



Awareness and utilization of m-health pregnancy apps among women of reproductive age in Anambra State

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Article Info

ISSN (online): 2582-7138

Volume: 04

Issue: 03

May-June 2023

Received: 07-04-2023

Accepted: 23-04-2023

Page No: 361-371

Abstract

The study carried out investigation into the awareness and utilization of m-Health pregnancy apps among women of reproductive age in Anambra State. It was guided by four research questions and anchored on Diffusion of Innovation Theory and Health Belief Model (HBM). It adopted a survey research method and had 380 respondents as the selected sample size. The researchers discovered that significant number of women in Anambra State, who are of reproductive age are exposed to m-Health pregnancy apps; it also found out that there is low level of awareness of m-Health pregnancy apps among women of reproductive age in Anambra State; in addition, the study revealed that a considerable number of women of reproductive age in Anambra State do not really utilize m-Health pregnancy apps; Finally, the study discovered that that the few women in Anambra State (68.8%) who make use of the m-Health pregnancy app use it mainly to monitor the development of their baby, another percentage of the women (56.8%) use it for daily guide on the needed essentials during pregnancy, few of them make use of the app to monitor their ovulation during pregnancy; a handful of them (21.6%) use the app to name their babies; and a few of them (3.5%) make use of the app to track labour period, as well as keep track of contractions during pregnancy.

Keywords: Awareness, utilization m-Health pregnancy apps, Women of Reproductive age

Introduction

The transformation engendered by technology in recent time, especially in the area of management of human health has been described as phenomenal (Adum, & Mozie, 2020) ^[1]. Interestingly, one of such areas that technology has made remarkable change is the mobile health technology (mHealth technology). mHealth has been describes as a rapidly growing area. According to Boston Consulting Group report, this industry has in recent time created more than 11 million jobs and generated more than \$3.3 trillion in global revenues. In fact, today, the mHealth technology has not only radically altered the way health care is delivered, it has increased patient's experience. It has also reduced the cost of health care (West, 2015, p.1) ^[45]. Today, there is ample empirical evidence that mobile devices and mHealth services help with maternal care, pregnancy management, chronic disease management, and disease epidemics (West, 2015; Dasuki & Damani, 2019) ^[45, 11]. Similarly, extant literature has also demonstrated that mHealth apps have immensely improved efficiency and effectiveness of patient tracking and reporting; they have also been extended to undeserved areas, consequently creating awareness in different areas of maternal health needs (West, 2015;) ^[45] More interesting is the fact that the benefit of mHealth apps is apparent in both the developed and developing countries (Houqe, Rahman, Nipa, & Hassan, 2020) ^[19] However, regardless of the numerous benefits derived from these health apps, research has shown that most people around the globe, especially in the developing world are yet to be adequately aware of the numerous advantages of these pregnancy apps. This study investigated the awareness and utilization of m-Health pregnancy applications among women of reproductive age in Anambra state.

Statement of the Problem

Pregnancy remains a very critical stage in the life of every woman of reproductive age (Nupur, Sharmin, Mulllick, & Mujib, 2020) ^[33]. The reason being that at this stage, women pass through stages of stress, pressures and burden of child bearing (Nupur, Sharmin, Mulllick, & Mujib, 2020) ^[33]. In other words, it is during this period that every pregnant woman deserves much attention. Interestingly, the present transformation of health care services as a result of the emergence of certain health care pregnancy applications have made maternal and antenatal care much easier. Anecdotal evidence shows that the arrival of such pregnancy apps like: Baby Center m-Health pregnancy app, Ovia Pregnancy Tracker, Preglife pregnancy Tracker, Sprout Pregnancy Tracker etc. have made the health management of pregnant women much easier (Sprout, 2021) ^[38]. With this technology, studies have also revealed that pregnant women have employed pregnancy apps beneficially in different areas and stages of their pregnancy, such areas like: information assessment, knowledge towards guiding them on breastfeeding, exercise and vital information they need to know during pregnancy and after delivery (Hughson, Daly, Woodward-Kron, Hajek, & Story, 2018) ^[20]. The apps are also known to render week-to-week information on the anatomical development of the baby (Zhang, Dong, Chen, Chai, & Liu, 2018) ^[45]. Sadly, irrespective of the plethora of benefits derived from these apps, it appears that most women, especially those in the developing world are yet to get sufficiently aware and as it were, make adequate use of the apps. It is against this backdrop that this research work investigated the extent that women of reproductive age (especially the pregnant ones) in Anambra state are exposed to, aware of and utilize these m-Health pregnancy apps. Are these women sufficiently aware of the apps? If they are, do they really make use of them and what uses do they make of the apps? The above therefore are the concerns that this study investigated.

Research Objectives

The main goal of the study is to assess the awareness and utilization of mHealth pregnancy apps among women of reproductive age in Anambra State. However, in more precise terms, the study pursued the following specific objectives.

1. To find out the extent that women of reproductive age in Anambra state are exposed to m-Health pregnancy apps.
2. To ascertain the extent that women of reproductive age in Anambra state are aware of m-Health pregnancy apps
3. To find out the extent that women of reproductive age in Anambra state utilize mHealth pregnancy apps.
4. To find out the uses that women of reproductive age in Anambra state make of the m-Health pregnancy apps.

Research Questions

The following research questions were addressed in the study.

1. To what extent are women of reproductive age in Anambra State exposed to m-Health pregnancy apps?
2. To what extent are they aware of m-Health pregnancy apps?
3. To what extent do women of reproductive age in Anambra state utilize m-Health pregnancy apps?
4. What use do women of reproductive age in Anambra state make of m-Health pregnancy apps?

Literature Review

M-Health Application: Quick Overview

The World Health Organisation notes that 99% of all maternal deaths take place in the developing countries. Globally, approximately 289, 000 women died from childbirth or pregnancy in 2019. Many of these losses could have been prevented through better medical care. Most times, those who die or suffer preventable complications often do so as a result of high blood pressure, severe bleeding, infections or obstructed labour – all resulting from challenges witnessed during pregnancy.

In the recent time, several countries, especially in developing nations experience high level of maternal mortality. The rate in Sierra Leone is 107 death for every 1000 births, while it is 74 in Nigeria, 54 in Liberia and 48 in Kenya. In contrast however, the United States of America has only 6 infant deaths for every 1000 live births (West, 2015, p.12) ^[45] – this disparity is alarming and raises much concern. In other words, what the above statistics suggests is that there is the need for improvement in the management of maternal and child health in the developing countries like Nigeria. Interestingly, with the arrival of mHealth technology, which has brought about tremendous improvements, there appears the possibility of better maternal and child care.

The World Health Organisation (WHO) defines mobile health (mHealth) as delivery of health care services and practice of medicine using mobile devices such as phones, computers, wearables and PDA's. Gruessner, (2015) ^[15] also agrees with the above statement and note, "The mobile health industry is defined as the generation, accumulation, and exchange of medical information through mobile and wireless tools" In fact, today, there are seemingly wide varieties of mobile health devices and applications available to the general public; including fitness trackers, diet apps, sleep monitors; sleep checkers and pregnancy apps. Similarly, Gruessner, (2015) ^[15] argues that "the mobile health industry could not have had a beginning without the invention of the first cell phone" As time went on, mobile phones became common and companies like Apple, Samsung, Android, Microsoft Widows mobile and others developed complex smartphones which stimulated the creation mHealth applications for consumers worldwide.

Anabiah, Udunwa, Malathi, (2019) ^[4] also agrees with the submission above when they note that "mobile health technology experienced exponential growth in recent time as a result of high diffusion and adoption of mobile technology around the globe" The mobile health technology particularly focuses on the collection of data for immediate diagnosis of illness, monitor illness, enhance treatment adherence and provide information to clients in different areas in a timeous manner (Anabiah, Udunwa, Malathi, 2019) ^[4]. Likewise, Holman (2022) ^[18] argues that "The most common application of m-Health is the use of mobile devices to educate consumers about preventive healthcare services" Equally, m-Health apps has also been used for disease surveillance, treatment support, epidemic outbreak tracking and chronic disease management (Holman, 2022) ^[18].

In 2015, the mobile health industry was projected to grow to nearly \$12 billion by 2018, an estimate that was realized before 2018 (Holman, 2022) ^[18]. Today, m-Health computing market is predicted to reach nearly \$65 billion. More interesting is the fact that in the recent time, nearly 50 percent of physicians are utilizing mobile health apps on a day-to-day

basis and as the mobile health industry continues to expand, research has shown that both smartphone capabilities as well as wearable technologies will likely impact the healthcare industry and improve patient's care across different climes (Holman, 2022; Dipesh, & Yugal, 2021) ^[18, 12].

Evaluating m-Health Pregnancy Apps and Trackers

Pregnancy apps are becoming a common place around the globe and the industry is growing on daily basis (Hughson, Daly, Woodward-Kron, Hadjek & Story, 2018) ^[20]. Extant literature has shown that these apps are popular among women of reproductive age in different countries around the globe-Nigeria is not an exception (Iyawa, & Hamunyela, 2019) ^[21]. From the perspective of healthcare and health information provision, the m-Health pregnancy technology is no doubt encouraging. Currently, the demand for these apps visibly indicate the direction of health care management among women of reproductive age in the present era.

Engaging with pregnancy apps appears to have become a routine part of maternity experience and a practice most women of reproductive age would like to engage in. Universally, there are a large number of pregnancy apps (Hainey, Liu, Poulton, Peek, Kim, & Nanan, 2018). Research has demonstrated that the majority of smart phone owners are women (Bert, Scaioli, Gualano & Siliquini, 2016) ^[6], with indication that pregnancy itself remains one of such reasons that women buy a smartphone (Baby Center Internet, 2019). A number of reasons have been identified for the present surge around the globe in the usage of pregnancy apps. One of such reasons is the fact that pregnancy remains a normal life process influenced by many social and cultural practices. Furthermore, the kinds of information and resources required by women during pregnancy span many domains such as: healthcare, social, cultural and material. Therefore, these pregnancy apps integrate a range of platforms with diverse features catering for these various needs. There are large numbers of pregnancy apps categorised along a continuum - from entertainment through to health care (Hughson, Daly, Woodward-Kron, Hadjek & Story, 2019).

Common features of pregnancy apps include the following: information provision, pregnancy tracking, record keeping, and gestation calculation (Lupton & Thomas, 2016, p.134) ^[26]. Research has also shown that games, alongside web-based pregnancy-related products, gender predictors and baby name generators constitute the highest number of pregnancy apps available today (Lupton, 2015, p.12) ^[25]. In addition, some pregnancy apps offer multi-functionality, while others are dedicated to particular areas (Lupton, 2015, p.12) ^[25]. There are different types of m-Health pregnancy trackers, and expecting mothers can chose from the plethora of these apps available in Google shops. Emila (2017) provides an insight into the number of pregnancy trackers there are, their functionality and features thus:

What to Expect is a pregnancy app that gives pregnant women daily guidance on the needed essentials during pregnancy, it has the features that show the stages of pregnancy and the baby's development, while connecting expecting mothers in the same pregnancy week to share experiences. *Pregnancy Week by Week* serves as a tracker for pregnant women. It provides adequate information about the foetus on weekly basis and helps pregnant mothers track their babies' kicks. *Baby Names* is another pregnancy tracker which has over 50, 000 names with

their meanings. It compiles the world's popular names from 1880 till date; providing origin, gender and meaning of such names. *Full Term* is another pregnancy app which helps pregnant women keep track of labour contractions. It clearly keeps track of the entire labour period and does this effectively.

Beside the above pregnancy apps, there are also such pregnancy apps like: Baby Center, m-Health pregnancy app, Ovia Pregnancy Tracker, Preglife pregnancy Tracker, Sprout Pregnancy Tracker etc. (Hughson, Daly, Woodward-Kron, Hajek, & Story, 2018) ^[20]. Research has shown that most of these apps have fairly comprehensive information for different stages of pregnancy which include health promotion, patient education, communication and health tracking (Frid, Bogaert, Chen, 2021) ^[14].

Innovations in m-Health Technology

A number of studies have shown that the advancement of m-Health technology has helped in a number of ways to improve maternal care, aid in reducing infant mortality and most importantly, helped women during their pregnancies (West, 2015; Dasuki & Zamani, 2019; Iyawa & Hamunyela, 2019) ^[45, 11, 21]. In fact, with the arrival of m-Health technology, a number of innovations have been recorded. According to West (2015) ^[45] "m-Health technology is known to strengthen training of medical workers by providing access to accurate and current information regarding health conditions and treatment, as well as latest ideas on treating particular problems" From clinical standpoint, m-Health apps are known to empower the patients. With it, individuals no longer need to always run to the hospital to be reminded to take medication, instead, mobile apps allow patients to receive personal reminders and get professional information that will aid good health.

Furthermore, on other fronts, m-Health applications have aided education and awareness programmes (Mason, 2014, p.124) ^[30] The apps have been used in reaching remote areas – such as rural areas which may have limited access to public health information and education, health clinics and deficit of healthcare workers (Mason, 2014, p123) ^[30]. Besides, Nuber and Nordgren (2014) ^[32] comments on the innovative transformational power of m-Health applications in Morocco thus:

The mobile ultrasound Patrol Program in Morocco uses portable ultrasound machines and 3G smartphones to improve diagnostic times for expectant mothers. Implemented in cooperation with Qualcomm's Wireless Reach initiative; a program that works with rural clinics throughout Morocco, it provides doctors and nurses with devices that are wireless connected to maternal health specialists in urban hospitals and clinics. This programme aids in ensuring far reaching, high quality diagnostic services.

In China, findings show that m-Health programmes continue to garner positive results. Recently, an estimated 281, 000 new mothers signed up for the text4Baby service, m-Health powered programme designed for women of reproductive age (Marquez, 2012, p.234) ^[28]. Furthermore, West (2015) ^[45] reports that "researchers in China found that text messages and telephone reminders improved appointment attendance of pregnant and expectant mothers by 70 percent. In recent

years, increased cellphone penetration has brought the potential for m-Health to improve preventive maternal healthcare services. More so, several m-Health pregnancy apps can assist with maternal education and support socially disadvantaged pregnant women in India (Klein, 2022, p.23). All these point to the possibilities stimulated by mobile health applications.

Challenges and Opportunities for m-Health in Developing countries

There is no doubt that the development of m-Health has not only succeeded in revolutionizing the health sector, it has also brought about large number of positive changes in maternal health. However, research has as well revealed that in the face of the different innovations of m-Health technology, there seems to be a number of challenges affecting the novel development. First, data security and privacy issues has remained a big challenge, especially to the developing countries to effective use of m-Health apps (Lunde, 2017, p.123) ^[24]. Patient's data is very critical to treatment and should be put under public view and scrutiny, this could cause patient trauma and public ridicule depending on the type of ailment. Put differently, m-Health has not really shown strong evidence of patient data confidentiality. This is a grievous weakness as data capture, storage and retrieval systems are not effectively handled (Vitalis, 2016; Lunde, 2017) ^[40, 24]. In addition, the availability and affordability of network access, speed and signal has regularly remained a humongous challenge, especially in the developing countries to the functionality and adequacy of m-Health technology. Often time, network coverage is not usually evenly distributed, similarly there is usually bad signal in some areas, mostly, the rural areas – in fact, some rural communities most times, are entirely unserved. The implication of the foregoing is that m-Health cannot be effectively operational in such areas (Coggin, 2018; Connor & Donoghue, 2015) ^[8, 9]. Similarly, illiteracy, as well, remains another huge challenge faced by the m-Health platform in developing countries. According to Peters (2008) ^[37] “illiteracy has consistently remained a problem when it comes to technical issues and managing of m-Health facilities” Lack of education induces lack of understanding and confusion for technology and its adoption” In the recent time, users have failed to maximize m-Health device functionality and as such, unable to effectively operate them (Peters, 2008) ^[37].

Furthermore, financial accessibility has also remained an issue in the adoption of m-Health technology. Martin (2017) ^[29] captures this challenge thus: “cost of apps and devices remain an impediment to successful deployment of m-Health apps by patients” With the increasing cost of everything, especially in developing countries, adoption of this technology is seriously jeopardized” Equally, the correlation between service providers and the socio-cultural need of individuals customers and communities have been established. Some ethnicities and individuals would not use certain services due to cultural beliefs, hence, this has impinged on the utilization and/or adoption m-Health services (Martin, 2017) ^[29]. From the foregoing therefore, it is evident that irrespective of the plethora of advantages provided by m-Health technology, there are still a number of challenges that the technology is facing.

However, Wattanapisit, Amaek, Wattanapisit, Tuangratananon, Wongsiri, Pengkaew, (2021), irrespective

of the challenges affecting the utilization of m-Health apps, lucidly identifies, a number of opportunities for it in developing countries. He argues:

Potentials of m-Health in developing countries include: the significant impact on clinical outcomes such as longer life span, reduced maternal mortality, child death and infant mortality. mHealth has also improved patient health due to compliance and adherence to treatment. It has engendered effective disease surveillance and quick response to epidemic management. Similarly it has created improvement of public awareness, leading to increased quality care delivery and improved lifestyle, which enables remote treatment and enhances patient-centeredness. It has also stimulated efficient and real-time transmission of patient information and increased the quality of healthcare access towards universal health coverage.

m-Health pregnancy app in Nigeria: Awareness and Utilization

Awareness remains a very critical variable in health communication. It does not only create the consciousness that one needs to adopt health message, technology and know-how, but enhances health promotion (Nwosu & Okeke, 2020) ^[34]. Awareness simply means the state of being conscious of something. Moreover, it is the ability to directly perceive or be cognizant of events (Don, 2002 in Nwosu & Okeke, 2020) ^[34]. In other words, for awareness to occur, the audience must basically be exposed to information, attend to such information and most importantly, remember such information. Therefore, it becomes realistic to argue that when the concept of awareness is viewed from the prism of present study, one can contend that users of m-Health pregnancy apps need be majorly aware of such apps before they decide to make use of it. The above assertion reinforces the relationship that exists between awareness and use or utilization (Nwosu, Chukwuka & Chinazom, 2021) ^[35]. In this regards therefore, it becomes increasingly imperative to interrogate the extent that women of reproductive age are aware of and make use of these apps.

Danshafif, Iyawa, Oweseni & Iyawa (2019) conducted a study to understand the perception and awareness of pregnant women towards m-Health apps, they discovered that “majority of the participants were aware that mobile technologies could be used for self-management during pregnancy. However, 50 percent of the respondents were really not aware of the specific health tools used for self-management during pregnancy.” This finding is instructive; it somewhat illuminates the need for increased media awareness program among women of reproductive age towards the knowledge and use of these apps. Furthermore a significant number of the women (60%) were aware of different uses that these apps can be put to, (like diet for pregnant women, exercise, providing guide for pregnant women etc) but hardly make use of these apps. This discovery further reinforces the fact that there is need to emphasise through media campaigns, the importance of awareness in adoption of health-improving tools.

Similarly, Mozie and Adum (2020) ^[1] also revealed that majority of the respondents (61.1%) showed significant awareness of m-Health apps but had low use (48.6%) of the apps. However, a majority of the respondents showed positive attitude towards the applications (Mozie & Adum, 2020) ^[1]. The above statistics are instructive as they show

significant awareness of the m-Health pregnancy apps, but low usage or utilization. This is an indication that the need for increased awareness program is needed among women for greater adoption of the m-Health pregnancy app. Of course, what difference will it make that one is aware of a health-improving app, but does not make use of such app, even when it is established that such app will be of immense help? It therefore becomes increasingly germane to pay attention to media campaigns that will not only emphasise the importance of being aware of certain health-improving apps, but corresponding utilization of such apps – the reason for this conjecture being that increased awareness usually engenders behavioural change that covertly or overtly influences utilization (Nwosu & Okeke, 2020) ^[34].

Theoretical Framework

The Diffusion of Innovation theory and Health Belief Model (HBM) are considered appropriate for situating this study in a proper theoretical perspective. The theory of Diffusion of Innovation recognises that new ideas such as mobile health applications do not just become adopted, in other words, it says that people do not just decide to adopt certain technologies in a particular society at the same time. The theory rather argues that the process of adoption is usually gradual; moving from one layer of the society to the other, i.e., from innovators down to laggards (Lewis, 2009 cited in Mozie & Adum, 2020) ^[1]. The theory also assigns very limited role to the mass media, as it argues that the media mostly creates awareness of innovations. Only early adopters are directly influenced by media content (LaMorte, 2022) ^[23]. Others adopt innovations only after being influenced by other people. The theory therefore recommends that change agents lead diffusion efforts in order to influence other categories of adopters (Rogers, 1964, cited in Adum & Mozie, 2020) ^[1]. Hence, the Diffusion of Innovation theory provides an explanation on how and why a particular smartphone user may accept m-Health pregnancy app at a particular point in time, why such user may also accept it faster or slower than the other. The theory again explains the factors that motivate adoption of technology like m-Health pregnancy health app technology. These factors, the theory goes on to elucidate, includes: relative advantage, that is the degree to which m-Health apps are seen as better than the idea, product or programme they replace; compatibility – that is how consistent the apps are with the values, experiences and needs of the potential adopters; complexity: how difficult the apps are to understand and use; triability; the extent to which the apps can be tested before commitment to adoption is made; and observability; the extent to which the apps provide tangible results (Adum & Mozie, 2020) ^[1].

On the other hand, the Health Belief Model (HBM) sees smart phone users as people who would likely adopt m-Health apps because of their belief that such practice would engender particular health values that at the end would improve their life. In other words, if they perceive use of such application as beneficial health action, they are likely to adopt them. Mboho and Batta (2008) ^[27] also argue that the individual's health behavior is usually guided by the following:

- Perceived susceptibility-ones opinion of changes of getting a condition
- Perceived Severity-ones opinion of how serious a condition and its consequences are.
- Perceived benefits-ones opinion of the efficacy of the

advised action to reduce risk of seriousness of impact

- Perceived barrier-ones opinion of the twist and psychological cost of the advised action.
- Cues to action-events, either bodily or environment that motivates people to take action.
- Self-efficacy-ones confidence in one's ability to take action.

When HBM model is viewed in relationship with this present study one can conjecture that the extent that women of reproductive age would accept or reject the adoptions of mHealth pregnancy apps would be directly dependent on their perception of the identified variables contained in the model (Nwosu & Okeke, 2020, p.34) ^[34]. Consequently, based on the foregoing, it becomes reasonable to infer that women of reproductive age in Anambra State are likely to take health action or fail to do so based on their perceived severity, susceptibility, and/or the benefit derived from taking such action. They could as well take such action as a result of how they are cued to take them.

Methodology

The methodology adopted in this study was the survey design. Survey design is an excellent method for measurement of attitude and opinion of people within a large population. The design particularly entails asking the respondents about their opinion on the subject matter.

The population of this study comprise all the women of reproductive age in Anambra state. Anambra state is one out of the five states in the South – Eastern part of Nigeria. The researchers considered Anambra State appropriate for this study owing to the fact it has got a large number of women of reproductive age who also own mobile phones (Technology Times, 2016) ^[39]. The population of these women of reproductive age when put together is about 666, 0000. The above statistics is according to the records obtained from Anambra state population statistics Bureau (2022).

The sample size of this study is 384 women of reproductive age. The sample was statistically worked out by using the Krecjie & Morgan (1972) sample determining formula, as cited in Nwosu, Okeke and Chiaghana, (2020) ^[34]. This sample of 384 women was accepted at 95% confidence level. Therefore, 384 copies of questionnaire were distributed to randomly selected respondents (residents in Anambra state). The entire copies of questionnaires distributed were successfully retrieved and analysed. The multi-stage sampling technique was adopted to select to the respondents across the different towns in the state for the purpose of instrument administration. The researchers realised the multi-stage sampling procedure this way: at the first stage; the sampling procedure involved the selection at the senatorial district level of the State, making use of a table of random numbers, two senatorial districts were selected. These districts included: Anambra Central and Anambra North Senatorial Districts. At the second stage of the selection, the researchers made use of the table of random numbers in selecting four local governments from the selected Senatorial Districts. For Anambra Central Senatorial District; Dunokofia and Awka North Local Government Areas were chosen, while Onitsha North and Ogbaru Local Government Areas were chosen for Anambra North Senatorial District. At the ward level; which represents the third stage of sampling, for Dunokofia LGA, Awka ward I and Ifitte ward II were selected. For Awka North, LGA, Achalla ward I and Ebenebe

ward II were selected. Similarly, for Onitsha North, Fegge ward I and Woliwo Layout were chosen. While for Ogbaru, Atani Ward I and Ogwuikpele Ward were selected. The fourth stage of sampling involved selection of residential units. At this point, 48 houses were randomly selected from each of the 8 wards. In achieving this, the researchers made use of the records of housing enumeration statistics produced by the National Population Commission for 2006 National Population Commission. A total number of 384 houses were selected. The fifth stage, the researchers chose only one sample unit (one respondent) from each of the 384 houses. In order to arrive at the required 384 sample units, the selection at this point was done using purposive sampling method

whereby only women who were between 18-49 years were chosen (these are people who are within the reproductive age). The justification for this choice is that the age bracket fall within the category of people which the study investigated.

Data presentation and analysis of results

The researchers recovered all the questionnaires distributed to the respondents. In other words, (100%) of the questionnaire were returned and found useful for data analysis. Consequently, the returned questionnaire were used in analysing the data.

Table 1: Distribution of Responses Showing Socio Demographic Data of Respondents

S/N	Variables	Frequency	Percentage (%)
Age			
1	18 -24	63	16.4%
2	25 – 31	147	38.3%
3	32-36	54	14.1%
4	39 -45	20	5.2%
5	46 -49	100	26%
Total		384	100%
Gender			
1	Single	140	35.5%
2	Married	244	63.5%
Total		384	100
Occupation			
1	Professional	47	12.2%
2	Teacher	117	30.5%
3	Artisan	20	5.2%
4	Trader	92	24.0%
5	Sudent	83	21.6%
6	Others	25	6.5%
Total		384	100 %
Educational Status			
1	FLSC	20	5.2%
2	SSCE/EQUIV	50	13.0%
3	OND/NCE/PD	76	19.8%
4	First Degee/ HND	183	47.7%
5	Post Graduate Qual.	55	14.3%
Total		384	100%

The respondent were categorised under five age brackets. The data showed that 16.4% of them fell within the age range of 18-24 years; 38.3% of them fell within the age of 25-31 years, 14.1% were under the ages of 32-36 years, and 5.2% of them fell within the ages of 39 -45 years, while 26% fell within the age range of 46 – 49 years. From the foregoing, it is clear that people who were within the ages of 25-31 years had the highest distribution in age. The gender distribution of the respondents showed that 35.5% were single, while about 63.5% indicated that they are married. The data on occupation of the respondents showed that 12.2% of the respondents are professionals. 30.5% of them are teachers, 5.2% are artisans, 24% of them are traders; 21.6% of them are students while only 6.5% fell within the category of

“others”. Furthermore, the educational qualification of the respondents showed that only 5.2% of the respondents have First School Leaving Certificate (FSLC), about 13.0% of the respondents have their SSCE and equivalent, 19.8% of the respondents have their OND/NCE Pre Degree. In addition, about 47.7% of the respondents have their First Degree and 14.3 of them have their Post Graduate Degrees (PGD). The data on educational qualification of the respondents showed that women with First Degree had the highest distribution in educational qualification.

Research Question 1. To what extent are women of reproductive age in Anambra State exposed to m-Health pregnancy apps?

Table 2: Exposure of women of Reproductive Age to m-Health pregnancy apps

	Have a functional smart phone that enables me to do a lot of things	I Have been exposed to m-health app once on my phone	I can describe and mention what m-Health pregnancy apps are	I can attest that these m-Health apps are everywhere
Yes	76.7%	66.1%	40.9%	40.9%
	N=280	N=254	N=157	N=157
No	16.1%	33.9%	28.6%	37.5%
	N=62	N=130	N=110	N=144
Do Not Know	10.0%	-	30.5%	21.6%
	N =42	-	N=117	N=83
Total	384	384	384	384

Data in table 1 above shows that 76.7% of the respondents have a functional smart phone, while only 16.1% of them don't, only 10. % of the respondents said that they don't know. In the same vein, about 66.1% of the respondents said that they have been exposed to pregnancy health apps on their phones, while 33.9% of them said that they have not had such exposure. Again, 40.9% of the respondents said that they can mention and describe what m-Health pregnancy apps are, 26.6% of them said they cannot, while 30.5% said that they don't know. Similarly, 40.9% of the respondents indicated

that they can attest to the presence of m-Health pregnancy apps everywhere, 37.7% of them said that they cannot while only 21.6 said that they don't know. The deduction here based on the above data is that significant number of women in Anambra State, who are of reproductive age are exposed to m-Health pregnancy apps.

Research Question 2: To what extent are women of reproductive age in Anambra State aware of m-Health pregnancy apps?

Table 3: Awareness of Women of Reproductive Age to m-Health Pregnancy apps

	I am aware of what women of reproductive age can do with m-Health app	I can mention at least five things that women of reproductive age can do with m-Health pregnancy apps	I can mention at least five different types of m-Health apps	I have fair knowledge of the mechanisms of m-Health pregnancy app.
Yes	29.4%	15.1%	33.3%	33.3%
	N=113	N=58	N=128	N=128
No	51.3%	76.8%	61.7%	62.8%
	N=197	N=295	N=237	N=241
Don't Know	19.3%	8.1%	4.9%	3.9%
	N=74	N=31	N=19	N=15
Total	384	384	384	384

Table 5 show the level of awareness that women of reproductive age in Anambra State have concerning pregnancy m-Health app. From the data, it was clear that minority (29.4%) of the women indicated that they are aware of what women of reproductive age can do with m-Health pregnancy app. Majority (51.3%) said that they are not. Only 19.3% of them said that they don't know. Furthermore, only 15.1% of the respondents said that they can mention at least five things that that women of reproductive age can do with m-Health pregnancy apps, while only 76.8% of them said that they cannot. 8.1% of them said that they don't know. Similarly, about 33.3% of the said that they cannot, while

only 4.9% of them said that they don't know. Again, only 33.3% of the respondents indicated that they have fair knowledge of the mechanisms of m-Health pregnancy app, 62.8% of them said that they do not have such knowledge, only 3.9% said that they do not know. From the forgoing analysis therefore, it is evident that there is low level of awareness of m-Health pregnancy app among women of reproductive age in Anambra State.

Research Question 3: To what extent do women of reproductive age in Anambra state utilize m-Health pregnancy apps?

Table 4: Utilization of m-Health pregnancy apps by women in Anambra State.

	I know how to use m-Health pregnancy app	I have made use of m-Health pregnancy app severally	I have made use of m-Health pregnancy app few times	I have not made use of m-Health pregnancy app few at all
Yes	36.2%	17.7%	34.4%	40.9%
	N=139	N=68	N=132	N=157
No	50.8%	78.4%	48.4%	30.5%
	N=195	N=301	N=186	N=117
Do Not Know	13.0%	3.9%	13%	28.6%
	N=50	N=15	N=50	N=110
Total	384	384	384	384

Data generated in table 4 shows that about 36.2% of the respondents said that they know how to use m-Health pregnancy app and a higher percentage (50.8%) indicated that they don't. In the same vein, only 17.7% of the respondents

said that they have made use of made use m-Health pregnancy app severally, while 78.4% of them said that they have not. About 3.9% of the respondents answered that they don't know. Furthermore, 34.4% of the respondents indicated

that they have used the apps few times, 48.4% of them said that they have not, while about 13% said that they don't know. Similarly, about 40.9% of the respondents said that they have not made use of the app at all, 30.5% of them said that they have, while 26.6% of the respondents indicated that they don't really know. The data generated from this table is instructive. It clearly shows that a considerable number of

women of reproductive age in Anambra do not really utilize m-Health pregnancy apps. In other words, there is low level of utilization of m-health app among women of reproductive age in Anambra State.

Research Question 4: What use do women of reproductive age in Anambra state make of the m-Health pregnancy apps?

Table 5: The Use that Women of Reproductive age in Anambra State make of m-Health pregnancy apps.

	I made use of the m-Health pregnancy app before I got pregnant to monitor my ovulation cycle:	I made use of the m-Health pregnancy app during my pregnancy as a daily guide on the needed essentials during pregnancy	I used it monitor the development of my baby while connecting expecting mothers in the same pregnancy week to share experiences	I made use of the pregnancy app after birth when I wanted to name my baby	I made use of the pregnancy app to track my entire labour period and keep track I labour contractions
Yes	41.9%	56.8%	68.8%	21.6%	35.5%
	N=161	N=218	N=264	N=83	N=136
No	51.6%	27.6%	19.5%	72.4%	60.7%
	N=198	N=106	N=75	278	N=233
Don't Know	-	-	11.7%	6.0%	3.9%
			N=45	N=23	N=15
Total	384	384	384	384	384

Table 6 above shows that 41.9% of the respondents made use of the m-Health pregnancy app before I got pregnant to monitor my ovulation cycle, while 51.6% of them do not. Furthermore, 56.8% made use of the m-Health pregnancy app during their pregnancy as a daily guide on the needed essentials during pregnancy, while about 27.6% of them said that they do not. Only 11.0% of them said they don't know. Similarly, about 68.8% said that they used it to monitor the development of their baby, only 11.0% said that they don't know. In addition, only 21.6% of the respondents said that they made use of the pregnancy app after birth when they wanted to name their baby, while 72.4% said that they do not, while about 6.0% said that they don't know. Also, only 35.5% of the respondents said that they use the app to track the entire labour period and keep track of labour contractions during pregnancy, 60.0% of them said that they do not and about 3.9% of them said that they don't know.

From the foregoing, the data in table 5 tend to suggest that the few women of reproductive age in Anambra State who utilize mHealth apps (68.8%) mainly make use of them to monitor the development of their baby while, another significant proportion of the women (56.8%) use it as daily guide on the needed essentials during pregnancy, few of them use it to monitor their ovulation during pregnancy; only a handful of them used it to name their babies, while few of them make use of the apps to track labour period and keep track of contractions.

Discussion of Findings

Generally, the first finding of this study suggests that a significant number of women of reproductive age in Anambra State are exposed to m-Health pregnancy apps. What the above finding presupposes is that considerable number of women who are in their reproductive age were apparently exposed to m-Health pregnancy apps. Interestingly, Beukering, Van den Berg, Kok, William Mol, Frings-Dresen, Velu, De Lewuu, Van der Post, and Linda Peute (2019) had similar discovery; they note that "a considerable number of women investigated in their study were exposed to m-Health pregnancy apps" Some of the women, the study however identified, got exposed to this health apps before their pregnancy, some others saw the app

when they got pregnant and some after their pregnancy. In the same way, Hughson, Daly, Woodward-Kron, Hajek and Story (2018) ^[20] had similar finding. They revealed that a large number of respondents in their study were exposed to different forms of m-Health pregnancy apps, however, irrespective of this experience, the study showed that lower rates of pregnancy app uptake were indicated among the respondents – suggesting the poor relationship between exposure and use. Other studies (Wessolo, 2020; Musgrave, Homer & Kizirian, 2019) ^[31] were also in congruence with the present study.

The second finding of the study disclosed that there is low level of awareness of m-Health pregnancy app among women of reproductive age in Anambra State. This finding agrees with Adum and Mozie (2020) ^[1] who revealed that that "there was low level of awareness of m-Health app among the respondents they studied" Similarly, this finding is also in line with Dansharif, Iyawa, Oweseni, & iyawa, (2020) ^[10] who found that "there was low level of awareness of mobile health pregnancy apps among pregnant women they studied" Here, it might be important to note that awareness would mean the ability to directly know and/ or perceive, feel, or be cognizant of something (Don, 200 cited in Nwosu, Okeke & Chiaghana, 2020, p.12) ^[34]. It is therefore somewhat instructive to point out that while these women were exposed to these apps, most of them did not really take time to find out what they could use the apps to do – this to a certain degree explains the discrepancy between exposure and awareness. In other words, it might be imperative to harp that while these women were exposed to m-Health pregnancy apps, they really did not pay attention to the benefits of the apps or put differently, what they could do with the apps. In the contrary, Alotaibi, Abalawi, and Alwakeel (2018) ^[2, 3] is not in agreement with the present finding as they discovered high level of awareness among respondents. The authors write "The newly developed apps is aimed at empowering pregnant woman in India to become more knowledgeable and prepared about their period of pregnancy. There is in the present time, high level of awareness of m-Health apps among pregnant women in India" In other words, one could at this point extrapolate that there may have been certain factors that caused the high level of awareness found in India

as compared to the one in the present study.

The Third finding clearly showed that significant number of women of reproductive age in Anambra State do not really utilize m-Health pregnancy apps. This finding is instructive as a number of factors were identified as intervening variables towards the use of m-Health pregnancy apps – such factors like: illiteracy, technical know-how and how to use mobile apps appropriately, financial barrier, environmental factors like: poor network; social factors like: domestic and health issues (Dasuki, & Zamani 2019) ^[11]. Oyeyemi and Wynn (2014) ^[36] incidentally is in line with the present finding. The authors also discover low level of the use of m-Health pregnancy app among the women they studied.

Finally the fourth and last research question suggests that the few women of reproductive age in Anambra State (68.8%) who make use of the m-Health pregnancy apps use it mainly to monitor the development of their baby. They also use it as a daily guide on the needed essentials during pregnancy (56.8%). Few of them, the study showed, use it to monitor their ovulation during pregnancy. Only a few of them make use of the apps to search for names of their babies. Limited number of them make use of the app to track labour period, and as well keep track of contractions during pregnancy. Interestingly, Wessolo (2020) had similar finding, he notes that “pregnant women make use of m-Health pregnancy app to provide useful information to help them manage their health threats during pregnancy” Similarly, In their study, Habibi and Moghbeli (2020) ^[16] divided these pregnancy apps unto different types and noted that women make use of the apps for “information, entertainment and monitoring mother’s physical health” Although Habiab *et.al.* (2020) looked at the use women make of m-Health pregnancy apps from a broader perspective, their viewpoint also captured the fourth findings of the present study.

Conclusion and Recommendation

From the foregoing, it is apparent that technology has to a large extent redefined maternal health, especially in the area of attending to pregnant women. However, it appears that even with the improved technological landscape, most women of reproductive age are yet to maximize the utility of this novel technology. Although there are quite a number of factors that imping on the ability of women of reproductive age to take full advantage of the m-Health pregnancy technology, it still remains absolutely important that they embrace this new development for an improved pregnancy/maternal health management. From the foregoing therefore, it is evident that there is still a gap to be filled in this area – there is therefore, the need to educate, inform and most importantly, find a way to enlighten women of reproductive age, especially those living in rural areas, on the usefulness of m-Health pregnancy apps.

Against the above backdrop therefore, the following recommendation are put forward

- First, Anambra State government should prioritize at the health policy stage, the implementation of policies that would make the use of mobile health applications (especially m-health pregnancy apps) a key aspect of health delivery in the state’s healthcare sector.
- Since it was discovered that the awareness and use of m-Health pregnancy applications is generally low in Anambra State, relevant government and non-governmental health bodies or agencies should organise

health awareness campaign programmes that will principally focus on informing women, especially those of reproductive age (18-49 years) on the availability of m-Health pregnancy applications and as much as possible, sensitise these women on the need to make use of the applications regularly. This no doubt will engender faster behaviour change.

- Furthermore, relevant government and non-governmental bodies in the state should partner with both the local and international software developers to develop mobile health applications that will provide the peculiar health needs and preferences of women of reproductive age.
- Similarly, because technology depends on a number of infrastructures to perform maximally, and it is established that poor infrastructure in developing countries like Nigeria has continued to constitute an impediment to the use of mobile technology which powers m-Health applications (West 2015) ^[45]. One solution to this is that the government should create policies that will improve on existing infrastructures like: mobile network systems in Nigeria, as this will directly or indirectly engender an advancement in the use of these m-Health mobile technologies for pregnant women.

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