usage in sub-Saharan African countries has grown rapidly due to its availability and affordability with the usage of mobile phones[24]. The use of mobile phones has grown rapidly over the last decade, this is believed to have influenced the lives of people in developing countries, therefore, more recently, mobile phones are being adopted in different aspects of socioeconomic growth such as education and healthcare services[25]. Due to the high usage and acceptability of mobile phones among women in Nigeria as well as other developing countries, mHealth is used to provide healthcare services especially maternal healthcare[26]. Mobile phones are largely used among women in developing counties like Nigeria[14], hence, the potential in the use of mHealth to improve healthcare service delivery for women accessing maternal healthcare services in rural communities in northern Nigeria.

mHealth has been widely used for maternal health. These include mobile apps such as Winsenga[27] and Health e-Babaies[16].

Winsenga is a mobile application designed to monitor the heart rate of a foetus using a mobile phone[27]. This application is a technological extension of the Pinard Horn app that is used by many midwives in the rural areas to monitor foetus heart rate during pregnancy. The app is affordable which is aimed at increasing timely healthcare access to pregnant women in rural and remote communities, it is a bloodless and painless testing tool and it displays the results within two minutes.

Health e-Babies app which is an android based application for maternal health is aimed at providing health information about early pregnancy signs so as to increase confidence and reduce anxiety to expecting mothers. This application provides information on where to seek medical assistance (nearest health facility) in case of any complications during pregnancy[16].

Commcare mobile app is a mobile app developed to help community healthcare extension workers (CHEWs) in Nigeria, to provide maternal healthcare services to expecting mothers in urban areas[28]. This app provides guide CHEWs through antenatal care protocols and also captures patient data in real time[28]. This app has thirteen health education audio clips embedded so as improve and standardize client counselling[28].

Ezeanolue et al.[29] suggest that "Nigeria is Africa's largest mobile phone market with over 114 million users and high penetration of internet services through mobile networks". Therefore, the use of mHealth has the potential to improve maternal healthcare service delivery and reduce the death rate resulting from pregnancy-related issues in Nigeria. A mobile app for the maternal health framework was developed which is aimed at developing a mobile app that uses smart cards. Data was collected from the community, the data is then fed into a smart card and the smart card is then read through the use of a mobile phone-based app without the use of the internet. This helps healthcare givers have full information regarding their patients at the point of delivery which will help improve health outcome[29].

According to West[30], CliniPAK, a mobile application that uses touch screen tablets, was developed in Nigeria to assist medical practitioners in keeping track of their patient data. This app was not developed for women accessing maternal health, as such, is unable to as a self-management tool for women in rural communities.

3. Methodology

This study adopted a qualitative approach. Semi-structured interviews were conducted with ten women in a low-resource setting in northern Nigeria. Participants were purposively selected to include women above the age of 18, pregnant, could speak English and owned a mobile phone. For the purpose of pre-testing the interview questions, three interviews were conducted with participants not included in the actual interviews[35]. The pre-test interviews helped refine the questions used in the actual interviews[35].

The purpose and procedure of the study were presented to the women and they were told that their participation was voluntary and there would be no penalty if they decided not to take part in the study. They were also informed that they could withdraw from the interview at any time, their names and identities would not be collected and the findings will be used only for the purpose of the research. All the women agreed to take part in the study and they were asked to sign the informed consent form. With the permission of the women, the interviews were recorded and later transcribed. Each interview lasted approximately thirty minutes.

4. Results

4.1. Awareness of mHealth for self-management for pregnancy

The findings of the study showed that the majority of the participants were aware that mobile technologies could be used for self-management during pregnancy. The participants were asked to describe any known methods available to them with regards to using self-management mHealth tools for self-management during pregnancy. Half of the participants (5/10, 50%) were unaware of specific mHealth tools used for self-management during pregnancy. However, the remaining participants mentioned a diet app, using Google search engine to search for information and apps for exercises and workout, as well as getting information from a health worker. Some of the participants stated:

> *"I know there is an app that is used to guide women on certain types of exercises when they are pregnant"*

> *"I am aware of one app that people can download an application to help them to choose the right food when they are pregnant. Those things are nice, but I hardly use it because I cannot even afford that kind of diet."*

4.2. Perceived benefits of mHealth tools for self-management during pregnancy

Half of the participants who took part in this study did not explain which specific mHealth tools they could use for self-management; because they have not previously used mHealth tools for self-management. The majority of the participants believed that mHealth could provide benefits during pregnancy. The findings revealed that one benefit of mHealth tools for self-management is being able to limit the hospital visits and reduce the burden on healthcare workers. Some of the participants stated:

> *"It will be good if I can get information from my phone on how to do the basic things during pregnancy like food to eat when there is a problem, what is a normal sign and what is not a normal sign during pregnancy. I think working like that will be easier because I don't have to come to the hospital frequently and join the queue to get attention to small things. It will make life easy for the doctor and I."*

> *"If I can use my phone to manage my pregnancy, that would be fantastic, especially during the early stages where they are so many complaints. We don't have many nurses and doctors, and you wait for long to be attended to. If a mobile tool of any sort can be used to provide this basic information that will be good and it will not compile the load of doctors and nurses."*

The participants also believed that it could be used to provide useful tips to women in low-resource settings and save costs. Some of the participants explained:

> *"Women can be provided with very important information at their fingertips. This could be information about how their pregnancy is progressing, diet and exercise."*
>
> *"It can also save costs and expenses for us since we don't have to visit the hospital always, we only visit when it is critical or about to give birth. It will reduce the cost because we are not visiting all the time."*
>
> *"The mobile phones can be used to provide support, even the ones the doctor may have missed. So this can be very important for the pregnant woman."*

The participants also believed that it could be used to maintain a healthy lifestyle during pregnancy and educate women during pregnancy especially women pregnant for the first time. Some of the participants expressed:

> *"When women have mobile apps to support them at hand, it can help them maintain a healthy lifestyle during pregnancy, which is good for both the pregnant woman and her baby."*
>
> *"Some women need to get educated on pregnancy and what comes with it, sometimes they may forget when they leave the hospital after the doctor or nurse has explained, but with the self-management app, it is possible to stay up to date with the information on pregnancy. This important for women who are pregnant for the first time."*

4.3. Barriers to the adoption of mHealth tools for self-management during pregnancy

The participants highlighted various challenges which could hamper the adoption of mHealth tools for self-management during pregnancy which includes: erratic power supply, illiteracy, language, poor communications network, low access to data, lack of understanding of how to use specific app or technology, cultural beliefs and the lack of mobile technologies and mobile phone functionalities available to some women. The erratic power supply is a problem in Nigeria and this could affect the use of mobile phones since they may not have access to their phones when there is no electricity to charge the phones. Some of the women in low-resource settings may not understand English, so if these apps are only developed in English, most women will not be able to use it. The findings also revealed that due to illiteracy, some women may not be able to read the text even if they have to read the text but will follow instructions when it is sent as a voice message. Some of the participants believed that some women may not have access to smartphones that require them to download apps and many have cultural beliefs that do not support the use of mHealth tools for self-management during pregnancy. Some of the participants stated:

> *"I know it's good to use mobile phones to manage the health of a woman when she is pregnant, but this will work when women can charge their phones always and if there is no light this is not possible since the battery will be flat."*
>
> *"Power supply is bad here. In our area, sometimes no light for days and we cannot charge our phones, so it may affect us if we are using our phone to support our pregnancy."*
>
> *"Most women cannot even read text on their phone, but they can hear, if the information can allow for voice note instead, the people listen to what advice they are given so that they can do what they are asked in their language too."*
> *"It will be better if some women can receive the message in their language instead of English. I don't think those apps that use English will work for women who speak the local language."*

"Some women who don't know how to use that kind of app should be taught. Even when they have the phone, they will struggle to use it for this kind of thing."

4.4. Improving adoption and addressing the barriers of mHealth tools for self-management during pregnancy

The participants described various methods in which the use of mHealth tools for self-management during pregnancy can be improved to address the barriers of adopting such technology. The participants highlighted providing power banks to women in these environments to supplement power supply when power is off, ensuring that the apps are not data-intensive, providing easy apps that can be easily understood by women. Other adoption methods highlighted by the women include using voice messaging apps that limit the use of text, converting text to images, where women in these areas can easily understand, providing training to women in these areas, and educating women on the importance of self-management during pregnancy.

4.5. Preferred mHealth approach for self-management during pregnancy

The participants described various methods in which they would want mHealth to be used for self-management during pregnancy. The participants explained that they would prefer when their spouses are involved in the use of the app. One of the participants explained:

"It is very good when your husband can use mobile phones with you, so he understands how you are faring with the pregnancy."

The participants also explained that they would prefer mobile apps to help diagnose diseases and identify symptoms during pregnancy in the simplest way using a language they are familiar with. Some of the participants also explained that they would prefer apps with fewer tasks. Some participants indicated an interest in the use of apps that would help them monitor their health even after they have given birth, to identify any negative signs. Some of the women also preferred an app that does not require the use of the internet and apps that could help them check their vital signs and alert the doctor directly if there was a problem without them having to contact the doctor themselves.

5. Discussion

This study investigated the perspectives of women in low-resource settings towards the use of mHealth tools for self-management. The findings of the study provided new insights into barriers, preferred benefits and the preferred mHealth approach for self-management during pregnancy. To our knowledge, this is the first study that presents the findings on how women in low-resource settings perceived mHealth tools for self-management during pregnancy. This study contributes to the current literature on mHealth for self-management.

The results show that women in low-resource settings are aware of mHealth tools for self-management and are also open to using these technologies for self-management during pregnancy. This is contrary to other studies where mHealth has been designed to support healthcare workers providing support to patients in low-resource settings[31]. The perceived benefits of self-management mHealth tools during pregnancy are in line with the benefits of self-management apps identified in the literature which includes improved healthcare[32]. The findings also highlight fewer hospital visits as a potential benefit when adopting self-management during pregnancy. This finding is in contrast to the findings from other studies which suggest that using a self-management mobile app during pregnancy improved hospital attendance[33]. While it is possible that maintaining a healthy lifestyle could create fewer complications and less need to visit the hospital except during an appointment, mobile apps can help boost attendance, not because of complications but to maintain regular contact with the doctor.

The participants in this study highlighted the barriers to adopting mHealth in low-resource settings and they also provided solutions to mitigate these barriers which include providing power banks to women in low-resource settings. This could be a viable approach for local governments to provide power banks or cheaper ones in these areas to support the use of self-management mHealth apps. This also calls for the need to develop mobile technologies that utilise less electricity or devices that use solar power systems. This could support women in low-resource settings. It was

identified that language is a barrier to using mHealth apps for self-management and instructions should be presented in other languages using voice messaging for those who are illiterate. This approach is important in order to cater to a wide range of women using these apps.

Interestingly, the participants presented novel ideas such as designing an app that can be used by couples. This is necessary in order for couples to be able to get involved in managing the health of the expectant mother but there needs to be further research to investigate if the partners of pregnant women in this setting are willing to use these apps together with their spouses. Surprisingly, women in low-resource settings are also interested in diagnosis and communication with healthcare practitioners. This can be implemented using artificial intelligence techniques.

6. Conclusion

In summary, this study investigated the perceptions of women in low-resource settings on the use of mHealth tools for self-management during pregnancy; the findings were divided into five themes namely: awareness of mHealth for self-management, perceived benefits, barriers to adoption, improving adoption, the preferred approach for mHealth in low-resource settings. The findings of this study extended existing knowledge on the perception, design considerations, challenges and methods for improving adoption in terms of using mHealth technologies for self-management during pregnancy. The findings of this study provide researchers, mHealth app designers and developers, healthcare providers and practitioners with information on how to improve the design of mHealth solutions and interventions for women in low-resource settings to support self-management during pregnancy.

Although, the objective was met, the limitation of the study could be based on the number of participants who took part in the study. For future work, more participants can be included. Future work includes incorporating the findings of this study into the designing, development and evaluation of a mobile app for self-management during pregnancy for women in low-resource settings.

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