

Appraising the Knowledge of Nigerian Women on the Use of Mobile Health Applications

Babatunde Adeyeye¹, Obianuju Okeke², Stella Aririguzor³,
Tolulope Kayode-Adedeji⁴, Favour Nwantah⁵ and Nkem Osere⁶

¹Department of Mass Communication, Covenant University,
Ota, Ogun State, Nigeria/Indigenous Language Media in Africa Research Entity,
North-West University, Mafikeng Campus, South Africa

^{2, 3, 4, 5, 6} Department of Mass Communication, Covenant University,
Ota, Ogun State, Nigeria

E-mail: ¹<babatunde.adeyeye@covenantuniversity.edu.ng>,
²<obianuju.okekepgs@stu.cu.edu.ng>,
³<stella.aririguzoh@covenantuniversity.edu.ng>,
⁴<tolulope.kayode-adedeji@covenantuniversity.edu.ng>,
⁵<nwantah.nkiruka@covenantuniversity.edu.ng>,
⁶<nkem.osere@covenantuniversity.edu.ng>

KEYWORDS Awareness. Digital Health. Empowerment. Health Education. Mobile Health. Well-being

ABSTRACT This study appraises the awareness and usage patterns of mobile health (mHealth) applications among Nigerian women. Six Nigerian women from different locations participated in the focus group discussion (FGD), in which purposive sampling was used to get informed consent and record the participants' responses for analysis. The results showed different levels of awareness about mHealth, emphasising the need for more education to improve acceptance and understanding. Personalised medical counselling, better menstrual cycle management, and the promotion of general well-being were among the main benefits of mHealth. On the other hand, difficulties with device accessibility, connectivity, and possible over-dependency were mentioned. The study concluded that mHealth positively impacts women's health decisions and practices, emphasising the need for inclusive design, equitable access, and integrated care approaches to optimise mHealth implementation. These results emphasise the importance of focused efforts to address gaps and improve healthcare outcomes for Nigerian women through mHealth technologies.

INTRODUCTION

Nigeria has crucial healthcare challenges, such as poor infrastructure, limited access to services, and high maternal and infant death rates (Knop et al. 2024). Women, as primary caretakers, are disproportionately affected by these problems. Their health outcomes are intimately related to their ability to obtain timely and effective healthcare treatments. According to Statista (2024), Nigeria, a country of over 215 million people, faces numerous issues in its healthcare system. Despite being Africa's largest economy and an essential player in the region, the country's healthcare infrastructure is still inadequate, with a lack of medical facilities, equipment, and healthcare experts, particularly in rural and neglected areas (Kabongo et al. 2021; Omojola et al. 2021). This study will help to better understand the awareness levels and patterns of usage surrounding mHealth adoption among Nigerian women. It also aims to assess the unique difficulties and potentials surrounding mHealth

adoption among Nigerian women, which will help to improve healthcare access and outcomes for this crucial population segment.

A large proportion of the Nigerian population has limited access to quality healthcare services, compounded by poverty, geographical constraints, and a lack of understanding about available treatments (Lugard 2022; Ope 2020). This lack of access disproportionately impacts disadvantaged groups, such as women and children, who frequently face more significant barriers to receiving timely and effective healthcare. One of the most significant difficulties is Nigeria's high maternal and child death rates. According to a WHO (2023) report, from 2000-2020, it was recorded that 28.5 percent of global maternal deaths took place in Nigeria. This report further states that women in Nigeria have a 1 in 19-lifetime risk of dying during pregnancy, childbirth or postpartum, while in developed countries with access to quality healthcare services, it is 1 in 4900. Similarly, the country has one of the world's highest child mortality rates,

with an under-five death rate of 120 per 1,000 live births in 2019 (UNICEF 2021). These healthcare issues place a considerable strain on women, who are frequently the primary caretakers in families and communities. Their health results are heavily influenced by their ability to obtain timely and effective healthcare services, such as prenatal care, competent delivery attendance, and postnatal care.

Inadequate reproductive health services, restricted access to family planning tools, and cultural beliefs and behaviours can all exacerbate the issues that Nigerian women confront. Akingbade et al. (2022) opine that addressing these healthcare challenges requires a multifaceted approach that includes improvements to healthcare infrastructure, increased investment in training and retaining healthcare professionals, and the implementation of targeted interventions to improve women's and children's access to high-quality care. Furthermore, measures to empower women, promote gender equality, and remove socio-cultural barriers are critical to improving health outcomes for women and their families.

Gender gaps in accessing and making use of healthcare services continue to be a problem in Nigeria, with women suffering considerably more significant barriers than males (Ogundana et al. 2022; Kayode-Adedeji 2023). These gaps stem from a complex interaction of sociocultural, economic, and educational variables that create barriers and impede women's capacity to seek and receive necessary healthcare treatments. Cultural norms and traditional gender roles in Nigerian society frequently contribute to women's marginalisation in a variety of areas, including healthcare. Deeply ingrained patriarchal beliefs and practices, such as the requirement for women to seek permission from their husbands or male relatives before seeking healthcare facilities, can limit their autonomy and ability to make decisions about their health (Ajayi et al. 2021; Development Research and Projects Centre 2023; Mensah 2023).

Economic constraints also significantly limit women's access to healthcare. A 2019 poll by NOI Polls identified a lack of financial empowerment (42%) and poverty (35%) as the top challenges faced by women in Nigeria. Poverty, which significantly impacts women in Nigeria, can make it difficult for them to afford the costs of getting medical care, such as transportation, consultation fees, and prescriptions (Okoli et al. 2020; Development Re-

search and Projects Centre 2023). Furthermore, women's limited economic options and lack of financial independence might compound these issues. Another barrier affecting Nigerian women's health-seeking behaviours is education. Low literacy rates and limited access to information about accessible healthcare services can impede women's awareness and comprehension of the significance of getting timely and adequate medical care. Furthermore, inadequate health education and a lack of information about preventative measures might lead to delays in seeking care or reliance on outdated, ineffective, or safe techniques (Adeosun and Owolabi 2021).

These restrictions have far-reaching implications for women's well-being in Nigeria. They can cause delays in seeking care, late diagnosis, and inadequate treatment for a wide range of health concerns, including maternity and reproductive health difficulties, noncommunicable illnesses, and infectious infections. Finally, discrepancies in healthcare utilisation led to increased morbidity and mortality rates among Nigerian women (Belay et al. 2024). Addressing gender gaps necessitates a multidimensional approach that addresses the underlying sociocultural, economic, and educational issues. Efforts to promote gender equality, empower women, and expand their educational and economic possibilities are critical. Targeted interventions to raise awareness, provide culturally relevant healthcare services, and remove financial barriers can also assist Nigerian women in improving their health-seeking habits and access to essential healthcare services (Ezenwaka et al. 2021; Lugard 2022).

The global adoption of mobile health (mHealth) technology has increased significantly in recent years. mHealth, or the use of mobile devices and applications for healthcare delivery, has emerged as an effective method for addressing various healthcare concerns, particularly in areas with limited access to traditional healthcare services (Ajegbile 2023; Goel and Taneja 2023; Hong 2024). Studies worldwide have shown that mHealth applications can improve patient engagement, promote preventative care, and empower individuals to participate actively in their health management. These applications include a variety of abilities, such as remote monitoring, individualised health tracking, disease management support, and access to instructional materials (Okolo et al. 2024.)

One of the primary advantages of mHealth is its ability to extend beyond geographic

boundaries and reach disadvantaged populations. By taking advantage of the broad availability of mobile devices, mHealth applications can provide access to healthcare information, facilitate communication with healthcare practitioners, and enable remote consultations, thereby closing the healthcare access gap. Furthermore, mHealth solutions have demonstrated efficacy in promoting preventative care and encouraging healthy habits. These programs, which include tailored reminders, goal-setting features, and real-time tracking of health indicators, might encourage people to adopt and maintain healthy lifestyles, potentially lowering the burden of preventable diseases and associated expenses (Adeyeye et al. 2023; Staszak et al. 2021; Orte et al. 2023).

Nigeria is well-positioned to gain from the implementation of mHealth technological developments. With increasing smartphone usage and developing digital infrastructure, the groundwork for mHealth adoption is being established. According to Statista (2024), smartphone usage in Nigeria has grown at an impressive rate. In 2015, barely 10 percent of Nigerians had access to smartphones. By 2020, this figure had increased to 39.5 percent, with a compound annual growth rate (CAGR) of 32.5 percent. With this trajectory, Nigeria's smartphone penetration will reach 55.4 percent by 2025. Fayehun et al. (2020), Babatunde et al. (2021) and Aimuengheuwa (2023), opine that Nigerians' increased access to and use of smartphones can help Nigeria address some of its healthcare challenges by adopting mHealth technologies, therefore addressing issues such as inadequate infrastructure, limited access to healthcare services, and the need for preventative care and health education. mHealth applications can serve as a beneficial solution, encouraging individuals to take an active role in their health management while also assisting healthcare practitioners in providing more efficient and accessible care.

Despite the potential benefits of mHealth, more studies must be conducted on its adoption and utilisation among Nigerian women. This knowledge gap is especially concerning considering gender disparities in healthcare access and outcomes. Women frequently encounter constraints and problems that affect their capacity to accept and effectively use mHealth technologies, especially in Nigeria (Udenigwe et al. 2022). This study aims to fill

this research vacuum by giving essential and personal insights into Nigerian women's knowledge, experiences, preferences, and obstacles regarding mHealth applications. By investigating their perspectives, motives, and barriers, this study will offer knowledge on the factors influencing their willingness and ability to use mHealth solutions to obtain healthcare services, control their health, and boost overall well-being.

Existing research sometimes lacks a gender-specific lens or fails to consider the sociocultural elements influencing women's experiences with digital health technologies (Acilar and Sæbø 2021). This study aims to fill this gap by investigating mHealth adoption from the eyes of Nigerian women, considering their unique sociocultural conditions. Specifically, this research investigates Nigerian women's awareness of mHealth applications and usage patterns, explores the factors influencing mHealth adoption among Nigerian women, and assesses the impact of mHealth on women's health outcomes.

Objectives of the Study

This research aims to address the following specific objectives as it concerns appraising mHealth knowledge among Nigerian women:

1. To investigate the level of awareness among Nigerian women regarding mHealth applications and their usage patterns.
2. To explore the factors that influence the adoption of mHealth applications by Nigerian women.
3. To assess the impact of mHealth applications on the health outcomes of Nigerian women.

Theoretical Framework

To attain the research objectives stated in the previous section, this study adopts the Technology Acceptance Model (TAM) and Gender and Technology Adoption Theories (GTAT). The Technology Acceptance Model (TAM) is a well-known theory that posits that an individual's intention to use technology is primarily driven by two fundamental factors, that is, perceived usefulness and perceived ease of use (Sheppard and Vibert 2019). In this study, perceived usefulness refers to Nigerian women's belief that mHealth apps will improve

their abilities to manage their health and obtain healthcare services. On the other hand, perceived ease of use refers to how users consider mHealth apps to be easy to use and understand. Using TAM, this study examines how these two elements influence Nigerian women's perceptions of mHealth apps and their behavioural intention to use these technologies. Furthermore, TAM enables the investigation of external variables that may influence perceived usefulness and convenience of use, such as sociocultural norms, literacy levels, and technological hurdles.

GTAT theories highlight potential inequalities in men's and women's perceptions, attitudes, and behaviours toward technological advances. Relevant theories include the Gender Socialisation Theory, which proposes that societal gender roles and norms can influence people's interests, motivations, and self-efficacy beliefs in technology. Furthermore, the Gender and Technology Theory suggests that gender differences in technology adoption are caused by factors such as access to resources, perceived significance, and cultural effects. By taking these theoretical viewpoints into account, this study will be able to investigate how gender-specific factors such as cultural attitudes, education levels, and economic restrictions influence Nigerian women's adoption and use of mHealth apps.

Several theories shed light on the gender-specific factors that may influence technology adoption, which is pertinent to this research on Nigerian women and the adoption of mHealth.

The Gender Socialisation Theory proposes that societal gender roles and norms impact people's interests, motives, and self-efficacy views about technology from a young age. In Nigeria, cultural norms and conventional gender roles may influence women's perceptions of mHealth apps' importance and confidence in utilising them.

The Gender and Technology Theory suggests that gender differences in technology adoption are caused by factors such as access to resources, perceived relevance, and cultural influences. Economic constraints, poor knowledge, and societal attitudes may all impact Nigerian women's access to and perceptions of the significance of mHealth apps, influencing adoption decisions.

The Intersectionality Theory posits that individuals face various intersecting kinds of oppression or privilege due to their overlapping identi-

ties, such as gender, race, class, and age. In Nigeria, the intersectionality of gender, socioeconomic level, and educational achievement may present distinct challenges or facilitators to women's adoption of mHealth technologies.

MATERIAL AND METHODS

This study aims to understand better how Nigerian women adopt and relate to mobile health applications and their uses, barriers, challenges, and prospects for improvements.

This study's focus group discussion (FGD) approach is an excellent choice for many reasons. Focus Group Discussions are a widely acknowledged qualitative research technique that entails carefully prepared discussions to gather perceptions and thoughts from a group of people on a specific topic (Khan and Abedin 2022). This method is beneficial for investigating multifaceted topics, attitudes, actions, and motivations that are difficult to capture using conventional data collection methods (Lander et al. 2023).

Regarding understanding mHealth adoption among Nigerian women, the focus group discussion method has various advantages. First, it allows for an in-depth analysis of the lived experiences, perspectives, and barriers Nigerian women face when using mobile health technologies. The interactive group environment encourages participants to freely discuss their ideas, feelings, and opinions, resulting in rich, contextual data that may not be available using other methods (Akingbade et al. 2022). Furthermore, a purposeful selection of participants through a social media poll and an additional form to gather their personal information ensures the inclusion of a wide range of opinions and experiences. This sampling technique is consistent with the principles of qualitative research, which highlight the significance of obtaining a variety of perspectives and understanding the multifaceted nature of the phenomenon under examination (Yadav 2022). By including individuals from various backgrounds and experiences, the study is better positioned to reveal the complexities and nuances of mHealth adoption among Nigerian women.

The focus group discussion method is also appropriate for discussing sensitive or personal issues since the group dynamic can foster a supportive and comfortable environment where indi-

viduals can share their experiences (Sim and Waterfield 2019). This is especially important in mHealth adoption, where concerns like privacy, trust, and access to technology might be sensitive or regarded as stigmatising. Furthermore, the FGD approach makes it possible to investigate group dynamics and social interactions, which can provide essential insights into the social and cultural aspects driving mHealth app adoption, especially among Nigerian women, which is the case of this study (Aririguzoh 2022; Scheelbeek et al. 2020). Future researchers can better understand the shared beliefs, norms, and values that impact people's attitudes and behaviours towards adopting mHealth by studying their interactions and exchanging ideas.

Overall, this study's focus group discussion method is justifiable and consistent with known qualitative research methods. This method enables the collection of rich, contextual data, captures multiple viewpoints, allows for the study of sensitive themes, and sheds light on the social and cultural variables driving mHealth adoption among Nigerian women.

Data

For this study, six women were chosen from various locations in Nigeria, including Lagos, Abuja, Ogun, and Oyo states. This purposive sampling technique is consistent with qualitative research principles, which highlight the need to gather various opinions and experiences to thoroughly understand the topic under inquiry (Patton 2014).

The focus group discussion (FGD) was conducted using Zoom, a video conferencing technology, which enabled the selected women from various locations in Nigeria to participate. The use of a virtual method enabled the participation of various participants, overcoming geographical barriers and administrative limitations (Tang et al. 2024). With the participants' permission, the focus group discussion session was recorded, allowing the researchers to document the conversations and make transcription and analysis easier later.

Transcribing the recorded focus group discussion session is a crucial step in qualitative data analysis, as it allows for a detailed examination of the discussions and facilitates the identification of emerging themes and patterns (McLellan et al. 2003). The transcripts are a comprehensive record

of the participant's responses, enabling the researchers to thoroughly analyse the data and draw well-supported conclusions.

Six participants were introduced to the focus group discussion for this study, and informed consent was sought. Using a pre-prepared discussion guide to provide better organisation and regulation, the virtual focus group discussion (FGD) session was conducted via Zoom and lasted for around one and a half hours. As moderators, the researchers ensured everyone was respected and the conversation flowed easily. The participants were encouraged to appreciate different viewpoints, speak freely, and openly share their thoughts. Clarifications were asked when remarks or comments were unclear to ensure appropriate interpretation and comprehension of the participants' responses.

RESULTS

This study's focus group discussion (FGD) explored the experiences and perspectives of women aged 20 to 45, purposively selected from Lagos, Nigeria, regarding mHealth app's adoption. Excerpts from this focus group discussion highlight the vital thematic areas assessed, offering insights into the cultural beliefs, attitudes, and factors influencing mHealth acceptance and use among this demographic.

Knowledge, Awareness, and Patterns of Usage of mHealth Technologies

The responses from the six participants provide valuable insights into their knowledge and experiences with different types of mobile health (mHealth) technologies and their features and capabilities.

Respondent D demonstrated a good understanding of mHealth technologies, highlighting various platforms such as mobile applications and websites. They mentioned several key features and capabilities, including virtual consultations with healthcare professionals, symptom tracking, and referrals to nearby pharmacies. Respondent D provided specific examples of mHealth apps they are familiar with, such as Flo, a popular menstrual-tracking application.

"I have much knowledge of mobile health technology and its applications. Sometimes, they are not just apps; sometimes, they are websites you

can easily visit. For capabilities, I know of some that can give a free consultation where you can speak to a virtual doctor. They have subscriptions, and when you have issues, you can describe your symptoms, and it would explain them to you. Some can connect you to a real doctor. You can book a virtual session with an actual doctor from any hospital to which the mHealth company is subscribed. Another example I know is the Flo app, just like the other person mentioned. Flo app is another mobile health application. Then, some others also direct you to pharmacies that are close to you. Those are the types that I know of.”

Respondent C’s knowledge and usage of mHealth technologies appeared more limited. Their experience centred around using a period-tracking app called “My Calendar” to monitor their menstrual cycle and associated symptoms. Respondent C expressed uncertainty about whether their health insurance provider’s mobile app, Reliance Health Maintenance Organisation (HMO), could be classified as a mHealth technology, indicating a potential gap in their understanding of the broader mHealth landscape.

“I do not use my mobile health apps much except to track my menstrual period. I do not know if Reliance HMO, which we use in Nigeria, can also be classified as a type of mHealth technology because when I started using it, it connected me to the hospital I used the last time I had health issues. It was from the hospital. I was referred to another one to see a specialist. So, I do not know if the Reliance HMO mobile app can also be categorised as one. My Calendar has been helpful as it has helped me keep track of my period for more than three years, so I know when my period is meant to come and when it is late. I keep notes on the app too, so it can recommend reasons why my period came late, what could help, things to take for period pain relief, etc. It has helped me keep a record of my period for a very long time, and it has been helpful to me. I remember the doctor arguing with me, and I brought my app to show him how I had been keeping track for years.”

Respondent A demonstrated an in-depth knowledge of the Flo app’s features and capabilities, highlighting its period tracking, ovulation prediction, and ability to log sexual activity. They also mentioned free features like reminders for daily tasks like drinking water. Respondent A’s long-

term use of the app allowed it to personalise recommendations based on their menstrual patterns.

“The app I use most is the Flo app, and I have been using it for a while. Apart from just using it to track my period and everything, there are so many other features that you can use that are free for now. Some features that are still free are when you want to track your period, you can also set a timer for something to be doing every day like I set one to drink water, you can also log in if you have had sex, both protected and unprotected. There are so many features there, so when your period is late, it tells you why your period is late and ‘these are some of the possible reasons based on what you have given us why your period is late’. My Flo app already knows how regular my periods are because I have been logging it for a while. It also goes into more detail to say these are your prime ovulation times and other things.”

Respondent B’s knowledge of mHealth technologies appeared limited, as they only recently began using them around May 2023. Their experience was primarily focused on tracking general health metrics like walking distance and menstrual flow, indicating a more fundamental level of familiarity with mHealth app features.

“I found out about all mHealth technology around May 2023, and that was when I started using them, so I cannot say I can use them for anything specific other than checking my walk distance, general health, or menstrual flow.”

Awareness of mHealth Available in Nigeria

The responses from the participants show different levels of awareness regarding mHealth technologies available in Nigeria. Respondents mentioned several apps, including period tracking apps like Flo and My Calendar, health insurance apps like Avon HMO and Hajiya HMO, Better Health for consultations and therapy, and fitness apps like those on iPhones and Samsung devices. However, some respondents, such as Respondent A, expressed limited knowledge and were only aware of the Flo app. Respondent C mentioned an app healthcare providers use to track patient visits but was uncertain about its name or if it qualifies as a mHealth technology.

Respondent A said, “I do not know of any other mobile health-related application as it is only the Flo app I know and use.”

Respondent B, said “Apart from My Calendar app, there are my HMO apps, like Avon Hmo and Hajiya Hmo apps, then Flo app, Better Health. A hospital owns Better Health and has services where you can speak to a therapist, book a consultation or talk to a therapist online.”

Respondent D mentioned, “I am aware of the Flo app and the fitness app on the iPhone, which is connected to my watch.”

Respondent C said, “The one I use is My Calendar, and I do not know if the Reliance HMO app can also be categorised as a mHealth technology. Moreover, there is this one they use at the hospital I was using that helps you keep track of your visits to the hospital and details of the visits. However, it is between the doctors, who do not share it with the patients...”

Respondent E said, “I have only used the Flo app, and the fitness app on Samsung devices (Samsung Health) is all I have used. I cannot remember if I have used My Calendar app before, though I think I have used it before, so I am unsure.”

The responses suggest a limited awareness of mHealth features beyond period tracking and fitness apps. Respondents seemed more familiar with apps related to their health management but lacked comprehensive knowledge of the broader range of mHealth solutions available in Nigeria.

Frequency of Use of mHealth Technology

The responses indicate different frequencies of mHealth technology usage among the respondents. Respondents C and F reported using period-tracking apps like My Calendar and Flo almost daily or regularly to monitor menstrual cycles, ovulation, and discomfort or symptoms. Respondent E also mentioned using Flo to track ovulation and menstrual cycles, although less frequently.

Respondent C mentioned, “Almost every day, because I am always with my phone, so one thing leads to the other, and once I feel any discomfort, I go to my app to check... I go to My calendar app and put in what I feel to know if it is related to any pre-, post-, or ovulation symptoms or any pre-, post-, or period symptoms.”

Respondent F said, “Someone mentioned the i-fitness app, which I was talking about on my phone. I use it daily to track my steps and my physical fitness... The Flo app, I do not use it every day. I use it at intervals when I have done something that

makes me want to log in there, or when I feel my menstrual period is about to come, or if I feel some way, I will check. Alternatively, when I am about to go into ovulation period, I use the app.”

Respondent E said, “It has been a while since I have used Flo, but I use the fitness app on my phone to track daily steps... Then, I do not use Flo often, but it generally helps track my ovulation period and menstrual cycle. I also use fitness to check my stress levels, heart rate, and other things. So, I use it almost every day.”

Fitness and health tracking apps, such as those on iPhones and Samsung devices, were reported to be used more frequently, with Respondents F and E stating daily usage to track steps, physical activity, stress levels, and heart rate. However, some respondents like D and B reported less frequent usage of fitness apps, ranging from once every two weeks to monthly, respectively. Respondent D also mentioned using an HMO app once a month or when seeking a nearby doctor.

Respondent D said, “I just use my Samsung Health on my phone, but I do not use the fitness app for much. Only occasionally, maybe once in 2 weeks. Moreover, for my HMO app, it is only when I have issues and I am trying to find a doctor close to me. So that is also maybe once a month or so.”

Respondent B said, “For my fitness app, I use it every day because they send me notifications, and I have to check... However, for the Flo app, I would say I use it monthly to track ovulation, period and whatnot, but that is all.”

The responses suggest that while period tracking apps and fitness/health tracking apps are commonly used, the frequency of usage varies based on individual needs and preferences. Period-tracking apps tend to be used more regularly by those actively monitoring their menstrual cycles and reproductive health. In contrast, those prioritising daily physical activity tracking use fitness apps more consistently.

Advantages of mHealth for Nigerian Women

The respondents highlighted several vital advantages of using mHealth technologies in Nigeria. Period tracking apps like Flo and My Calendar were mentioned for their ability to accurately track menstrual cycles, provide reminders and notifications about upcoming periods and fertile windows, and maintain long-term records of menstrual histo-

ry. This alleviated the burden of manual calculations and forgetting important dates, making it easier to communicate with healthcare providers. Fitness and health-tracking apps were mentioned to motivate the respondents to improve their fitness levels, monitor daily steps and activity, and identify areas for improvement in their diets and overall wellness. The apps provided helpful insights and encouraged positive lifestyle changes.

According to Respondent A, "Some of the advantages I have experienced would be my fitness and the promptness and the push it gives me to be better and to do better honestly. That is for the fitness app. For the Flo app, it is essential for me because it helps me. I can go as far back as how many years to see when I had my period on such a date... It relieves the burden of calculations and calendar checking that our parents and grandparents want us to do... It is also the fact that I can get free advice on what to do better and what helps better."

Respondent C said, "I only use the My Calendar app... As far as 2018, this is the third phone I am using, and I still have my period tracks/records... It notifies me to back up my record from month to month so I do not lose my progress... Moreover, every time I am asked at the hospital when my last period was, I check it on my phone because there are so many things to think of... It helps relieve the burden of thinking of when my last menstrual period was."

Respondent B said, "I would say I majorly experienced its advantage for my period flow... way before I even found out about Flo app, I was one of those lackadaisical people who were not so concerned about when you are having your period, ovulation, and when it comes it comes...the Flo app gives notification six days before your period and when your period is late too, it gives symptoms and signs and gives suggestions on what could be wrong. The fitness app helped me know places I am lacking in, like adding minerals and more protein to my diet or focusing on my calories. It did change my life."

Also, virtual consultations offered through mHealth platforms were seen as convenient, saving respondents from unnecessary trips to the doctor's office and avoiding potential discomfort or embarrassment during in-person consultations. Additionally, HMO apps helped respondents locate nearby hospitals and healthcare facilities,

streamlining the process of finding medical services and saving time and effort.

Respondent D said, "I would say the app saves me a trip to the doctor because I can have a virtual consultation on the spot, and I do not have to look into their faces and feel guilty when they ask funny questions. Second, I can find the nearest hospital using my HMO app. It relieves me of having to go to all the hospitals individually to find a doctor or something."

Respondent F said, "For me, it has also helped in tracking my menstrual cycle, and I was also complacent and lackadaisical about the whole thing. Moreover, sometimes, it would catch me unaware, so I loved that the period tracking app was accurate. It also helps me remember my last period date and to calculate my menstrual cycle. My fitness app helps me keep track of my daily steps. The first time I found out about it, there was excitement about keeping up with the daily goal, and it encouraged me to take long walks and inadvertently keep fit."

Drawbacks of mHealth for Nigerian Women

The respondents identified several drawbacks associated with using mHealth technologies in Nigeria. Respondent B highlighted the need for an internet connection and the limitation of many mHealth apps accessible only on smartphones, which could exclude individuals without access to these resources. Additionally, there was a concern that relying too heavily on mHealth apps for home remedies and symptom management could lead to neglecting in-person medical checkups.

Respondent B said, "The first drawback would be a lack of internet connection. Because without it, the apps are as good as useless. Many also only work with smartphones, so it is limited to those with smartphones. Also, it could make a person lazy because you stop going for physical checkups. After all, they have some to give you home remedies for your symptoms."

Respondent C pointed out a specific drawback with the Flo app, which requires manual input of the start date for each menstrual cycle rather than automating the process based on previously entered data. This manual data entry requirement can be problematic for individuals who are forgetful or too busy to consistently log their periods, leading to inaccurate tracking and recommendations from the app.

Respondent C said, “I would say personally, one of the setbacks of the Flo app is the fact you would have to log in to the app to manually set a date when your period starts instead of being automated given your previously inputted trends, especially for people who are lackadaisical about recording their periods. It happened to me twice when I was too stressed to open the app to click on when my period started for the rest of the days to calculate. I had finished the entire period cycle, and two weeks later, I remembered that I had not clicked it, and I feel like that is a major disadvantage for the app, unlike the fitness apps that give updates no matter what.”

These respondents touched on issues related to accessibility, limitations of technology, and the potential for overreliance on mHealth solutions at the expense of professional medical care. These drawbacks highlight the need for ongoing improvements in mHealth app design, internet infrastructure, and user education to ensure responsible and effective utilisation of these technologies, especially in Nigeria.

The Impact of mHealth Adoption on Nigerian Women’s Health Outcomes

The respondents mentioned several impacts of mHealth adoption on Nigerian women’s health outcomes. Respondent C emphasised the benefits of using period tracking apps to plan sexual activity and avoid unwanted pregnancy, as well as receive personalised recommendations for diet and exercise before and during menstrual cycles. This has improved her overall menstrual health management.

Respondent C said, “It helps me keep track of things I am not supposed to do on specific days. I do not have coital activities on some days with my boyfriend to avoid pregnancy. Nobody wants to risk that. My eating habits, when it comes to a few days before or after my period, what I am meant to eat and not eat because before, I did not care and did not even know when my period was coming. However, now the app notifies me about three days before my period. Because of some information I gave on the app about how I feel, when I eat some things, it would tell me to cut back on those things and advise me on what to take to feel relieved and refreshed five days after my period. And pre-period exercises. I did not know those were a thing till the app.”

Respondent D mentioned a potential reduction in doctor visits, although unsure if it was directly attributable to mHealth adoption. This could suggest either improved self-care through mHealth apps or a potential overreliance on them at the expense of professional medical consultations.

Respondent D mentioned, “For me, how has my behaviour changed? I would say, I do not know if this is a consequence of the app, but I do not think I have been to a doctor’s place in two years.”

Respondent A noted that mHealth apps have positively impacted their water intake, hormonal balance, and period regularity through personalised tracking, notifications, and recommendations. The apps have provided valuable insights into their bodily changes, enabling proactive measures to maintain optimal health.

Respondent A said, “The impact of mHealth adoption for me is that it helps me with water intake as it reminds me to drink water daily, and it tells me the prime times when I am not supposed to do some things. It also helps me to know when something is off with my body or my period like when my hormones start to fluctuate, I know that something is wrong. It also gives me advice on how to get back on track and sort that out. The information it gives me has helped to improve my life. It has also helped to improve my period balance, so my period is more regular because I am watching it, tracking it, and eating things that are beneficial to me.”

Overall, the responses indicate that mHealth adoption has empowered Nigerian women to take control of their menstrual health, make informed decisions about sexual activity and pregnancy prevention, and improve their overall well-being through personalised diet, exercise, and self-care recommendations. However, the potential overreliance on mHealth apps highlighted by Respondent D raises concerns about the need for a balanced approach that includes professional medical consultations when necessary.

DISCUSSION

The FGD shows different levels of awareness and knowledge about mHealth technologies among Nigerian women. While some participants fully understood different mHealth platforms, features, and capabilities, others exhibited limited knowledge, primarily focused on period-tracking

and fitness apps. This suggests a need for increased awareness and education efforts to ensure a broader understanding and adoption of the diverse range of mHealth services available in Nigeria. Adebayo et al. (2022) and Olonade et al. (2019) corroborated the need for increased awareness and education, as it relates to mHealth services in Nigeria by examining mobile health (mHealth) literacy and the use of mHealth apps for reproductive health services among young people in Nigeria. The study supports the claim that while some Nigerians are familiar with period/fitness tracking apps, knowledge of the broader mHealth landscape is limited, highlighting the need for improved mHealth awareness and education initiatives.

A multifaceted strategy must be adopted to efficiently assess and improve the knowledge and utilisation of mHealth applications among Nigerian women. On the one hand, better awareness campaigns and educational programs could help bridge the knowledge gap and introduce women to the different health services that are accessible to them. To reach the target audience, these initiatives should use different communication platforms, such as digital and traditional media, community outreach initiatives, and collaborations with women's organisations and healthcare professionals. Pantoja et al. (2017) and Amodu et al. (2019) suggested the different ways the Internet can encourage public relations efforts, even in countries like Nigeria, where Internet penetration is still growing. This study aligns with the need to adopt a strategy that helps build better awareness campaigns and educational programs for mHealth.

Regarding the frequency of use, period-tracking apps like Flo and My Calendar were reported to be used more regularly, especially by women actively monitoring their menstrual cycles and reproductive health. Fitness and health-tracking apps were also commonly used, with some participants reporting daily usage to monitor physical activity, stress levels, and overall wellness. However, the frequency of usage varied based on individual needs and preferences, highlighting the importance of tailoring mHealth solutions to cater to diverse user requirements. This finding resonates with the study by Adekunle et al. (2021), who found that the most used mHealth apps were fitness tracking and health monitoring. Also, there was a need to develop mHealth to address the different needs of people and enhance usability and sustainability.

This means that the development and implementation of mHealth apps should prioritise user-centred design concepts, and feedback from the target population must be considered. By actively including Nigerian women in the design process and customising the solutions to their needs, situations, and cultural contexts, mHealth applications are more likely to resonate with users, leading to increased adoption and continued usage. Supportive efforts involving government agencies, telecom companies, media houses and technology providers can help overcome these barriers and create an environment for the widespread adoption of mHealth apps among Nigerian women.

The participants identified several benefits of mHealth adoption, including accurate menstrual cycle tracking, reminders for fertile windows and upcoming periods, long-term record-keeping of menstrual history, motivation for improved fitness levels, convenient virtual consultations, and easy access to nearby healthcare facilities through Health Maintenance Organisation (HMO) apps. These benefits have empowered women to take control of their menstrual health, fitness, and overall well-being while receiving convenient access to medical advice and resources. Despite the advantages, the respondents also highlighted drawbacks such as the need for an internet connection and access to smartphones, the potential for overreliance on mHealth apps at the expense of in-person medical checkups, and the manual data entry requirements of some apps, which could lead to inaccurate tracking if not consistently updated. These drawbacks emphasise the need for ongoing improvements in mHealth app design, internet infrastructure, and user education to ensure responsible and effective utilisation of these technologies. The above finding reinforces the opinions of Zakerabasali et al. (2021) and Nmadu et al. (2020) on the systemic barriers to adopting mHealth technology.

Furthermore, the ease of virtual consultations and quick access to local healthcare facilities through HMO apps corresponds with the observations of Aljohani and Chandran (2021), who mentioned the potential of mHealth apps to improve geographical barriers and improve access to healthcare services in rural and marginalised areas of Nigeria. However, the barriers identified, such as the need for access to the internet, access to smartphones, the risk of overreliance on mHealth apps over the face-to-face medical checkups, and

the manual data entry requirements, are similar to concerns raised in the study by Zakerabasali et al. (2021). Several studies have observed the benefits and limitations related to adopting and implementing mHealth applications, especially in developing countries like Nigeria. The observed benefits, such as accurate menstrual cycle tracking, timely reminders for fertile windows and periods, continuous documentation, and increased fitness levels, align with the results from the study by Jennings and Gagliardi (2013). These studies have shown that mHealth apps can empower women by allowing them to take control of their reproductive health and overall well-being.

More research by Adum and Mozie (2020) also investigated the role of user education and awareness campaigns in encouraging Nigerian women to use mHealth apps. Their findings mentioned the significance of addressing the knowledge gap and promoting a better understanding of the proper use and limitations of these mHealth apps. Examining the observations and results within the context of these recent studies, it becomes clear that while mHealth apps have numerous benefits for Nigerian women in terms of empowerment, convenience, and access to healthcare resources, notable challenges must be addressed. Continuous efforts are needed to improve internet infrastructure, digital literacy, and user education to ensure the responsible and efficient use of mHealth apps. Additionally, a cooperative approach involving mHealth app developers, decision-makers, healthcare providers, policymakers, and users is needed to design and implement gender-responsive mHealth apps that resonate with Nigerian women's cultural and contextual needs.

Notably, the participants reported positive impacts of mHealth adoption on Nigerian women's health outcomes. The apps facilitated informed decision-making about sexual activity and pregnancy prevention, provided personalised recommendations for diet and exercise during menstrual cycles, and improved overall menstrual health management. Additionally, mHealth adoption contributed to improved water intake, hormonal balance, and period regularity through personalised tracking, notifications, and recommendations. This discussion aligns with Choe et al. (2021) on the potential of mHealth technology to improve health outcomes amongst its users.

However, one respondent mentioned a potential reduction in doctor visits, although unsure if it was directly attributable to mHealth adoption. This highlights the need for a balanced approach that integrates mHealth solutions with professional medical consultations when necessary to ensure comprehensive and holistic healthcare management. Overall, the focus group discussion results suggest that mHealth adoption has the potential to empower Nigerian women in managing their menstrual health, fitness, and overall well-being while also highlighting areas for improvement in terms of accessibility, user education, and responsible integration with traditional healthcare services. This final discussion resonates with the opinions discussed by Ajuebor et al. (2020) and Mishra et al. (2023), emphasising and exploring the potential impact of mHealth interventions in low- and middle-income countries. However, the study also emphasises the need for a balanced approach that includes mHealth apps with professional medical consultations when necessary, aligning with the concerns raised by a respondent about the potential reduction in doctor visits.

In conclusion, the FGD results are also in line with recent studies that highlight the potential of mHealth apps in empowering Nigerian women to take better control of their health and well-being. They also highlight the significance of a comprehensive approach that addresses challenges related to accessibility, user education, and integration with traditional healthcare services. Addressing these challenges by including collaborative efforts, stakeholders, and evidence-based strategies, mHealth apps can help greatly improve healthcare access and outcomes for Nigerian women across various socioeconomic and geographical settings.

CONCLUSION

The discussion revealed varying awareness and knowledge about mHealth apps among Nigerian women, highlighting the need for increased awareness and education efforts, especially in Nigeria. Period-tracking and fitness/health-tracking apps were commonly used, with usage frequency varying based on individual needs. Participants identified advantages such as accurate menstrual cycle tracking, reminders, long-term record-keeping, motivation for improved fitness, convenient virtual consultations, and easy access to nearby healthcare facilities.

However, drawbacks like the need for internet connectivity, smartphone access, potential over-reliance on mHealth apps, and manual data entry requirements were also highlighted. Notably, mHealth adoption positively impacted Nigerian women's health outcomes by facilitating informed decision-making, providing personalised recommendations, and improving overall menstrual health management, water intake, hormonal balance, and period regularity.

To optimise the potential advantages of mHealth solutions for Nigerian women across diverse socioeconomic and geographic contexts, it would be important to tackle the barriers through focused awareness campaigns, user education, and stakeholder collaboration.

RECOMMENDATIONS

Based on the findings and conclusions, it is recommended that targeted awareness and education campaigns be implemented to increase Nigerian women's knowledge and understanding of the diverse mHealth services available. Additionally, mHealth app developers should adopt a user-centred design approach incorporating Nigerian women's unique needs, preferences, and cultural contexts. Accessibility barriers should be addressed by promoting affordable and reliable internet connectivity and enhancing access to smartphones or alternative mobile devices capable of running mHealth apps. Furthermore, mechanisms for continuous monitoring and evaluation of mHealth interventions targeting Nigerian women should be implemented to inform iterative improvements and the development of more effective and sustainable mHealth solutions.

ACKNOWLEDGEMENTS

The researchers appreciate the Covenant University Centre for Research, Innovation and Discovery (CUCRID) for the financial support for this publication.

REFERENCES

- Acilar A, Sæbø Ø 2021. Towards understanding the gender digital divide: A systematic literature review. *Global Knowledge, Memory and Communication*, (ahead-of-print). <https://doi.org/10.1108/gkmc-09-2021-0147>
- Adebayo AM, Awoloye OJ, Olajide TD 2022. Mobile health literacy and the uptake of mobile health applications for reproductive health services in Nigeria. *BMC Public Health*, 22(1): 1-15.
- Adekunle AS, Afolabi BI, Raji YR, Ogunwale G 2021. Knowledge, use and factors influencing the use of mobile health applications among young adults in Nigeria. *BMC Medical Informatics and Decision Making*, 21(1): 1-11.
- Adeosun OT, Owolabi KE 2021. Gender inequality: determinants and outcomes in Nigeria. *Journal of Business and Socio-Economic Development*, (ahead-of-print). <https://doi.org/10.1108/jbsed-01-2021-0007>
- Adeyeye BK, Oyedele O, Yartey D, Ojih SE et al. 2023. Newspaper Coverage of Rape-related Issues in Nigeria during Covid-19 Pandemic. *Ethno-Medicine*, 17(1-2): 82-90. From <<https://eprints.lmu.edu.ng/5255/>> (Retrieved on 1 April 2024).
- Adum AN, Mozie CE 2020. Awareness and utilization of Mobile health applications among teaching and non-teaching staff of Nnamdi Azikiwe University Awka, Anambra state. *International Journal of Innovative Science and Research Technology*, 5(2): 827-839.
- Aimuengheuwa J 2023. Statistical Analysis of Smartphone Growth and the Impact on Nigeria's Economy. 14 April. Tech | Business | Economy. From <<https://techeconomy.ng/statistical-analysis-of-smartphones-growth-and-the-impact-on-nigerias-economy/>> (Retrieved on 13 April 2024).
- Ajayi CE, Chantler K, Radford L 2021. The role of cultural beliefs, norms, and practices in Nigerian women's experiences of sexual abuse and violence. *Violence against Women*, 28(2): 107780122110001. <https://doi.org/10.1177/10778012211000134>
- Ajegbile ML 2023. Closing the gap in maternal health access and quality through targeted investments in low-resource settings. *Journal of Global Health Reports*, 7: e2023070. <https://doi.org/10.29392/001c.88917>
- Ajebor O, Boniol M, McIsaac M et al. 2020. Increasing access to health workers in rural and remote areas: What do stakeholders' value and find feasible and acceptable? *Human Resources for Health*, 18(1). <https://doi.org/10.1186/s12960-020-00519-2>
- Akingbade O, Adediran V, Somoye IE et al. 2022. Perceived feasibility and usefulness of mHealth interventions for psychoeducational support among Nigerian women receiving chemotherapy for breast cancer: A focus group study. *Supportive Care in Cancer*, 30(12): 9723-9734. <https://doi.org/10.1007/s00520-022-07403-w>
- Aljohani N, Chandran D 2021. The adoption of mobile health applications by patients in developing countries: A systematic review. *International Journal of Advanced Computer Science and Applications*, 12(4). <https://doi.org/10.14569/ijacsa.2021.0120403>
- Amodu L, Omojola O, Okorie N et al. 2019. Potentials of Internet of Things for effective public relations activities: Are professionals ready? *Cogent Business & Management*, 6(1). <https://doi.org/10.1080/23311975.2019.1683951>
- Aririguzoh S 2022. Communication Competencies, Culture and SDGs: Effective Processes to Cross-Cultural Communication. *Humanities and Social Sciences Communications*, 9(1): 1-11. From <<https://www.nature.com/articles/s41599-022-01109-4>> (Retrieved on 1 April 2024).
- Babatunde AO, Abdulkareem AA, Akinwande FO, Adebayo AO et al. 2021. Leveraging mobile health technology

- towards Achieving Universal Health Coverage in Nigeria. *Public Health in Practice*, 2: 100120. <https://doi.org/10.1016/j.puhip.2021.100120>
- Belay W, Belay A, Mengesha T, Habtemichael M 2024. Demographic and economic inequality of antenatal care coverage in 4 African countries with a high maternal mortality rate. *Archives of Public Health*, 82(1). <https://doi.org/10.1186/s13690-024-01288-3>
- Choe EK, Klasnja P, Pratt W 2021. mHealth and applications. In: HS Edward, JC James (Eds.): *Biomedical Informatics: Computer Applications in Health Care and Biomedicine*. Cham: Springer International Publishing, pp. 637-666.
- Development Research and Projects Centre 2023. Gender Norms, Media Narratives and Women in Appointive Positions in Nigeria. Align Platform. October 30. From <<https://www.alignplatform.org/resources/gender-norms-media-narratives-and-women-appointive-positions-nigeria>> (Retrieved on 5 April 2024).
- Ezenwaka U, Manzano A, Oyedina C, Ogbzor P et al. 2021. Influence of conditional cash transfers on the uptake of maternal and child health services in Nigeria: Insights from a mixed-methods study. *Frontiers in Public Health*, 9. <https://doi.org/10.3389/fpubh.2021.670534>
- Fayehun F, Omigbodun A, Owoaje ET 2020. mMobile Technology can Improve Access to Healthcare in Nigeria – If It's Regulated - Nigeria | ReliefWeb. ay 7. Reliefweb.int. From <<https://reliefweb.int/report/nigeria/mobile-technology-can-improve-access-healthcare-nigeria-if-it-s-regulated>> (Retrieved on 5 April 2024).
- Goel A, Taneja U 2023. Mobile health applications for health-care delivery: Trends, opportunities, and challenges. *Journal of Public Health*. <https://doi.org/10.1007/s10389-023-02165-z>
- Hong W 2024. Advances and opportunities of mobile health in the postpandemic era: Smartphonization of wearable devices and wearable deviceization of smartphones. *JMIR MHealth and UHealth*, 12(1): e48803. <https://doi.org/10.2196/48803>
- Jennings L, Gagliardi L 2013. Influence of mHealth interventions on gender relations in developing countries: A systematic literature review. *International Journal for Equity in Health*, 12(1): 85. <https://doi.org/10.1186/1475-9276-12-85>
- Kabongo EM, Mukumbang FC, Delobelle P, Nicol E 2021. Explaining the impact of mHealth on maternal and child health care in low- and middle-income countries: A realist synthesis. *BMC Pregnancy & Childbirth*, 21(1): 1-13. <https://doi.org/10.1186/s12884-021-03684-x>
- Kayode-Adedeji T, Orisabiya A, Bamigbolayin-Afolabi F 2023. The stereotype of Nigerian singles in selected Nollywood Series. *Quarterly Review of Film and Video*, 55(1): 1-21. <https://doi.org/10.1080/10509208.2023.2239124>
- Khan NA, Abedin S 2022. Focus group discussion. In: MR Islam, NA Khan, R Baikady (Eds.): *Principles of Social Research Methodology*. Singapore: Springer Nature Singapore, pp. 377-387.
- Knop MR, Nagashima-Hayashi M, Lin R, Chan Hang Saing et al. 2024. Impact of mHealth interventions on maternal, newborn, and child health from conception to 24 months postpartum in low- and middle-income countries: A systematic review. *BMC Medicine*, 22(1). <https://doi.org/10.1186/s12916-024-03417-9>
- Lander J, Altawil H, Dilger E-M, Bruett AL et al. 2023. Synchronous online focus groups in health research: Application and further development of methodology based on experiences from two mixed-methods research projects. *BMC Res Notes*, 16(1). <https://doi.org/10.1186/s13104-023-06288-0>
- Lugard SB 2022. The right to health in Nigeria and its impact on citizens' access to medical care. *Journal of African Law*, 67(1): 1-19. <https://doi.org/10.1017/S0021855322000304>
- McLellan E, MacQueen KM, Neidig JL 2003. Beyond the qualitative interview: Data preparation and transcription. *Field Methods*, 15(1): 63-84. <https://doi.org/10.1177/1525822x02239573>
- Mensah EO 2023. Husband is a priority: Gender roles, patriarchy and the naming of female children in Nigeria. *Gender Issues*, 40. <https://doi.org/10.1007/s12147-022-09303-z>
- Mishra M, Parida D, Murmu J, Singh D et al. 2023. Effectiveness of mHealth interventions for monitoring antenatal care among pregnant women in low- and middle-income countries: A systematic review and meta-analysis. *Healthcare*, 11(19): 2635. <https://doi.org/10.3390/healthcare11192635>
- Nmadu AG, Mohamed S, Usman NO 2020. Barriers to adolescents' access and utilisation of reproductive health services in a community in north-western Nigeria: A qualitative exploratory study in primary care. *African Journal of Primary Health Care & Family Medicine*, 12(1). <https://doi.org/10.4102/phcfm.v12i1.2307>
- Ogundana EA, Ajite AB, Subulade AA 2022. Knowledge, attitude and uptake of family planning among adolescent girls in rural and urban areas of FCT, Nigeria. *Texila International Journal of Public Health*, 10(3): 349-358. <https://doi.org/10.21522/tijph.2013.10.03.art030>
- Okoli C, Hajizadeh M, Rahman MM, Khanam R 2020. Geographical and socioeconomic inequalities in the utilization of Maternal Healthcare Services in Nigeria: 2003–2017. *BMC Health Services Research*, 20(1). <https://doi.org/10.1186/s12913-020-05700-w>
- Okolo CA, Babawarun O, Arowoogun JO, Adeniyi AO et al. 2024. The role of mobile health applications in improving patient engagement and health outcomes: A critical review. *International Journal of Science and Research Archive*, 11(1): 2566-2574. <https://doi.org/10.30574/ijrsra.2024.11.1.0334>
- Olonade O, Olawande TI, Alabi OJ, Imhonopi D 2019. Maternal mortality and maternal health care in Nigeria: Implications for socio-economic development. *Open Access Macedonian Journal of Medical Sciences*, 7(5): 849-855. <https://doi.org/10.3889/oamjms.2019.041>
- Omojola O, Ayeni O, Oladosun M, Amodu LO 2021. Telecom Outcasts? Exploring Women Airtime Hawking and Mobile Telephony in Southwest Nigeria. *African Journal of Business and Economic Research AJBER*, 2021. From <<http://eprints.covenantuniversity.edu.ng/id/eprint/16631>> (Retrieved on 30 April 2024).
- Ope BW 2020. Reducing maternal mortality in Nigeria: Addressing perception and experience of maternal health services. *Journal of Global Health Reports*, 4. <https://doi.org/10.29392/001c.12733>
- Orte S, Migliorelli C, Sistach-Bosch L et al. 2023. A tailored and engaging mHealth Gamified Framework for nutritional be-

- haviour change. *Nutrients*, 15(8): 1950. <https://doi.org/10.3390/nu15081950>
- Pantoja T, Opiyo N, Lewin S, Paulsen E, Ciapponi A et al. 2017. Implementation strategies for health systems in low-income countries: An overview of systematic reviews. *Cochrane Database of Systematic Reviews*, 5. <https://doi.org/10.1002/14651858.cd011086.pub2>
- Patton M 2014. *Qualitative Research & Evaluation Methods*. 15 March. SAGE Publications Inc. From <<https://us.sagepub.com/en-us/nam/qualitative-research-evaluation-methods/book232962>> (Retrieved on 18 April 2024).
- Scheelbeek PFD, Hamza YA, Schellenberg J, Hill Z 2020. Improving the use of focus group discussions in low income settings. *BMC Medical Research Methodology*, 20(1). <https://doi.org/10.1186/s12874-020-01168-8>
- Sheppard M, Vibert C 2019. Re-examining the relationship between ease of use and usefulness for the net generation. *Education and Information Technologies*, 24(5): 3205-3218. <https://doi.org/10.1007/s10639-019-09916-0>
- Sim J, Waterfield J 2019. Focus Group methodology: Some ethical challenges. *Quality & Quantity*, 53(6): 3003-3022. <https://link.springer.com/article/10.1007/s11135-019-00914-5>
- Staszak W, de Paula D, Uebernickel F 2021. The power of habits: Evaluation of a mobile health solution for the management of narcolepsy. *Proceedings of the Design Society*, 1: 3081-3090. <https://doi.org/10.1017/pds.2021.569>
- Statista 2024. Nigeria: Mobile Internet User Penetration 2025. Statista. From <<https://www.statista.com/statistics/972900/internet-user-reach-nigeria/>> (Retrieved on 1 April 2024).
- Tang Y, Du X, Hung J-L, Li H, Tang H, Xie Y 2024. Exploring the effects of roles and group compositions on social and cognitive interaction structures in online collaborative problem-solving. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-024-12569-3>
- Udenigwe O, Okonofua FE, Ntoimo LFC, Yaya S 2022. Understanding gender dynamics in mHealth interventions can enhance the sustainability of benefits of digital technology for maternal healthcare in rural Nigeria. *Frontiers in Global Women's Health*, 3. <https://doi.org/10.3389/fgwh.2022.1002970>
- UNICEF 2021. Child Mortality - UNICEF DATA. December. UNICEF DATA. From <<https://data.unicef.org/topic/child-survival/under-five-mortality/>> (Retrieved on 30 April 2024).
- WHO 2023. Trends in Maternal Mortality 2000 to 2020: Estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. From <www.who.int. <https://www.who.int/publications/i/item/9789240068759>> (Retrieved on 30 April 2024).
- Yadav D 2022. Criteria for good qualitative research: A comprehensive review. *The Asia-Pacific Education Researcher*, 31(6): 679-689. <https://doi.org/10.1007/s40299-021-00619-0>
- Zakerbasali S, Ayyoubzadeh SM, Baniyasi T, Yazdani A, Abhari S 2021. Mobile health technology and healthcare providers: systemic barriers to adoption. *Healthcare Informatics Research*, 27(4): 267-278. <https://doi.org/10.4258/hir.2021.27.4.267>

Paper received for publication in May, 2024
Paper accepted for publication in September, 2024