Social norms and power structures: Exploring mobile health technologies for maternal healthcare in Nigeria

Ogochukwu Udenigwe

A thesis submitted in partial fulfillment of the requirements for the
Doctorate in Philosophy degree in International Development

School of International Development and Global Studies
Faculty of Social Sciences
University of Ottawa

Abstract

Background: Maternal and child health initiatives are embracing the use of electronic or mobile technology, a branch of digital health popularly referred to as eHealth or mHealth. While digital health can offer extensive benefits, it has raised various challenges. For instance, digital health programs are not often designed with a focus on equity in distribution nor are they designed from a gender equity standpoint. Although digital health interventions for maternal healthcare focuses predominantly on women as beneficiaries, few studies explore gendered power relations and how they impact the success of maternal and child health projects in African contexts such as Nigeria. This gap in literature risks excluding women from engaging in the digital space and can worsen the negative and unintended consequences of participating in digital health. This thesis examines the impact and implications of digital health interventions for maternal health in sub-Saharan Africa.

Method: Two secondary and three primary studies described the various implications of digital health in sub-Saharan Africa more broadly and in rural Edo State, Nigeria, specifically. The secondary studies involved a review and a systematic review of the literature, the primary studies involved focus group discussions and in-depth interviews with pregnant or postpartum women who were beneficiaries of a digital health program and their community members.

Results: The first paper illustrated exclusionary practices of digital health programs in sub-Saharan Africa, the second paper showed how digital health programs can challenge and redress harmful and unequal gender norms, roles, and power relations that privilege men over women. Observations from the third paper indicate that while mHealth programs are helpful to women in many ways, they are not enough on their own to undo entrenched systems of power through which men control women's reproductive lives. The fourth paper affirms that a community-centered approach to implementing digital health programs enhances women's acceptance and sustained use of digital health. The fifth paper shows how women navigate patriarchal environments through negotiation, collaboration and maneuvering to yield the best possible maternal health outcomes.

Conclusion: At the core of all the studies was the need to understand and redress overarching factors contributing to ill health and exacerbating health inequities in maternal health through gender transformative approaches. Potentially unintended consequences, side effects, and negative effects of digital health impedes its many benefits, therefore, to achieve meaningful impact, gender and digital inclusion must remain a priority in the development, implementation, and evaluation of digital health. This thesis illuminated the needs of those with the greatest barriers to health technologies for maternal health thereby contributing to the discussion on digital health social justice with overarching themes on how to achieve equitable opportunities for all women and girls to access, use and benefit from digital health for maternal health.

Acknowledgements

It has truly taken a village to get to this point of completing a PhD dissertation. I have been blessed with the guidance and generosity of faculty, colleagues, mentors, friends, and family.

To my supervisor, Dr. Sanni Yaya, your wisdom, guidance and knowledge made the accomplishment of this thesis possible. You are an incredible source of inspiration, and you served as a model for me to firmly believe in my own work. Thank you for your support through challenges and for the many doors of opportunities you have opened.

I am grateful to my thesis proposal committee members Drs. Susan Spronk and Josephine Etowa (proposal) whose perspectives and knowledge enhanced the rigour of my work, and to my dissertation defense committee members Drs. Susan Spronk, Idrissa Beogo, Raywat Deonandan and Ejemai Eboreime. Thank you for your time, insightful questions, and inspirational discussions regarding my work.

Thank you, Dr. Chris Huggins, for your mentorship given freely, be it feedbacks on research projects or much needed advice on navigating the intricacies of the academic job market.

To Drs. Friday Okonofua, Lorretta Ntoimo, and the entire staff of WHARC who made this work possible. Thank you for sharing your expertise with me and giving me the opportunity to grow as a researcher.

I deeply appreciate you, Marilyn Entwistle, for cheering me on and for your extraordinary commitment to mentorship. To Dr. Vic Neufeld, I deeply appreciate your guidance and mentorship.

To the women and men of Okpekpe and Ewatto communities, thank you for sharing your lives and experiences with me, I am humbled by your courage.

I had the pleasure of being steeped in rich intellectual environments fostered in discussions with my colleagues; my PhD cohort: Georgina Alonso, Somed Shahadu, Akalya Kandiah, the various

bright minds from the 2018 PhD School, my amazing colleagues, and faculty from SIDGS. I thank you all for an enriching PhD experience.

To the leadership teams at the Nigerian Working Group, the Global Health Ottawa Hub, Global Health Research Group, and WUSC Sri Lanka. Your passion and fierce commitment to a better discipline and indeed a better world is inspiring. Thank you, Lis Huang, for your endless and contagious vibes of positivity.

To Alzahra Hudani, Dina Idriss-Wheeler, Helena Yeboah and Sandra Sagbohan with whom I have had memorable intellectual exchanges, gossipy chats, and motivational sessions, I have grown in the light of your friendship and your commitment to public and global health. I am very thankful for you. Thank you, Chinonye Udechukwu, Jessica Okonkwo, Richard Nyiawung, Akalewold Gebremeskel for your support and encouragement through the highs and lows of graduate school and life.

To my family: My parents (Dr and Mrs. Osita & Caroline Ogidi) and siblings (Chinedu, Ifeanyi, Ikenna), my extended Ogidi and Okoli family, your prayers and support have been an invaluable resource. Thank you for your commitment and excitement for me to pursue a PhD. To my parents-inlaw (Mr. Francis Udenigwe, Mrs. Obiageli Udenigwe) and siblings (Chukwuma and Mrs. Ada Udenigwe): Thank you very much for your prayers, support, and encouragement throughout this journey. To my friends and family, home and abroad, thank you for all your best wishes.

To my husband and best friend Chibuike, you are one person to whom I owe the most. I continue to be in awe of your tenacity, grit, and passion and everything that makes you a stellar academic. You inspire me intellectually and personally every day to be the best version of myself. Thank you for believing in me and for all your efforts into making sure that I get to do work that is challenging and fulfilling. I am eternally grateful for you. To my babies, Chimamanda, Chiwetelu and Chibimnobi. Thank you for keeping me grounded and for all the joy and excitement you bring. Thank you for being my biggest cheerleaders and for your patience through the whole process, I dedicate this to you.

I give glory to God in whom I draw strength daily and to whom I owe everything. Thank you for your endless blessings, mercies, and favour and for making my dream a reality.

Table of Contents

Abstract ..... **ii**

Acknowledgements ..... **iv**

Table of Contents ..... **vii**

List of Tables ..... **ix**

List of Figures ..... **x**

Format of the thesis and contribution of co-authors ..... **xi**

Chapter 1. Introduction **1**

1.1 Overview and thesis outline 1

1.2 The state of maternal mortality in Nigeria 2

1.3 The use of mHealth in maternal and child health 5

1.4 mHealth and gender dynamics in a SSA context 6

1.5 Gaps in knowledge 8

1.6 Research aim, objectives and questions 9

1.7 Overall thesis design 10

1.8 Overview of mobile health intervention 11

1.9 Conceptual framework 13

1.10 Locating myself in the research 17

Chapter 2. Paper 1: Leaving no woman or girl behind? Inclusion and participation in digital maternal health programs in Sub-Saharan Africa. **21**

2.0 Abstract 21

2.1 Introduction 21

2.2 Intersectionality in digital maternal health programs 25

2.3 Exclusionary practices in digital maternal health programs 26

2.4 Moving towards inclusivity: Recommendations and conclusion 32

Chapter 3. Paper 2: Gender transformative approaches in mHealth For maternal healthcare in sub-Saharan Africa. 36

3.0 Abstract 36

3.1 Gender integration in mHealth interventions for maternal health 37

3.2 Method 41

3.3: Quality appraisal 44

3.4 Data analysis and synthesis 47

3.5 Results 47
3.6 Results table of studies 55
3.7 Discussion 83
3.8 Conclusion 88
Chapter 4. Paper 3: Understanding gender dynamics in mHealth interventions can enhance the sustainability of benefits of digital technology for maternal healthcare in rural Nigeria 89
4.0 Abstract 89
4.1 Introduction 90
4.2 Understanding gender inequalities in mHealth 91
4.3 Text4Life: A description of the intervention 95
4.4 Materials and methods 97
4.5 Results 104
4.6 Discussion 112
4.7 Conclusion 118
Chapter 5. Paper 4: Enablers and barriers to the acceptability of mHealth for maternal healthcare in rural Edo, Nigeria 120
5.0 Abstract 120
5.1 Background 121
5.2 The theoretical framework of acceptability 123
5.3 Method 125
5.4 Results 130
5.5 Discussion 137
5.6 Conclusion 143
Chapter 6. Paper 5: Seeking maternal healthcare in rural Nigeria: Through the lens of Negofeminism 145
6.0 Abstract 145
6.1 Introduction 146
6.2 Autonomy in the context of maternal health 148
6.3 Maternal health through the lens of Negofeminism 150
6.4 Method 151
6.5 Results 155

6.6 Discussion 161
6.7 Conclusion 166

Chapter 7. Conclusion **168**
7.1 Summary of research findings 168
7.2 Future research 170
7.3 Strengths and limitations 171
References 173
Appendices 203
Appendix A In-depth interview guide with WDC chairpersons 203
Appendix B Focus group discussion guide (Women) 205
Appendix C Focus group discussion guide (Men) 207
Appendix D PRISMA 2020 checklist 208
Appendix E Search strategy 212
Appendix F Inclusion and exclusion criteria 213
Appendix G List of excluded studies 216

List of Tables

Table 2.1 Types of digital maternal health programs 24
Table 3.1A Quality appraisal of qualitative studies 44
Table 3.1B Quality appraisal of quantitative studies. 45
Table 3.1C Quality appraisal of mixed method studies. 45
Table 3.2A Summary of studies selected for review. 55
Table 3.2B Summary of studies selected for review (continued) 61
Table 3.3 Gender transformative considerations 73
Table 4.1 Gender dimensions of the Text4Life intervention 102
Table 4.2 Study participants for focus groups 104
Table 6.1 Study participants 156

List of Figures

Figure 1.1 Conceptual framework 26
Figure 3.1 Gender integration continuum.....39
Figure 3.2 PRISMA flow diagram depicting the flow of information screened and reviewed 48
Figure 4.1 Overview of the Text4Life program design 96
Figure 4.2 Operationalizing theoretical frameworks exploring gender dimensions in health interventions.....98
Figure 5.1 The theoretical framework of acceptability: Constructs and definitions.....124
Figure 5.2 Logic model showing Text4Life program theory 126
Figure 5.3 Enablers and barriers to Text4Life acceptance 137

Format of the thesis and contribution of co-authors

This dissertation follows an article-based format. There is some repetition in the text since three of the five papers are based on the same study districts and communities. The reference list for all the chapters is assembled at the end of the thesis.

I co-authored Paper 1 with my supervisor, Dr. Sanni Yaya. I co-authored Paper 2, a systematic review, with my supervisor, Dr. Sanni Yaya, and a co-reviewer, Dr. Olamuyiwa Omonaiye. I co-authored Papers 3, 4, and 5 with my supervisor, Dr. Sanni Yaya, and research collaborators in Nigeria, Drs. Friday Okonofua and Loretta Ntoimo.

I am the lead and corresponding author in the five papers. I developed the research idea in my thesis proposal and developed the theoretical and analytical frameworks. I conducted the data analysis and wrote the first draft of each paper. The co-reviewer (MO) and I independently screened and reviewed the studies included in the systematic review. My research collaborators based in Nigeria (FO, LN) were responsible for data collection in Nigeria.

Chapter 1. Introduction

1.1 Overview and thesis outline

This thesis examines the impact and implications of digital health interventions that extend maternal healthcare in sub-Saharan Africa. Specifically, this thesis investigates how social norms and power structures impact the use of digital health programs for maternal health in sub-Saharan Africa and Nigeria. This thesis comprises five connected papers:

The first paper (Chapter 2) illustrates exclusionary practices of digital health programs through an extensive literature review of digital maternal health programs across sub-Saharan Africa. Taking an intersectional approach, the paper discusses women and girls' digital exclusion and how the most vulnerable are still underserved in the digital health arena.

The second paper (Chapter 3) provides a systematic review of the literature to synthesize evidence of gender transformative approaches in mHealth for maternal health in sub-Saharan Africa. Study findings indicate that mHealth studies are not substantively incorporating gender considerations into their study aims; instead, gender considerations are treated tangentially within mHealth programs' design, implementation, or evaluation. This highlights the need for an explicit and intentional focus on gender considerations and the promotion of gender equality in mHealth programs for maternal healthcare.

The third paper (Chapter 4) describes how understanding gender dynamics in mobile health interventions can enhance the sustainability of the benefits of digital technology for maternal healthcare in rural Nigeria. This chapter explores the gender dimensions of Text4Life, a mobile health intervention for maternal healthcare in Edo State, Nigeria. Perspectives of women who are the primary beneficiaries, their spouses who are all men, and community leaders who oversaw the implementation and delivery of the intervention are presented.

The fourth paper (Chapter 5) uses the theoretical framework of acceptability as a tool to describe the enablers and barriers to the acceptance of the Text4Life mobile health program. This study assessed acceptability from a retrospective perspective and centres participants' cognitive and

emotional responses to the intervention and how it influences sustained engagement with the intervention.

The fifth paper (Chapter 6) explores maternal healthcare decision-making and wellness through the lens of African feminism, specifically negofeminism. Through conversations with men and women about maternal healthcare seeking and wellness, this paper examines how discourses underlying negofeminism are tied to maternal health in rural Nigeria. Findings show how women navigate patriarchal environments through negotiation, collaboration and maneuvering to yield the best possible maternal health outcomes.

1.2 The state of maternal mortality in Nigeria

Maternal mortality remains an issue of global importance with continued efforts by the international development community toward its reduction. As at 2020, the global maternal mortality ratio (MMR) ratio was estimated at 223 maternal deaths per 100,000 live births (WHO et al., 2023). Nigeria, Africa's most populous country had the highest estimated number of maternal deaths and accounted for 28% of global maternal deaths (WHO et al., 2023). Specifically, Nigeria recorded 1047 maternal deaths per 100,000 live births in 2020. It is estimated that a Nigerian woman faces a 1 in 19 lifetime risk of complications during pregnancy or childbirth. To address maternal mortality, countries have united to reduce the global maternal mortality rate to less than 70 deaths per 100,000 births by 2030 (Kassebaum et al., 2014; WHO. UNICEF. UNFPA, 2015). While progress is projected in East Asian and Latin American countries, countries in Sub-Saharan Africa (SSA) are likely to lag in meeting global targets (Nicolai et al., 2015).

An important step towards progress in maternal health is improving knowledge of the causes of maternal deaths. The WHO defined maternal mortality as "the death of a woman while pregnant or within 42 days of the termination of a pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes"(World Health Organisation, 2011). This definition allows for maternal deaths to be identified as direct and indirect obstetric deaths. Direct deaths result from obstetric complications during pregnancy, labour and postpartum. Indirect obstetric deaths result from pre-existing infections such as HIV

or cardiovascular diseases that are aggravated by pregnancy. The major causes of death were identified as hemorrhage which accounted for 27.1% of maternal deaths, hypertensive disorders accounted for 14%, Sepsis 10.7% and unsafe abortion 7.9% (Say et al., 2014). Causes of maternal deaths are mostly preventable, particularly when pregnant women are knowledgeable of obstetric danger signs and seek skilled maternal health care for pregnancy and childbirth.

The provision of high-quality maternal health care has been identified as a key strategy in preventing maternal mortality. In 2005, the United Nations Task Force on Child and Maternal Health positioned health systems at the centre of addressing maternal mortality. The Task Force prioritized the strengthening of the primary healthcare (PHC) system, from first-referral level facilities to the community level (Freedman et al., 2005). Since 2007, Nigeria's maternal, newborn, and child health (MNCH) policies have been guided by the Integrated Maternal, Newborn, and Child Health (IMNCH) strategy which echoes the UN task force's priority in its objective to increase maternal access to and utilization of primary health care services (Government of Nigeria, 2009). This policy focused on providing services to marginalized women through pregnancy, childbirth, and the postnatal period.

Healthcare services in Nigeria are delivered within a three-tiered healthcare system namely tertiary, secondary and primary levels of healthcare (WHO, 2014). Tertiary healthcare which falls under the federal government's responsibilities is provided by teaching hospitals and specialist hospitals. The secondary level of healthcare is managed by the ministries of health at the state level. Healthcare services at the state level include state-owned general hospitals and health centres. Patients at this level are often referred from primary healthcare centres. The primary level of care is the responsibility of the local governments and health services are organized through wards (WHO, 2014). Within the country's three-tiered healthcare system, the Nigerian Ministry of Health implemented the IMNCH strategy through its primary healthcare system (PHC). PHC in Nigeria remains the most accessible and affordable form of care that serves most of the population (Aregbeshola & Khan, 2017). PHCs provide a range of services ranging from family planning to maternal and child healthcare. It is the first point of contact between government-funded health systems and individuals living in rural areas. Primary healthcare continues to be the recommended route for improving access to skilled birth

attendants in low-resource settings. In Nigeria, the current state of the PHC system lacks the capacity to provide essential healthcare services. Out of the 34,000 PHCs across the country, only 20% are sufficiently operational (Aregbeshola & Khan, 2017).

Women's use of health facilities is constrained by several factors which can be understood from the demand and supply framework (Ajaegbu, 2013; Aremu et al., 2011). Demand side factors operate at individual, household, or community levels to determine the demand for health care. Impediments from the demand side include inadequate knowledge of health providers, lack of affordable transport to healthcare facilities, lack of control over household resources, reluctance to seek care due to cultural attitudes or due to inability to make informed health decisions and lack of autonomy. The lack of autonomy as it relates to decision-making in maternal health has been shown to have adverse effects on women (Namasivayam et al., 2012; Okonofua et al., 2018; Maricianah Onono et al., 2019), however, feminist perspectives extend discussions around autonomy to include relational autonomy which intrinsically includes collective responsibility and shared social practice as evidenced in different cultural settings (Mohanty, 1991; Nnaemeka, 2004). MacDonald et al (2018) attribute poor maternal health outcomes to the lack of community or collective responsibility by acknowledging women's interconnectedness and the relevance of their relationships both at familial and community levels to maternal health (MacDonald et al., 2018; Pacagnella et al., 2012).

Supply-side factors are determined by the healthcare service and include barriers such as poorly staffed facilities, poorly equipped facilities, hostile attitudes of health workers and shortage of health workers to provide healthcare. Rural areas are disproportionately plagued with such issues. Free maternal healthcare policies have been adopted in Nigeria to alleviate financial barriers to the use of skilled healthcare services. For example, between 2009 and 2015, the National Health Insurance Scheme Free Maternal and Child Health Program was implemented in 12 out of 36 states across Nigeria (Okonofua et al., 2011a; Onwujekwe et al., 2019). The federal government provided 75% of the required funding for the program. The states were expected to contribute counterpart funding (25% of the funding) to match the grant from the federal government (Onwujekwe et al., 2019). The funds were pooled and used by pregnant women and children less than 5 years old to access free healthcare services from primary health

centres, but they were referred to selected general hospitals in the event of health complications. While the project showed improved use of skilled healthcare services, funding and governance challenges impeded its scale-up and sustainability (Onwujekwe et al., 2019). Therefore, across the country, service utilization remains relatively low. National data from the 2018 Nigerian Demographic Health Survey indicates that 50% of pregnant women did not receive adequate antenatal care from a skilled provider during pregnancy and only 43% of births were assisted by skilled birth attendants (National population commission Nigeria, 2019). Significant geographical variation was evident in pregnant women's use of antenatal care services with a range of 15% in a Northwestern region and 97% in a Southeast region. Abundant evidence shows an increased risk of maternal death among women who did not receive skilled antenatal, intrapartum and postnatal care and those whose deliveries were not attended by skilled birth attendants (Harrison, 2009).

Nigeria continues to embark on a series of reforms to extend maternal healthcare across the population. The country's 2014 Presidential Summit declaration affirmed Nigeria's commitment to achieving Universal healthcare coverage, a commitment that could potentially avert 309,000 maternal deaths by 2030 (Abubakar et al., 2022). Achieving this goal highlights an urgent and unparalleled need to develop, implement, and evaluate innovative, contextually appropriate, and sustainable health interventions to improve access to healthcare and encourage women's use of skilled health providers in Nigeria. One such intervention is the application of digital technology to health which has the proven potential to enhance health outcomes. It is no surprise, therefore, that Nigeria has prioritized the use of digital technology to fast-track the attainment of universal healthcare.

1.3 The use of mHealth in maternal and child health

Maternal and child health initiatives are embracing the use of electronic or mobile technology, a branch of digital health popularly referred to as eHealth or mHealth. The main component of mHealth is the exchange of health-related information using mobile devices. Information can be in the form of coded data, texts, images, audio and video (Amoakoh-Coleman et al., 2016). mHealth applications are touted as being cost-effective and accessible, particularly to marginalized and vulnerable populations. They have been proposed as effective solutions for

improving maternal and newborn health. A systematic review reported that mHealth interventions in low- and middle-income countries more than doubled women's antenatal care attendance (Amoakoh-Coleman et al., 2016). A study conducted in Sierra Leone found that a mHealth intervention that enabled two-way communication between healthcare workers and traditional birth attendants improved women's use of health facilities through referrals from traditional birth attendants (Sondaal et al., 2016). In Uganda, an integration of mHealth and geographic information systems provided a low-cost method of identifying the spatial and temporal pattern of malaria, thereby improving the chances of responding to the disease, especially among pregnant women (Larocca et al., 2016). In Nigeria, a mHealth project called the Abiye project provided free cell phones to women and saw an increase in facility use and a reduction in maternal mortality in Ondo State. This intervention enabled bi-directional communication between pregnant women and their health providers during obstetric complications (Oyeyemi & Wynn, 2014a). Other studies showed that mobile phone programs that provide health information to pregnant and postpartum women increased women's self-efficacy (LeFevre et al., 2018).

1.4 mHealth and gender dynamics in a SSA context

The benefits of mHealth not-withstanding, it is important to understand that mHealth programs take place within complex social, economic, and political settings. These programs can transform contexts within which they occur thereby having diverse impacts-positive, negative or mixed - on equitable services and gender relations in communities (George et al., 2018; Sinha & Schryer-Roy, 2018). Achieving social change within a community requires identifying and involving institutions within which power is exercised (Green, 2016). Women's disadvantage in access to technology has been noted, however, they are often targeted as key beneficiaries of mHealth programs (Jennings & Gagliardi, 2013). Many programs face the risk of disregarding gender relations that govern women's access to care. Furthermore, there is a risk of homogenizing women and ignoring the diversity within them which can lead to health and gender inequalities. Paying attention to disparities in women's access to health within the context of intersecting domains such as ethnicity, class, or socioeconomic status reduces such risks.

George et al. (2018) presented a compelling case on the importance of understanding existing gender dynamics in mHealth interventions and working with women and men alike to avoid negative outcomes (George et al., 2018). Mobile health programs that aim to address demand-side issues would often require that the beneficiaries have access to mobile phones, however, women are overall less likely to own or have independent control of mobile technologies (George et al., 2018; OECD, 2018). In such instances, mHealth interventions may not only miss the intended population but exacerbate inequality in health promotion and access to health services. Furthermore, while mHealth interventions can provide information on pregnancy and child health care practices, they may threaten familial relationships if recommended practices conflict with the norm. For example, in the Democratic Republic of Congo, a pilot program that provided confidential and accurate family planning information through a hotline saw a high rate of participation from men instead of women who were the intended targets (Corker, 2010). Reasons for this unanticipated result were attributed to the gendered gap in access to mobile devices. It is therefore important to recognize how gender dynamics affect women's access to and use of mHealth services.

Acceptability of eHealth Interventions

Beyond considering gender dimensions and unintended consequences of mHealth, an intervention's acceptability is a necessary consideration for its effectiveness and ultimately sustainability. In Nigeria, just as in other sub-Saharan African countries, priority is often given to implementing mHealth programs, however, most of these programs remain at the pilot or informal stage (WHO, 2013). Few of them go to have well-established programs that are sustained and scaled up. Policy approaches to the adoption and use of digital health technologies call for active community-based approaches in designing, implementing, and evaluating mHealth interventions. Engaging and mobilizing community members improves outcomes and enhances the longevity of mHealth programs because when health programs are deemed acceptable by intended beneficiaries and their communities, the program thrives in delivering the intended benefits and is sustained. Determining acceptability can help highlight progress made by the intervention and challenges that need to be addressed for the program to realize its full potential. Studies are showing that despite the potential of emerging mHealth interventions to improve the quality of healthcare in Nigeria, low levels of acceptability has led to the underutilization of

interventions by health workers and patients (Zayyad & Toycan, 2018). The WHO identifies the acceptability of a mHealth intervention from both the perspectives of health workers and clients as an indicator of the success of an intervention (WHO, 2019). Clients or beneficiaries are more likely to adhere to an intervention if they perceive that its content and context are acceptable. The unique contexts of clients as it relates to mHealth include access to network/electricity or access to mobile phones or literacy levels and digital skills. Similarly, healthcare practitioners who are often tasked with delivering interventions to patients may not do so effectively if they are not considered acceptable, thereby impacting the overall effectiveness of an intervention (Dillip et al., 2012; Sekhon et al., 2017). In line with this perspective, acceptability has been defined as "a multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experienced cognitive and emotional responses to the intervention" (p.4) (Sekhon et al., 2017). This definition helps understand users' cognitive and emotional responses to mHealth intervention and its impact on their engagement with it.

1.5 Gaps in knowledge

Across Nigeria, studies have reported on the role of mobile health interventions in maternal care. Findings show that mHealth innovations have brought healthcare expertise to health officials and continue to provide a streamlined system of compiling pregnant women's health information which in turn is used to support decision-making by health workers (E.Abel & Obeten, 2015; Obasola et al., 2015a; Oyeyemi & Wynn, 2014a; Thompson et al., 2010; West, 2015). However, the digital transformation of healthcare has raised various challenges. For instance, digital health programs are not often designed with a focus on equity in distribution nor are they designed from a gender equity standpoint. Although digital health interventions for maternal healthcare focus predominantly on women as beneficiaries, few studies explore gendered power relations and how they impact the success of maternal and child health projects in African contexts such as Nigeria. This gap in literature risks excluding women from engaging in the digital space and can worsen the negative unintended consequences of participating in mHealth.

There is little but necessary evidence on gender transformative approaches to mHealth intervention across SSA. The WHO defines a gender transformative health program as one that

"addresses the causes of gender-based health inequities through approaches that challenge and redress harmful and unequal gender norms, roles, and power relations that privilege men over women (WHO, 2011, p. 136)". However, there remains a paucity of synthesized evidence on gender transformative considerations being made in digital health programs for maternal healthcare in sub-Saharan African contexts and the corresponding research, program, and policy implications. Addressing this gap is necessary to highlight best practices for integrating gender in mHealth design and implementation.

The World Health Assembly through its global strategy on digital health urged WHO Member States to prioritize a people-centred approach to digital health. In the case of digital health for maternal healthcare, this focus covers not only women but their families, communities and health workers using digital health. Digital health, the strategy argues, should be developed, and implemented with principles of acceptability among other things. Digital health interventions will be adopted only if end users deem it appropriate. Against this backdrop, the gaping issue identified across various studies lies in delineating factors that determine the acceptance of mHealth programs(Dillip et al., 2012; Sekhon et al., 2017; WHO, 2019). Studies have anchored acceptability solely on concepts such as satisfaction with or adherence to an intervention. These definitions fall short in acknowledging the multifaceted ways in which an intervention can be accepted such as based on attitudes, skills, and perceptions of end users. This has led to a lack of consensus on a definition of acceptability. In keeping with a person-centred approach to digital health, efforts toward reducing maternal mortality must contextualize the socio-cultural realities of women to appropriately inform program planning and development and radically adapt existing programs to meet their needs. Therefore, adopting localized theories that centre the stories and histories of women within the cultural and philosophical spaces they occupy will provide a better understanding of their realities that could be diminished through the lens of dominant theories.

1.6 Thesis aim, objectives and questions

Aim: This thesis aims to explore women's interaction with digital health technologies (specifically mobile health) for maternal healthcare by situating gender within the context of social determinants of health.

Research questions: The overarching research questions that guided this thesis include:

- Why does a gender lens matter in digital health programs for maternal healthcare in sub-Saharan Africa?
- What are the implications of social norms and power structures in women's use of mobile health technologies for maternal healthcare in rural Nigeria?

Objectives: This thesis addresses the aforementioned knowledge gaps with the following objectives:

- To describe exclusionary practices that deter women's participation in digital health for maternal healthcare in sub-Saharan Africa.
- To explain gender dimensions of a mHealth intervention for maternal healthcare in rural Nigeria through the experiences of women, their spouses, and communities.
- To apply acceptability as a tool to describe the enablers and barriers to the acceptance of a mHealth intervention that extends maternal healthcare services to rural areas of Edo State Nigeria.
- To understand maternal healthcare seeking and wellness in a rural Nigerian context through an African feminist perspective.

1.7 Thesis design

My thesis used secondary and primary data collection methods. Two secondary and three primary studies described the various implications of women's use of digital health technologies for maternal healthcare in sub-Saharan Africa more broadly and in rural Edo State, Nigeria, specifically. The secondary studies involved a review and a systematic review of the literature. The primary studies involved focus group discussions and in-depth interviews with pregnant or post-partum women who were beneficiaries of a mobile health program and their community members. The primary research involved a cross-sectional qualitative research study set in Etsako East and Esan Southeast local government areas of Edo state, Nigeria. Between September 2021 and January 2022, eight focus group discussions (FGDs) were conducted with 64 participants: 39 women and 25 men. Two in-depth interviews (IDI) were conducted with ward development committee chairpersons of Okpekpe and Ewatto communities.

Nigeria is Africa's most populous country with a population of 180 million people (Population Reference Bureau, 2017). With an annual population growth rate of 3%, Nigeria is projected to have the second-largest population increase in the world by 2050 (Population Reference Bureau, 2017). The country is divided into six geopolitical zones and is made up of 36 States. Each state is further divided into local government areas, and each is divided into approximately 10 wards. About 50% of Nigeria's population reside in rural areas (Okigbo et al., 2016). Edo state was chosen because it is one of the lowest-performing states in terms of developing and maintaining its primary healthcare system. Edo State is one of Nigeria's 36 states and home to eight million residents (Edo State Government, 2019). The study sites are located in the Northern part of Edo and are predominantly rural. The healthcare system in Edo and Nigeria as a whole is structured across three levels, i.e., primary, secondary, and tertiary. The majority of basic maternal healthcare occurs at primary healthcare facilities, and this serves as the main source of healthcare in these communities. Both communities comprise 31 villages and hamlets. This qualitative study was carried out in 20 out of the 31 communities. There are two primary healthcare centres in each community for a total of four facilities covering the 31 villages. These communities were chosen as study sites because of their rural locations, weak health infrastructure and high rates of maternal mortality (Yaya et al., 2018).

1.8 Overview of mobile health intervention: Text4Life

My primary research project was part of a larger study by the Women's Health Action Research Centre aimed at improving rural women's access to skilled pregnancy care (WHARC, 2022). The larger study was funded by the International Development Research Centre Canada, in partnership with Global Affairs Canada and the Canadian Institute for Health Research under the Innovating for Maternal and Child Health in Africa project. The Women's Health Action Research Centre (WHARC) is a non-governmental and non-profit organization based in Benin City, Edo State, Nigeria. Through formative and intervention research, the Centre documents the socio-cultural determinants of women's health. WHARC developed and implemented the Text4Life program (Okonofua et al., 2023). Text4Life is a mobile health technology designed to enhance women's use of health facilities and facilitate two-way communication between

healthcare workers and pregnant women. It also serves to increase pregnant women's self-efficacy through the provision of relevant health information.

WHARC conducted formative studies with the women, men, policymakers, primary healthcare providers, and community elders of Ewato and Okpekpe communities, two Local Government Areas of Edo State in southern Nigeria. Findings from these studies identified the need for interventions that address women's difficulty with transportation and lack of access to healthcare providers during pregnancy (Udenigwe et al., 2021a; Yaya, Okonofua, Ntoimo, Kadio, Deuboue, Imongan, et al., 2018). These key actors proposed the use of rapid short message services (SMS) as a viable means of linking pregnant women with healthcare providers. WHARC worked with information communication technology experts to design a rapid SMS model called Text4Life. This model enables real-time dual communication and alerts. On the Text4Life platform, new pregnancies can be registered with support for healthcare providers to monitor pregnancies through the antenatal, delivery, and post-partum periods. In these communities, the program is managed by Ward Development Committees (WDC). The WDC constitutes select community members and a chairperson who serves as a bridge between primary healthcare facilities and their communities. WDCs monitor the quality of service delivery to the community and enhance community involvement in health by harnessing community resources (human, financial, material) to sustain quality healthcare delivery (Oyari et al., 2017).

Text4Life was built on an open-source framework written in Python and Django programming language. It uses a web user interface created for the project by Textit® to enable instant reporting of pregnancy-related events and timely notification of health facilities. SMS system-based technology enables dual communication between pregnant women and healthcare providers. It functions as an alert system and supports the documentation of pregnancies in the community. Pregnant women also receive health messages on topics around preconception, pregnancy, childbirth, and the postnatal period. To use this mHealth service, women need to have access to a mobile phone including shared phones and provide their contact information including name, residential address, telephone number, and telephone numbers of the next of kin. Women were also required to pay a registration fee of 2000 Naira (equivalent to $6.00) to join a community health fund. Through the Text4Life platform, pregnant women are able to request

swift transportation to primary healthcare facilities during obstetric emergencies. If a pregnant woman is in distress, she can send a keyword to a registered number via SMS signalling distress. The message, in the form of a dual SMS, is relayed to both the primary healthcare facility and the WDC chairperson. The WDC chairperson is responsible for dispatching a community driver to pick up the woman in distress while the health workers prepare to receive the woman at the health facility. Women registered in this program do not pay additional fees for antenatal care, childbirth, postpartum and referral services at their primary healthcare facilities. To enhance women's participation in the Text4ife program, WHARC loaned out phones to women through the health facilities for the duration of their pregnancies. Okpekpe community received 3 phones while Ewatto community received 10 phones.

Training workshops were conducted with women, healthcare providers, and WDC chairpersons to educate them on the use of the Text4Life platform. Sessions covered possible scenarios and complications for which women would require transfer and how to send and receive messages from their healthcare providers. Healthcare providers were taught how to prepare for and respond to incoming emergencies. Women with severe complications could be referred to more specialized hospitals. Text4Life was implemented in June 2019 and has since registered 1,620 pregnant women. The sample size consideration for my research project was informed by the initial number of registrants in 2019. There were 74 women registered for the Text4Life intervention from both Okekpe and Ewatto communities. Further details about the Text4Life program have been reported in a journal article (Okonofua et al., 2023).

1.9 Conceptual framework

Identifying a conceptual framework was necessary to guide this thesis and connect all five chapters. An extended version of the three-delay model was chosen as an appropriate framework to guide this thesis.

The three-delay model uses three distinct phases to explain and characterize factors that lead to maternal mortality (Pacagnella et al., 2012). Type 1 Delays are caused by factors that constrain the decision to seek skilled healthcare services. Various factors play a role in this phase of delay

given that decision-making is a complex behaviour interfacing individual traits with social, cultural and economic conditions. For example, a woman's decision to seek skilled healthcare during pregnancy may be dependent on the advice of her spouse and other relatives. Guided by this framework, Paper 5 explores women's decision-making by exploring how negofeminism is deployed in maternal healthcare seeking. By using a theory that is closest aligned with the realities of participants, the negofeminist position centres the African woman's stories and histories and highlights the various ways she negotiates with and subverts patriarchy.

Type 2 delays identify difficulties with reaching appropriate care. This delay is usually influenced by distance and transportation to health facilities. In the context of this thesis where mobile health primarily serves to improve access to healthcare by increasing the speed of access, delays in reaching appropriate maternal healthcare are illustrated through exclusionary practices of digital health programs (Paper 1). Through an extensive literature review of digital maternal health programs across sub-Saharan Africa, this chapter takes an intersectional approach to discuss ways in which women are digitally excluded and how the most vulnerable are still underserved in the digital health arena. Furthermore, it was important to explore gender-related constraints that impact women's meaningful participation in digital technologies and subsequently their access to healthcare (Paper 3). Type 3 Delay is the delay experienced when a woman arrives at a health facility and is unable to receive adequate and appropriate treatment and care. The acceptability of the digital health intervention reflects the extent to which women consider it appropriate (Paper 4). Poor maternal health outcomes are likely if any of these delays occur.

The strength of the three-delay model lies in its capacity to present the delays as sequential yet interrelated. Maternal deaths are often not a consequence of delays in one phase alone, it is often a combination of factors. For instance, not reaching the healthcare facility promptly (cumulative effect of phases 1 and 2) could mean reaching the hospital in a serious condition whereby treatment is not possible. Inadequate care received at health facilities (phase 3) could deter the use of skilled care for subsequent maternal healthcare needs (phase 1). These strengths notwithstanding, the three-delay model falls short in acknowledging other crucial aspects of maternal health. The three-delay model provides a framework to conceptualize violations of

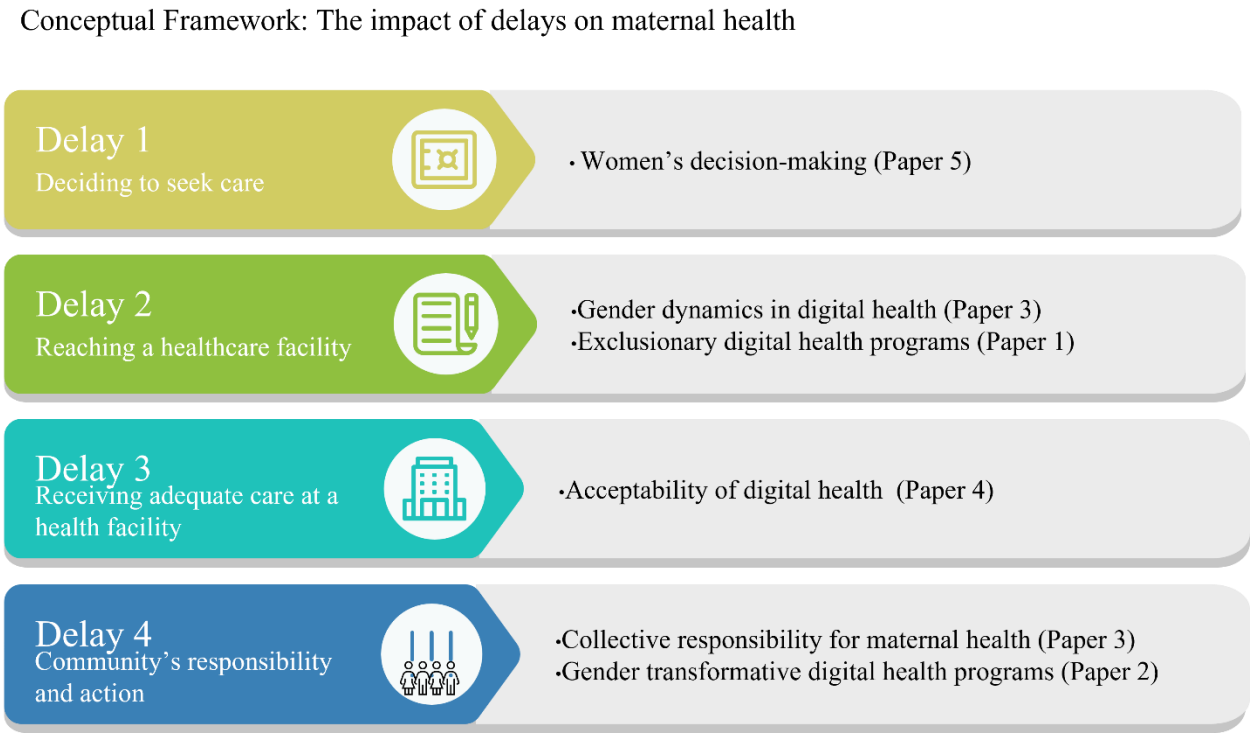
women's human rights but does not necessarily acknowledge the human rights violations inherent in the delays. Acknowledging maternal mortality as a consequence of violated human rights makes visible issues of inequity and gender discrimination that impede maternal health. Furthermore, an extensive review of the three-delay model found that it is largely retrospective and does not sufficiently reinforce preventive action aimed at reducing maternal mortality (MacDonald et al., 2018; Pacagnella et al., 2012). The potential for preventive action in maternal health lies heavily on an understanding of women's general status in the context of their community. For instance, studies have shown that women's partners and family members such as mothers or grandmothers are key players in maternal health as they influence women's healthcare-seeking (Aubel, 2021). Therefore, women's community impacts (positively or negatively) maternal health. Similarly, studies have indicated the importance of community and political will and action in ensuring that women's sexual and reproductive needs are met (Fantaye et al., 2019). The socio-political realities of women's lives such as their status in society and their power and influence (or lack thereof) could impair or enhance maternal health. Key efforts toward reducing maternal mortality must contextualize the socio-cultural realities of women and their communities to appropriately inform program planning and development and radically adapt existing programs to meet women's needs.

A fourth delay as proposed by MacDonald et al (2018) attributes poor maternal health outcomes to the lack of community or collective responsibility. Delays arise when a community is not sufficiently knowledgeable or aware of issues contributing to maternal deaths, or where there is an absence of collective responsibility to drive political action on issues pertaining to maternal health (Pacagnella et al., 2012). Maternal health is impacted by a community's capacity to self-identify norms and expectations around health service use, identify and harness resources available to them, and mobilize efforts to prevent and reduce maternal health. Community-based research studies bring to light the role of community efforts to enhance healthcare services (Abimbola et al., 2016; Fantaye et al., 2019; MacDonald et al., 2018; Yaya, Okonofua, Ntoimo, Udenigwe, et al., 2019). These efforts include the provision of land and labour to build healthcare facilities, collective action for demanding accountability from healthcare services, and mobilized efforts towards improved community infrastructure such as better roads and

transportation services. Taken together, all delays are embedded within the community, occur because of the community and impact the community as a whole.

In keeping with the importance of women's extended social network, this thesis focused on maternal health and the impacts of the digital health program, Text4Life, from the perspective of women and their community members. In accordance with prior evidence of a collectivist expression of cultural values in my study communities, I designed the study with the consideration that women's experiences during pregnancy would be a communal experience and thus influenced by sociocultural aspects of their community (Fantaye et al., 2019). I draw upon a wider concept of personhood that extends beyond the individual to understand maternal health (Paper 5). Furthermore, gender transformative approaches to digital health go beyond couples or individual interventions but also community-level engagement to address negative social norms that restrict women's access to digital technology (Paper 2).

Figure 1.1 Conceptual framework



1.10 Locating myself in the research

> *"The qualitative researcher's perspective is perhaps a paradoxical one: it is to be acutely tuned in to the experiences and meaning systems of others—to indwell—and at the same time to be aware of how one's own biases and preconceptions may be influencing what one is trying to understand"* (Maykut & Morehouse, 1994, p. 114).

Much of the research on the role of the researcher in qualitative research concurs that there is no neutrality in research approaches; instead, the researcher is either conscious or less aware of their biases whether or not it be declared explicitly (Corbin Dwyer & Buckle, 2018; Maykut & Morehouse, 1994). In indwelling, qualitative researchers are called to be empathetic, not sympathetic, to their research participants, to gain an understanding of participants' reality in a way that is meaningful to participants. A detailed reflection on the subjective process of qualitative research as well as a researcher's awareness of their biases and perspectives enhances the methodological rigour of the study. Therefore, I reflect on my positionality in the research process and question my assumptions in the hopes of contributing toward strategies that address the influence of power, positionality, and privilege in the qualitative research process. In doing so, I hope to contribute to the rigour with which we discuss researcher positionality within global health research.

I conducted my doctoral research in Etsako East and Esan local government areas of Edo State, Nigeria. I was born in and spent my formative years in Nigeria. In terms of positionality, I consider myself an insider and privy to knowledge that enables me to contextualize perspectives and experiences shared by participants in my research communities. However, I also consider myself a foreigner in relation to the specific customs in these communities and acknowledge my limits in understanding and conveying the nuances and complexities of these customs in my research. I also acknowledge that as an academic in a Canadian education system, I am part of an academic system that has long silenced African Indigenous knowledge systems as a legitimate field of academic enquiry. The tension between my *gaze* (my audience for whom I as an academic write) and *pose* (the standpoint from which I write) informs my role as a researcher (Abimbola, 2019).

Identifying as an insider carries with it a risk of heightened subjectivity in the research project. The risk of being 'too immersed' to suspend personal viewpoints and remain objective in investigating a phenomenon is of particular concern (Corbin Dwyer & Buckle, 2018). However, I identify with counterarguments that have problematized the emphasis on objectivity, which has unduly rendered subjectivity a pejorative. A feminist critique of objectivity in health and development research illustrates how closely integrated objectivity is with structures of power (Fee, 1982). Objectivity reproduces power relationships on a social scale such as a dichotomy between experts and non-experts. This dichotomy often presents as the dominance of certain population groups whose knowledge is undisputed, inaccessible, and only flows in one direction, i.e., from the expert to non-experts. The assertion of objectivity over the subjective is implicated in discounting often marginalized groups such as women or racial minorities as active subjects in the creation of knowledge (Corbin Dwyer & Buckle, 2018). Furthermore, accusations of heightened bias as insiders are more so directed towards researchers of ethnic and racial minorities than Caucasian researchers working within their population. An important requirement for the qualitative researcher is to be open, authentic, and committed to representing the experiences of participants accurately and adequately.

I believe that my insider status granted me the unique opportunity to be empathetic to the research participants. As an insider, I also felt a profound sense of accountability to my research participants which in turn inspired me to investigate maternal health in a way that is meaningful to them and reflective of their realities. Over the course of five years, I worked in the Okekpe and Ewatto communities on other projects, alongside my supervisor, Dr. Yaya and research collaborators in Nigeria. Through this experience, I have learned the importance of reducing power differentials between researchers and research participants by involving participants as active collaborators in the research process. The communities have always been actively involved in the research process; the opinions of women and diverse stakeholder groups including their spouses, community leaders, policymakers and healthcare providers have been integral in identifying causes of maternal morbidity and mortality and strategies to prevent them. I have learned to be attentive to and respectful of these diverse perspectives. Expressing the priorities and values of these communities in my research was of utmost importance.

Global health and development research, steeped in its colonial legacies, has historically been used as a tool through which the powerful exert power. I acknowledge that as a foreign-trained researcher, I am not immune to reinforcing assumptions and perpetuations of colonial constructs in my research in Nigeria, however, I was critically aware of this and sought to reduce my impositions in research. Therefore, I reflected on the need to abandon colonial research practices wherein approaches to research are prone to bias in interpretation and focus instead on approaches that are grounded in the realities of participants (Garcia-Basteiro & Abimbola, 2021). This approach places the participants who bear the burden of ill maternal health as central knowledge holders, acknowledges subjectivity, privileges participants' definition and interpretation of research concerning them, and emphasizes researcher accountability and community.

The collective ethic of the African value system has been well-researched. It posits Africans as being strongly oriented towards collective values and a shared sense of responsibility (Mabetha et al., 2021; Mkabela, 2015; Nnaemeka, 2004; Nzegwu, 1995). This has also been reported in Nigeria. I drew from this approach and centred "the collective" in my exploration of digital health and maternal health. I sought the perspectives of women, their spouses and community leaders. In interpreting my data, I explored women's motivations in seeking maternal healthcare and ways in which they empower themselves in challenging circumstances. As I reflected on theoretical lenses through which to understand this, I learned to interrogate sources of theories and their applicability in an African context. For example, I incorporated a gender framework that considered women and other relevant stakeholders that inform and shape gender relations and practices. I applied Negofeminism to show how women negotiate to yield the best possible maternal health outcomes. In exploring the acceptability of digital health in Okekpe and Ewatto communities, I worked with the assumption that women's experiences during pregnancy would be a communal experience and thus influenced by socio-cultural aspects of their community.

When I designed my research project in 2020, I was hopeful for an imminent return to normalcy which would have meant me travelling to Nigeria to undertake in-person fieldwork. Due to the COVID-19 pandemic, health safety measures and travel restrictions, I was unable to travel to Nigeria as planned. I am fortunate to have established collaborations with Nigerian-based

researchers who provided me with the feasible alternative of working remotely in collaboration with them. They conducted data collection which involved in-depth interviews and focus group discussions. We communicated regularly to address any issues that arose, and I provided clarification where needed. Their knowledge and expertise were invaluable as they have been at the forefront of addressing maternal health challenges in these communities.

Chapter 2. Paper 1: Leaving no woman or girl behind? Inclusion and participation in digital maternal health programs in Sub-Saharan Africa.

Published in Reproductive Health, Volume 19, Issue 54, 2022
https://doi.org/10.1186/s12978-022-01358-1

2.0 Abstract

Across sub-Saharan Africa where access to adequate maternal healthcare is fraught with myriad challenges, especially for hard-to-reach populations, digital health technologies offer opportunities to improve maternal health outcomes. Digital health can circumvent inefficiencies in the traditional healthcare system and address challenges such as limited access to in-person medical consultations, and poor access to skilled birth attendants and health promotion activities. These benefits notwithstanding, digital health can be exclusionary. Too often, digital maternal health programs are not designed with a focus on equity in distribution nor are they designed from a gender equity standpoint. In this paper, we illustrate exclusionary practices of digital health programs through an extensive literature review of digital maternal health programs across sub-Saharan Africa. Taking an intersectional approach, we discuss how women are most vulnerable and excluded at the intersection of gender, literacy, and disability. Tackling exclusionary practices in digital health is crucial to ensure that no woman or girl is left behind.

Keywords: Digital health, maternal health, health inequity, gender, sub-Saharan Africa

2.1 Introduction

At the heart of the ambitious sustainable development goals (SDGs) is the commitment by member states to end poverty by "leaving no one behind" and to "endeavour to reach the furthest behind first" (WHO, 2016c). The SDGs recognise that prioritizing maternal, neonatal and child health is key to eliminating poverty and disparities in low-and middle-income countries. This is of particular importance in Sub-Saharan Africa where a majority of women are without access to essential healthcare during pregnancy and childbirth (United Nations, 2015). Systemic and persistent gaps in access to maternal healthcare services were reported across socio-economic and geographic lines (United Nations, 2015). The three main contributors to unequal access to maternal healthcare among women are wealth, education level, and area of residence

(urban/rural). These socio-economic barriers are often interlinked; women from poor families are more likely to be uneducated and live in rural areas. Furthermore, limited access to maternal healthcare services is higher in instances where provider-patient interactions are required, for example, in antenatal care or delivery attended by a skilled birth attendant.

Measures put in place to curb the spread of COVID-19 have been shown to exacerbate the gap in access to maternal healthcare, particularly among the most vulnerable. Across sub-Saharan Africa, various studies show disruptions in the delivery of maternal healthcare services due to the diversion of healthcare resources to COVID-19 care (Balogun et al., 2021; Oluoch-Aridi et al., 2020). The rural-urban divide in access to maternal healthcare services has grown wider and some women remain unable to access maternal healthcare services due to financial challenges brought about by job losses during the pandemic (Tadesse, 2020). The UN advocates for gender-inclusive responses and recovery measures during the pandemic including the sustenance of sexual and reproductive health services (United Nations, 2020b). In prioritizing gender-inclusive response strategies, the UN recommends moving services online.

Online platforms particularly in the health sector have become increasingly important. The use of digital technology remains a key element of countries' resilience and recovery as their health systems respond to shocks and disruption caused by the COVID-19 pandemic (Haldane et al., 2021). The WHO noted that digital health "plays a unique and pivotal role in achieving universal health coverage. It extends the scope, transparency, and accessibility of health services and health information. It widens the population base capable of accessing the available health services and offers innovative and efficient gains in the provision of health care" (Health Organization Regional Office for Europe, 2016).

Digital health for maternal healthcare

Across sub-Saharan Africa where access to adequate maternal healthcare is fraught with myriad challenges especially for hard-to-reach populations, digital health technologies offer opportunities to improve maternal health outcomes (Balogun et al., 2021). Digital health (specifically mobile health) looks at the use of mobile devices for medical and public health practices. For example, mobile devices such as mobile phones, patient monitoring devices,

personal digital assistants (PDA), and wireless devices can be applied to a broad spectrum of health activities including telephone helplines or text message-based health information (WHO, 2016b). Digital health can circumvent inefficiencies in the traditional healthcare system and address challenges such as limited access to in-person medical consultations, and poor access to skilled birth attendants and health promotion activities. These benefits notwithstanding, digital health can be exclusionary.

Too often, digital health programs are not designed with a focus on equity in distribution nor are they designed from a gender equity standpoint (Figueroa et al., 2021). Digital health programs would often require that beneficiaries have access to mobile devices without noting the uneven distribution in ownership of mobile devices (henceforth referred to as "mobile ownership"). There is a significant variation in mobile ownership between men and women across sub-Saharan Africa, this gap persisted even with the increased reliance on digital technologies during the pandemic (GSMA, 2021). Women, who are often key beneficiaries of digital health programs for maternal healthcare, are overall less likely to own or have independent control of mobile technologies. Across sub-Saharan Africa, country-level gender gaps in mobile ownership range from 4% in Nigeria (89% men mobile owners vs 86% women mobile owners) to 27% in Mozambique (64% men mobile owners vs 47% women mobile owners) (GSMA, 2021). This gender gap is further exacerbated by socioeconomic characteristics such as illiteracy and poverty whose negative effects are greater for women (Alozie & Akpan-Obong, 2017). In such instances, digital health programs may not only miss their intended population but exacerbate inequality in access to healthcare services.

These unfolding arguments have implications for operationalizing digital health programs for maternal healthcare in sub-Saharan Africa. In this paper, we illustrate exclusionary practices of digital health programs through an extensive literature review of digital maternal health programs across sub-Saharan Africa. Taking an intersectional approach, we discuss ways in which women are digitally excluded and how the most vulnerable are still underserved in the digital health arena.

Table 2.1 indicates the types of digital maternal health programs included in this paper. This paper focuses exclusively on programs directed towards pregnant or postpartum women as direct beneficiaries and end-users; and reports majorly on programs that involve interactions between women and healthcare providers.

Table 2.1. Types of digital maternal health programs

Program Type	Description
Appointment reminders	Reminder messages to women from healthcare providers to attend appointments using mobile devices. Messages can be sent through SMS-based text, video, or multimedia messages.
E-vouchers (mobile money)	Electronic vouchers to finance maternal healthcare services using mobile devices; involves the use of mobile apps.
Healthcare telephone helplines	Healthcare advice to women through live phone interactions with healthcare providers or pre-recorded messages; accessible through mobile phones or landlines.
Health information	Administering health information through mobile devices. Can be conveyed through uni- or bi-directional SMS-based text, video, or multimedia messages.
Health promotion	Health promotion campaigns through mobile devices. Can be conveyed through SMS-based text, video, or multimedia messages.
Treatment adherence	Messages sent to women to achieve treatment adherence. Can be conveyed through SMS-based text, video, or multimedia messages.
Surveillance	Surveillance of patients to ascertain pregnancy and/or birth outcomes, obtained through mobile telephone calls to women or bi-directional text messages between women and healthcare providers.

2.2 Intersectionality in digital maternal health programs

In explaining poor maternal health outcomes across sub-Saharan Africa, feminist critiques have problematized patriarchy (Gkiouleka et al., 2018; R. Morgan et al., 2017). Patriarchy underlies gender roles that reduce women's access to material resources compared to men, as well as complex systems of power organised across institutions that restrict women's rights and freedoms. Similarly, gender hierarchies within men and women foster discrimination against gender-diverse and non-conforming individuals (Gkiouleka et al., 2018). Gender is, therefore, an important stratification in understanding determinants of maternal health. Beyond gender as a crucial category, it is important to recognise that women are situated differently across racial, economic, social, and political contexts. Maternal health reform efforts such as digital health, portray women as a homogenous group without acknowledging their intersecting identities and positions (Hankivsky & Christoffersen, 2008). In so doing, only a select few experiences and perspectives are privileged while others are neglected and put at high risk of adverse health outcomes. Viewing maternal access to health services through an intersectionality lens sheds light on these connections between privilege and oppression.

Intersectionality as a theory draws attention to the multiple layers of disadvantage at societal and individual levels that impact health and well-being. The basic tenet of this theory is that an individual's experience cannot be explored and understood by isolated categories of their identities, instead, experiences are shaped by multiple identities that interconnect and interact (Allen, 2005; Kimberle Crenshaw et al., 2016; Figueroa et al., 2021). These interactions are key in producing experiences of oppression or privilege. Some feminist scholars conceptualise intersectionality through the intimate connections between privilege and oppression to encompass the different positionalities of marginalised women. For instance, some women can be privileged by race but victimized by patriarchy (Allen, 2005; Nash, 2008). Other feminist scholars highlight the positions of multiply marginalised women. Intersectionality, as developed and discussed by black feminists, critiques the erroneous assumption of isolated categorical axes of oppression such as gender, class, or race and instead highlights the complexity and interconnectedness between diverse modes of domination (Allen, 2005; Kimberlé Crenshaw, 1989; Kimberle Crenshaw et al., 2016). It considers that identities and systems of power can vary across different contexts be it geographic or political. Intersectionality theory is deeply rooted in

advancing social justice and advocates for strategies that address inequities and reduce or eliminate vulnerabilities (Heard et al., 2020).

An intersectional lens in digital health emphasises diverse modes of oppression including but not limited to sexism, class oppression, racism, ableism, and heterosexism, that underlie intersecting systems of power that compound and exacerbate inequities and ill health (Gkiouleka et al., 2018). For example, the impact and benefit of a digital health intervention for pregnant women in a sub-Saharan African context could be anchored on geographic binaries (rural vs urban settings) (Alozie & Akpan-Obong, 2017; Chib et al., 2013). Compared to a pregnant woman in an urban setting, a pregnant woman in a rural area is less likely to benefit from a digital health program due to limited mobile phone access despite having more barriers to accessing skilled maternal healthcare services (Chib et al., 2013). Even among women with digital technologies within the same geographic location, vulnerabilities such as low literacy or disabilities could diminish the impact of a digital health program (Chib et al., 2013). Thus, intersecting factors such as socioeconomic status, literacy level, and disabilities are crucial to women's access to and use of digital health technologies for maternal healthcare (Figueroa et al., 2021). In the next section, this paper discusses how these systems of oppression are further used as grounds for exclusion in digital health.

2.3 Exclusionary practices in digital maternal health programs

At the intersection of gender and mobile ownership

The literature suggests benefits to using digital technology for maternal healthcare tasks ranging from text messaging as a notification system, or as a form of health education, to tools for data collection on maternal health information (Flueckiger et al., 2019a; Van Heerden et al., 2013). However, experiencing these benefits, even for those with the greatest healthcare needs, depends largely on access to mobile devices.

A recent review of mobile health initiatives across sub-Saharan Africa indicates that compared to women with access to mobile devices, women with no mobile access have limited health knowledge and are significantly less likely to receive skilled maternal care services including antenatal care, delivery care, and postpartum care (Jennings et al., 2015). This suggests that the

digitally excluded women have a greater need of services offered by digital health technologies yet are being left behind. This consideration brings under scrutiny the elusive participation criteria in digital maternal health programs.

From a sub-Saharan Africa context, a major criterion for participation or inclusion in digital maternal health programs is mobile ownership and independent control of a mobile device (often phone) (Obasola et al., 2015a; Odetola & Okanlawon, 2016; Maricianah Onono et al., 2021; Zunza et al., 2017). This criterion inevitably excludes women who may not own mobile phones but have access to shared devices. Another restrictive participation criterion is a focus on internet access. For instance, a digital maternal health intervention study in South Africa required participants to have access to a smartphone and internet even after noting that only half of the general population has access to smartphones and reliable internet (Clouse et al., 2020). There was no indication of gender-specific considerations in mobile ownership or access to the internet. This criterion is often further complicated by the requirement to be connected to specific internet providers (Frances H. Ampt et al., 2020; Ommeh et al., 2019; Unger et al., 2018). These criteria dictate who reaps the intended benefits of digital health programs and who is left behind.

Mobile devices, though a necessity, are not ubiquitous (Hafkin, 2002). However, this point is seemingly neglected in digital health practices and reflects, to a large extent, the social structures and systems of power that govern their design and use. The sociology of digital technologies is largely informed by men, and this is reflected in the wider socio-cultural and economic context within which they are accessed and used (Alozie & Akpan-Obong, 2017; Figueroa et al., 2021; Hafkin, 2002). Men's dominance in digital technology is woven into its various facets including infrastructure, decision-making and leadership, app design, and algorithms (Alozie & Akpan-Obong, 2017; Figueroa et al., 2021; Hafkin, 2002). Therefore, gender-specific constraints to women's active engagement with digital technology are largely ignored. In fact, a widely pervasive assumption is that digital technology is gender-neutral, therefore men and women use and benefit from it equally(Alozie & Akpan-Obong, 2017; Hafkin, 2002). Arguably, digital maternal health programs demanding mobile ownership as a criterion for inclusion and participation are assuming gender neutrality in access to and use of mobile devices. Not only is

this approach engendering gender inequality, but it also risks leaving behind the most vulnerable women.

In contrast to restrictive participation and inclusion criteria, some digital maternal health programs reported on inclusive strategies to enhance women's engagement in digital health, particularly for women without mobile ownership. For instance, digital health programs in South Africa and Kenya have taken a pragmatic approach and included as their participation criteria women who have access to a mobile phone through a family member or friend (Flueckiger et al., 2019b; Linda et al., 2019; Lund et al., 2012b; M. A. Onono et al., 2019; Skinner et al., 2018). While there is some evidence to show that mobile phone sharing is a common practice in some sub-Saharan African settings, critics view this strategy as a limitation (Lamont et al., 2016). A major critique of this approach hinges on privacy concerns (Kola et al., 2021a; Van Heerden et al., 2013). For example, pregnant women living with HIV who were also recipients of health information via text messages feared inadvertently disclosing their status if their text messages were read by a third party (Phillips et al., 2019; Pintye et al., 2020). Understandably, restrictive criteria are necessitated by privacy concerns particularly when it involves sensitive health topics. However, some digital health programs are circumventing privacy concerns. One digital health program reportedly pivoted from sending sensitive text messages to voice calls, this allowed women the privacy of discussing their health concerns with their healthcare providers rather than having them written down (Mogoba et al., 2019). To prevent privacy breaches, other programs have considered password-protected health apps or auto-lock functions that activate immediately after use for women using shared mobile devices (Kola et al., 2021a).

Furthermore, some digital health programs, borne out of the cognisance of the low rates of mobile ownership among women, offered alternatives to participating in digital health programs. In Nigeria, a digital maternal health program offered group mobile phone-based programs to pre-existing community groups instead of programs based on individual mobile ownership. The study was able to reach the poorest and least educated women who were also less likely to own mobile phones or engage in optimal health practices (Flax et al., 2017). This approach was deemed feasible and acceptable by participants. In another instance, women without access to

mobile devices were offered in-home services whereby community health workers brought mobile devices to women's doorsteps to disseminate health information (Adam et al., 2019).

At the intersection of gender and literacy

Beyond the constraint of gender inequality in digital technology ownership, issues of access to digital health technologies are exacerbated by low levels of literacy. The basic idea of literacy refers to having reading, writing, and numeracy skills (Ronda Zelezny-Green et al., 2018). Much of the requirement for participation and inclusion in digital health programs require basic literacy, although this could also extend to other domains including digital literacy. Digital literacy refers to the basic skills and competencies required to use digital technologies to access, manage and use information, produce new knowledge, and communicate with others (Ronda Zelezny-Green et al., 2018). Around the globe, individuals with low levels of literacy are concentrated in South East Asia and sub-Saharan Africa; women make up about two-thirds of this group (Ronda Zelezny-Green et al., 2018). As of 2020, only 59% of adult women in sub-Sahara Africa were literate (The World Bank, 2021). At country levels, these rates range from 95% adult female literacy in South Africa to 14% in Chad (The World Bank, 2021). Studies have highlighted the unique health circumstances of low-literate women by establishing an association between low literacy rates and excessive maternal healthcare costs, higher maternal mortality, and negative healthcare outcomes (Faust et al., 2017; Gazmararian et al., 2012). This segment of women, who are undoubtedly most in need of digital health services, are less likely to enroll in them (Obasola et al., 2015b; Oyeyemi & Wynn, 2014b).

Yet, an overwhelming number of digital maternal health programs in sub-Saharan Africa list literacy as an inclusion criterion (Frances H. Ampt et al., 2020; Clouse et al., 2020; Nachega et al., 2016; Ndlovu et al., 2019; Odetola & Okanlawon, 2016; Parkes-Ratanshi et al., 2020; Unger et al., 2018) with no purposefully designed solutions to help women with limited literacy skills navigate the digital health space. In instances where literacy was not an explicit exclusion criterion, low literacy was associated with low engagement with the digital health program (Oyeyemi & Wynn, 2014b). This suggests that even when literacy is acknowledged as a barrier to accessing digital health programs, certain challenges linger. For instance, health-related information may not be conveyed in simplified terms, or digital health programs may be too

sophisticated in their design and require advanced digital literacy skills (Ronda Zelezny-Green et al., 2018).

Another conspicuous challenge was the exclusion of participants based on language competencies. Some digital health programs included as a participation criterion, the ability of women to read and speak in English. This was observed even in settings where English was not considered the official language or language of the majority (F H Ampt et al., 2020; Ndlovu et al., 2019). For instance, a study noted that while English was a preferred choice of the majority in the population, the study did not reach women at a greater disadvantage due to language barriers (F H Ampt et al., 2020). A general assertion in digital health is to provide services in a country's national language or in a common language that serves the majority (Addotey-Delove et al., 2020). This is problematic in a continent such as Africa that is reputed for its multiple languages so much so that a national language or one considered to be "commonly spoken" by the majority is in fact truly common to only about 20% of the population (Bamgbose, 2011).

These criteria for participating in digital maternal health programs suggest a failure to acknowledge the disparities across the target population and a flawed assumption that the benefits of digital health interventions are universal (Alozie & Akpan-Obong, 2017). This poses a challenge for the most underserved and excluded women. Viewing digital maternal health through an intersectional lens would extend beyond serving the majority and instead acknowledge the unique challenges faced by women at the intersections of overlapping systems of power such as women with low literacy levels who do not speak their country's dominant language.

Some digital health programs illustrated efforts to enhance the accessibility and inclusivity of their programs. For instance, literacy was not a participation criterion for some programs provided women had someone who could read messages or operate mobile devices on their behalf (Harrington, Drake, et al., 2019; Odeny et al., 2014; Onono et al., 2019; Purcell-Jones et al., 2019; Ronen et al., 2018). Other digital health programs acknowledged low levels of literacy in their target population and augmented text-based informational programs with videos and

pictorial messages (Purcell-Jones et al., 2019). This strategy also worked to overcome language barriers.

At the intersection of gender and disabilities

While inclusion and participation criteria in digital maternal health programs are subjects of intense inquiry in this paper, accessibility considerations for women with disabilities are an equally important subject of scrutiny. In a sub-Saharan Africa context, women with disabilities continue to face barriers to maternal health services. They are largely ignored in reproductive and maternal health research studies and programs and can be argued to be the ones most "left behind" in digital health (Ganle, Otupiri, et al., 2016; Ronda Zelezny-Green et al., 2018). Compared to non-disabled women, women with disabilities face an increased risk of multiple forms of violence, are more likely to have lower educational attainment, poorer health outcomes, limited economic opportunities, and have higher rates of poverty (World Health Organization (WHO), 2011). When viewed from an intersectional lens, women with disabilities encounter all of the above and still face physical, structural, and attitudinal barriers that infringe on their reproductive rights (Mac-Seing et al., 2020). They have poor access to maternal healthcare services and are at risk of having poor maternal health outcomes. Digital health solutions can help women with disabilities overcome these intersectional challenges. However, they are more likely than non-disabled women to be digitally excluded and unable to access digital health services for maternal care. The digital divide experienced by women with disabilities is severely under-researched and there remains a paucity of data on their unique challenges particularly in a sub-Saharan African context.

Disabilities, broadly defined by the World Health Organization, encompasses physical, cognitive, speech, sensory, mental, emotional, and developmental impairments that place limitations and restrictions on an individual's social participation and environmental access (Ganle, Otupiri, et al., 2016; Jones et al., 2020; World Health Organization (WHO), 2011). It is important to note that in the context of maternal health, health disparities observed among people with disability is a result of being denied maternal health services. As an example, studies in sub-Saharan Africa have cited the pervasive assumption of women with disabilities as asexual or not likely to have children thereby limiting the number of programs tailored to their health needs

(Ganle, Otupiri, et al., 2016). They are also more likely to be met with hostile and insensitive attitudes from healthcare providers (Ahumuza et al., 2014).

There is limited evidence in sub-Saharan Africa's digital maternal health literature to show inclusive considerations for women with disabilities. There were no mentions of considerations made for women with hearing or vision impairments including the deaf and deafblind. While considerations were made for women with limited literacy in terms of pivoting to multimedia messages instead of text-based messages, there were no mentions of accessible visual presentations adjusted for size or the use of colours for women with visual and sensory impairments. Furthermore, while some women may have access to mobile devices, they may face dexterity impairments that limit their use of mobile devices and associated apps. There was no mention of this as a consideration in digital maternal health programs.

2.4 Moving towards inclusivity: Recommendations and conclusion

These observations highlight the growing need to ensure that the benefits of maternal digital health strategies are equitably distributed. It has been shown that the use of digital health can lead to better health outcomes, better patient experiences, and better value of care for the most vulnerable population and in hardest to reach areas (Addotey-Delove et al., 2020; Jones et al., 2020). These would not be realised without widening the population capable of accessing digital health services. Addressing the aforementioned barriers that continue to exclude women from the benefits of digital health- ownership, literacy, and disabilities - requires action from multiple stakeholders. This section of the paper includes recommendations intended for researchers, digital health implementers, policymakers, and advocates to facilitate equitable access to digital health services for maternal healthcare and to ensure that no woman is left behind.

Enhancing mobile ownership

The persistent gender digital divide is in part driven by affordability. Across sub-Saharan Africa, affordability was a major barrier to women owning mobile devices (GSMA, 2021). This is because women are more likely than men to have lower incomes and lower financial autonomy which limits their ability to purchase mobile digital devices. Improving the affordability of mobile devices will go a long way to bridging the gender divide in mobile ownership. A viable

step towards increasing access to digital maternal health services for the most underserved women is to provide free or subsidised mobile phones to women in target populations who are less likely to own mobile devices (Highet et al., 2021). Studies have supported the hypothesis that giving women free or subsidized digital devices improves their use of health care services and in turn, reduces maternal mortality (Oyeyemi & Wynn, 2014a). Other stakeholders such as internet companies can ensure affordable access to digital health services by creating low-cost connectivity options without compromising on quality such as data light options for health apps (GSMA, 2021). Policymakers must implement and support initiatives in their communities that help make mobile devices affordable for women.

To address the gender digital divide, efforts must go beyond ensuring women's access to digital technologies. Women should not be confined to spectators and consumers of digital health technologies. Therefore, alongside increasing women's access as users, women must be designers and leaders in the digital health spaces. Communities must challenge social norms that act as barriers to women using and accessing digital technology. This tilts the power differential in a patriarchal society and increases the likelihood that women's needs and priorities are reflected in digital health services for maternal healthcare.

Digital inclusion of women with low literacy

Furthermore, an intersectional lens to digital health programs is needed to amplify the needs of often neglected and excluded women. It would be unwise to assume that owning mobile devices alone could redress inequalities that persist among women groups such as women with limited literacy skills. Implementers should always be cognizant of the multiple social disadvantages that are experienced across different axes, many of which can be experienced simultaneously. Furthermore, strategies to reduce privacy breaches such as password-protected health apps or auto-lock functions can enhance women's participation and inclusion in digital health services in cases where women are confined to shared ownership of mobile devices.

A patient-centred approach in the context of digital health is imperative to understanding the barriers and facilitators to women's use of and access to digital health services. A patient-centred approach "is rooted in active collaboration between patients and researchers"(Hernandez-Ramos

et al., 2021). This often entails much research and interaction with end-users to receive critical, honest, and regular feedback. However, researchers should be cautious of the perceived power differential between them and the end-users. They might feel intimated by the researcher's perceived social status and are prone to response bias, which is a perceived favourable response instead of an honest one. Furthermore, digital health developers are usually not members of communities where their programs are used and may fail to fully comprehend the cultural complexities involved with digital health programs' access and use. Partnering with intermediaries who are embedded in the community such as women's groups, is critical to enhancing social and cultural acceptance of digital services as well as to enhancing a patient-centred approach to digital health. Digital health implementers ought to assess the literacy and digital literacy skills of their target population and make plans to support participants according to their skill levels. The use of multimedia promotes the use of digital health platforms by women with different proficiencies and competency levels. For instance, digital maternal health programs can present text messages alongside graphics or videos thereby removing the requirement for end-users to have the ability to read or write in order to participate.

Digital inclusion for women with disabilities

Given the paucity of data on the technological needs of sub-Sahara African women with disabilities in a maternal healthcare context, there needs to be more research and data generated in this regard. Crucial to research and data generation is a deep understanding of the intersectionality of gender, literacy, and disabilities. The availability of data will inform action and policy directed at addressing the needs of women with disabilities in general and in the context of sexual and reproductive health, specifically. It is also important to raise awareness of digital products and services that address the needs of women with disabilities (GSMA, 2020b). Beyond awareness, these products and services need to be accessible and affordable. Processes of designing digital health programs will need to align with lived experiences of women with disabilities, this would mean involving them early in the design and implementation process and being mindful of issues of trust and critical feedback.

African countries are seizing the opportunities offered by digital technologies. At least 42 of Africa's 54 countries currently have a national digital health policy (IDRC, 2021). While this is a

positive step, policies must be implemented from a gender and equity perspective to ensure the benefit of digital health for all.

Abbreviations

SDGs, Sustainable Development Goals

UN, United Nations

WHO, World Health Organisation

Chapter 3. Paper 2: Gender Transformative Approaches in mHealth For Maternal Healthcare in Sub-Saharan Africa: A Systematic Review

Revised and Resubmitted: Frontiers in Digital Health

3.0 Abstract

Background: This review focuses on studies about digital health interventions in sub-Saharan Africa. Digital health interventions in sub-Saharan Africa are increasingly adopting gender-transformative approaches to address factors that derail women's access to maternal healthcare services. However, there remains a paucity of synthesized evidence on gender-transformative digital health programs for maternal healthcare and the corresponding research, program and policy implications. Therefore, this systematic review aims to synthesize evidence of approaches to transformative gender integration in digital health programs (specifically mHealth) for maternal health in sub-Saharan Africa.

Method: The following keys terms 'mobile health', 'gender', 'maternal health', 'sub-Saharan Africa' were used to conduct electronic searches in the following databases: PsycInfo, EMBASE, Medline (OVID), CINAHL, and Global Health databases. The method and results are reported as consistent with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Data synthesis followed a convergent approach for mixed-method systematic review recommended by the JBI (Joanna Briggs Institute).

Results: Of the 394 studies retrieved from the databases, 11 were included in the review. Out of these, six studies were qualitative in nature, three were randomized control trials, and two were mixed-method studies. Findings show that gender transformative programs addressed one or more of the following categories : 1) gender norms/roles/relations, 2) women's specific needs, 3) causes of gender-based health inequities, 4) ways to transform harmful gender norms, 5) promoting gender equality, 6) progressive changes in power relationships between women and men. The most common mHealth delivery system was text messages via short message service on mobile phones. The majority of mHealth programs for maternal healthcare were focused on

reducing unintended pregnancies through the promotion of contraceptive use. The most employed gender transformative approach was a focus on women's specific needs.

Conclusion: Findings from gender transformative mHealth programs indicate positive results overall. Those reporting negative results indicated the need for a more explicit focus on gender in mHealth programs. Highlighting gender transformative approaches adds to discussions on how best to promote mHealth for maternal health through a gender transformative lens and provides evidence relevant to policy and research.

The authors declare no competing interests and no funding was received for this work.

Systematic review registration
PROSPERO CRD42023346631

Key words: Digital health, mHealth, maternal health, gender integration, gender transformative, sub-Saharan Africa

3.1 Introduction: Gender integration in mHealth interventions for maternal health:

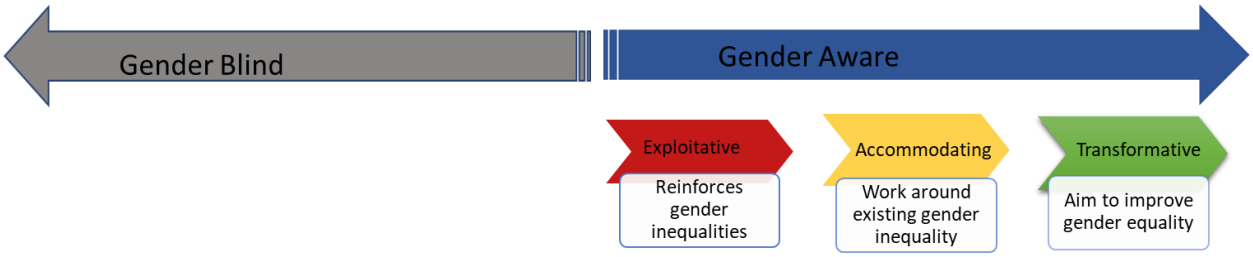
At the 71st World Health Assembly in 2018, resolutions on digital health underscored the need for digital health to not only enhance existing health service delivery models but to also contribute towards achieving health equity including gender equality (WHO, 2019). Precedents on gender integration in women's health were set in the 1990s. Significant global gatherings such as the International Conference on Population and Development and the World Conference on Women in Beijing recognized gender inequality as a critical factor influencing health, particularly for women who face disproportionate disadvantages in health outcomes (UN, 1995; UNFPA, 2022). Women face unequal access to healthcare resources and bear the burden of gender stereotypes that are perpetuated through health policies and programs, this had resulted in inadequate or inappropriate services for women (Ruane-McAteer et al., 2019; UN, 1995; UNFPA, 2022). Targeting gender attitudes and norms is an important part of the broader strategy

to achieve the sustainable development goals, but explicit attention to gender is often missing in health programming.

Aligned with SDG 5 which aims to *Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women*, digital health is showing the potential to drive gender equality by reducing unequal access to and use of healthcare services (United Nations, 2020a). The field of digital health focuses on the use of information and communication technologies systems or channels, software, and data to improve health and wellness (WHO, 2020). While the healthcare transformations brought about by digital health are fundamentally technological, digital health also transforms the social, economic, and political context within which they occur (Figueroa et al., 2021; George et al., 2018). Therefore, digital health programs must foreground the voices and realities of users, especially marginalized populations in their program design and delivery. Digital health has been incorporated across the pregnancy care continuum in efforts to address social determinants of health, improve the quality of care and ensure positive maternal health outcomes (Coleman et al., 2017; Job et al., 2021; Omonaiye et al., 2018). However, to achieve meaningful impact, gender and digital inclusion must remain a priority in developing, implementing and evaluating digital health programs. Women, who are often the target groups for maternal health programs, are not homogenous. Their social, cultural and structural context will differ based on the relationships that govern their everyday lives (George et al., 2018). Barriers brought about by gender dynamics have demand and supply-side implications for women's participation in digital health for maternal healthcare. On the demand side, for example, the gender divide in mobile phone ownership or unfavourable community and cultural preferences, attitude, and norms around women's participation in digital health can impede women's participation in digital health and even exacerbate existing inequalities in access to digital health services (GSMA, 2021; Mlambo et al., 2022). On the supply side, breaches of confidentiality of women's health data on digital health programs or culturally insensitive digital health programs are detrimental to women's participation in digital health (Phillips et al., 2019; Udenigwe et al., 2022). These implications demonstrate the importance of sex and gender considerations in digital health programming especially for maternal health. Considering gender in and of itself is not sufficient because some pathways to gender consideration in health can exploit or accommodate harmful gender norms rather than

transform them. Figure 3.1 depicts different types of gender inclusion strategies and serves as a guide for discussions on the implications of these strategies on gender equality outcomes..

Figure 3.1 Gender integration continuum.



(Source: Interagency Gender Working Group, 2016).

Gender-blind health programs have no gender considerations, they ignore gender norms and relations and consequently risk reinforcing gender-based discrimination, biases, and stereotypes. Gender-aware programs on the other hand acknowledge gender norms and adopt an approach along a continuum as follows: First, gender exploitative approaches intentionally or unintentionally take advantage of gender inequalities to advance program outcomes thereby exacerbating gender inequalities; Second, gender-accommodating programs acknowledge but circumvent gender inequalities to achieve program outcomes; Third, gender transformative approaches in health programming aim to change gender power dynamics and/or reduce gender gaps in access to resources to achieve equitable gender norms and dynamics (Interagency Gender Working Group, 2016; Rutgers, 2018; WHO, 2011). Such gender-informed implications are integral to understanding how to approach health intervention efforts for maternal health.

The need for gender transformative approaches in health programming is increasingly highlighted in global health research, especially as it pertains to maternal healthcare (R. Morgan et al., 2016; Ruane-McAteer et al., 2019). This need recognizes gender as a key determinant of maternal health and acknowledges that women and girls are disproportionately disadvantaged in health outcomes. Gender transformative approaches in non-digital health programs have been shown to be effective in improving maternal health. For example, integrating gender-specific differences in health promotion measures across sub-Saharan Africa led to shifts in gendered attitudes and behaviours which in turn improved reproductive health outcomes for women

(Ruane-McAteer et al., 2019). In Rwanda, an intervention that tackled inequitable power dynamics within heterosexual relationships saw increased modern contraceptive use among women and increased men's engagement in pregnancy care (Doyle et al., 2018). In Uganda, a gender transformative approach to prevent violence against women and prevent HIV risk saw shifts in deeply entrenched attitudes on inter-partner violence among men and women (Abramsky et al., 2014).

Digital health interventions in sub-Saharan Africa are also adopting gender transformative approaches to address factors that derail women's access to maternal healthcare services. For instance, in Kenya, a mHealth program identified a digital divide within their target population and implemented strategies to improve women's digital access to quality maternal health services (MSD, 2021). Their strategies included the provision of inexpensive mobile phones, digital literacy for women, and working with men and the community to address negative social norms that restrict women's access to digital technology. In Nigeria, studies showed that addressing women's specific needs such as increased access to required technology improves women's participation in digital health programs and maternal health outcomes (Oyeyemi & Wynn, 2014a; Udenigwe & Okonofua, 2022).

Identifying such gender transformative approaches will inform policy and enhance best practices for gender integration in digital health. However, there remains a paucity of synthesized evidence on gender transformative considerations being made in digital health programs for maternal healthcare in sub-Saharan African contexts and the corresponding research, program and policy implications. Therefore, this systematic review aims to synthesize evidence of approaches to transformative gender integration that address gender inequality in mHealth for maternal health in sub-Saharan Africa. Addressing gender inequality in health programming is conceptualized as a gender-transformative approach. This review adopts the definition offered by the World Health Organization (WHO) and interprets a gender-transformative digital health program as one that "addresses the causes of gender-based health inequities through approaches that challenge and redress harmful and unequal gender norms, roles, and power relations that privilege men over women (p.136)".

This systematic review will address the following questions:

1. How are mHealth interventions for maternal health in sub-Saharan Africa adopting gender transformative approaches?
2. To what extent are gender-transformative interventions positively impacting maternal health outcomes?

3.2 Method

This review has been registered on PROSPERO with the registration ID CRD42023346631. A review protocol for this review was not prepared. The reporting of this review follows the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statements (Page et al., 2021). (Appendix D). We took a systematic approach to identify peer-reviewed articles where a mHealth intervention for maternal health was designed and implemented in a sub-Saharan African country. Studies were identified by searching for articles published between 2010 and 2021. Date limits were set in congruence with the widespread adoption of digital health foundations (such as programs, strategies and policies) across sub-Saharan African countries (WHO, 2016a).

Eligibility criteria

We sought to identify studies reporting primary evidence regarding digital health for maternal healthcare, thus, we included research that examined the implementation, distribution and evaluation of digital health programs for maternal healthcare. We included peer-reviewed journal articles without restrictions on the study type therefore quantitative, qualitative, and mixed-method studies were included. Our targets were programs or interventions aiming to improve the uptake of preventive services during pregnancy, childbirth, and post-partum follow-up which also reported gender transformative considerations such as consideration for gender roles. We also sought out studies that were conducted in a sub-Saharan country and limited the language to English due to the authors' language proficiencies.

We focused on studies that targeted women and/or men as end users, therefore studies targeting healthcare workers were excluded. We also excluded studies whereby mobile devices were only used for data collection purposes because we wanted the focus to be on devices used for intervention purposes. We did not include studies that were discussing the literature for the purpose of theory building or critique. The inclusion and exclusion table is available as a supplementary document (Appendix F).

Search strategy

Five databases were searched from 2010 to September 2021. The databases are PsycInfo, EMBASE, Medline (OVID), CINAHL, and Global Health. We conducted test searches between September 2020-December 2020 and iteratively adjusted and refined the search strategy. We conducted initial searches in February 2021 and updated them in September 2021. Search terms included 'mobile health', 'gender', 'maternal health', 'sub-Saharan Africa' using synonyms, truncations, and wildcards. The electronic search strategy for Medline (OVID) database is available as a supplementary document (Appendix E).

Data extraction and appraisal

Studies included in this review were independently screened by two reviewers (OU and OO). The software Covidence (Covidence, 2022) was used to organize and screen each study's title and abstract. The two reviewers subsequently conducted full text reviews of the selected studies. They assessed and resolved conflicts jointly or in consultation with the third author (SY). The two reviewers extracted the relevant data using a data extraction form developed purposely and piloted prior to review. Relevant data from quantitative and qualitative studies were collated and reported on the form. Relevant information included study design, type of mHealth intervention, study aim, intervention outcomes, findings, and limitations. We illustrated gender transformative approaches by adapting the definition of gender transformative programming into six categories as provided by WHO, they included ways in which programs; 1) consider gender norms/roles/relations, 2) consider women's specific needs, 3) address the causes of gender-based health inequities, 4) include ways to transform harmful gender norms, 5) seek to promote

gender equality, 6) have strategies to foster progressive changes in power relationships between women and men. We were also open to including relevant data that did not fall within the WHO's definition, but we were able to align the extracted information with the predefined categories. See Table 3 for gender consideration categories.

The reviewers appraised the quality of the manuscripts using the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). This tool enabled the appraisal of different classes of research including quantitative research, qualitative research, and mixed-method studies. In assessing the methodological quality of data, the tool examines the appropriateness of data collection methods, the concurrency between the study aims and data collection methods, the sample choice and the interpretation of results. We did not exclude articles based on quality scores alone because critically appraising mixed research studies remains controversial given the complexities involved (Fàbregues & Molina-Azorín, 2017; Pace et al., 2012; Thomas & Harden, 2008). We, however, adhered to recommendations by Hong et al., 2018 whereby studies not meeting the screen criteria (S1 and S2) were not considered appropriate for appraisal. All 11 studies passed the screening. For each study design, scores were allotted percentages based on a methodological scoring system where possible items are divided by affirmative items (De Vet et al., 1997; Renwick et al., 2022). Quality scores of each study were classified as weak (< 50%), moderate (50%-80%) and strong (> 80%). Screening questions were not allotted percentages. While Hong et al., 2018 discourage an overall calculation of scores using the MMAT, we sought to provide a representation of ratings to inform the quality of studies included in this review.

Overall, the quality of the studies ranged from 0% (none of the criteria were met) to 100% (all the criteria were met). The qualitative studies were generally moderate to strong. One of the mixed-method studies was classified as weak for not meeting any of the criteria (Schwartz, Clouse, Yende, Rie, et al., 2015). The randomized control trial studies generally showed the risk of performance bias, this means that outcome assessors may have been aware of the applied intervention which could unconsciously or intentionally alter their assessment (Probst et al., 2016). Quality appraisals are detailed in Table 3.1.

3.3 Quality appraisal

Table 3.1A Quality appraisal of qualitative studies								
Screen			Qualitative studies					Quality score
	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	1.1. Is the qualitative approach appropriate to answer the research question?	1.2. Are the qualitative data collection methods adequate to address the research question?	1.3. Are the findings adequately derived from the data?	1.4. Is the interpretation of results sufficiently substantiated by data?	1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation?	
(Dev et al., 2019)	✓	✓	✓	✓	✓	✓	✓	100%
(Elizabeth K. Harrington et al., 2019)	✓	✓	✓	✓	✓	×	✓	80%
(Isler et al., 2020)	✓	✓	✓	✓	×	×	✓	60%
(M Onono et al., 2019)	✓	✓	✓	✓	✓	✓	✓	100%
(Skinner et al., 2018)	✓	✓	✓	✓	✓	✓	✓	100%
(Trafford et al., 2020)	✓	✓	✓	✓	✓	✓	✓	100%

Table 3.1B Quality appraisal of quantitative studies								
Screen			Quantitative randomized control trials					Quality score
	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	2.1. Is randomization appropriately performed?	2.2. Are the groups comparable at baseline?	2.3. Are there complete outcome data?	2.4. Are outcome assessors blinded to the intervention provided?	2.5 Did the participants adhere to the assigned intervention?	
(F H Ampt et al., 2020)	✓	✓	✓	✓	✓	×	✓	100%
(Lund et al., 2012a)	✓	✓	✓	✓	✓	×	×	60%
(Parkes-Ratanshi et al., 2020)	✓	✓	✓	×	✓	×	×	40%

Table 3.1C Quality appraisal of mixed method studies								
Screen			Mixed method studies					Quality score
	S1. Are there clear research questions?	S2. Do the collected data allow to address the research questions?	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?	5.2. Are the different components of the study effectively integrated to answer the research question?	5.3. Are the outputs of the integration of qualitative and quantitative components	5.4. Are divergences and inconsistencies between quantitative and qualitative results	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the	

					adequately interpreted?	adequately addressed?	methods involved	
(Flax et al., 2017)	✓	✓	✓	×	✓	×	✓	60%
(Schwartz, Clouse, Yende, Rie, et al., 2015)	✓	✓	×	×	×	×	×	0%

3.4 Data analysis and synthesis

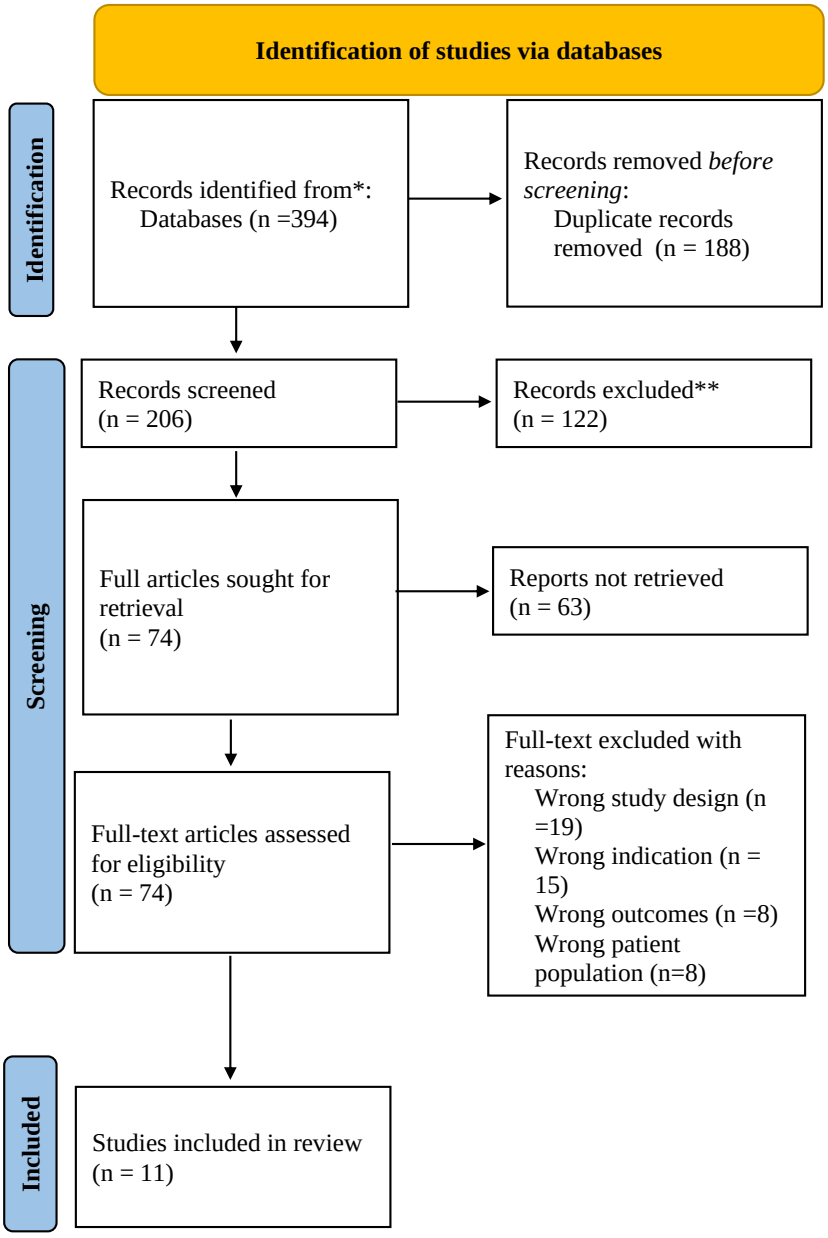
Data synthesis followed a convergent approach for mixed-method systematic review recommended by JBI (Stern et al., 2020). The review questions can be answered by both quantitative and qualitative studies therefore data synthesis involved data transformation by way of qualitizing. Qualitizing involves extracting data from quantitative studies and converting them to textual descriptions to allow integration with qualitative studies (Stern et al., 2020). Data were extracted using a data extraction form that collects information on the study design, type of mHealth intervention, study aims, intervention outcomes, findings, and limitations. The synthesized data are arranged in tabular forms to allow for comparison of the different approaches to gender transformative integration. The authors classified studies into subgroups according to the gender transformative categories identified within the studies. There is a global policy interest in addressing gender inequality in health programming (Rutgers, 2018). Highlighting the different approaches separately is important because it will add to the discussions on how best to promote mHealth for maternal health through a gender transformative lens and will provide evidence relevant to policy and research.

3.5 Results

Study Characteristics

Figure 3.2 indicates a PRISMA study flow diagram describing how papers were selected for inclusion. Table 3.2 provides a summary of the 11 studies that were appraised in this review. The studies are diverse in terms of sample size, sample population, study design and mHealth delivery system. Sample sizes ranged from 18 to 2550 participants. Participants included pregnant and postpartum women.

Figure 3.2 PRISMA flow diagram depicting the flow of information screened and reviewed.



Key finding 1: *SMS-based services are the most common mHealth delivery system*

Study designs included six qualitative studies (Dev et al., 2019; E K Harrington, McCoy, et al., 2019; Isler et al., 2020; M Onono et al., 2019; Skinner et al., 2018; Trafford et al., 2020); three randomized control trials (Frances H. Ampt et al., 2020; Lund et al., 2012b; Parkes-Ratanshi et al., 2020); and two mixed method studies (Flax et al., 2017; Schwartz, Clouse, Yende, Van Rie, et al., 2015). The most common mHealth delivery system was text messages via standard short message service (SMS) on mobile phones (Frances H. Ampt et al., 2020; Flax et al., 2017; E K

Harrington, McCoy, et al., 2019; Isler et al., 2020; Lund et al., 2012b; Parkes-Ratanshi et al., 2020; Schwartz, Clouse, Yende, Van Rie, et al., 2015; Skinner et al., 2018; Trafford et al., 2020), the other approaches used interactive mobile apps (Dev et al., 2019; M Onono et al., 2019). Outcomes of interventions to improve maternal health varied across the studies. Three studies focused on reducing unintended pregnancies through the promotion of contraceptive use (Frances H. Ampt et al., 2020; Dev et al., 2019; E K Harrington, McCoy, et al., 2019). Two studies focused on improving breastfeeding among postpartum mothers (Flax et al., 2017; Trafford et al., 2020), two studies aimed to increase women's access to skilled health personnel during pregnancy, childbirth and postpartum (Lund et al., 2012b; M Onono et al., 2019). One study targeted improved and adequate nutrition among pregnant and breastfeeding mothers (Isler et al., 2020). Two studies aimed to prevent and manage sexually transmitted diseases among pregnant and postpartum women (Parkes-Ratanshi et al., 2020; Schwartz, Clouse, Yende, Van Rie, et al., 2015).

Key finding 2: *Few studies substantively incorporated gender transformative dimensions in their study aims*

Findings responding to the first research question indicate that all studies included at least one of the six gender transformative considerations but only three studies substantively incorporated gender transformative dimensions in the aim of their study (E K Harrington, McCoy, et al., 2019; Isler et al., 2020; Parkes-Ratanshi et al., 2020). One study aimed to examine how gender impacts the content and delivery of a nutrition intervention focused on mothers (Isler et al., 2020). Another study aimed to involve men and women in discussions around family planning education and decision making (E K Harrington, McCoy, et al., 2019). Finally, one study aimed to encourage men (partners of pregnant women) to get tested and treated for sexually transmitted infections (STI) to decrease incidences of STIs in women during pregnancy (Parkes-Ratanshi et al., 2020). For the rest of the studies, gender considerations were not explicitly stated but treated tangentially within the mHealth program's design, implementation, or evaluation.

Key finding 3: *A common gender consideration was of women's specific needs*

Two studies each included 3 gender transformative considerations (E K Harrington, McCoy, et al., 2019; Isler et al., 2020), four studies included 2 gender transformative considerations

(Frances H. Ampt et al., 2020; Dev et al., 2019; Flax et al., 2017; Skinner et al., 2018), the rest of the studies only had one (Lund et al., 2012b; M Onono et al., 2019; Parkes-Ratanshi et al., 2020; Schwartz, Clouse, Yende, Van Rie, et al., 2015; Trafford et al., 2020). Two studies included strategies to promote gender equality (Dev et al., 2019; Flax et al., 2017). Strategies to promote gender equality included closing the knowledge gaps about family planning between men and women and improving women's financial stability through microcredit programs. Most of the gender considerations fell under the category of considering women's specific needs.

One study indicated consideration for women's specific needs by co-designing a mHealth program aimed at improving contraceptive knowledge and use with the target population, this approach enabled the researchers to integrate the needs of the women into their program (Frances H. Ampt et al., 2020). Four studies conducted preliminary research with their target population and designed mHealth programs based on identified needs; One study identified knowledge gaps as a barrier to women's decision-making about family planning and subsequently designed a mHealth program to educate women on contraceptive choices and enhance their decision-making regarding family planning (Dev et al., 2019). Another study was informed by formative studies that linked limited decision- making support to use of pregnancy care. Consequently, the researchers designed a mHealth intervention to support women's decision-making (M Onono et al., 2019). Two studies considered women's specific needs by first conducting a formative study which revealed a gender gap in women's access to mobile devices (Flax et al., 2017; Lund et al., 2012b). The researchers designed their mHealth program to optimize women's participation even without individual mobile phone ownership or with low literacy status. Women were able to participate either using group cell phones or shared cell phones. In addition, one study considered women's specific needs by being mindful of their schedules, domestic responsibilities, and transportation challenges during their study (Isler et al., 2020). The mHealth intervention, which involved presenting nutrition information through an interactive video, was delivered to women at their doorstep. One study met the needs of pregnant and postpartum women with HIV through the provision of HIV counselling and support (Schwartz, Clouse, Yende, Van Rie, et al., 2015). This study also guaranteed women's privacy by protecting their sensitive health information. Another study delivered mHealth programs at no cost to low-income pregnant and new mothers (Skinner et al., 2018).

Key finding 4: *Men have a pivotal role in maternal health*

Turning to another category of gender transformative consideration, the aims or outcomes of three studies addressed causes of gender-based health inequities. One study indicated that SMS messages from the mHealth program challenged social norms around the use of contraceptives and pregnancy risk (E K Harrington, McCoy, et al., 2019). Another mHealth program sought to enhance adequate nutrition among pregnant women by involving men who are often major decision-makers in maternal nutrition (Isler et al., 2020). Finally, one study identified untreated men partners as primary drivers of syphilis in women during pregnancy, therefore the program targeted pregnant women's partners to test for and treat syphilis symptoms (Parkes-Ratanshi et al., 2020). Three studies included considerations under the category of seeking to transform harmful gender norms. One acknowledged that women faced an increased likelihood of gender-based violence due to participating in the mHealth study (Frances H. Ampt et al., 2020). The authors arranged for the protection of women by providing urgent medical care where necessary and garnered support for and protection of women from community mobilizers. In another study, transforming gender norms also meant educating couples (men and women) about family planning through SMS text messages and supporting their joint decision-making (E K Harrington, McCoy, et al., 2019). One study encouraged women to share text messages on pregnancy and child care with their spouses (Skinner et al., 2018). Within these messages, the dangers of domestic violence were emphasized. Women reported a sense of support from receiving and sharing messages with their spouses.

Gender considerations in two studies indicated strategies to foster progressive changes in power relationships between women and men; One study engaged men in family planning education and decision-making support and also employed innovative strategies to go beyond couples or individual interventions but also community-level engagement to improve knowledge on family planning (E K Harrington, McCoy, et al., 2019). Another study fostered progressive changes in power relationships between women and men by legitimizing the importance of breastfeeding through SMS text messages (Trafford et al., 2020). Men's disapproval of breastfeeding deterred women from breastfeeding, however, women indicated that receiving and sharing the text

messages from the mHealth program enabled them to resist pressure from men and encouraged breastfeeding.

Key finding 5: *Findings from gender transformative mHealth programs indicate positive results overall*

Studies included in this review showed positive results overall. One mHealth program aimed at altering postpartum women's habits and behaviour toward contraceptive use saw improvements in women's knowledge of contraceptives (Dev et al., 2019). Another mHealth program aimed at increasing exclusive breastfeeding practice among postpartum women was described as acceptable and functional by the participants (Flax et al., 2017). Including men in a mHealth family planning program for postpartum women improved their communication with their women partners around contraceptive use (E K Harrington, McCoy, et al., 2019). One study saw an increased rate of skilled delivery attendance amongst women participants as a result of the mHealth program (Lund et al., 2012b). A mHealth program that provided a 24-hour transport navigator system reported improved maternal access to skilled pregnancy care including virtual communications with their healthcare providers (M Onono et al., 2019). In another mHealth study, an intervention which aimed to retain and support HIV-infected mothers was perceived as helpful and supportive by participants (Schwartz, Clouse, Yende, Van Rie, et al., 2015). In two studies, participants demonstrated the positive impact of MomConnect, a mHealth program for pregnant and postpartum women. The mHealth program was responsive to the needs of new mothers and served as an empowering force toward positive breastfeeding practices for women (Skinner et al., 2018; Trafford et al., 2020).

However, not all studies reported positive findings. One mHealth program was developed jointly with target participants in order to reduce incidents of unintended pregnancies, however, the program showed no clinically significant effect on unintended pregnancies among participants (Frances H. Ampt et al., 2020). Additionally, other studies indicated the need for a more explicit focus on gender consideration in a mHealth program's design or implementation. One study targeted pregnant and breastfeeding women to educate them on adequate nutrition during pregnancy (Isler et al., 2020). While participants improved their knowledge of appropriate nutrition during pregnancy and postpartum, they were powerless to make any nutritional changes

without support from their male partners. Similarly, another study aimed at encouraging the testing and treatment of STIs among male partners of pregnant women indicated a limited or low effect of the program (Parkes-Ratanshi et al., 2020). The authors pointed to insufficient gender considerations in the mHealth design and implementation. In another mHealth study, limited considerations of intersecting domains of disadvantages, specifically gender and geographic location, led to the exclusion of the most vulnerable of women (Lund et al., 2012b). In the study which aimed to improve women's access to skilled birth attendants, women were able to participate in the mHealth program regardless of phone ownership or literacy status. The study saw improvements in access to skilled birth attendants in urban areas but failed to reach rural women who were in dire need of skilled attendants during childbirth (Lund et al., 2012b).

Key findings 6: *Gender considerations and maternal health outcomes*

Furthermore, this review offered some evidence on how gender considerations influenced maternal health outcomes. In considering gender differences, one study identified crucial knowledge gaps that hampered post-partum women's use of modern contraceptives (Dev et al., 2019). Women's unmet need for contraception was exacerbated by their limited knowledge on contraceptives. Through the mHealth program, women showed improved knowledge and more thorough understanding of contraceptives. The authors highlighted the potential of increased knowledge to improve contraceptive use among postpartum women (Dev et al., 2019). In another study, specific considerations for women's limited phone ownership increased their odds of exclusive breastfeeding for up to 6 months (Flax et al., 2017). Through the use of group cell phones, women received text messages that promoted optimal breastfeeding practices and were more likely to breastfeed exclusively for the first 6 months. In a similar study aiming to improve breastfeeding rates, text messages shared with women and their families targeted unfavourable social norms (Trafford et al., 2020). Women felt empowered to make breastfeeding choices and to resist pressures against breastfeeding that were often brought about by patriarchal norms. Women in the study reported high rates of breastfeeding. In a study aimed at improving postpartum retention in HIV care, a mobile health program delivered health information and reminder text messages to women directly from their healthcare providers (Schwartz et al., 2015). Gender considerations ensured that women's HIV status were not disclosed in those text messages. This study showed improved communication between women and healthcare

providers, especially among women who wanted to maintain the privacy of their health information. Overall, interactions with healthcare providers contributed to women's retention in HIV care (Schwartz et al., 2015).

3.6 Results table of studies

Table 3.2A Summary of studies selected for review						
	Study Authors, Title, Year	**Country**	**Number of participants**	**Sample of population**	**Study Design**	**mHealth Delivery System**
	(Ampt et al., 2020) **Effect of a mobile phone intervention for female sex workers on unintended pregnancy in Kenya**	Kenya	786 women	-93 randomly selected sex-work venues in two sub counties of Mombasa, Kenya (Kisauni and Changamwe) -401 participants from the intervention group from 47 venues -385 participants from the control group from 46 venues	A two-arm, cluster-randomized controlled trial study	SMS text messages

	(Dev et al., 2019) **Acceptability, feasibility, and utility of a mobile health family planning decision aid for postpartum women in Kenya**	Kenya	25 postpartum women and 17 Family planning providers	Twelve (48%) postpartum women were from rural MCH clinics from the Nyanza region, and 13 (52%) were from urban clinics in Nairobi; 15 (60%) were adolescents and young women between the ages of 14–21.	A cross-sectional qualitative study	An interactive mobile application
	(Flax et al., 2017) **Group cell phones are feasible and acceptable for promoting optimal breastfeeding practices in a women's microcredit program in Nigeria.**	Nigeria	375 postpartum women participants in total: Quantitative study n=195 Qualitative study n=162		Mixed method: interview and Focus group discussions	SMS text messages and voice message
	(Harrington et al., 2019) **Engaging men in a mHealth approach to support postpartum family planning among couples in Kenya: a qualitative study.**	Kenya	50 pregnant and postpartum women and men	35 men and 15 women Participants were chosen from two counties in the Nyanza region of Western Kenya. These hospitals serve a primarily low- to middle-income rural population, the	Qualitative study: Focus group discussions	SMS messages

				majority of whom identify with the Luo ethnic group.		
	(Isler et al., 2020) **'If he sees it with his own eyes, he will understand': how gender informed the content and delivery of a maternal nutrition intervention in Burkina Faso.**	Burkina Faso	78 pregnant or breastfeeding women and 8 Community Health Workers	The study sampled the catchment areas of two urban and four rural health centres. Healthcare providers identified pregnant and breastfeeding mothers to participate in the study	Qualitative study: focus group discussion	Video was shown on a tablet
	(Lund et al., 2012a) **Mobile phones as a health communication tool to improve skilled attendance at delivery in Zanzibar: a cluster-randomized controlled trial.**	Tanzania	2550 pregnant women	1311 women were allocated to the mHealth interventions and 1239 women were allocated to standard care, i.e. no phone intervention. Participants were recruited from 24 primary healthcare facilities.	Cluster-randomized controlled trial with	SMS
	(Onono et al., 2019) **Narratives of women using a 24-hour ride-hailing transport system to increase access and**	Kenya	18 postpartum women	Emphasis was placed on ensuring participants were from different socioeconomic	A qualitative study using in-depth interviews (IDIs) as the primary data	A mobile phone app

	utilization of maternal and newborn health services in rural western Kenya: a qualitative study.			backgrounds. Women were on average 27 years old, married and multiparous with over half having secondary education.	collection method.	
	(Parkes-Ratanshi et al., 2020) **Low male partner attendance after syphilis screening in pregnant women leads to worse birth outcomes: The Syphilis Treatment of Partners (STOP) randomized control trial**	Uganda	290 pregnant women	144 participants enrolled in SMS reminder, 146 enrolled in telephone call reminder	The sample was taken from the IDI clinic located within urban Kampala, where 220 pregnant women are seen at the ANC per month, 5.1% of whom tested positive for syphilis, and the Mulago Hospital ANC, where, on average, 2000 pregnant women are seen monthly, with 2.4% testing positive for syphilis.	Text messages and telephone calls
	(Schwartz, Clouse, Yende, Rie, et al., 2015) **Acceptability and Feasibility of a Mobile Phone-Based Case**	South Africa	50 pregnant women	HIV-infected, pregnant women attending antenatal care (ANC) at Witkoppen Health	Quantitative cohort study	SMS text messages and phone calls

	Management Intervention to Retain Mothers and Infants from an Option B+ Program in Postpartum HIV Care			and Welfare Centre (WHWC)		
	(Skinner et al., 2018) **User assessments and the use of information from MomConnect, a mobile phone text-based information service, by pregnant women and new mothers in South Africa.**	South Africa	46 women (pregnant women and new mothers)	Participants were purposively selected from 15 facilities in five provinces—Western Cape, KwaZulu-Natal, Free State, Gauteng and Mpumalanga—which were purposively selected to represent different language and cultural groups in South Africa. Within each province, three facilities were purposively selected among those serving large urban communities and those serving semirural	Qualitative study: interviews and focus groups.	Text-based information service

				communities or villages.		
	(Trafford et al., 2020) **Reported infant feeding practices and contextual influences on breastfeeding: qualitative interviews with women registered to MomConnect in three South African provinces**	South Africa	115 pregnant and postpartum women	Women over the age of 18 with an expected due date of delivery between April and October 2017 were recruited -using a series of SMS surveys sent out in English and the most common local language in each region – isi-Zulu (KwaZulu-Natal, Gauteng) or Sesotho	Qualitative study: included IDIs and FGDs.	Text messages via standard short message service (SMS) on mobile phones

Table 3.2B Summary of studies selected for review (continued)					
Study authors, date	**Intervention description**	**Study aims**	**Intervention outcomes**	**Major findings**	**Limitations**
Ampt et al., (2020)	WHISPER is an SMS intervention. Text messages in English are delivered two to three times per week for 12 months. Message content in the intervention group focused on promoting contraception, particularly long-acting reversible contraception. Message content in	This study aimed to assess the effectiveness of the intervention to reduce the incidence of unintended pregnancy among sex workers in Kenya.	Incidence of unintended pregnancy. Long-acting reversible contraceptive use. Dual contraceptive-method use. Contraceptive knowledge.	The intervention did not have a clinically significant effect on unintended pregnancies despite being developed in consultation with participants (sex workers). The intervention was associated with improved knowledge about contraception, particularly intrauterine devices, as well as increased use of dual-method contraception.	Short-lived measurement of outcomes The study did not account for selective loss of pregnancy among sex workers.

	the control group focused on promoting nutritional knowledge and practices, including food safety, preparation, and purchasing.				
Dev et al., (2019)	iMACC is a client-facing mobile application designed to provide systematic, yet personalized, contraceptive counselling to postpartum women. iMACC combines images and text in	This study aimed to evaluate the acceptability and feasibility of the self-administered iMACC decision aid	Behaviour change	Participants indicated that the decision aid was easy to use but challenges arose as to low literacy levels posing a barrier to understanding and using the app. -The app was perceived as a confidential decision aid. -Improved knowledge of contraception with a personalized approach.	The evaluation study did not completely reflect the underlying view of participants towards the FP decision aid.

	a heuristic approach to provide tailored contraceptive counselling to women.				
Flax et al., (2017)	Weekly cell phone breastfeeding text and voice messages were delivered to women in groups during group breastfeeding learning sessions	This study aimed to examine the feasibility and acceptability of using group cell phones to deliver cell phone messages within a multi-component breastfeeding promotion intervention.	Increased the odds of exclusive breastfeeding. Shift social norms around breastfeeding practices.	Group phones were described as acceptable and functional. Participants reported improved status of the phone holder because she was seen as a leader. Some non-phone recipients wanted their own phones. Health information was passed along to family and friends.	Giving out cell phones to groups is not widely sustainable.

		The study also aimed to test the association between participation in small groups and reported breastfeeding practices. Methods			
Harrington et al.,(2019)	The intervention is an interactive SMS program that supports women and couples in contraceptive decision-making, method initiation and continuation.	The study aimed to explore men's and women's perspectives on using SMS to facilitate postpartum family planning counselling in Kenya. It also aimed to engage	Family planning initiation and continuation	Men strongly desire inclusion in FP decision-making. Men participants indicated that they were open to receiving family-panning related SMS, and discussed multiple advantages of using SMS dialogue for FP counselling.	There may have been selection bias of married women participants. Issues of access to reproductive healthcare may be different for non-married women.

		men in family planning decision-making.		The majority of men and women in FGDs felt that receiving SMS about FP could promote improved communication with their partners.	
Isler et al., (2020)	Healthcare providers visited pregnant and breastfeeding mothers at home to show them a set of maternal nutrition videos on a tablet.	To examine how gender affects the content and delivery of a nutrition-focused intervention in Burkina Faso.	Gender-sensitive nutrition intervention	Some mothers said that while they appreciated being shown the videos, they felt powerless to make nutritional changes without the support of their male partners. Healthy promotion in areas such as healthy nutrition, pregnancy and	The study did not interview fathers therefore, it lacks the perspectives of men and their role in maternal and child nutrition.

				breastfeeding is largely considered a mother's domain. Mothers divulged feeling embarrassed at the prospect of discussing certain topics with men, including intra-household dynamics around nutrition financing.	
Lund et al., (2012)	An automated short messaging service (SMS) system providing mothers with unidirectional text messaging, and a mobile phone voucher system providing the	The study aimed to evaluate the use of mobile phones to bridge the communication gap between pregnant women and health	Increased skilled delivery attendance amongst pregnant women.	60% of women in the intervention group delivered in the presence of a skilled birth attendant, compared to 47% of women in the control group. However, the intervention did not improve skilled birth attendance in rural areas.	Methodological limitation in study design and external validity.

	possibility for direct two-way communication between mothers and their primary healthcare providers	providers. The study also aimed to increase skilled delivery attendance in a setting with scarce resources.		Not owning a mobile phone was associated with lower odds of skilled delivery attendance.	
Onono et al., (2019)	MAcess is a phone app with the following functions 1) A free SMS-based service that involves sending personalized trimester-based texts to mothers and reminders to use ante- and postnatal care services; 2) An interactive chat	The study aimed to explore how pregnant and postnatal women made decisions regarding care-seeking for pregnancy and childbirth; the processes of getting care from home to the	Reduction in maternal mortality through frequent communication with healthcare providers and access to reliable transport services.	The bidirectional text messages influenced the decision-making process for the mothers by increasing their knowledge of danger signs, individual birth plans, possible complications, and immediate post-delivery neonatal care. The bidirectional SMS system offered by the MAccess mitigated the challenge of inadequate information.	The gatekeeping role of nurses who influenced participant selection might have introduced a bias.

	service known as m-convo; and 3) 24-hour transport navigator system, through which women can request transport	hospital as well as their perceptions on how the MAccess intervention affected their pregnancy and childbirth care-seeking and utilization experience.		MAccess linked mothers to reliable transport providers to transport them to hospitals. The mHealth innovation was found to be attractive and highly acceptable to women throughout pregnancy and childbirth and helped them navigate the complex and layered individual, infrastructural, and health system factors that put them at risk of adverse maternal and newborn outcomes.	
Parkes-Ratanshi et al., (2020)	Weekly text message reminders are sent out to women participants	The aim of this study was to determine the effectiveness of	The proportion of partners who presented at the clinic and	Post-enrollment partner attendance was 18%. This was considered low attendance. There were no	The attendance rate recorded in this study is lower than the national average.

	to encourage their partners to get tested for syphilis in clinics. This message lasts up to 8 weeks after women's diagnosis.	three partner notification strategies, they include: standard of care (SOC) notifications vs SOC plus text message reminders vs SOC plus telephone call reminders.	received syphilis testing or treatment.	significant differences between the methods used (SOC notification slip, telephone call or SMS).	Insufficient attention to cultural and systemic barriers faced by women to inform their partners of syphilis status and partner getting tested.
Schwartz et al., (2015)	This intervention provides support to HIV-infected women on highly active antiretroviral therapy (HAART) during late pregnancy and for	The objective of the study was to assess the acceptability, feasibility and potential for scale-up of the mobile phone-based case	Retention of mothers in HIV care.	Findings showed that 98% of participants indicated that it was helpful to have a case manager assigned to support them during their pregnancy and postpartum, and all women indicated that they would recommend the case	The study was not powered or designed to assess efficacy. The study only collected prospective data and completed questionnaires with women enrolled in the pilot

	six weeks postpartum. Participants received weekly pre-scripted messages from Case managers during pregnancy (36 weeks) and up to 8 weeks postpartum. Case managers made one pre-delivery and two post-delivery telephone calls to participants during follow-up to discuss delivery plans and postpartum care.	management intervention.		management program to a friend. The pilot intervention provided support to HIV-infected women on HAART during late pregnancy and for six weeks postpartum to be feasible and was highly acceptable. Post-partum contact at 6 weeks was maintained via cellphone with 88% of enrolled women and via telephone or clinic visits amongst 96% of women.	intervention.

Skinner et al., (2018)	MomConnect is a text service provided to pregnant women and new mothers. Women received text messages covering broad areas of child care and health.	The study aimed to describe the experiences of pregnant women and new mothers with MomConnect and assess participants' perceived value of MomConnect, and obtain suggestions for its further improvement.	Empowered mothers who have skills to care for their children.	The pregnant women and mothers uniformly were highly appreciative of MomConnect. First-time mothers felt that they had a lot to learn and drew support and confidence from the messages. MomConnect met the requirement of being responsive to the target group's needs.	
Trafford et al., (2020)	Mom connect was introduced as a strategy to increase breastfeeding rates. Women registered with	To provide evidence towards a richer understanding of women's practices around	Increased breastfeeding initiation	MomConnect messages (often used in conjunction with health workers' advice) were noted as a very valuable source of information that	Many of the women were unemployed. Evidence shows an association between low rates of employment and high rates of breastfeeding.

	MomConnect receive health information through text messages and have access to a helpdesk which allows them to ask questions about health services received.	breastfeeding, key influences on their decision-making, and what might facilitate or prevent the enactment of their breastfeeding intentions.		supported women's knowledge and decision-making. Women found MomConnect empowering and used the messages to teach their peers.	

Table 3.3 Gender transformative considerations						
Author, Year	**Considers gender norms/roles/relations**	**Considers women's specific needs**	**Addresses the causes of gender-based health inequities**	**Includes ways to transform harmful gender norms**	**Seeks to promote gender equality**	**Strategies to foster progressive changes in power relationships between women and men**
Ampt et al., (2020**)**		The mHealth intervention was co-designed and tested with self-identified female sex workers from the target population.		The mHealth intervention acknowledges gender-based violence was likely as a result of participating in the mHealth intervention. To safe guard women, intervention ensured		

				counseling, urgent medical treatment and protection by the community		
Dev et al., (2019)		The authors identified women's limited knowledge on family planning (FP). The authors developed a FP decision aid designed to help prepare postpartum women to make personalized de-liberated contraceptive choices.			The FP program was designed to narrow the knowledge gap on family planning between men and women.	
Flax et al., (2017)		The authors conducted a study apriori and			The mHealth program was	

		identified that only 11% of women had phones. The mHealth program was designed to address cell phone gaps and enhance access to mHealth interventions by providing a group cell phone messaging intervention to promote optimal breastfeeding practices. Therefore women were able to participate even without individual phone ownership.			offered as a multi-component program to improve women's financial independence through a microcredit program	
Harrington et al., (2019)			SMS messaging was designed to challenge personal	The study was guided by women's emphasis on the need to educate men about FP in		The mHealth program took an innovative strategy to promote couple FP education and

			subjective and social norms about postpartum pregnancy risk and contraceptive use.	order to improve women's FP access.		subsequently support couple decision-making through SMS messaging. Men provided feedback on the need to think beyond the woman-spouse dyad and include community-level engagement in FP.
Isler et al., (2020)	The study considered gender norms such as the division of labour along gender lines resulting in domestic	In evaluating the mHealth program, The authors planned data collection activities around cooking hours to	mHealth showed that it is essential to involve male partners in			

	responsibilities for women. The intervention took tablets to women's door steps to show them educational videos on maternal and child nutrition.	allow for mothers to fulfil their household duties. Data collection took place in nearby health centres or participants' homes to avoid mobility issues. In recognition of participants' childcare responsibilities, childcare provisions were made for women during focus group discussions as needed.	mHealth maternal nutrition interventions as a means of facilitating the implementation of nutritional advice and fostering constructive couple communication.			
Lund et al., (2012)		The intervention design included women regardless of mobile phone and literacy status. This approach was chosen				

		because the voucher component allowed all women, regardless of mobile phone status, access to emergency obstetric care, which the authors felt unethical to limit.				
Onono et al., (2019)		mHealth Intervention provided decision-making support because the authors identified decision-making for pregnancy and childbirth service care-seeking as a complex behavior influenced by individual, family, societal, access, and health system factors.				

Parkes-Ratanshi et al., (2020)			The study identified untreated men (partners to pregnant women) as primary drivers of Syphylis in pregnant women. This study aimed to increase the testing and treatment of pregnant women's male partners to reduce pregnant women's risk of syphilis.			
Schwartz et al., (2015)		The content of the intervention ensured				

		confidentiality by not disclosing women's HIV status. Messages were focused on counselling and support. Women that did not have partner support disclosed that the intervention was particularly important for them and met their needs.				

Skinner et al., (2018)		There was no cost for women to participate in the mHealth program. If a woman did not own a phone, messages were sent to another phone where she could read them.		Women indicated that the messages provided a base for discussion. The sharing of certain messages, such as around domestic violence, left the women feeling supported. Messages were shared with expectant fathers, close friends and colleagues.		
Trafford et al., (2020)						Women participants attributed low levels of breastfeeding to social norms. The male gaze

						which indicated men's disapproval of women breastfeeding in public was cited as a reason for not breastfeeding. The messages from the mHealth program enabled women to resist pressure. Women also shared the messages with male relatives to prove the importance of breastfeeding.

3.7 Discussion

To our knowledge, this is the first systematic review reporting evidence on gender transformative approaches in mHealth programs for maternal healthcare in sub-Saharan Africa. The study highlights the various approaches to integrating gender transformative approaches in mHealth studies in line with the WHO's definition of a gender transformative approach to health programs. The findings indicate that while most of the evidence of transformative approaches centred on considering women's specific needs, there was a limited focus on advancing gender equality. No study covered the entire categories of gender transformative approaches and a few studies included approaches from a maximum of three categories.

Our findings with the most significant policy concern are the limited number of mHealth programs with an explicit focus on gender transformative considerations. Gender transformation was not necessarily central to most mHealth programs although they manifested during the study. This highlights the need for an explicit and intentional focus on gender considerations and the promotion of gender equality in mHealth programs for maternal healthcare. Our findings indicated that consideration of only one gender target is often insufficient to effect change. For instance, in a mHealth study to improve nutrition during pregnancy and early childhood, women who were target participants improved their knowledge of adequate nutrition, but improved awareness did not translate into appropriate action because men were not actively engaged in the program. Improving nutrition by targeting women alone presupposes their access to financial resources and decision-making power. In line with this insight are findings from studies in sub-Saharan Africa that illuminate the gender power dynamics inherent in the context of women's nutrition and health (Mwangome et al., 2010). The study highlighted the importance of considering women's broader social, cultural, and economic realities and involving men in health interventions.

Engaging men in and of itself is not a panacea as illustrated by another mHealth study in our review. The study observed that men were the predominant drivers of syphilis in pregnancy and encouraged women to recruit their men partners to test for and treat STIs (Parkes-Ratanshi et al., 2020). The study saw poor attendance from men and contended that gender-based barriers prevented effective communication between partners. A similar study in Congo highlighted the

dangers of poorly designed mHealth programs for engaging men in maternal healthcare(Corker, 2010). The study, jointly targeting men and women, was designed to bridge the knowledge gap around modern contraceptives but instead saw higher participation among men than women. The study failed to account for the digital gap whereby men were often primary users of technology. As evidenced by our findings and the broader literature, engaging men in maternal health requires a deeper consideration of men's privilege and power about women (Ruane-McAteer et al., 2019). Men need to be engaged meaningfully in maternal health programs.

Encouragingly, most of the studies showed positive findings in advancing women's access to maternal healthcare services. Specifically, our findings show evidence of positive outcomes in multi-sectorial approaches to enhancing maternal health. One study from our review integrated breastfeeding promotion into a microcredit program for pregnant mothers in Nigeria. The aim was to improve women's financial stability while supporting breastfeeding through a mHealth program. Similar studies in the literature demonstrate how multi-pronged gender transformative programs for maternal health led to positive health outcomes. A mHealth program in Kenya empowered women in informal employment sectors to save for maternal health expenditure as well as improve their knowledge of maternal healthcare (Abajobir et al., 2021; Pembe et al., 2017). When financially empowered, women are more likely to seek and adhere to skilled maternal health care (Abajobir et al., 2021; Pembe et al., 2017). Similarly, programs to redress anemia in pregnant women in Burkina Faso and DRC went beyond nutrition-related activities to involve women in sanitation supply chain initiatives, enhance women's leadership in communities and shed light on gender-based violence (UNICEF, 2022). These examples show a recognition of the complex and interconnected factors that determine maternal health. They also highlight the potential of mHealth to facilitate a multisectoral approach to redress maternal mortality and morbidity.

Findings from our study illustrate influences of gender considerations on maternal health outcomes. Our studies highlight the importance of gender considerations such as acknowledging that women are more likely than men to be digitally excluded. According to the Mobile Gender Gap Report 2021 published by the GSMA, the gender gap in mobile phone ownership in sub-Saharan Africa is at 13%, this translates to 74 million women who do not own a mobile phone

(GSMA, 2021). Studies have shown that enhancing women's access to mobile devices enhances their participation in mHealth studies, increases their use of maternal healthcare services, and consequently improves maternal health outcomes (Jennings et al., 2015; Oyeyemi & Wynn, 2014a). Our findings show that women's perception about the security of their health information impacts their use of mHealth programs. A mHealth study that guaranteed women's privacy saw increased engagement with the program and subsequent improvement in maternal health outcomes (Schwartz, Clouse, Yende, Rie, et al., 2015). Similar to our findings, evidence from Tanzania shows that positive perceptions of personal privacy and security of a mHealth program enhances pregnant women's participation in the program (Hackett et al., 2018). The study also showed enhanced relationships between women and their healthcare providers.

Policy implications

Implications of our findings for policy have been interspersed in the discussion. We draw further attention to privacy as a growing concern in digital health especially as it pertains to sensitive health information (Clouse et al., 2020). Disclosing private health information puts women at increased risk of violence (Schwartz et al., 2015). Our findings showed strategies for circumventing privacy issues such as purposefully designed mHealth programs that deliver general messages on HIV without divulging women's HIV status. An additional strategy could be the integration of password protected messages to ensure that only the intended recipient reads messages. Beyond program-level strategies, the Global Strategy on Digital Health advocates for country-level regulatory frameworks to enhance the protection and confidentiality of health data with the use of digital health (WHO, 2021). To address the challenges identified in our findings, it is important that gender considerations are integrated in the planning and implementation of these frameworks. Our findings also indicate the need for improved digital access for women. Addressing issues related to affordability and literacy are key in enhancing women's access to and use of mobile health technologies (UN women, 2023). This will require cross-sectoral collaborations and an explicit focus on gender perspectives in polices and plans for digital health. For instance, subsidizing phones for women and girls and digital literacy programs can overcome gendered access barriers to mobile technologies (UN women, 2023).

An understanding of the existing gender ecosystem maximizes the potential of digital health innovations and minimizes risks particularly as it relates to engaging men in maternal health (Flynn-Dapaah & Rashid, 2008). Our findings show the need for men to be engaged meaningfully in maternal health programs. Strategies to enhance male engagement in sub-Sharan African countries have included the development of male engagement guidelines as evidenced in Tanzania (Osaki et al., 2021). It is important to note that while well-intended, unintended consequences of these guidelines have been shown to present challenges for women. For instance, partner absence during antenatal care visits has resulted in delays in women seeking healthcare or refusal of care by healthcare workers (Osaki et al., 2021). It is important to understand the existing gender ecosystem and assess unintended consequences of strategies to engage men in maternal health.

The lack of programs that addressed all the gender-transformative categories indicates the need for a gender objective in each digital health program. Canada's International Development Research Centre (IDRC) recommends that digital health programs in underserved communities should include at least one research question or objective that aims to understand gender issues (Flynn-Dapaah & Rashid, 2008). This will address the noticeable risks to inadequate gender considerations as observed in some of the studies. In our findings, studies with explicit gender objectives also allowed gender to inform further actions in the research process such as data collection. Therefore, beyond having a clear objective to consider gender issues, it is important to maintain a commitment to adapting programs as gender issues become apparent during the course of a program.

Future research

As demonstrated in our review, there is limited research on gender transformative approaches in mHealth for maternal health in sub-Saharan Africa. Given the transformational potential of digital health, there is need for more research on how digital health can reduce inequalities for end users especially women and girls. Research is needed to investigate how gender inequalities shape assumptions, design and implementation of digital health tools. Studies also indicate the need to meaningfully engage gatekeepers in society who enforce gender power relations to

enhance the success of digital health programs. Critical gaps identified in our study point to the need for methodologically strong gender transformative studies. There needs to be greater consistency in quality terminology and criteria that accommodates different study contexts. Future studies can investigate the adverse effects of enacting gender transformative approaches including familial tension because of changes in gender dynamics in relationships.

Strengths and limitations

This study reviewed evidence from both quantitative and qualitative studies thereby uncovering gender as presented from different perspectives. This approach allowed the authors to examine a robust pool of data while gaining insights into users' experiences of gender-transformative mHealth programming. These may not have been possible with only a quantitative or qualitative review of evidence. Despite the generally successful outcomes of gender transformative studies, these studies should be interpreted with caution in light of a few low-quality studies. Low methodological quality scores of studies are indicative of poorly designed studies, therefore, while they may include the relevant gender transformative dimensions, methodological gaps and low-quality studies may exaggerate result outcomes and lead to incorrect inferences. There is a need for more rigorous study designs, especially for mixed methods mHealth studies for maternal healthcare. Furthermore, our analyses of findings indicate strong individual and community-level approaches to gender integration in mHealth programs. Similar approaches have been shown to transform gender norms and health-related outcomes in sub-Saharan Africa (Heymann et al., 2019). However, previous research emphasizes gender transformative approaches at the structural level including legal or policy approaches (Fisher & Makleff, 2022; Heymann et al., 2019). These approaches have been shown to transform health challenges brought about by gender inequality and achieve effective and sustainable change.

Due to the language limitations of the authors, there was no non-English mHealth study included in this review. The authors may have missed other relevant studies that provide evidence on gender transformative approaches. Another limitation is that while the authors extracted the relevant data using the WHO definition as a guide, the gender transformative parameters were not explicitly stated in the studies. This calls attention to the need for clear reporting guidelines

for gender considerations, especially in mHealth research. The literature shows a growing recognition of the importance of consistent standards for reporting gender considerations in health research, however, the deficiencies in the quality of reporting remain an issue (Day et al., 2017; Kalenga et al., 2020).

3.8 Conclusion

Digital health has been incorporated across the pregnancy care continuum in efforts to address social determinants of health, improve the quality of care and ensure positive maternal health outcomes. To achieve meaningful impact, gender and digital inclusion must remain a priority in developing, implementing and evaluating digital health programs. This study reviews gender transformative approaches to gender integration in mHealth for maternal health in sub-Saharan Africa. This review adopts the definition offered by the WHO and interprets a gender-transformative digital health program as one that "addresses the causes of gender-based health inequities through approaches that challenge and redress harmful and unequal gender norms, roles, and power relations that privilege men over women". Considering gender in and of itself is not sufficient because some pathways to gender consideration in health can exploit or accommodate harmful gender norms rather than transform them. While this review affirms that gender transformative approaches in digital health programs are advancing maternal healthcare outcomes, we noted that most programs were not substantively incorporating these considerations into their design, implementation, or evaluation. Implications of our study findings indicate the need for mHealth studies to explicitly acknowledge how power dynamics, values and norms impact maternal health and address these factors throughout the course of a mHealth program.

Chapter 4. Paper 3: Understanding gender dynamics in mHealth interventions can enhance the sustainability of benefits of digital technology for maternal healthcare in rural Nigeria

Published in Frontiers in Global Womens Health, Volume 6, Issue 3
https://doi.org/10.3389/fgwh.2022.1002970

4.0 Abstract

Introduction: Nigeria faces enormous challenges to meet the growing demands for maternal healthcare. This has necessitated the need for digital technologies such as mobile health, to supplement existing maternal healthcare services. However, mobile health programs are tempered with gender blind spots that continue to push women and girls to the margins of society. Failure to address underlying gender inequalities and unintended consequences of mobile health programs limits its benefits and ultimately its sustainability. The importance of understanding existing gender dynamics in mobile health interventions for maternal health cannot be overstated.

Objective: This study explores the gender dimensions of Text4Life, a mobile health intervention for maternal healthcare in Edo State, Nigeria by capturing the unique perspectives of women who are the primary beneficiaries, their spouses who are all men, and community leaders who oversaw the implementation and delivery of the intervention.

Method: This qualitative study used criterion-based purposive sampling to recruit a total of 66 participants: 39 women, 25 men, and 2 ward development committee chairpersons. Data collection involved 8 age and sex desegregated focus group discussions with women and men and in-depth interviews with ward development committee chairpersons in English or Pidgin English. Translated and transcribed data were exported to NVivo 1.6 and data analysis followed a conventional approach to thematic analysis.

Results: Women had some of the necessary resources to participate in the Text4Life program, but they were generally insufficient thereby derailing their participation. The program enhanced women's status and decision-making capacity but with men positioned as heads of households and major decision-makers in maternal healthcare, there remained the possibility of deprioritizing maternal healthcare. Finally, while Text4Life prioritized women's safety in various contexts, it entrenched systems of power that allow men's control over women's reproductive lives.

Conclusions: As communities across sub-Saharan Africa continue to leverage the use of mHealth for maternal health, this study provides insights into the gender implications of women's use of mHealth technologies. While mHealth programs are helpful to women in many ways, they are not enough on their own to undo entrenched systems of power through which men control women's access to resources and their reproductive and social lives.

Keywords: mHealth, maternal health, gender dynamics, digital health technologies, engaging men

4.1 Introduction

An increasing number of interventions targeted toward social and behaviour change are recognizing health behaviours as embedded in social and structural factors such as gender norms and unequal access to resources. This has led to an increased call for gender integration into health interventions, particularly digital health innovations which are at the forefront of transforming maternal healthcare delivery (Figueroa et al., 2021). Digital health, more specifically mobile health or mHealth is defined as the use of mobile devices to support medical and public health practices (WHO, 2016b). Mobile devices such as mobile phones, patient monitoring devices, digital assistants and wireless devices support a broad spectrum of mHealth programs for maternal health including telephone helplines, text message appointment reminders, mobile telehealth and mobile patient electronic information.

Mobile health primarily serves to improve access to healthcare by increasing the speed of access and reducing cost, particularly in countries where there is inequity in the distribution of healthcare. For instance, in Nigeria where the global burden of maternal mortality is dire, there is a remarkable gap in access to skilled healthcare personnel based on women's socio-economic status. In a country with a maternal mortality rate of 512 pregnancy-related deaths per 100,000 live births, only 12 % of births in the poorest households were assisted by skilled birth attendants, compared to 87% in the richest households (National population commission Nigeria, 2019). Beyond marked disparities based on socioeconomic status, inequalities in access and use of maternal healthcare exist across geopolitical zones in Nigeria. Women in Northern Nigeria are less likely than women in Southern Nigeria to use skilled maternal healthcare services (National

population commission Nigeria, 2019). Furthermore, the rural-urban divide brought about by unequal distribution of health resources and services among other reasons has manifested in the lower use of skilled maternal care services in rural areas compared to urban areas. Women's access to healthcare is moderated by several factors including the high cost of maternal services, the social and cultural mismatch between compassionate traditional care and often disrespectful care at skilled health facilities, and distance to healthcare facilities compounded by poor road and transportation infrastructure (Abubakar et al., 2022).

There is a growing consensus that the healthcare system in Nigeria faces enormous challenges to mitigate the aforementioned issues thereby necessitating the need for digital technologies to supplement, but not replace, existing maternal healthcare services. It is no surprise that Nigeria is prioritizing mobile health technologies to increase equitable access to and uptake of skilled maternal healthcare services and ultimately improve maternal health outcomes (Federal Ministry of Health, 2017). However, mHealth is not a panacea, its potential to promote health equity can only be achieved if it is undertaken in a contextually relevant manner where it retrenches rather than exacerbate inequities [4]. To better understand how mHealth can exacerbate inequalities including that involving gender, the next section discusses gender biases in mHealth.

4.2 Understanding gender inequalities in mHealth

Per the sustainable development goal of ensuring healthy lives and well-being for all at all ages, digital health is projected to extend universal health coverage to 1 billion more people globally and ensure that more people enjoy better health and well-being by 2030 (Ibeneme et al., 2020; WHO, 2016b). Universal health coverage can contribute to improving access to health services, particularly maternal healthcare services for the most vulnerable and underserved. However, celebrations of the anticipated progress of digital health are tempered with gender blind spots that pose a barrier to sustainable progress. Gender-based digital exclusions continue to push women and girls to the margins of society. Across low and middle-income countries, women are 15% less likely than men to own a mobile phone (GSMA, 2021). In Nigeria specifically where mobile phone ownership ranges from 95% of the population in urban areas to 82% in rural areas, 14% more men than women in urban areas have ownership of a mobile phone while 35% more men than women are mobile phone owners in rural areas (National population commission

Nigeria, 2019). This presents a significant challenge to women's ability to benefit from mHealth interventions. It must be understood that mHealth programs take place within complex social-cultural, economic and political settings and while they can transform aspects of these settings and have diverse impacts on equitable access to healthcare, their use and reach would largely reflect the wider socio-cultural, economic or political context (George et al., 2018). For instance, if the wider socio-cultural context allows gender-related constraints to prevent meaningful participation with digital technologies, it will be reflected in who can use and benefit from mHealth. Against this backdrop, a gender analysis is necessary when planning and prioritizing mHealth interventions.

To be effective, a gender analysis must go beyond the binary and heteronormative differences between girls and boys, men and women, and acknowledge the socially constructed nature of gender and the experiences within and among different groups of women, men, gender diverse people or gender non-conforming people (Chaitali Sinha, 2013; Figueroa et al., 2021; R. Morgan et al., 2016, 2017). Biases that perpetuate gender inequalities are rooted in unequal power relations between genders and how power is constituted to determine access to resources, division of labour and decision-making authority (R. Morgan et al., 2016). Women's access to maternal healthcare is hindered when they lack access to resources, have limited decision-making power, face the burden of unfair division of labour, and bear the brunt of unfavourable social norms (Manda-Taylor et al., 2017; R. Morgan et al., 2016; Yaya et al., n.d.). Varied experiences of gender intersect with social positions, creating hierarchies of privilege and power that structure people's lives. Individuals can experience multiple oppressions at various points of intersection (Kimberlé Crenshaw, 1989; Nash, 2008). For instance, a study found that across sub-Saharan Africa, mobile health interventions demonstrated exclusionary practices at various intersections of women's identities (Udenigwe & Yaya, 2022). Not only were women excluded from participating in digital health programs based on mobile phone ownership, but they were also digitally excluded due to disabilities or low literacy levels. Ironically, these are often women who already have poor access to maternal healthcare services and are at risk of poor maternal health outcomes (GSMA, 2020b; Udenigwe & Yaya, 2022).

Studies have presented a compelling case for the importance of understanding existing gender dynamics in mHealth interventions for maternal health (George et al., 2018). Programs that aim to address demand-side issues such as inadequate health knowledge and lack of affordable transport to healthcare facilities would often require that beneficiaries have access to mobile phones but without properly acknowledging the gender gap in mobile phone ownership, these programs can miss the intended beneficiaries. Furthermore, the lack of a gender and equity focus in the design of mHealth programs runs the risk of exacerbating inequality in access to health services and even enabling men's appropriation of women-centred programs (George et al., 2018; GSMA, 2021). A mHealth program aimed at improving women's knowledge of HIV/AIDS saw higher participation from men than women. The study concluded that due to gender gaps in mobile phone ownership, it unintentionally reinforced gaps in access to health information by providing more services to men than women, and the project was deemed unsuccessful (Chib et al., 2012). Additionally, while mHealth interventions can provide timely information on pregnancy and child health practices, they may threaten familial and community relationships if recommended practices conflict with the norm or if sensitive medical information is exposed. This is of particular importance when phone sharing patterns are taken into consideration. A study in Kenya indicated that women were more likely than men to share their phones with household and non-family members (Van Der Kop et al., 2017). Similarly, an SMS-based program designed to improve ART adherence among pregnant women with HIV reported that 84% of participants shared their phones (Ronen et al., 2018). Participants expressed concern over the risk of exposing their HIV status to family and non-family members due to the program's overt HIV-related text message content. Taken together, these examples show that the success and continuous use of mHealth programs for maternal health are contingent on recognizing the implications of women's participation in these programs from a gender perspective.

The relational nature of gender and associated ills that arise due to gender inequalities is interwoven through the research reported above and through much of what is reported in this paper. Infusing a gender perspective in mHealth does not mean working with women in isolation but involves working across silos to engage women's broader social networks including men, community leaders, and decision-makers to bring about transformational change in gender

relationships and sustain the benefits of mHealth. Addressing issues related to gender with women alone carries the risk of reinforcing their exclusion from the digital space and can worsen negative unintended consequences of participating in mHealth (George et al., 2018). This is because men and community elders are more likely to be enforcers of gender power relations and have the potential to positively advance gender relations for the benefit of those marginalized by gender power relations who are often women (Deshmukh, Madhu & Mechael, 2013; R. Morgan et al., 2016). Yet, studies rarely engage these diverse perspectives in addressing issues and seeking equitable and sustainable solutions. Furthermore, while mHealth programs hold promise for extending maternal health services to underserved populations, they are rarely assessed on their differential impacts along gender lines. A vast majority of mHealth programs for maternal healthcare in Nigeria report on the feasibility or acceptability of mHealth programs (Akeju et al., 2022; Ebenso et al., 2021; West, 2015), but research assessing the gender dimensions of mHealth interventions in communities remains scarce.

This study explores gender dimensions of a mHealth intervention for maternal healthcare in Edo State, Nigeria by capturing the unique perspectives of women who are the primary beneficiaries of the intervention, their spouses who are all men, and community leaders who oversaw the implementation and delivery of the mHealth intervention. The ensuing discussion is guided by three major questions (George et al., 2018): Do women have the resources to access and use the mHealth program? How does the use of the mHealth intervention impact gender dynamics and relationships? What markers of social inequality impact women's access to mHealth programs?

Study setting

This study assesses the impact of the Text4Life program, a mHealth intervention aimed at increasing women's use of healthcare facilities for maternal, newborn and child health in rural Edo, within the context of the Innovating for Maternal and Child Health in Africa (IMCHA) project (Yaya, Okonofua, Ntoimo, Kadio, Deuboue, Imongan, et al., 2018). This study was conducted in Etsako East and Esan South East; they are two local government areas (LGAs) of Edo state. Edo state is one of Nigeria's 36 states and home to eight million people, half of which live in rural areas (Edo State Government, 2019). The two LGAs Etsako East and Esan South East are in the Northern part of the State and are predominantly rural. Participants were recruited

from two communities within the two LGAs, Okpekpe from the Etsako East LGA and Ewatto from the Esan South East LGA. Both communities have two primary healthcare centres each covering 20 villages. The study sites are characterized by weak health infrastructure and high rates of maternal mortality. Furthermore, primary healthcare facilities serve as their main source of healthcare with no secondary or tertiary healthcare facilities located within any of the communities. The study sites were chosen based on the aforementioned characteristics.

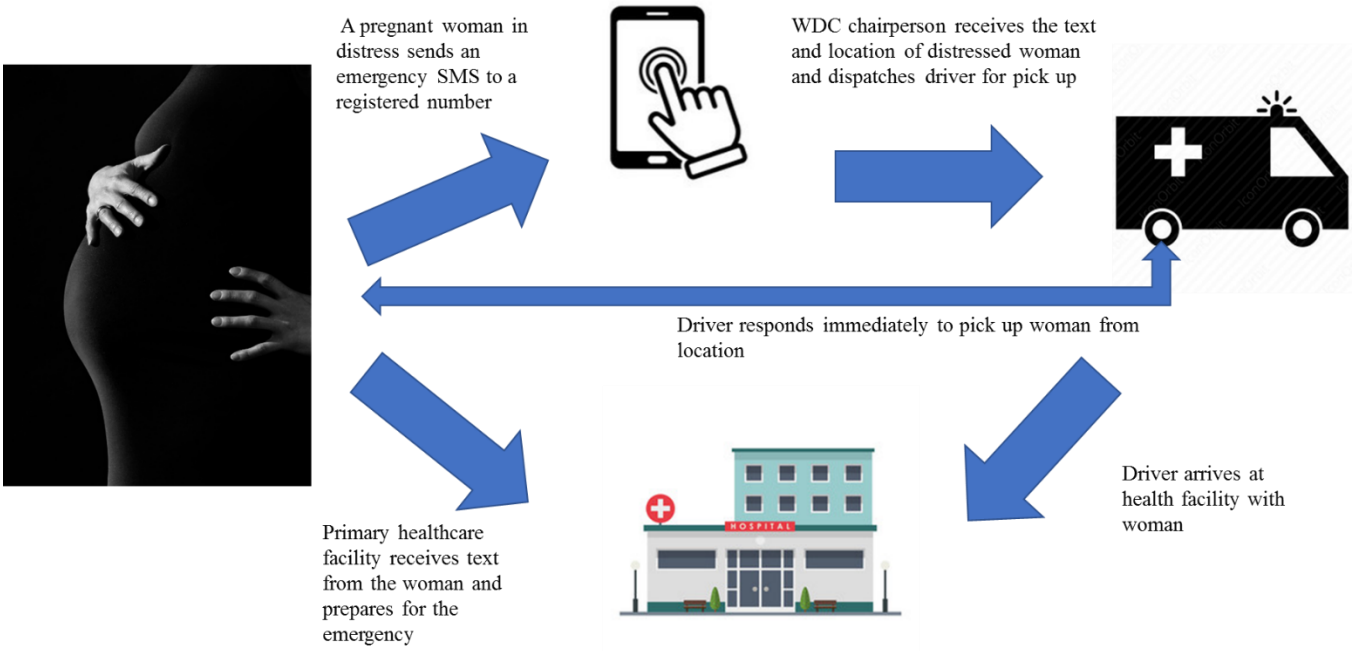
4.3 Text4Life: A description of the intervention

In 2017, the Women's Health Action Research Centre (WHARC), a research-based non-governmental, non-profit organization in Nigeria in conjunction with the University of Ottawa, Canada, conducted formative research with the women, men, community elders, and policymakers in Etsako East and Esan South East. The studies identified challenges related to transportation, cost, and availability of healthcare providers as major deterrents to the use of primary healthcare centres in rural Edo communities, particularly for maternal healthcare (Ntoimo et al., 2019; Okonofua et al., 2018; Udenigwe et al., 2021a; Yaya, Okonofua, Ntoimo, Udenigwe, et al., 2019). The mission of WHARC is to advance women's health in Africa through research and evidence-based advocacy. The centre is located in Benin, Edo state Nigeria. Solutions proffered by the community led to the creation and implementation of the Text4Life Program from June 2019-December 2020. The mHealth program implementation was overseen by the Ward Development Committee (WDC) in each Local Government Area. The WDC constitutes select community members and a chairperson who serves as a bridge between health facilities and their communities. WDCs monitor the quality of service delivery to the community and enhance community involvement in health by harnesses community resources (human, financial, material) to sustain quality healthcare delivery (Oyari et al., 2017).

Text4Life uses a web user interface created for the project by Textit® to enable instant reporting of pregnancy-related events and timely notification of health facilities. The short message service (SMS) system-based technology enables dual communication between pregnant women and healthcare providers. It functions as an alert system and supports the documentation of pregnancies in the community. Pregnant women also receive health messages on topics around preconception, pregnancy, childbirth, and the postnatal period. To use this mHealth service,

women need to have access to a mobile phone including shared phones, pay a registration fee of 2000 Naira (equivalent to $6.00) to join a community health fund, and provide their contact information including name, residential address, telephone number, and telephone numbers of the next of kin. Through the Text4Life platform, pregnant women are able to request swift transportation to primary health facilities during obstetric emergencies. If a pregnant woman is in distress, she can send a keyword to a registered number via SMS signalling distress. The message, in form of a dual SMS, is relayed to both the health facility and the WDC chairperson. The WDC chairperson is responsible for dispatching a community driver to pick up the woman in distress while the health workers prepare to receive the woman at the health facility. Women registered in this program do not pay additional fees for antenatal care, childbirth, postpartum and referral services at their primary health facilities. To enhance women's participation in the Text4ife program, WHARC loaned out phones to women through the health facilities for the duration of their pregnancies. Okpekpe community received 3 phones while Ewatto community received 10 phones.

Figure 4.1 Overview of the Text4Life program design



4.4 Materials and methods

Study design

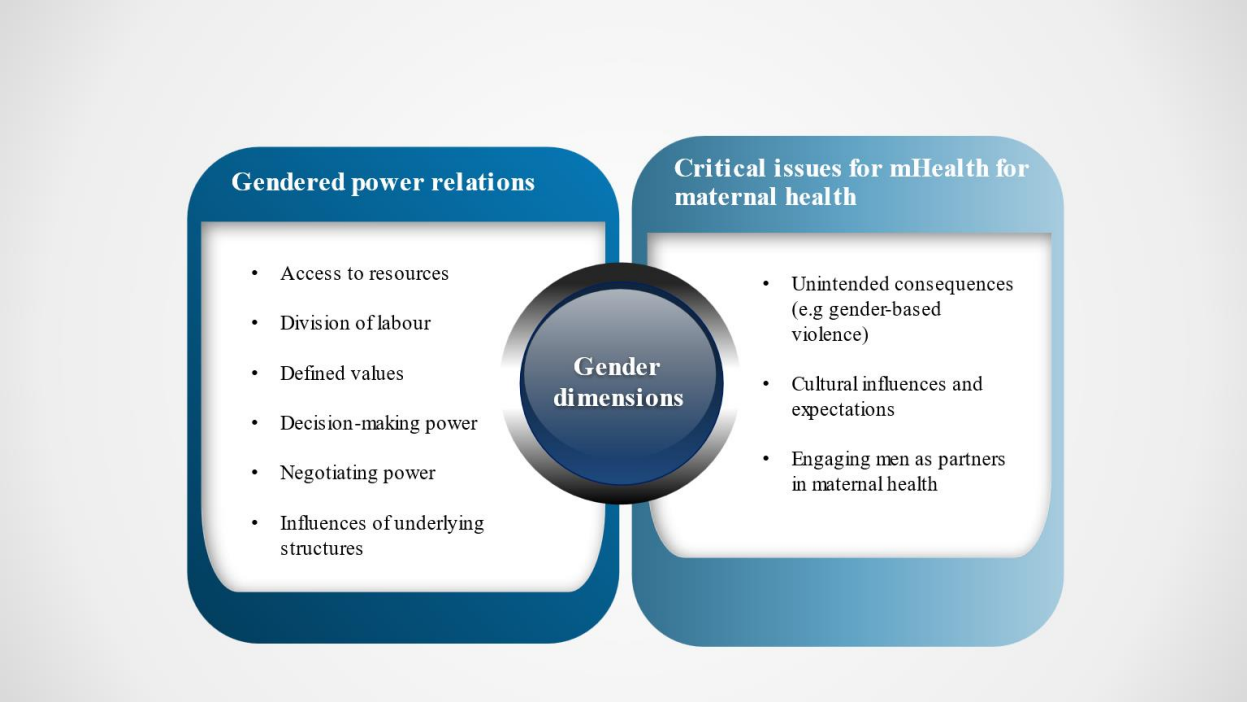
This is a cross-sectional qualitative study of women who registered on the Text4Life platform, their spouses, and the WDC chairpersons in both communities. This study presents findings from focus group discussions (FGDs) and in-depth interviews and takes a subjectivist inductive approach to the use of theory (Varpio et al., 2020). This approach follows a bottom-up process of working from the data up to conceptualizations and rests on the assumptions of individuals' socially and experientially constructed realities and the researchers' responsibility to acknowledge these realities and explore meanings constructed by individuals. By acknowledging that reality is subjective and varies from person to person and by centering the participants as holders of knowledge, this study draws on constructivist ontology and epistemology (Braun & Clarke, 2006).

Theoretical approach

Guiding the study was an understanding of gender within the context of social determinants of health. Beyond the biological and physiological health needs, the social construction of gender which varies across stratifiers such as age groups, cultures, and socioeconomic class generates specific health situations and conditions for individuals (Hartigan et al., 1997). Attaining equity in health means recognizing the different health needs and identifying drivers of health inequities. Gender has been identified as a driver of inequity in access to healthcare in various frameworks. The WHO's social determinants of health tool identified key factors that impact women's health including gender roles, degree of access to and control over resources needed to safeguard health, aptitudes and skills (Hartigan et al., 1997). Women's roles and skills are judged to be less significant than roles and skills associated with masculine spheres. Morgan et al's[10] gender framework in health systems expands on the social determinants of health tool and argues that gender power relations are constituted and negotiated through access to resources, division of labour and their health implications, social norms and decision-making power (R. Morgan et al., 2016). All of these factors are arguably drivers of inequity in health. Furthermore, Deshmukh and Mechael's [21] framework on gender in mHealth within maternal, new-born and child health argues that critical components to the success of mHealth interventions are gender-related issues including an understanding of unintended consequences of mHealth such as gender-based

violence, a focus on women's empowerment, and engaging men and other relevant stakeholders that inform and shape gender relations and practices (Deshmukh, Madhu & Mechael, 2013). These frameworks operationalized gendered approaches to health research (Figure 2). They address the research questions posed in this study and therefore provide a meaningful guide and basis for interpreting the data.

Figure 4.2 Operationalizing theoretical frameworks exploring gender dimensions in health interventions



Participants recruitment

As of 2019, there were 74 women registered for the Text4Life intervention from both Okekpe and Ewatto communities. While the sample size determination for this study was adaptive and emergent, this study relied on sample size guidelines for focus groups by Guest, Namey and McKenna (2017) who observed that almost all themes emerge within three to six groups depending on the scope of the research (Guest et al., 2017). Furthermore, this study followed recommendations by Fush and Ness who argue in favour of the richness and depth of the data (Fusch & Ness, 2015). The goal for this study was to stress the uniqueness of experiences across

communities by obtaining thick and rich information through focus group discussions with participants in each study site.

This study used criterion-based purposive sampling to recruit a total of 66 participants: 39 women, 25 men and two WDC chairpersons. Women were target participants if they registered and/or used the Text4Life program. The next target group was men whose spouses registered and/or used the Text4Life program. Finally, WDC chairpersons who were key in the implementation of the program were the last target group of participants. Participants were recruited from the Text4Life database containing their names and phone numbers which were collected upon registration. Participants consented to have their contact information collected and stored on the Text4Life database by WHARC for research purposes. This database is not publicly available, however, the authors received authorization from WHARC and community members through the WDC chairpersons to access the database for research purposes only.

Two local research assistants conducted data collection. The research assistants, one man and one woman each possessing a bachelor's degree or higher level of education, are experienced in qualitative method data collection. The research assistants made telephone calls to women on the Text4Life database to solicit their participation. They adapted a telephone script for participant recruitment developed by OU. Eligible participants were women between the ages of 15 and 45 years old who used the Text4Life program during their most recent pregnancy. The research assistants explained to participants that the study aimed to understand their experiences with the Text4Life program. Research assistants followed up with men and introduced the study and solicited their consent to participate. All women who were approached agreed to participate in the study but some of the men declined to participate. There were only two WDC chairpersons, they are both men, and each is from one of the local government areas. They both agreed to participate.

Data collection and procedure

The two research assistants conducted a total of eight focus group discussions (FGDs) with a total of 64 participants across the two communities between September 2021 and January 2022. Following a recommendation by Fusch and Ness, each group consisted of six to 10 participants

(Fusch & Ness, 2015). Groups were small enough for members to talk and share their opinions yet large enough to create a diverse group. Focus group discussions occurred at community squares. Discussions lasted between 45-60 minutes. Two in-depth interviews (IDI) with WDC chairpersons occurred at community centres and lasted for approximately 45 minutes. Research assistants and participants adhered to COVID-19 protective measures during the study which included wearing masks and social distancing. Sanitizers were also made available to participants. Each participant received 3000 Naira ($10CAD) to cover transportation and refreshment expenses. Prior to participating in this study, participants provided their informed consent by signing a consent form. Research assistants facilitated FGDs in English or Pidgin English language.

Questions were translated verbally into Pidgin English language when necessary. Each FGD and interview was digitally recorded, and researchers took notes during the discussions. To allow for sex-desegregated data collection, FGDs were held separately for men and women. This was important to encourage open discussions of private experiences and minimize undesirable consequences such as spousal confrontation or abuse that may threaten the participants' or their family's stability (Nchanji et al., 2017). Women and men participants were further segmented by age with the intent to minimize the effects of age hierarchy as dictated by cultural norms which may hinder freedom of expression from younger participants (Nchanji et al., 2017).
Under the supervision of FO and LN, research assistants transcribed the recorded discussions and interviews. All parties are proficient in written and spoken Pidgin English and English languages. Both authors screened the transcripts for errors. Transcripts were reviewed and discussed with OU to ensure a shared concept of key terms. Participants' responses were either transcribed verbatim if they responded in English or translated if they responded in Pidgin English. OU who is also proficient in spoken and written Pidgin English and English languages translated the transcripts where necessary. Literal translation (word-by-word) was used to preserve participants' responses and provide readers with an understanding of the mentality of the participants (Filep, 2009). The process of translation involved back translation whereby data were translated from the source language (Pidgin English) into the target language (English) and back into the source to clarify any ambiguities or discrepancies (Filep, 2009). The findings are

reported in English language. Any identifying information for participants was altered to protect their privacy, they are referred to simply as a man or woman participant instead.

Research instrument

Guides for focus group discussions and interviews were developed by OU. They were designed to capture contextual information related to the topic and elicit detailed discussions from women, men, and WDC chairpersons regarding their experiences with Text4Life. Questions covered topics related to their general perceptions of the Text4Life program, motivations for use, barriers, and facilitators to using the intervention, and perceived quality of the intervention (Sekhon et al., 2017; Thaddeus & Maine, 1994). Questions were carefully crafted to include neutral, non-biased, and non-leading questions to avoid influencing participant responses. Guides were modified where appropriate to suit the local language, literacy levels and cultural interpretations.

Data analysis

The transcripts were exported to NVivo 1.6 and OU led the data coding process which was heavily inductive. This study used a conventional approach to thematic analysis to explore responses from FGDs and IDIs (Braun & Clarke, 2006). First, the coder was immersed in the data and initiated coding with five apriori codes based on interview guides such as ‘cost for mHealth”, and “decision-making”. As coding progressed, existing codes were refined inductively with the discovery of newer codes such as “safety”, “status”. In this phase, the author allowed new insights to emerge. There was limited reliance on a pre-existing category, instead, codes and categories flowed from the data (Hsieh & Shannon, 2005). Codes captured data relevant to the primary questions of this study as well as emergent themes that arose from the initial review. Upon identifying and defining codes, representative quotations from the transcript were assigned to different codes. Codes were reviewed and overlapping codes were further organized into categories. Themes were subsequently generated from categories that reflected a level of pattern in response or meaning. Table 1 indicates key themes, sub-themes and corresponding participants through whose perspectives subthemes and themes were constructed.

Table 4.1 Gender Dimensions of the Text4Life Intervention

Key Themes	Sub-themes	Answers divided by participant		
		Women	**Men**	**WDC Chairpersons**
Resources for mHealth use and access				
Mobile Phone Ownership	Gender gap in phone ownership: Women's limited phone ownership or independent control over phones	X	X	X
Mobile Phone Maintenance Challenges	Connectivity challenges impacted the use of mHealth intervention	X	X	X
	Fluctuating power supply impacted proper phone functions	X		X
	The need for phones for women in the community	X	X	X
Cost Associated with mHealth	Phones disbursed to beneficiaries for free.	X		X
	Cost of mHealth program and pregnancy care offset by intervention.	X		X
mHealth Literacy	Sufficient training provided on how to use Text4Life	X		X
Markers of inequality				
Women's Status	Phone ownership as a means of changing women's status	X		
	Maternal health under the purview of women		X	
Women's Decision to seek Pregnancy Care	mHealth improved women's decision-making power	X	X	X

Women's Safety	Women described as victims of crimes when seeking pregnancy care at nighttime	X		
Gender relationships				
Social Norms	Women under scrutiny for interactions with other non-spouse men	X		X
Childbearing Intentions	Women's reproductive life under men's control		X	
Men's Influence	Success of the mHealth program contingent upon men's approval		X	X

Ethics approval

A certificate of ethical approval was obtained from the University of Ottawa's Research Ethics Board- file number S-02-21-6573, and from Nigeria's National Health Research Ethics Committee (NHREC) -file number NHREC/01/01/2007–18/04/2017.

4.5 Results

Focus group participant characteristics

Focus group participants ranged from 6 to 10 individuals per group. The median age for women was 26 years old and 45 years old for men, age categories are indicated in Table 2. The predominant level of education in these rural communities is primary education and the conventional occupation is farming.

Table 4.2 Study Participants for focus groups

	Participants	Contact type	Number of participants	Age range (median) in years
	Ewatto Women 1	FGD	6	34-39 (36)
	Ewatto women 2	FGD	8	25-30 (27)
	Okpekpe women 1	FGD	8	45-52 (45)
	Okpekpe women 2	FGD	10	40-47 (45)
	Okpekpe women 3	FGD	7	52-57 (54)
	Ewatto Men	FGD	8	25-28 (26)
	Okpekpe men 1	FGD	8	20-25 (23)
	Okpekpe Men 2	FGD	9	24-29 (26)

In this section, we explore the necessary resources for women's participation in the Text4Life program; we highlight the role of Text4Life in retrenching or magnifying social inequalities, and finally, we describe the impact of Text4Life on gender relationships and social norms in the community.

Resources for mHealth use and access

Phone Ownership: Participants generally described a gender gap in mobile phone ownership. Women who were the primary beneficiaries of the Text4Life program were less likely than men to own mobile phones. Women generally reported not owning or not having independent control over mobile phones. Lack of access to mobile phones constrained women's use of the mHealth program and deepened their dependency on their spouses. In the absence of their spouses who were often the primary owners and holders of mobile phones, participants reported that some women remained vulnerable in emergencies; some experienced delays in reaching care and others had home births without a skilled birth attendant. The implications of women's vulnerabilities were not lost on men as they acknowledged the risk women face without access to phones during emergencies, however, even in the face of precarity such as having a spouse who had neared her delivery date, men were not relinquishing their phones.

"For most of the women in the village here, some of them do not have phones. If something happens, she will need to get to a nearby person to say help me call this number. The woman is already under stress, pain and everything. More phones should be provided so that in case of an emergency she can call. The phone will not be given to the women permanently, they will return the phone that will be in possession of the health care centre" (IDI, WDC chairperson, Ewatto).

"My wife, she has no phone to call me, so upon my return from the farm, I will be told congratulations. I will say what happened, and they will say my wife has delivered at home because I was not around" (FDG, Man participant, Ewatto)."

Participants disclosed that women received phones on loan to participate in the Text4Life program, but it was not sufficient for all the women registered in the program. WDC chairpersons indicated that program participants from Okpekpe received three phones while women from Ewatto received ten phones. Women were expected to use the phones for the duration of their pregnancy and return it after childbirth. Efforts to reduce the burden of limited phone ownership were acknowledged by recipients who emphasized that without the phones, they would not have been able to participate in the mHealth program at all. Men and WDC

chairpersons raised concerns over the issue of ownership and feared that insufficient mobile phone ownership will hinder women's future use of the mHealth study.

"The phone was free even if we don't have money, we could use it as we were not required to pay" (FGD, Woman participant, Ewatto)

"Like I said, they only gave out three phones which were not adequate, not enough. The ability to possess a phone is important for pregnant women that's why I suggested that they can bring more phones." (IDI, WDC Chairperson, Okpekpe)

Phone connectivity and maintenance challenges: Women's mobile phone ownership issues were further compounded by network connectivity challenges and maintenance challenges. Most participants reported poor network coverage which impacted the use of the mHealth program. Poor and fluctuating supply of electricity was also highlighted as an issue for keeping phones charged to use Text4Life consistently. A few participants reported that women owned a backup power generator through which they are able to charge their phones. However, this was not a consistent response from participants. This indicates that beyond the gender gap in mobile phone ownership, wealthier participants were confronted with fewer challenges in using Text4Life than poorer participants.

"*My wife and I have phones, but we do not have steady power supply, but we use a generator. That is how we charge our phones."* (FGD, Man participant, Ewatto).

"Yes, you know in the village here, sometimes the network is rubbish, not only in my community but nationwide. (IDI, WDC chairperson, Ewatto,).

Cost of mHealth: To access the Text4Life program, women were required to pay N2000 ($6) to a community health fund. Many of them deemed this cost affordable. More so, their registration for the health fund gives them access to free pregnancy care at their primary health facility which encompassed antenatal care visits, childbirth and postpartum care. They also had free use of the mHealth program through which they received health-related messages and communicated one-

on-one with healthcare staff at their primary healthcare facilities. They also received free transportation services to health facilities in emergencies. The regular cost of the services was considered exorbitant for a lot of women who cited the cost of healthcare as a barrier to their use of skilled pregnancy care in previous pregnancies. Women were happy with the current subsidized cost of healthcare as it allowed them access to skilled care even when they could not afford it. Men termed the cost structure of mHealth an achievement and a gift for many families. WDC chairpersons reported a significant uptick in the number of women using primary healthcare facilities since the implementation of the mHealth program.

"It made pregnancy easier, the stress of worrying for lack of money was not there, things we needed were always available." (FGD, Woman participant, Ewatto)

"Healthcare services became better with regards to the assistance with transportation, the free delivery fee and medical personnel being available to attend to us on the phone and in-person" (FGD, Woman participant, Okpekpe)

mHealth literacy: Women received training from WDC chairpersons at the point of registration to enable them to use the Text4Life program. WDC chairpersons confirmed their role in providing training to women. Women received additional training from healthcare providers at their health facilities during antenatal care. Women provided detailed descriptions of operating the Text4Life platform which was indicative of their understanding of how to use the theText4Life program on their phones and consequently, an indication of effective training.

"We were trained on how to make it effective, how to use the tex4life, and when we came back to the village, we showed the women how to operate it on the phone whether it was the one provided by us or their own personal phones." (IDI, WDC chairperson, Okpekpe).

Markers of inequality

Women's status: For some women, owning a phone extended beyond the need for healthcare but was also a means of changing their status. For them, participating in the Text4Life program

meant taking charge of their health independent of their spouses. Some women took on extra responsibilities to earn money to purchase their own phones so as not to rely on their spouses. One woman noted:

"During that period, I had to work hard in other to get myself a phone so I can be part of it, or else I will need to ask my husband for assistance." (FDG, Woman participant, Okpekpe)

Women's decision making

The mHealth program had implications for women's decision-making in health care. Participants acknowledged that men were the primary decision-makers in women's ability to seek care. Men attributed the role of decision-makers to themselves based on gender and cultural expectations of their roles as fathers. Women, however, demonstrated their influence over their healthcare-seeking decisions in various ways. For instance, some women reported that they *tell* their spouses where to take them for pregnancy healthcare. Other women actively sought care through the Text4Life service independent of their spouses. Chairpersons also recognized men's roles in determining women's use of skilled pregnancy care services. They stated that the mHealth program was an effective means of empowering women to decide to seek care independent of other factors including their spouse's permission or economic status.

"Yes, with the awareness of it (Text4Life), every woman knows the importance of coming here. Women now whether their husband decides or not, whether he gives them money or not because they know it concerns their health, they find a way to come to the health center. There is hardly a woman now who has issues and refuses to come to the health center. Unlike before the program, the nurses are much busier now than before. The records are there, things have changed drastically." (IDI, WDC chairperson, Okpekpe)

Maternal health under the purview of women.

Men's role in maternal health focused primarily on providing financial resources for maternal care. This was deemed an important role considering women's account of out-of-pocket

expenditures for healthcare before the Text4Life program. However, some men indicated disinterest in women's health. They admitted to not often participating in community events related to maternal health and expressed surprise at the turnout of men for the focus group discussions. Some were generally unaware of the Text4Life program and its role in maternal healthcare in their communities. In one of the four focus groups with men, the majority of participants were unaware of the Text4Life program even though their spouses were registered on the platform. Some of the men argued that maternal healthcare is within the purview of women and did not require a man's involvement. Similarly, some women participants asserted that they are responsible for themselves during pregnancy therefore it was not surprising that some participated in the program unbeknownst to their spouses.

"Me, my wife did not tell me anything about that…it's not everything that has to do with women that men do. Sometimes women will attend some of these programs but feel reluctant to tell their husbands. I see they are at fault." (FGD, Man participant, Okpekpe)

"I am the one with the pregnancy, so I am the one to decide to go to the hospital." (FGD, Woman participant, Okpekpe)

Women's safety: Women's safety during pregnancy emerged as a key concern for participants, a concern they felt that the Text4Life program was addressing. Notions of safety emphasized protection and lack of harm during pregnancy and childbirth. Participants opined that women often faced precarious and unsafe conditions while reaching care, therefore notions of safety also meant protection from harm or crime while travelling for healthcare. Transportation assistance through the Text4Life program meant that women were not stranded on the roadside on their way to healthcare facilities, especially at night. Women unanimously agreed that they had safer childbirth experiences with the Text4Life program. Through the program, healthcare providers are alerted of an emergency before women's arrival and are prepared to offer prompt medical attention upon their arrival.

"We are no longer stranded at night. There was a situation where a woman was

stranded and delivered at home. She might have had bleeding issues or placenta issues. She now used Text4Life, and help came at midnight around 2 am. The Text4Life can help other people because in this area there are places that aren't accessible by cars and even riding a motorbike at night is sometimes problematic, but if we use this Text4Life, someone will come to our aid and save us and we now have a little safety and a successful life. We like this text4 life." (FGD, Woman participant, Ewatto)

Gender relationships

Social norms: Participants' responses revealed a prevalent etiquette for women's interactions with men who were not their spouses. Men (non-spouse) and women incurred suspicions from their spouses and the community at large when they are seen together at night. Women indicated that their interactions with men drivers especially late at night left community members *wondering*. They felt it was important that drivers become well known to the community. They also stated the importance of publicizing the program to the community to allay their suspicions. Similarly, WDC chairpersons describe the possibility of conflict arising from women's spouses due to women's interactions with them (WDC chairpersons) or with community drivers (men) at nighttime. They pre-empted conflicts by being cautious in their interactions and by raising awareness of their role in the Text4Life program.

"Everybody in the community should know him as the taxi man and they should know that ordinarily, he can't come to the area because he lives far away from the woman in question. So, they must be wondering what made the man come out to that area at that time, then we can tell them that it is with the help of Text4Life that we were able to reach the taxi man who came and conveyed her to the health center." (FGD, Woman participant, Ewatto)

"During that period, they had to know what I was doing, so they don't see me talking to a pregnant woman at midnight without her husband and think otherwise. I tell them I have no other connection with her other than to see that she delivers successfully." (IDI, WDC chairperson, Okpekpe)

Child-bearing intentions: The mHealth intervention evidently impacted men's construction of maternal bodies as sites through which women's reproduction could be regulated. Men participants extolled the benefits of Text4Life in ensuring safe pregnancies for women so much so that it heightened their intentions to have more children. Conversely, women praised the positive impacts of Text4Life in optimizing maternal care but did not give any indication of its influence on their childbearing intentions. For some men, safe maternal health as a result of the Text4Life program meant prolonging women's reproductive years, a decision seemingly taken without women's input. This signified men's control over women's reproductive lives.

*"Personally, the program is very good. In fact, I still want my wife to give birth twice again because you can just call at any time. So even at sixty years, she can still give birth." (*FGD, Man participant, Ewatto*)*

Men's approval of mHealth: A latent but important theme was an indication of men's influence in sustaining the intervention but only if they approved of it. The men participants indicated their approval of the program and permitted the program to continue in their communities. Furthermore, the success of the program seemed contingent on Chairpersons' efforts such as supporting the program using their personal resources in addition to those provided by the program. WDC chairpersons also indicated that some men who were not designated drivers also assisted with transportation.

"We sit here and welcome you to this place. This program (Text4Life) is very good. It has changed some of us. This time around you can stay." (FGD, Man participant, Ewatto)

"As the WDC chairman, which I still am, I have played my part, I have been playing my part especially when WHARC came here for research in our community. I played all the required roles in assisting them acting as an intermediary between the community, the women in particular. During pregnancies and delivery for the women, I liaise with the doctor and nurses and also ensure that the women follow instructions given to them by the nurses. With the transport system I ensure that the drivers were timely when needed I make sure in the absence of the driver, I use my car to help women get to health

centers for delivery or serious cases when need be. (IDI, WDC chairperson, Okpekpe)

4.6 Discussion

As communities across sub-Saharan Africa continue to leverage the use of mHealth for maternal health, this study provides insight into the gender implications of women's use of mHealth technologies. The study will influence how mHealth interventions for women as end-users are designed and deployed. Specifically, this study focused on Text4Life, a mHealth program aimed at improving women's access to skilled pregnancy care in rural Edo, Nigeria. We explored women's access to resources to participate in the study including mobile phone ownership and the financial cost of the mHealth program. We commented on markers of social inequality that were either amplified or redressed by the mHealth program. Finally, we discussed the impact of Text4Life on gender relationships in the community. In general, we observed that while mHealth programs are helpful to women in many ways, they are not enough on their own to undo entrenched systems of power through which men control women's access to resources, women's reproductive lives, and social lives.

All digital health programs occur in distinct social, economic and political contexts. It is not surprising therefore that women's use and access to mHealth as described by participants reflect, to a large extent, the wider context within which such technologies are produced and used. Women have less access to phones than men and are less likely to participate in digital spaces. They are often excluded from the benefits of mHealth especially when programs are designed without any regard for gender, age, ethnicity or disability. Our study corroborates findings across sub-Saharan Africa that have long-established the gender disparities in mobile phone ownership (Flynn-Dapaah & Rashid, 2008; Hafkin, 2002). For instance, despite the high presence of digital health tools and their potential in redressing maternal mortality in Southern African Development Countries, rates of maternal mortality in this region remain high (Mlambo et al., 2022). Reasons for this were attributed to the gender disparities in access to digital health tools. Similarly, our study shows that women were more likely than men to report shared use of phones. Men and women acknowledged this as an issue and a barrier to using the mHealth program. However, as our results demonstrate, men were not relinquishing their phones even in the face of an impending emergency.

Evidence from our study shows that the provision of free phones for program beneficiaries (pregnant women), though insufficient for all participants, was a promising means of ensuring their participation in the program. Similar findings were reported in a rural community in Southern Nigeria where pregnant women received free phones to participate in a mHealth intervention. The study reported that recipients of the phones found them helpful, and their use of primary healthcare facilities improved (Oyeyemi & Wynn, 2014a). However, other studies illustrated that simply providing free or subsidized phones for beneficiaries of mHealth programs in underserved communities does not guarantee their use (GSMA, 2020a). An initiative in Kenya and Rwanda saw limited phone usage even with the provision of phones for women. Limited phone usage was attributed to ongoing costs to maintain phones, limited digital literacy, and social norms that discourage women's use of phones (GSMA, 2020a). Similar issues were highlighted as barriers to women's use of Text4Life in our study. Efforts to avail phones to women must be carried out alongside interventions that address: the ongoing costs of phones, digital literacy and negative consequences of phone ownership at the household level. Network coverage especially in rural areas is imperative to foster a more inclusive digital world. A report on Nigeria's digital health landscape acknowledges infrastructural issues such as network coverage, but more investments are needed to enhance network coverage, especially in rural areas (Federal Ministry of Health, 2017). Furthermore, gender-oriented targets for digital technology infrastructure (e.g. network coverage, affordability of technologies) should be at the core of efforts to enhance Nigeria's digital health landscape.

Participants reported that registration to access the mHealth program cost N2,000 and it gave women the added benefit of access to pregnancy care including antenatal, childbirth and postpartum check-up at no additional cost. The consensus was that it was affordable and a fraction of the cost of healthcare in these communities. Previous studies conducted in these communities indicated that women pay approximately N10,000 for pregnancy care, with childbirth alone costing N2,000 (Udenigwe et al., 2021b; Yaya, Okonofua, Ntoimo, Udenigwe, et al., 2019). It is noteworthy that during consultations with various stakeholders in maternal health including women, policymakers, clinical managers and community elders, they advocated for free or subsidized healthcare to increase women's use of primary healthcare facilities in their

communities. Our study affirmed that subsidized user fees improved women's use of the mHealth program and health facilities. This is of particular importance because, in the formative studies, it was observed that women's dependency on their spouses' authorization before seeking care was deepened by high levels of poverty. Furthermore, our study shows that women's autonomy and ability to decide their own care without permission or coercion were expanded by the mHealth program. Similar to our study, other studies across sub-Saharan Africa confirm that subsidized cost of pregnancy care improves women's use of skilled pregnancy care (Gitobu et al., 2018).

WDC chairpersons opined that as a result of the mHealth program, women were no longer reliant on their spouse's authorization before seeking healthcare. Some women shared the same opinion and demonstrated their independence by partaking in the mHealth program unbeknownst to their spouses. There is a likelihood that this is a strategy to avoid conflict. While this was not explored extensively in our study, a plausible explanation was given in a Kenyan study where participants cited a lack of trust and fear of violence for women who covertly participated in a mHealth program for maternal health (E K Harrington, McCoy, et al., 2019). It is noteworthy that women's sole decision-making does not necessarily improve with the provision of free or subsidized healthcare. Findings from Burkina Faso stated that even in the context of free maternal healthcare, husbands' authorization was still necessary for using maternal healthcare and women were deemed stubborn or domineering if they ventured on healthcare decisions alone (Beaujoin et al., 2021). Interestingly, the study revealed that joint decision-making among couples was the most acceptable health-seeking behaviour.

The literature on men's involvement in maternal healthcare in various African contexts highlights how unequal social status and power relations begin at the household level (Adjiwanou & LeGrand, 2014; Amzat, 2015). Due to gender inequality, women's sexuality can become a matter of compulsion and not a choice, therefore in cases of early marriage, availability of sex, contraceptive use, number of children or even consensual marriage, men, not women, are primarily in control of those choices (Amzat, 2015). Our findings showed that despite men being referred to as the major decision-maker in seeking healthcare for pregnancy care, maternal health was generally under the purview of women and some men participants

demonstrated limited knowledge and interest in maternal health. This is important as it implies that men are likely to have inadequate knowledge of medical threats or danger signs during pregnancy which inevitably leads to deprioritizing adequate maternal healthcare. Similar findings recognize men's limited involvement in maternal health as a barrier to women's access to skilled care (Sharma et al., 2019). In contrast, studies in Ghana and Sierra Leone re-examined men's involvement in maternal health and argued that men's involvement occurs in contextual and culturally gendered ways such as financial responsibilities and emotional care. Women did not welcome male partner involvement in maternal health beyond the provision of money for healthcare and transportation costs (Ganle, Dery, et al., 2016; McLean, 2020).

Our study shows that the Text4Life program increased women's feeling of safety during pregnancy. Safety was expressed both as hospital-based births free of obstetric danger or properly managed complications; and physical safety from harm and crime while travelling to the healthcare facility. Safety is a primary aim of various mHealth programs across sub-Saharan Africa although they often focus on clinical safety (Frellsen, 2016). Similar to our study that defines safety in terms of enhancing safety from crime during travel, the definition of safety in mHealth has gone beyond clinical safety and encompasses outcomes such as confidentiality, privacy of patient information, and emotionally and socially safe mHealth service (Izugbara & Wekesah, 2018; Kola et al., 2021b). Interestingly, in our study, women's emphasis on a safe pregnancy sharply contrasted with men's emphasis on continual childbearing as a result of safe pregnancies. While Text4Life enabled safer pregnancies, it exacerbated opportunities for men's control over women's reproductive lives. Corroborating our findings is a multi-country analysis of unintended pregnancies across sub-Saharan Africa. The study shows that women's lack of control or participation in family size decisions increases the risk of unintended and short-interval pregnancies which consequently predisposes women to several risk factors such as unsafe abortion, higher chances of pregnancy complications, maternal deaths, and mental health issues (Kwabena et al., 2019).

Our study also examined changes in gender relationships due to the mHealth program. We acknowledge that this topic traverses findings already reported. We observed that while mHealth expanded women's autonomy in healthcare decisions and healthcare seeking, it seemed to pose a

threat to men spouses whose notions of gender relationships have been conditioned by patriarchal norms that seek to maintain control over women. Women's participation in the mHealth program created the possibility of conflict in their relationship with their spouses and the community as a whole. This was also an issue that impacted WDC chairpersons who feared confrontation from women's spouses. Evidence from a systematic review on mHealth interventions and gender relations affirms this study by showing that women's risk of experiencing domestic disputes increases during their participation in mHealth programs (Jennings & Gagliardi, 2013). Reasons for this were attributed to women's enhanced decision-making or autonomy which threatened men who have been conditioned to maintain control over women.

Corroborating other research involving men across sub-Saharan Africa (Palitza, 2010), our findings show that men wield power in the sustainability of the mHealth program. In their role as WDC chairpersons or as spouses, if they approved of the program, they provided the necessary human resources to contribute to the program's success. Formative studies conducted in the same community with elders (who are predominantly men) showed that they voluntarily offered lands as sites for new hospital buildings (Yaya, Okonofua, Ntoimo, Udenigwe, et al., 2019). It is important to note that under most customary laws in a Southern Nigerian context, land is communal, meaning that it belongs to families, villages or communities but not individuals, however, primary leadership over land is conferred on men more than it is on women, therefore, they have higher access to and control of resources including financial and natural resources (Oshio, 1990).

Implications of our findings on men's influence are twofold; first, it highlights the importance of men's involvement in maternal health in a gender transformative manner that seeks to promote respectful and equal relationships that change harmful gender norms. Emerging evidence from the literature shows that transformative change is possible but requires a shift from a fixed notion of masculinity and attention to specific contexts (Elizabeth K. Harrington et al., 2019). Second, it is important to explore means of elevating women's leadership in overseeing the design and implementation of maternal health programs within our study communities. This gives women a

voice in determining programs they need but also enables them to take ownership and ensures the sustainability of programs.

Study Strengths and Limitations

This study draws on the diverse perspectives of women, their men spouses and WDC chairpersons and enables a holistic consideration of gender dimensions in the study. Variations and similarities in perspectives brought issues around gender dynamics and power relationships in mHealth programs to great relief in ways that may be less apparent with only one group of participants. Additionally, this study was sensitive to gender dynamics and included those considerations as described in the methods section. Focus group discussions were disaggregated to ensure women-only and men-only groups. The study had a man and woman research assistants conducting focus group discussions and interviews to cater to participants' preferences, improve their comfort level and build rapport.

The strengths of the study notwithstanding, our work presented here also necessitated critical reflection and acknowledgement of its limitations. The degree to which probing was employed as a technique by the research assistants may have influenced the depth of responses generated by participants on some topics. However, the use of research assistants who could converse in the local languages undoubtedly impacted the dynamics between participants and researchers and improved rapport. Furthermore, the study did not gather information on participants' characteristics in great detail, nor does it report on other contextual situations that could have impacted participation in the Text4Life program such as marital status including polygamous families, female-headed households, and ethnic differences, among others. We have addressed this by citing relevant formative research undertaken within our study communities as part of the larger study. Finally, this study did not examine the aftermath of men's knowledge of the usefulness of mobile phones for their spouses, there is a possibility that this will influence mobile phone ownership among women.

Future Research

Our findings and discussion show that if underlying gender dynamics that impact maternal health are to be addressed, gender must be integrated into mobile health interventions for maternal

healthcare early on in the intervention process. Ongoing work in these communities already engages with those who enforce gender norms in the community such as community elders and men. Future research can investigate how to build on best practices while findings creative ways to challenge gender norms that lead to inequalities and consequently impacts maternal health. Future research can investigate women's leadership in digital health spaces, particularly in Nigeria's rural communities.

4.7 Conclusion

As communities across sub-Saharan Africa continue to leverage the use of mHealth for maternal health, this study provides insight into the gender implications of women's use of mHealth technologies. Through focus group discussions with women and men, and interviews with ward development committee chairpersons, our study highlights the many benefits of Text4Life but emphasizes that failure to address underlying gender inequalities and unintended consequences of mobile health programs limits its benefits and ultimately its sustainability. While women did have some of the necessary resources to access and use the program, they were insufficient and derailed their participation in the Text4Life program. The program enhanced women's status and decision-making capacity but with men positioned as heads of households and major decision-makers in maternal healthcare seeking, there remained the possibility of deprioritizing maternal healthcare at the household level. Text4Life expanded women's sphere of autonomy and interactions but that came with the possibility of exacerbating conflict within the family and community. While Text4Life prioritized women's safety in various contexts, it entrenched systems of power that allow men's control over women's reproductive lives. The evidence provided by our study demonstrates the need to integrate gender into digital health programs because, in addition to having limited resources that constrain women's participation, they are navigating wider structures of patriarchy where gender inequality is reinforced. This will help inform digital health policy that promotes and nurtures gender equality at all stages of a program's development.

Ethics Statement

This study was conducted as part of a thesis project. A certificate of ethical approval was obtained from the University of Ottawa's Research Ethics Board- file number S-02-21-6573, and

from the National Health Research Ethics Committee (NHREC) -file number NHREC/01/01/2007–18/04/2017. Handwritten informed consent was obtained from all participants prior to participation.

Author Contributions

OU conceptualized the study, coded and analyzed the data, and prepared the manuscript with input from SY, FEO, and LFCN. FEO and LFCN coordinated and directed data collection. All authors read and approved the final manuscript.

Chapter 5. Paper 4: Enablers and barriers to the acceptability of mHealth for maternal healthcare in rural Edo, Nigeria

Published in Dialogues in Health, Volume 1, 2022

http://dx.doi.org/10.1016/j.dialog.2022.100067

5.0 Abstract

Objective

Acceptability has become a key consideration in designing, implementing and evaluating digital health interventions. Current evidence points to acceptability as a crucial factor in sustaining mobile health programs for maternal health across sub-Saharan Africa particularly in Nigeria where the burden of maternal mortality is high. This paper describes the enablers and barriers to the acceptance of Text4Life, a mobile phone-based health intervention that extends maternal healthcare services to rural areas of Edo State Nigeria.

Method

This is a cross-sectional qualitative study of women who used Text4Life, their spouses who were all men and Ward Development Committee chairpersons who oversaw the implementation of Text4Life. This study was set in Etsako East and Esan Central Local Government Areas of Edo State, Nigeria. Between September 2021 and January 2022, eight focus groups were conducted with 64 participants: 39 women and 25 men. Two in-depth interviews were conducted with Ward Development Committee chairpersons. Data collection was conducted in English and Pidgin English. Discussions and interviews were digitally recorded and translated to English from Pidgin English where necessary. Data analysis followed a mainly deductive approach to thematic analysis, however, emergent information from the data was also considered and reported.

Results

The results show that participants' positive attitudes toward the intervention, the involvement of the community, participants' understanding of the intervention, and perceived effectiveness of the Text4Life program were enablers to women's acceptance of Text4Life and enablers to Ward Development Committee chairpersons' assistance with the program. On the other hand, limited resources and a clash with the community's value system presented barriers to the acceptability of the Text4Life program.

Conclusion

Our findings demonstrate the importance of alleviating the burdens associated with participating in mobile health interventions while noting that the risk of obstructing the gains from mobile health interventions is high if plans for sustaining it are not incorporated early enough in the design phase.

Keywords: Acceptability, mHealth, maternal health, Nigeria

5.1 Background

Acceptability has become a key consideration in designing, implementing, and evaluating digital health interventions. Digital health, specifically mobile health, is the use of mobile devices for medical and public health practices (WHO, 2016b). The concept of acceptability takes root in the classic Technology Acceptance Model which centres users' experiences and perceptions of technology rather than the technology itself (Davis, 1989). The model posits that the acceptance of technology such as digital health technology is determined by users' perception of its usefulness and their perceived ease of use (Davis, 1989; Perski & Short, 2021). Failure to understand and address users' acceptability of digital health technology raises the risk of overrating the benefits of digital health technologies and invariably adopting ineffectual programs. This has implications for scaling and sustaining mobile health programs, particularly programs that hold strong promises for improving maternal healthcare in underserved populations across sub-Saharan Africa.

The World Health Organisation acknowledges that across Africa, priority is often given to implementing digital health programs; however, most of these programs remain at the pilot or informal stage (WHO, 2013). Few of them go on to have well-established programs that are sustainable and scalable. Reiterating this view were global health professionals at a virtual round table discussion on accelerating the implementation of digital innovations for maternal health in low-income countries (Sunderji, n.d.). They strongly emphasized the need to consider scale-up and sustainability early enough in the design and implementation process of digital health solutions for maternal health.

Current evidence points to acceptability as a crucial factor in sustaining mobile health (mHealth) programs for maternal health across sub-Saharan Africa particularly in Nigeria where the burden of maternal mortality is high (National population commission Nigeria, 2019; Opoku et al., 2019). With a maternal mortality rate of approximately 512 pregnancy-related deaths per 100,000 live births, Nigeria has one of the highest maternal mortality rates in the world (National population commission Nigeria, 2019). One study in Nigeria attributed the effectiveness of a mHealth intervention for maternal healthcare to high acceptance by users (Hicks et al., 2021). Another study in Nigeria indicated that low acceptance of a mHealth program for maternal health meant limited use of the intervention by two important users; health workers and pregnant women (Zayyad & Toycan, 2018). It is important to note that primary users of mHealth programs such as pregnant women, do not exist in isolation. Their extended social network including family and community at large are important actors and contributors to their perception of the usefulness of a program (Dillip et al., 2012; Sekhon et al., 2017; WHO, 2019). Of equal importance are individuals delivering the intervention such as healthcare workers or researchers whose perspectives are also key in determining the success of the program. Users of mHealth programs for maternal health are more likely to adhere to them if they perceive that their content and context are acceptable. Similarly, individuals who are often tasked with delivering interventions to users may not do so effectively if they are not considered acceptable, thereby impacting the overall effectiveness of an intervention (Dillip et al., 2012; Sekhon et al., 2017; WHO, 2019). Determining acceptability can help highlight progresses made by the intervention and challenges that need to be addressed for the program to realize its full potential.

The usefulness of the concept of acceptability lies in delineating outcomes and factors that determine acceptance of interventions such as mHealth programs. While there is no consensus on a definition of acceptability, studies across sub-Saharan Africa have applied various definitions of acceptability of healthcare interventions including mobile health technologies. A study in Tanzania introduced the term “social acceptability” of interventions (Dillip et al., 2012). In contrast to the technology-assisted model where bounded rationality of users is assumed, this definition considers shared perception of health interventions such as digital health interventions. Here, social acceptability is defined as a user’s perceptions influenced by social representations and interactions (Dillip et al., 2012). This approach is useful due to the possibility of its

transcultural application in understanding the acceptance of biomedical approaches. However, it fails to recognize the possibility of a change in perception over the lifespan of the intervention. It is also ambiguous about users' adherence to interventions even when socially acceptable. Another study in Uganda acknowledges the importance of an acceptable mHealth intervention to users, healthcare workers and communities as a whole and defines acceptability as adherence to using and delivering an intervention both by users and those delivering the intervention (Waiswa et al., 2008). While adherence is an important indicator for the longevity of a mHealth intervention, it is not sufficient to define acceptability.

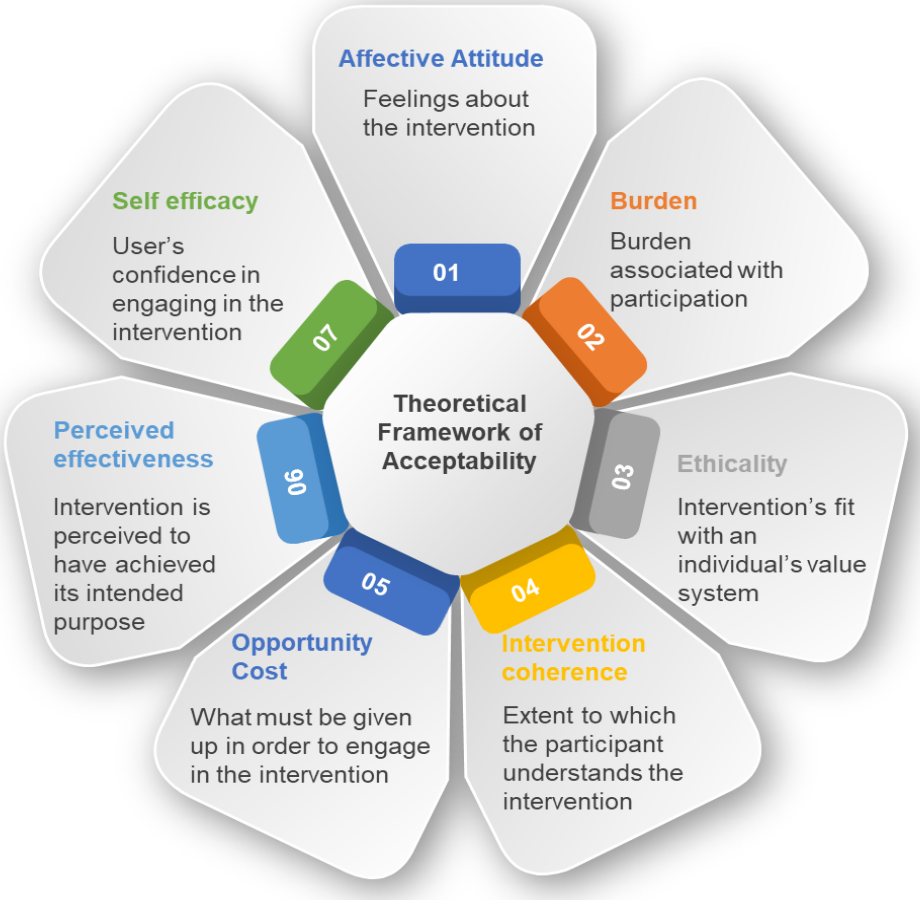
Following a review of previous studies on acceptability, Sekhon et al. (Sekhon et al., 2017) synthesized the aforementioned definitions and others and proposed a theoretical framework of acceptability where acceptability is defined as "a multi-faceted construct that reflects the extent to which people delivering or receiving a healthcare intervention consider it to be appropriate, based on anticipated or experienced cognitive and emotional responses to the intervention" (p.4). This definition is suitable for the purposes of this paper because it considers participants' cognitive and emotional responses to the intervention and how it influences sustained engagement with the intervention. Therefore, this paper operationalizes the theoretical framework of acceptability as a tool to describe the enablers and barriers to the acceptance of a mobile phone-based health intervention that extends maternal healthcare services to rural areas of Edo State Nigeria.

5.2 The theoretical framework of acceptability

Theorizing the concept of acceptability is an important step in understanding how it relates to engaging with and adhering to an intervention and this provides the foundations for developing the right tools for measurement. The theoretical framework for acceptability posits that the acceptability of interventions is best assessed using seven constructs, namely*: affective attitude, burden, ethicality, intervention coherence, opportunity cost, perceived effectiveness, and self-efficacy* (9). This definition considers the perspectives of intervention users and implementers. Not to be confounded with the concept of satisfaction from an intervention, which can only be assessed retrospectively, this framework is unique in its applicability to assess acceptability prospectively or retrospectively. Specifically, the assessment of the acceptability of an

intervention can occur prior to the intervention delivery, while there has been some exposure to the intervention and further exposure is planned, or after the intervention delivery period with no plans of further exposure to the intervention. Our study assessed acceptability from a retrospective perspective after exposure to the intervention. Furthermore, the framework can be applied qualitatively or quantitatively to assess acceptability in different stages of an intervention cycle. See Figure 5.1 for definitions of the various constructs of the framework.

Figure 5.1 The Theoretical framework of acceptability: Constructs and definitions



5.3 Method

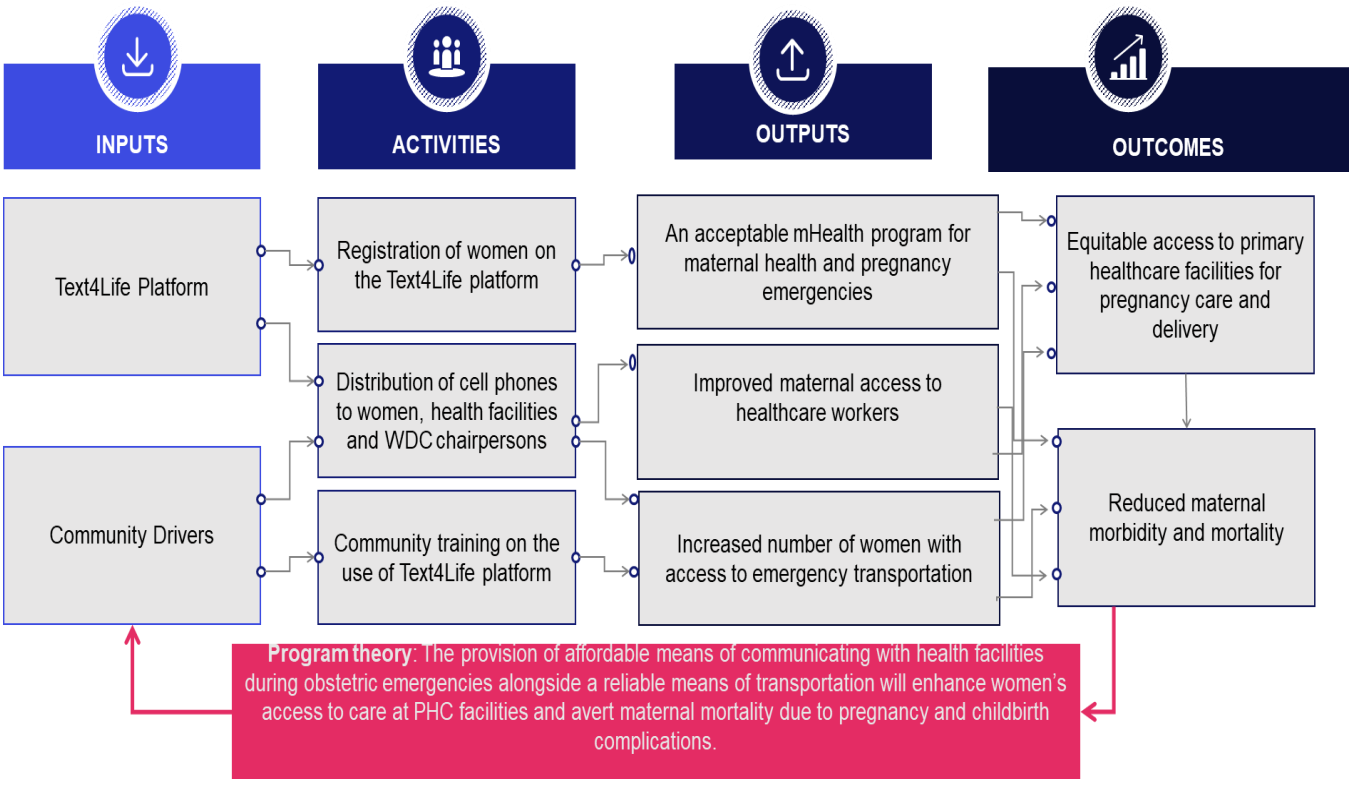
Study design

This is a cross-sectional qualitative study of women who used Text4Life, a mHealth intervention that extends maternal healthcare services to rural areas of Edo State, Nigeria. Backed by literature and previous studies on our study site, we assumed a collectivist expression of cultural values and therefore designed the study with the assumption that women's experiences during pregnancy would be a communal experience and thus influenced by socio-cultural aspects of their community (Fantaye et al., 2019; Yaya et al., n.d.). In keeping with the importance of women's extended social network, this study also sought the perspectives of women's spouses who were all men, and community leaders also known as ward development committee (WDC) chairpersons who oversaw the implementation of the mHealth project in our study sites. WDC chairpersons were both men.

Our study assesses the acceptability of the Text4Life intervention which was implemented in Okpekpe and Ewatto communities in Edo State from June 2019-December 2020 by the Women's Health and Action Research Centre (WHARC). WHARC is a Nigeria-based non-governmental organization that advances women's health in Africa through research and policy (WHARC, 2022). The Text4Life program was part of a larger intervention project funded by the International Development Research Centre (IDRC), Global Affairs Canada (GAC) and the Canadian Institute for Health Research (CIHR) under the Innovating for Maternal and Child Health in Africa project. The larger project aimed to increase women's access to maternal and child health care in primary health centres in rural Edo State, Nigeria. Text4Life was introduced to address the identified barriers to transportation and access to providers. Text4Life is a short message service (SMS) system-based technology that enables dual communication between pregnant women and their primary healthcare providers. Through Text4Life, pregnant women can request swift transportation to primary healthcare centres during labour or in pregnancy-related emergencies by sending a keyword to a dedicated phone number. This message is relayed as a dual SMS to the midwife on duty at the primary healthcare facilities and the WDC chairperson who dispatches community taxi drivers to the women in distress.

Women's names and phone numbers are displayed along with the SMS for ease of identification. Through Text4Life, group messages are also sent out to pregnant women regularly to provide essential information relevant to caregiving. To use this mHealth service, women need to have access to a mobile phone, pay a registration fee of 2000 Naira (equivalent to $6.00) into a community health fund (CHF), and provide their contact information including name, residential address, telephone number, and telephone numbers of the next of kin. Registration for the CHF gives women access to free pregnancy care at their primary health facility, which encompassed antenatal care visits, childbirth, and postpartum care. They also have free use of the mHealth program through which they received health-related messages. Furthermore, WHARC disbursed phones to indigent women for the duration of their pregnancy. Women received training on Text4Life from WDC chairpersons at the point of registration and additional training from healthcare workers at healthcare facilities during antenatal care. Details about the intervention are described in the program's Logic Model (see Figure 5.2).

Figure 5.2 Logic model showing Text4Life program theory



Study setting

This study was set in Etsako East and Esan Southeast local government areas of Edo state. Specifically, in Okpekpe community in Etsako East Local Government Area and Ewatto community in Esan Central Local Government Southeast local government area. Edo state is one of Nigeria's 36 states and home to four million residents (Edo State Government, 2019). The study sites are located in the Northern part of Edo and are predominantly rural. The healthcare system in Edo and Nigeria as a whole is structured across three levels, i.e., primary, secondary, and tertiary. The majority of basic maternal healthcare occurs at primary healthcare facilities (PHCs), and this serves as the main source of healthcare in these communities. Both communities comprise 31 villages and hamlets but the larger intervention and consequently this study was carried out in 20 out of the 31 communities. There are two primary healthcare centres in each community for a total of four facilities covering the 31 villages. These communities were chosen as study sites because of their rural locations, weak health infrastructure and high rates of maternal mortality.

Participant recruitment

Participants were chosen using a purposeful criterion sampling technique (Patton, 1990). The criteria for selection were that women were between 15-45 years old and were registered for the Text4Life program. Men participants were selected if their spouses registered for the Text4Life program. Finally, the ward development committee's (WDC) chairpersons were chosen based on their role in implementing the mHealth program in their communities. A WDC chairperson serves as a bridge between health facilities and their communities. They monitor the quality of service delivery to their community and enhance community involvement in health by harnessing community resources to sustain quality healthcare delivery (Oyari et al., 2017).

Participants were recruited from the Text4Life database containing their names and phone numbers, which were collected upon registration. At the point of registration, participants provided consent to have their contact information collected and stored on the Text4Life database by WHARC for research purposes. The database is not publicly available, and the authors received authorization from the community and WHARC to access the database for research purposes only. Authors FEO and LFCN oversaw participant recruitment and data

collection. Two research assistants invited women to participate in this study through telephone calls. Men were invited to participate first through word of mouth by their spouses and through a follow-up phone call from research assistants. WDC chairpersons were contacted through telephone calls. All women who were approached agreed to participate in the study, but some men declined to participate. Okepekpe and Ewatto communities each had one WDC chairperson, all two WDC chairpersons agreed to participate.

Data collection

Between September 2021 and January 2022, eight focus group discussions (FGDs) were conducted with 64 participants: 39 women and 25 men. Two in-depth interviews (IDI) were conducted with the WDC chairpersons of Okpekpe and Ewatto communities. Focus groups were desegregated by gender and age (Nchanji et al., 2017). Gender-desegrated focus groups were done to encourage open discussions of private experiences and minimize undesirable consequences such as spousal confrontation or abuse that may threaten the participants' or their family's stability. Furthermore, women and men participants were segmented by age to minimize the effects of age hierarchy as dictated by cultural norms which may hinder freedom of expression from younger participants (Nchanji et al., 2017). Participants in each focus group ranged from 6 to 10 and discussions lasted approximately 45-60 minutes, this followed recommendations by Fush and Ness who argue in favour of the richness and depth of the data (Fusch & Ness, 2015). This study sought to obtain thick and rich data that is detailed, nuanced and intricate as a way to stress the uniqueness of experiences across communities.

Focus group discussions occurred in community squares and interviews occurred at community centres. Each participant received 3000 Naira ($10) to cover transportation costs and refreshments. Participants and research assistants adhered to COVID-19 protective measures including wearing masks, social distancing and using sanitizers. Two local research assistants facilitated focus group discussions and interviews with a guide developed by author OU. The research assistants, one man and one woman each possessing a bachelor's degree or higher level of education, are experienced in qualitative method data collection. Questions were designed with reference to the theoretical framework of acceptability (Sekhon et al., 2017) and focused on topics such as participants' perceptions of the Text4Life program, motivations for use, barriers,

and facilitators to using the intervention, and quality of the intervention. Questions were carefully crafted to include neutral, non-biased, and non-leading questions to avoid influencing participants' responses. See Appendices A, B, C for sample FGD and interview guides with relevant questions. The framework also served as an interpretive tool for analyzing the data.

Data collection occurred in English and Pidgin English and was digitally recorded. Under the supervision of FEO and LFCN, research assistants transcribed the data in English or Pidgin English languages. OU, who is proficient in both languages translated from Pidgin English to English where necessary. Literal translation (word-by-word) was used to preserve participants' responses and provide readers with an understanding of the mentality of the participants (31). All authors re-examined the transcripts, screened them for errors and reviewed them to ensure a shared concept of key terms. Any identifying information for participants was altered to protect their privacy, they are referred to simply as a man or woman participant.

Data analysis

Transcripts from the focus group discussions and interviews were exported to NVivo 1.6 and data analysis followed a conventional approach to thematic analysis. Our approach to the use of theory uses an objectivist deductive research approach to thematic analysis (Braun & Clarke, 2006; Varpio et al., 2020). In this approach, the authors identified the theoretical framework of acceptability, which served as a guide for the study. The theory's constructs and assumptions informed the study design, data collection and analysis. While the theory shaped data analysis, data analysis was also done inductively and emergent information from the data was also considered and reported.

Analysis followed the following process: the coder, OU, was immersed in the data and generated initial codes. Codes captured data relevant to participants' acceptability of the Text4Life intervention. In an iterative process, the coder defined codes that appeared meaningful. Upon identifying and defining codes, representative quotations from the transcript were assigned to different codes. Codes were reviewed and overlapping codes were further organized into categories. Themes were subsequently generated from categories that reflected relevance to the constructs of acceptability including participants' feelings about the intervention, their perceived

burden or effort required to participate in the Text4Life study, their perception of how it fits with their value system, their understanding of the intervention, sacrifices made in order to participate in the mHealth program, their confidence to participate in the program appropriately and their perception on the effectiveness of the Text4Life intervention. These were further categorized as barriers or enablers to the acceptability of the Text4Life program.

Ethics approval

A certificate of ethical approval was obtained from the University of Ottawa's Research Ethics Board- file number S-02-21-6573, and from Nigeria's National Health Research Ethics Committee (NHREC) -file number NHREC/01/01/2007–18/04/2017.

5.4 Results

Participant characteristics

The median age for women participants was 26 years old and men were on average 45 years old. The predominant level of education in these rural communities is primary education and the conventional occupation is farming. In this section, we highlight participants' reports of enablers and barriers associated with their participation in the Text4Life program. See Figure 3 for a summary of the findings.

Enablers to accepting Text4Life

Positive attitudes towards the intervention: Participants were receptive to the intervention and spoke highly of it. Many women felt happy about participating in the intervention and considered the transportation part of the program to be the most important. Second to the ease of transportation through this program, women praised the program's ability to enable communication between them and their healthcare providers. Women's spouses and WDC chairpersons also indicated positive attitudes towards the intervention and recognized the program's benefits.

*"I feel very happy having someone assist with such things as transportation to the health center for free…Yes, we will use it again" (*FGD Woman participant, Okpekpe*)*

*"I can say on behalf of the community we all appreciated it because it has opened our women's eyes. During that period, we never recorded missing a baby at birth as they followed the directive of the doctors and nurses. Women didn't have a problem at all they were always fine, and their children were delivered safely." (*IDI, WDC chairperson, Okpekpe*)*

*Especially for this program (Text4Life), it is very sweet and very good. This time around the program can stay. (*FDG, Man participant, Ewatto*).*

Community involvement

Women acknowledged the pivotal role of the ward development chairpersons in championing the mHealth intervention and spoke of their altruistic acts. WDC chairpersons served in a volunteer capacity but were described as going above and beyond to make the intervention a success. They would voluntarily take pregnant women in distress to health facilities in the absence of community drivers. WDC chairpersons expressed pride in their work as overseers of the mHealth project.

*"The WDC chairman was so active, he helped us even at night when he was not around, we would call him, and he will send someone to us, and that person would take us in a vehicle to the hospital to make sure we are ok. That really helped us; I will appreciate it if it continues." (*FGD, Woman participant, Ewatto)

*"Well, the Ewatto community is my home. I was born and brought up in Ewatto so any responsibility given to me, I do it to the fullest of my mind. I participated fully in this mobile health program because health is wealth. If you are healthy, you are a multi-millionaire in this country. Health is wealth. The program is for the health benefit of my people, taking care of women and those yet to be born. I am very happy. I put in all effort I could, and I pray that God will assist me to do it." (*IDI, WDC chairperson, Ewatto*)*

Understanding the intervention

Participants displayed a good understanding of the Text4Life program. They understood how it worked and adhered to guidelines on how best to use the program. For women, a good understanding of the program meant a heightened awareness of the program's benefits, which improved their acceptance of it. Women understood that to request transportation services during an emergency, they needed to send a code as a text message. Women understood that the program enabled two-way communication with their healthcare providers through the phone, an opportunity that improved the range and quality of services they received from the health facilities.

"Before the program, we will just go to the healthcare center they would just give us treatment we will pay and go, but through the [Text4Life] program, they will tell us what to eat, things to do to enable us to deliver safely and it always turns out well." (FGD, Woman participant, Ewatto)

"When I was feeling pains, I sent a text message, in five minutes the driver came to carry me, and the delivery was successful, and I liked it." (FGD, Woman participant, Ewatto)

"Anytime a pregnant woman wants to deliver, she sends a text message to the maternity center." (FGD, Woman participant, Okpekpe)

Perceived effectiveness

Participants reflected on the effectiveness of the Text4Life intervention. They deemed it successful in meeting its goal, which was to prevent maternal deaths. Furthermore, participants indicated that women's use of healthcare facilities increased since the program was implemented. The evidence of the effectiveness of Text4Life influenced women's intention to continue using the intervention.

"We used to lose pregnant women and their newborns but now it has reduced." (FGD, Woman participant, Okpekpe)

"Unlike before, when you come to the health center you would not meet the nurse or doctor but with the Text4Life we easily have access to them." (FGD, Woman participant, Okpekpe)

"*I think it was something worth it, and it has to continue even till now. I think the community and the women have come to understand the effectiveness of using phones. It (Text4Life) was very helpful to them that they go home telling every other woman. That alone encouraged women to [use the Text4Life]."* (IDI, WDC chairperson, Okpekpe)

Participants linked the program's effectiveness to the subsidized cost of participating in the intervention and the distribution of free phones to women for the duration of their pregnancy. Program beneficiaries indicated that without these they could not have participated in the program. Women received phones on loan for the duration of their pregnancy with the expectation to return the phones after childbirth.

"Because of this Text4Life, many women are interested in this program. When initially this program came up, they paid N2,000 and WHARC took all the responsibilities. Even this Text4Llife there is no additional cost. I don't know if you understand me. There is no additional cost. Because of this, women and some parents, young ones who don't want to reproduce again decided to enter because they know that if their wife is pregnant, they are able to pay N2,000, and people are there to carry other responsibilities. That's a very big achievement." (IDI, WDC Chairperson, Ewatto)

"Yes, if we were not given phones, we would not be able to access the Text4Life package." (FGD, Woman participant, Okpekpe)

Barriers to accepting Text4Life

Limited Resources

Responses from participants were indicative of the effort or burden associated with participating in the mHealth program. The majority of participants suggest it was burdensome to participate

and also reported opportunity costs associated with participating in the Text4Life program. The provision of phones notwithstanding, there were insufficient phones to reach all women. Okpekpe community received three phones and Ewatto received 10 phones. Women indicated that participation in the program was hampered by their lack of mobile phones. For some women, participating in the program meant taking on extra paid labour to avoid relying on their spouses' or other relatives' phones. Some men reported having to buy extra mobile phones in the house to enable their spouses to participate in the program. The need for extra phones arose due to inadequate network coverage and inconsistent electricity that made it difficult to charge phones.

"The changes we made to participate? Well, my wife has a cellphone and I have one too, but I had to buy an extra one and an extra battery too in case of emergency." (FGD, Man participant, Ewatto*)*

*"The only cost for me to participate was that during that period I had to work hard in other to get myself a phone so I can be part of it, else I will need to ask my husband for assistance." (*FGD, Woman participant, Okpekpe*)*

"For me, the only difficulty is network issues sometimes." (FGD, Woman participant, Ewatto)

WDC chairpersons bore the burden of using their own resources to facilitate the mHealth program. They reported using their own vehicles to transport women during emergencies and also using their own phones to assist women.

"For me, I was using my own phone before they distributed about ten phones to them although it was not enough." (IDI, WDC chairperson, Ewatto)

"I as the WC chairman I was very much attentive, many times I didn't wait for the driver sometimes I call the driver and he is not responding; I use my car to make sure the woman get to the health center." (IDI, WDC chairperson, Okpekpe)

Community's value system

While participants generally indicated that the intervention fit with their value system including religious and cultural values, women identified covert taboos related to conducting oneself during pregnancy that seemed to clash with the requirements of the mHealth program. It was inappropriate for pregnant women to be seen interacting publicly with men (taxi drivers or WDC chairpersons) who were not their spouses, especially at nighttime. Women also expressed concerns over the scrutiny they received when drivers were seen coming in and out of their houses. WDC chairpersons were also cautious of interacting with pregnant women and drawing the wrath of their spouses. This concern notwithstanding, women did not disapprove of the program but took it upon themselves to raise awareness of the Text4Life program to mitigate unwarranted scrutiny.

*"Everybody in the community knows him as a driver man and they know that ordinarily, he can't come to the area because he lives far away from the woman in question. That will prevent them from wondering what made the man come out to that area at that time, then we can tell them that it is with the help of Text4Life that we were able to reach the driver who came and conveyed her to the health center." (*FGD, Woman participant, Ewatto*)*

Suggestions for the continuity of Text4Life

Financial commitment

Participants revealed that the program was already stalled in their communities due to the lack of funds to sustain it. Much of the program's success was attributed to its subsidized healthcare approach. This meant that regardless of women's economic status, they could afford quality care at their healthcare facilities. WDC chairpersons further revealed that promises and pledges were made by local government officials to sustain the program but have not been honoured. Participants feared that the program will discontinue and urged for more support from the

government. Participants contended the provision of phones for beneficiaries was crucial to ensuring the sustainability of the program because women's participation in the study was already hampered by the lack of phones.

"It is not working anymore because there is no money to sustain it, I even thought of the possibility of being able to sustain the program when WHARC finally is done with the project but there is no money. Our local people here are not trying to contribute to it, nobody. Even those that pledged to, even the chairman of this local government those are the people that should have supported the program they have failed to which is why we stopped registering other women." (IDI, WDC chairperson, Okpekpe)

Healthcare workers in healthcare facilities

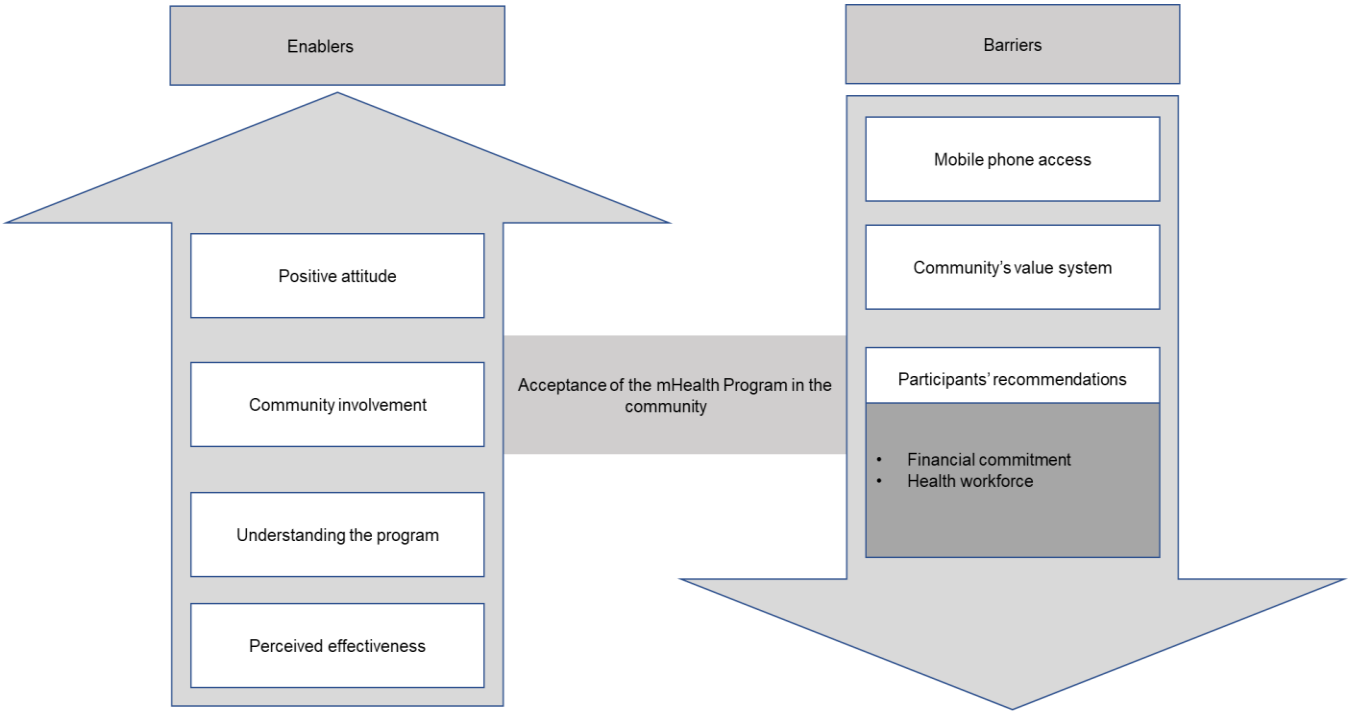
Another major deterrent to the continuity of the program was the shortage of healthcare workers. Although this was beyond the purview of the mHealth intervention, participants highlighted the need for more healthcare workers in the facilities.

"We need more nurses and doctors [in primary health facilities]." (FGD, Woman participant, Okpekpe)

"During the Text4Life program, we got a National Youth Service Corps (NYSC) doctor for us that actually came to promote the health center here because there was 24-hour service. To continue the Text4Life program, the provision of a station doctor, more nurses and also a senior health officer is needed." (IDI, WDC chairperson, Okpekpe)

I will say that the Text4ife program is a very good program, I will now suggest that they should provide more phones, provide vehicles (motorcycle) for the easy movement of these people, equipment to the health centres like delivery kits, sufficient beds, and foams at the health centres." (IDI, WDC Chairperson, Ewatto)

Figure 5.3 Enablers and barriers to Text4Life acceptance



5.5 Discussion

Findings from the study showed that participants' attitudes towards the intervention, the involvement of the community, participants' understanding of the intervention, and perceived effectiveness of the Text4Life program were enablers to women's acceptance of Text4Life and enablers to WDC chairpersons' assistance with the program. On the other hand, limited resources and a clash with the community's value system presented barriers to the acceptability of the Text4Life program.

Affective attitudes, which refer to users' feelings towards the mHealth intervention, were unanimously positive among participants. Women, men and WDC chairpersons conveyed positive feelings about the Text4Life program and described it as "an accomplishment", "sweet" and "very good". They expressed their gratitude for the intervention and were happy to have participated in it. Women's positive attitudes towards the intervention were commonly followed by the intention to continue using the Text4Life program in subsequent pregnancies. This link between users' attitude and continuance of use of mHealth programs is in line with Birkmeyer et

al.'s (Birkmeyer et al., 2021) study that highlights attitude as a core determinant of mHealth acceptance and success of a mHealth program across various countries (Birkmeyer et al., 2021). Attitude towards a mHealth program was shown to influence user satisfaction and consequently influence users' intention to continue using the intervention. Interestingly, the paper also pointed to health consciousness as an exogenous factor in determining users' feelings toward mHealth and their acceptance of it (Birkmeyer et al., 2021). This could be relevant to our study findings because our study sites were sites for the larger Innovating for Maternal and Child Health in Africa project (Yaya, Okonofua, Ntoimo, Kadio, Deuboue, & Imongan, 2018). It is not unreasonable to expect high levels of health awareness in these communities. Similarly, Adebara et al. (Adebara et al., 2017) reported that in Nigeria, doctors' positive attitude toward mHealth was an indication of their willingness to continue to use mHealth intervention.

The Text4Life intervention anchored on community participation was an enabler to the use of mHealth and provided an important lens through which acceptance of an intervention can be understood. WDC chairpersons, who are integral to the community, spearheaded the mHealth intervention. They were evidently influential in facilitating the mHealth project and gaining the trust of their community in participating in the mHealth program. Women's responses confirmed the vital role of WDC chairpersons in inducing positive attitudes towards mHealth. They ensured women's safe transportation to healthcare facilities as part of Text4Life and planned for contingencies with transportation. Confirming our findings is an analysis of digital health practices across African countries that showed that failure to engage communities in digital health innovations inadvertently leads to the outright rejection of innovations (van Stam, 2022). Similarly, Arnaert et al. (Arnaert et al., 2019) indicated that the engagement of community health workers in Burkina Faso in a mHealth program to support antenatal care enhanced spousal acceptance of the intervention and hence its continuity. Furthermore, in our study, complexities and specificities of the local context were implied in the clash between mHealth and social norms in the community. The embodied knowledge of community members is necessary to navigate the unforeseen consequences of participating in the mHealth program and aid the community as a whole in accepting the intervention. This point is discussed further under barriers.

A study in Kenya confirmed that users' familiarity and knowledge of digital health technology improves users' trust in the technology which in turn informs users' adherence to the digital health technology (Sowon & Chigona, 2020). As evidenced in our study, women's and WDC chairpersons' understanding of the Text4Life program meant they were using the program as intended and increased their positive perception of the program. Similarly, a systematic review of success factors of mHealth in sub-Saharan Africa revealed that users' literacy and competency in using mHealth increases its acceptance (Ag Ahmed et al., 2017). It is noteworthy that women, men and WDC chairpersons received training on how to use the Text4Life program. That could explain their knowledge and competence in using the program appropriately.

While definitions and evidence of the effectiveness of mHealth are contentious in the literature (Chen et al., 2018; Lee et al., 2016), this study relies on the definition given in the theoretical framework model where effectiveness is defined as the indication that the study is likely to achieve its intended purpose (Sekhon et al., 2017). Users of the Text4Life program, their spouses and WDC chairpersons believed that Text4Life is achieving its goal of improving pregnant women's use of skilled healthcare facilities and reducing maternal mortality in their communities. The program's effectiveness was further linked to the subsidized nature of the program and the provision of free phones. Similar to our findings, users' perceived effectiveness of mHealth interventions, which in some studies has also been linked to trust in the program, shapes mHealth acceptance and use in South African and Nigerian contexts (Olajubu et al., 2020; Sowon & Chigona, 2020). Reasons for perceived effectiveness by participants in our study were evidenced in their recollection of instances where women's lives were saved due to emergency transportation and in women's personal stories of safety in access to care.

Our study also points to constructs of acceptability through which to explain barriers to accepting the Text4Life program. The burden of participating in the Text4Life program was high for some of the women and the WDC chairpersons. The burden associated with the intervention refers to participants' perceived effort to participate in the intervention (Sekhon et al., 2017). Participation in Text4Life requires access to a phone; however, women generally reported limited mobile phone ownership. Disbursed phones were insufficient for all participants meaning that some women were left without phones. WDC chairpersons indicated using their own resources to

assist women. Women were faced with the double burden of work (domestic unpaid work, their paid work and extra paid work) to afford a phone. Various studies have related gender inequality to women's diminished access to and use of mHealth programs for maternal healthcare. The digital gender divide in Nigeria results in 25% more men than women having ownership of a mobile phone thereby presenting a significant challenge to women's ability to benefit from mHealth interventions (National population commission Nigeria, 2019). Similar studies assert that women's full participation in health interventions such as digital health programs is hindered when they lack access to resources, have limited decision-making power, and face unfair division of labour and unfavourable social norms (Manda-Taylor et al., 2017; R. Morgan et al., 2016; Yaya et al., n.d.).

Mobile health programs operate within a sociocultural context, which influences the acceptability of a program. The theoretical framework of acceptability examines the extent to which an intervention is a good fit with an individual's values (Sekhon et al., 2017). Our study extends this definition to include shared values and the strong influence of users' sociocultural context in shaping perceptions of mHealth programs. Women's sphere of interaction was expanded with the Text4Life program which necessitated their interactions with drivers and WDC chairpersons sometimes late at night. However, their interaction drew suspicion since it was not socially acceptable to be seen interacting publicly with men who were not their spouses, especially at nighttime. Confirming our findings is a study that links the properness of a mHealth program to its acceptance (Cheruto, 2020). Properness was based on a group's values and perceptions. Much like our study, this study indicates the importance of acknowledging various pregnancy-related taboos in a community to ensure the properness of a mHealth program.

Beyond the acceptability of the mHealth program, participants proffered solutions for sustaining Text4Life in their communities. WDC chairpersons stated that despite the verbal commitment from community members and local governments to sustain the Text4Life program, there was a lack of financial investments to sustain the program. They point to an underfunded health system as a barrier to sustaining the mHealth program. Nigeria's digital health landscape shows promise through its National Health ICT Strategy aimed at sustaining applications of digital health solutions in the country (Federal Ministry of Health Nigeria., 2016). However, recent reports

analyzing investments in Nigeria's digital health sector indicate that with only 4.1% of Nigeria's budget going to the health sector (compared to the recommended 13% by the World Health Organization), there has been limited budgetary provisions made to the digital health sector and indeed the health sector as a whole across the various levels of healthcare (Federal Ministry of Health, 2017; Zayyad & Toycan, 2018). The issue of funding also ties in with an inadequate health workforce. Evidence to support assertions of an inadequate health workforce abounds in a Nigerian context with significant rural-urban differences in worker distribution (Gyuse et al., 2018; Solanke & Rahman, 2018; Udenigwe et al., 2021a, 2021b). In response to this, Nigeria's ICT strategic framework identified the need to strengthen the capacity of the healthcare workforce to design, develop, maintain, govern and use digital health services. An important first step to achieving this would be to adopt strategies to recruit and retain an adequate health workforce, especially in rural areas.

Study implications and future research areas

Our findings demonstrate the importance of alleviating the burden of participating in mHealth interventions to enhance their acceptance and contribute to their sustainability. Being cognizant of barriers associated with participating in mHealth programs is of utmost importance. Developers of mHealth programs could liaise with internet companies or mobile operators to address the gender divide in mobile phone ownership. The Global System for Mobile Communication Association (GSMA) recommends the provision of low-cost or subsidized phones to address issues of unaffordability in underserved communities (GSMA, 2021). Furthermore, the subsidized nature of the mHealth intervention in our study aided in its acceptance among women and their families, especially those from disadvantaged socioeconomic groups. Digital health implementers must note that limiting the cost of participating in mHealth interventions improves the likelihood of use and acceptance. Understanding a community's value system is important in ensuring acceptance of a mHealth program. mHealth programs geared towards women and their communities must be developed in collaboration with them to ensure culturally sensitive programs and content.

Furthermore, our study highlights the importance of designing an appropriate plan for how best to sustain the project early enough in the design and implementation phase. Ebenso et al.

(Ebenso et al., 2021) recommend delineating parties responsible for project takeover upon project completion. Unfulfilled financial commitments by the government highlight the inadequacy of the government alone to sustain the benefits of the mHealth program. There is the potential to leverage public-private partnerships for sustaining mHealth programs in a Nigerian context. This is important considering that 50% of health services in Nigeria are provided by the private sector (Abubakar et al., 2022). However, the government-private partnership must be done with adequate regulatory measures that ensure appropriate coverage, quality, and distribution of mHealth programs.

Future research could take an intersectional approach to understand the acceptance of mHealth technologies at various intersections of users and delivers' identities and interrogate how resulting experiences of privileged or oppression influences their acceptance of mHealth. The authors are already exploring gendered dimensions of engaging with mHealth in these communities and believe such an approach will yield richer understandings of acceptability.

Strengths and limitations

This study is strengthened by the user-centred operationalization of the concept of acceptability of digital health interventions. Our adoption of the theoretical framework for the acceptability of health intervention covered important factors that centre participants' cognitive and emotional responses to the intervention and how it influences sustained engagement with the intervention. Furthermore, the multiple sources of information helped to triangulate and validate information regarding the mHealth program since it evidently influenced not only pregnant women who used the intervention but also their spouses and community.

This study is not without limitations. While the theoretical framework for acceptability is considered a strength of this study, we have not applied it in its entirety due to the absence of data to accurately operationalize specific constructs. However, the elements of the framework reflected in the study instantiate the acceptability of the Text4Life intervention from the perspectives of the end users. We adopted a qualitative cross-sectional approach to understanding users' experience with the intervention. Deeper insights may have been possible from an approach that incorporated a mixed method design to understanding the complexities of

accepting the mHealth program and a longitudinal approach that examined users' perception of the intervention from first use to subsequent uses.

5.6 Conclusion

This qualitative study applied the theoretical framework of acceptability as a tool to describe the enablers and barriers to the acceptance of a mobile phone-based health intervention that extends maternal healthcare services to rural areas of Edo State Nigeria. Findings highlight participants' attitudes towards the intervention, the involvement of the community, participants' understanding of the intervention, and the perceived effectiveness of the mHealth program as enablers to women's acceptance of the intervention. Implementers must alleviate the burden of participating in mHealth interventions, which in this case presented as limited resources and a clash with the community's value system. Furthermore, the risk of obstructing the gains from mHealth interventions is high if plans for sustaining it are not incorporated early enough in the design phase. This study provides evidence of participants' cognitive and emotional responses to the Text4Life intervention and how that influences engagement with and acceptance of the intervention.

Ethics statement

This study was conducted as part of a thesis project. A certificate of ethical approval was obtained from the University of Ottawa's Research Ethics Board- file number S-02-21-6573, and from the National Health Research Ethics Committee (NHREC) -file number NHREC/01/01/2007–18/04/2017. Handwritten informed consent was obtained from all participants prior to participation.

Author contributions

OU conceptualized the study, coded and analyzed the data, and prepared the manuscript with input from SY, FEO, and LFCN. FEO and LFCN coordinated and directed data collection. All authors read and approved the final manuscript.

Acknowledgements

OU acknowledges the support from the Social Sciences and Humanities Research Council of Canada (SSHRC) through the Joseph-Armand Bombardier Graduate Scholarship for her doctoral studies.

Chapter 6. Paper 5: Seeking Maternal Health Care in Rural Nigeria: Through the Lens of Negofeminism

Published in Reproductive Health, Volume 20, Issue 103, 2023
https://doi.org/10.1186/s12978-023-01647-3

6.0 Abstract

Background

Feminist scholarship is acutely aware that health is not dependent on behavioural choices alone but on interlocking social determinants that affect people's capacity to lead healthy lives. In a related vein, feminists acknowledge that women are situated within social structures that impact their health. This study focuses on Nigeria where the global burden of maternal mortality weighs heavily. Most maternal deaths in Nigeria result from obstetric complications that could be prevented with timely access to skilled maternal services. Women's limited autonomy in decision-making has been shown to cause delays in seeking care. However, concepts such as autonomy are highly contested in the literature and bring to the fore arguments about its definition, coherence and subsequent application in different contexts such as Nigeria. Acknowledging other realities such as the relevance of social networks to maternal wellness is important to drive appropriate action toward reducing maternal mortality. In doing so, one must refer to localized theories that centre the realities and histories of Nigerian women. This study seeks to examine maternal health within women's socio-cultural realities in a Nigerian context, and in congruence with articulations of African feminism.

Method

This is a cross-sectional qualitative study of a total of 64 participants: 39 women and 25 men in Ewato and Okpekpe communities, two Local Government Areas of Edo State in southern Nigeria. The study presents findings from eight sex-and-age desegregated focus group discussions. This study reports on emergent data related to women's decision-making in accessing skilled maternal care. Data were transcribed and translated to English. Using the NVivo 1.6 software, data were coded and analyzed using a conventional approach to content analysis.

Results

Findings describe ways in which women negotiate authority by ascribing the role of decision-maker to their men spouses while maintaining influence over their pregnancy healthcare decisions and actions. Negofeminism's concepts of alliance, community and connectedness were highlighted through men's constructive involvement in maternal health. Furthermore, women were shown to maneuver patriarchal norms to gain control of their healthcare decisions.

Conclusion

This study offers a different narrative from the dominant view of non-Western women, specifically African women, as oppressed passive victims who are ineffectual in taking charge of their health. From the perspective of negofeminism, women navigate patriarchal environments to yield the best possible maternal health outcomes. The current study can be useful in informing policy and programming that acknowledges women's social embeddedness.

Keywords: Maternal health, Nigeria, African feminism, Negofeminism

6.1 Introduction

Feminist scholarship in bioethics generally strives to advance health and well-being across diverse cultures and traditions by bringing attention to major injustices that override local boundaries (Donchin, 2004). Within this scholarship, there is an understanding of the manifestation of power hierarchies in the distribution of health resources at the local, national and international scale (T. Morgan et al., 2017). Feminist scholarship is acutely aware that health is not dependent on behavioural choices alone but on interlocking social determinants that affect people's capacity to lead healthy lives. In a related vein, feminists acknowledge that women are situated within social structures that impact their health. For instance, studies have shown that unequal power dynamics between men and women caused women to have limited control over their sexual and reproductive lives thereby limiting their timely access to care (Yaya, Ghose, et al., 2019). It is imperative that women's control over their reproductive health and autonomy in seeking care, particularly skilled maternal healthcare are understood within this context. This

study seeks to examine maternal health within women's socio-cultural realities in a Nigerian context, and in congruence with articulations of African feminism.

The state of maternal health in Nigeria

This study focuses on Nigeria where the global burden of maternal mortality weighs heavily. Nigeria, Africa's most populous country, accounted for nearly 20% of all global maternal deaths (National population commission Nigeria, 2019; World Bank Group, 2019). Specifically, Nigeria records 556 pregnancy-related deaths per 100,000 live births. Nigeria's Demographic Health Survey estimates women's lifetime risk of maternal death to be 1 in 34, meaning that 1 in 34 women will have a death related to maternal causes (National population commission Nigeria, 2019). Under the third Sustainable Development Goal, countries have united to reduce the global maternal mortality rate to less than 70 deaths per 100,000 live births by 2030 (Kassebaum et al., 2014; WHO, UNICEF, UNFPA, 2019). However, current trends indicate that Nigeria risks falling short of this target. Most maternal deaths in Nigeria result from obstetric complications that could be prevented with timely access to skilled maternal services. The three-delay model is a prominent framework that describes the sequential and interrelated phases of delays that lead to maternal deaths and morbidity. Women's limited autonomy in decision-making can cause delays in seeking care (phase 1 delay), distance from healthcare facilities can cause delays in reaching adequate healthcare (phase 2 delay), and inadequate medical assistance can cause delays in receiving adequate care (Pacagnella et al., 2012; Thaddeus & Maine, 1994). Most maternal deaths in Nigeria have been attributed to a combination of these factors. An extension of the three-delay model reinforces preventive action that averts these delays (MacDonald et al., 2018; Pacagnella et al., 2012). The potential for preventive action on maternal health lies heavily on an understanding of women's general status in the context of her community. For instance, studies have shown that women's partners, family members such as mothers or grandmothers, and community members are key players in maternal health as they influence women's healthcare-seeking behaviour (Aubel, 2021).

A fourth delay proposed by MacDonald et al (2018) attributes poor maternal health outcomes to delays in community action or lack of collective responsibility (MacDonald et al., 2018; Pacagnella et al., 2012). Maternal health is impacted by a community's capacity to self-identify

norms and expectations around health service use, identify and harness resources available to them, and mobilize efforts to prevent and reduce maternal health. This fourth delay acknowledges women's interconnectedness and the relevance of their relationships both at familial and community levels to maternal health. Delays arise when a community is not sufficiently knowledgeable or aware of maternal health, or where there is an absence of collective responsibility to drive political action on issues pertaining to maternal health (Pacagnella et al., 2012). Community-based research studies bring to light the role of community efforts to enhance healthcare services (Abimbola et al., 2016; Fantaye et al., 2019; MacDonald et al., 2018; Yaya, Okonofua, Ntoimo, Udenigwe, et al., 2019). These efforts include the provision of land and labour to build healthcare facilities, collective action for demanding accountability from healthcare services, and mobilized efforts towards improved community infrastructure such as better roads and transportation services. In exploring the role of women's community in maternal health, the following section draws upon a wider concept of personhood that extends beyond the individual.

6.2 Autonomy in the context of maternal health

Studies across Africa have noted that the lack of autonomy as it relates to decision-making in maternal health has adverse effects on women (Namasivayam et al., 2012; Okonofua et al., 2018; Maricianah Onono et al., 2019). However, concepts such as autonomy are highly contested in the literature and bring to the fore arguments about its definition, coherence and subsequent application in different contexts (P. E. Osamor & Grady, 2016, 2018). For instance, feminists have spoken about the rigid individualism embodied by the concept of autonomy. The overemphasis on masculinist ideologies of domination and personal control neglects relational values (Donchin, 2004). Acknowledging other realities such as the relevance of social networks to maternal wellness is important to drive appropriate action toward reducing maternal mortality. It is for this reason that feminists have sought to revise the concept of the autonomous person and the autonomous decision-maker to include relational autonomy. The notion of the autonomous individual- independent, rational and self-interested-is strongly influenced by Kantian ideas of rational agents (Beauchamp & Childress, 1994; Prainsack, 2018). This rational choice lens promises a measurable and predictable approach to understanding personhood and human action, however, its flawed conceptualization of people as inherently independent and

self-interested ignores collective responsibility and shared social practice evidenced in different cultural settings.

Relational autonomy balances the argument of the rational and autonomous person with arguments of the realities of a person's social embeddedness (Ells et al., 2011; Prainsack, 2018). Some feminist scholars argue that being able to reflect on choices and their consequences affords a person some sort of autonomy. Stoljar (2018) asserts that "preferences for relationships of care and dependency such as those within marriage or other family structures can be just as autonomous as preferences for self-reliance or relative social isolation; preferences for cultural and religious norms into which agents are born can be just as autonomous as preferences to repudiate these norms" p.7 (Stoljar, 2018). This argument provides a necessary framing of agency for situations that have previously been interpreted as oppressive and offers up a different understanding of choices and forms of agency, particularly in a non-Western context. For instance, the emphasis on women's sole decision-making for maternal healthcare often precludes considerations of couples' joint decision-making as an important determinant of maternal health (P. E. Osamor & Grady, 2018).

In a similar vein, African feminism challenges the foreign gaze imposed by Western feminist scholarship that subsequently dictates narratives of feminism in an African context (Mohanty, 1991; Nnaemeka, 2004). African women, often seen as the 'other' are depicted as subordinated, dominated and passive subjects of patriarchal structures in their society. Western feminist discourse of autonomy and empowerment in maternal health is also not immune to ideologies that privilege individual freedom, choice and personal responsibility without the necessary critique of the systems that constrain women (Mack, 2016). In describing Western feminism's scrutiny of human agency, Nnaemeka (2004) posits that "Western feminism is caught up in its ambivalence: fighting for inclusion it installs exclusions; advocating change it resists change; laying claims to movement, it resists moving"p.363. This serves as a reminder that while feminism as understood and practiced in a Western context can offer important perspectives for maternal health, it can be lopsided in theorizing women's realities across non-Western contexts and is therefore not wholly applicable in an African context. Therefore, to understand women's

lives in an African context, one must refer to African feminist theories that centre the stories and histories of African women within the cultural and philosophical spaces they occupy.

6.3 Maternal health through the lens of Negofeminism

The authors agree that in theorizing women's authority in maternal healthcare across cultures, one must interrogate the source of the theory and its positionality through which a social, intellectual and political stance is legitimized. A glaring risk of failing to localize theories for subjects of research is the danger of homogenizing their lives (Abimbola, 2019). The authors agree that the location of African women as knowledge producers and subjects of knowledge production is imperative to avoid the pitfall of homogenizing women's experiences in line with 'victimhood'(Mohanty, 1991). Not only does this trope of victimhood negate women's agency, but it also perpetuates gender inequities. Discourses on feminism in Africa reflect the differences in religion, ethnicity and regions of Africa but they share a common theme of complementarity of genders, equity and justice for both women and men. African feminists assert that aspects of Western feminism engagement such as the call to 'disrupt', 'challenge' or 'blow apart' are antithetical to feminist engagement in an African context where the approach is to 'collaborate' and 'negotiate' (Akin-Aina, 2011; Ezenwa-Ohaeto, 2019; Nnaemeka, 2004; Nzegwu, 1995).

Nigerian feminist scholar, Obioma Nnaemeka describes feminism in an African context as feminism of negotiation or negofeminism (Akin-Aina, 2011; Nnaemeka, 2004). Negofeminsim strives for gender equality through negotiations and compromise. It involves situational 'give and take' exchanges within the dominant culture in lieu of confrontational exchanges. In a maternal health context, the dominant culture can be driven by factors such as patriarchal norms around decision-making authority or men's obligations during pregnancy. In Nnaemeka's words, African women do feminism for themselves but also as acts of altruism. Importantly, African women understand that context is important for tackling patriarchy, therefore negofeminism knows when/where/how to negotiate around patriarchy and when/where/how to overthrow patriarchy. Snail-Sense feminism, a similar African feminist theory proposed by Akachi Adimora-Ezeigbo adopts the metaphor of a snail to indicate the process through which women navigate oppressive conditions (Ezenwa-Ohaeto, 2019). The theory alleges that much like the

snail, women survive patriarchal conditions by dealing with men slowly and retracting in difficult situations. Similar to negofeminism, snail-sense feminism is underlined by principles of negotiation and cooperation but has been problematized for its depiction of cowardice or subjugation as a means to address gender inequality(Ezenwa-Ohaeto, 2019). In a maternal health context, this theory would encourage women's negotiation around seeking maternal healthcare but would also encourage their quiet recline if men disapprove of their attempts at negotiation. In contrast to the snail approach of retracting, negofeminism recognises the need to "challenge" and "detonate" through dialogue and negotiation even in unfavourable conditions. These nuances make negofeminim a more suitable lens through which to explore maternal health in this paper.

Negofeminsim in practice is pervasive in an African context. For instance, while aiming to achieve gender equity, the Maendeleo Ya Wanawake Organization, a women's non-governmental organization in Kenya successfully deployed negofeminsim in their campaign against female genital mutilation (Akin-Aina, 2011). Women recognized the cultural significance of cutting in the broader context of a central rite of passage that ushers girls into womanhood. Their campaign successfully eliminated the harmful practice of cutting while retaining the cultural significance of the ceremony (Akin-Aina, 2011).

Against this backdrop, a gaping issue is the limited engagement with interpretive tools such as feminist theories that centre the realities of African women, particularly in the context of maternal health. Therefore, this paper uses African feminism, specifically negofeminism as a theoretical underpinning for exploring maternal healthcare decision-making and wellness in rural Nigeria. Through conversations with men and women on maternal healthcare seeking and maternal health wellness, this paper examines how discourses underlying negofeminism are tied to maternal health.

6.4 Method

Study Design

This study forms part of a larger study by the Women Health Action Research Centre (WHARC), a research based organisation aimed at improving maternal health in rural Edo,

Nigeria. This is a cross-sectional qualitative study of women and men involved in the larger study and presents findings from focus group discussions (FGDs) with them. The study takes a subjectivist inductive approach which follows assumptions of socially and experientially constructed realities through an individual (or group)'s interpretation and understanding of reality (Varpio et al., 2020). The researchers have a responsibility to acknowledge these realities and explore meanings constructed by individuals. Specifically, this study uses a theory-informing inductive data analysis study design, meaning that this study employs theory, in this case, negofeminism, as an interpretive tool but not as a basis for conducting and designing the study. By acknowledging that reality is subjective and varies from person to person and by centering the participants as holders of knowledge, this study draws on constructivist ontology and epistemology (Braun & Clarke, 2006).

Research setting

The study is set in Ewato and Okpekpe communities, located in two predominantly rural Local Government Areas of Edo State, in southern Nigeria. Edo State is one of Nigeria's 36 states, the majority of Edo's population of over 4 million people reside in rural areas. The two communities comprise 20 villages and hamlets. Each of the two communities have two primary healthcare centres (PHCs) making a total of four PHCs covering the 20 villages. These communities were chosen because preliminary baseline assessments revealed high maternal mortality rates and low use of primary healthcare facilities. Furthermore, these communities are located in rural areas where there are no secondary or tertiary health facilities in the vicinity. PHCs serve as their nearest healthcare facilities.

Participant sampling and recruitment

There were ongoing research or intervention activities in the study sites, therefore we anticipated that most potential participants would already have experience with the WHARC team. Participants were purposefully chosen from WHARC's database containing names and contact information of women participating in maternal health interventions. Women consented to have their contact information collected and stored on the database. Their contact information was only made available for research. Two research assistants conducted data collection. The

research assistants, one man and one woman, each had a bachelor's degree or higher level of education and are experienced in qualitative method data collection. They made telephone calls to women to solicit their participation and followed a telephone script for participant recruitment developed by the lead author (OU). Eligible participants were women between the ages of 15 and 45 years old who participated in maternal health intervention programs during their most recent pregnancy. Men spouses were contacted through snowball sampling whereby women invited their spouses through word of mouth to participate in the study. Research assistants followed up with men and introduced the study and solicited their consent to participate. All women who were approached agreed to participate in the study but some of the men declined to participate.

Data collection and procedure

The two research assistants conducted a total of eight focus group discussions with a total of 64 participants across the two communities between September 2021 and January 2022. Following a recommendation by Fusch and Ness, each group consisted of six to 10 participants. Groups were small enough for members to talk and share their opinions yet large enough to create a diverse group (Fusch & Ness, 2015). Focus group discussions occurred at community squares. Research assistants and participants adhered to COVID-19 protective measures during the study which included wearing masks and social distancing. Sanitizers were also made available to participants. Each participant received 3000 Naira ($10CAD) to cover transportation and refreshment expenses. Prior to participating in this study, participants provided their informed consent by signing a consent form. Research assistants facilitated FGDs in English or Pidgin English language.

Questions were translated verbally into the local dialect when necessary. Each FGD was digitally recorded, and researchers took notes during the discussions. To allow for sex-desegregated data collection, FGDs were held separately for men and women. This was important to encourage open discussions of private experiences and minimize undesirable consequences such as spousal confrontation or abuse that may threaten the participants' or their family's stability(Nchanji et al., 2017). Women and men groups were further segmented by age as this helps to minimize the effects of age hierarchy as dictated by cultural norms which may force younger participants to withhold their opinions (Nchanji et al., 2017). Discussions were simultaneously translated and transcribed to English and were reviewed and discussed by the lead author to ensure a shared

concept of key terms. Other coauthors with proficiencies in both languages re-examined the translated transcripts and screened them for errors. Any identifying information for participants was altered to protect their privacy, they were referred to simply as a man or woman participant instead. Participants' responses were either transcribed verbatim if they responded in English or translated if they responded in Pidgin English. Literal translation (word-by-word) was used to preserve participants' responses and provide readers with an understanding of the mentality of the participants (Filep, 2009).

Research instrument

The lead author designed qualitative FGD guides to capture contextual information related to the topic and elicit detailed discussions from women and their spouses regarding their opinions and lived experiences as it relates to seeking maternal healthcare and maternal health in general. Questions for the larger study were designed with reference to the three-delay model, the theoretical framework for acceptability and existing literature which covers topics related to general perceptions of the Text4Life program, motivations for use, barriers, and facilitators to using the intervention, perceived quality of the intervention, and acceptability of the intervention (Sekhon et al., 2017; Thaddeus & Maine, 1994). Questions were carefully crafted to include neutral, non-biased, and non-leading questions to avoid influencing participant responses. FGD guides were modified where appropriate to suit the local language, literacy levels and cultural interpretations. The current study reports on findings specific to maternal healthcare decision-making and maternal wellness in general. A sample of issues discussed with participants include:

1. The first person a woman consults for general pregnancy care, and more specifically during pregnancy complications.
2. The major decision-maker (s) for seeking maternal healthcare.
3. Lived experiences of men's involvement in maternal and child health from the perspectives of fathers.

Data analysis

The transcripts were exported to NVivo 1.6 and OU led the data coding process. This study used a conventional approach to content analysis to explore responses from FDGs. In this process, the coder was immersed in the data and allowed new insights to emerge. There was no reliance on a pre-existing category, instead, inductively, categories flowed from the data (Hsieh & Shannon, 2005). The initial transcript review aimed to identify general perceptions of the Text4Life program, however, this initial review also revealed emergent data related to women's decision-making in accessing skilled maternal care.

Codes captured data relevant to the primary questions of this study as well as emergent themes that arose from the initial review. In an iterative process, the coder defined codes that appeared meaningful. Although the codes emanated from the data, the coder acknowledges the influence of their background and experiences in defining codes. Upon identifying and defining codes, representative quotations from the transcript were assigned to different codes. Codes were reviewed and overlapping codes were further organized into categories. Themes were subsequently generated from categories that reflected a level of pattern in response or meaning. Salient themes were identified as those that reflected experiences around maternal healthcare decision-making and wellness.

Trustworthiness

The authors adopted various strategies to ensure trustworthiness in this qualitative study following suggestions by Shenton; FGDs were structured to allow for iterative questioning including the use of probes to elicit detailed responses, questions were rephrased to participants when necessary, member checks were conducted after data collection to ensure accuracy of the data (Shenton, 2004). All authors reached a consensus on emerging themes and the manuscript provides thick descriptions of the phenomenon of interest.

6.5 Results

The total of 64 participants comprised 25 men and 39 women. Participants ranged from 6 to 10 per focus group discussion. The median age for women was 26 years old and 45 years old for men. The predominant level of education in these rural communities is primary education and

the conventional occupation is farming. Please see Table 1 for a breakdown of participants in focus groups.

Table 6.1 Study Participants

	Participants	**Contact type**	**Number of participants**	**Age range (median) in years**
1.	Ewatto Women 1	FGD	6	34-39 (36)
2.	Ewatto women 2	FGD	8	25-30 (27)
3.	Okpekpe women 1	FGD	8	45-52 (45)
4.	Okpekpe women 2	FGD	10	40-47 (45)
5.	Okpekpe women 3	FGD	7	52-57 (54)
6.	Ewatto Men	FGD	8	25-28 (26)
7.	Okpekpe men 1	FGD	8	20-25 (23)
8.	Okpekpe Men 2	FGD	9	24-29 (26)

The following section examines how discourses underlying negofeminism are tied to maternal healthcare seeking and maternal health in general. Men and women's responses are categorized as negotiation, collaboration and maneuvering, all basic tenets of negofeminism (Nnaemeka, 2004). This approach is not intended to essentialize hegemonic masculinity that establishes men's dominance over women thereby severely limiting their reproductive rights (Amzat, 2015).

Instead, this section offers a different narrative from the dominant view of non-Western women, specifically African women, as oppressed passive victims who are ineffectual in taking charge of their health (Mohanty, 1991). From the perspective of negofeminism, findings show how women navigate patriarchal environments to yield the best possible maternal health outcomes.

Negotiating authority

Decision-making in maternal healthcare is an important point of departure as it situates women and men in the reality of their interdependence through social relationships and how this interdependence impacts maternal health goals. Responses from participants indicate that decision-making authority was predicated on gender roles and norms. Gender incorporates one's biological sex, sense of self and socially constructed characteristics and is highly influenced by roles, rights and obligations in a given society. A common theme was the evidence of a descriptive role of men and women at the household level. Descriptive in the sense that it highlights beliefs of what men and women should typically do even if those expectations are not carried out in reality. Evidently, men were considered the decision-makers at the household level. Participants opined that a woman's spouse should be the first to know of her pregnancy once confirmed.

"When a woman finds out she is pregnant, the first thing she does is to thank God, then she tells her husband." (Woman participant, Ewatto)

"Number one, she has to first give the report to her husband. She then goes to the nurses to confirm whether signs of pregnancy are true." (Man participant, Ewatto)

Upon receiving the confirmation of a pregnancy, men were deemed the decision-makers in seeking maternal healthcare. This position was verbalized even when there was evidence of joint decision-making between men and women. Men's views of their decision-making authority were tied to their role and duty as "fathers of the house", a role the men collectively took pride in and indicated their responsibility towards their spouses during pregnancy. A salient response was how it was "normal and common" for the man to perform his responsibilities as the father of the house.

'Because you cannot just go without the husband's decision. We as fathers of the house, it is our responsibility to ensure that everything takes place properly." (Man participant, Okpekpe)

"Normally, if you and your woman stay together, you are supposed to know each other's problems and share. So she is supposed to say my husband, I am not feeling well and he will say Ok, go and see the doctor." (Man participant, Okpekpe)

Similarly, women ascribed the role of decision-makers to men but would also narrate instances where they influenced the decision to seek medical care. For instance, it was not uncommon to hear participants say that after confirming their pregnancy and informing their spouses of the pregnancy, women tell their spouses to take them to the health facilities. The use of language to influence decisions on access to maternal healthcare can be thought of as a form of negotiation on the part of women. First, she recognizes the patriarchal environment and ascribes the decision-making authority to men but is also actively enacting her agency within that environment. Furthermore, men reported that their spouses would often make the sole decision on seeking skilled care in their absence. Several participants reported that their spouses were able to seek skilled care if they (the men) were absent from the home.

"In the aspect of care, I will tell my husband, so he will decide. After my husband knows, I will go to the hospital to tell the doctor so he can tell me what to do." (Woman participant, Okpekpe)

"Sometimes, your wife will tell you "take me to go and see nurse'. When I am not around, she can go see the doctor on her own. It is a normal thing in our community." (Man participant, Okpekpe)

It is noteworthy that regardless of who made the final decision, men and women in this study unanimously acknowledged the importance of seeking skilled maternal healthcare, particularly during obstetric complications. In one instance, a woman mentioned in order of importance, consulting a nurse first at the onset of an obstetric complication and secondly, consulting her mother. Men also stated that pregnant women needed to have frequent hospital visits to ensure

the baby's survival. This indicates that men and women were generally knowledgeable about the importance of seeking skilled care during pregnancy.

Collective responsibility for maternal health

African feminism conceives men and women as critical halves of the human whole, men are therefore seen as equally important in improving the lives of women. This section describes men's involvement in maternal health and shares men's opinions of the constructive role they play in maternal health. It is important to highlight, however, that men's role in maternal health is nuanced and can vary based on location and contexts. In this case, men displayed positive and collaborative roles in ensuring women's optimal health during pregnancy.

Men indicated their familial obligation to their pregnant spouses and their perceived roles as fathers. Salient themes around men's responsibilities were of financial, supportive and domestic responsibilities. Men's financial obligations during pregnancy included ensuring financial resources were available to cover the cost of maternal healthcare visits such as antenatal care, childbirth and other non-routine services. They admitted that fulfilling their financial obligations was sometimes a challenge but deemed it their responsibility, nonetheless. Another common theme pertaining to men's responsibilities was ensuring that women reached healthcare facilities. They coordinated transportation for women or accompanied them to healthcare facilities even when it was not convenient to do so. Some men noted they had to abandon other tasks and accompany their spouses. Additionally, they reported that they took on domestic responsibilities around the house during their spouse's pregnancy.

"As a father, as the head of the family, it is our own responsibility to ensure that our women get to the place [health facility] and return when it is time for childbirth. The woman has to go for scanning and the father has to be aware of the date and time so he can safeguard her transportation to and from. On the day of childbirth, he has to shoulder the responsibility of ensuring her transportation to the nearest health facility to have the baby. I have to be with her when labour starts. The husband is the head of the household and has those responsibilities." (Man participant, Okpekpe)

"The normal thing in this community is that he [the man] is supposed to give his woman good food, treat her well and take good care of her because of the baby. He should always make sure she takes her medication. Then he should pray that God will be with her before she delivers the baby. After the delivery, he will still continue to take care of her." (Man participant, Okpekep)

"Every week, I have to take her to attend clinic regularly, every Tuesday or so, I will make sure I give my wife money too." (Man participant, Ewatto)

Their notions of responsibility and collectivity are key to conversations about maternal health. It can be argued that in ascribing decision-making authority to men, women benefit from men's duty and responsibility to be providers. Evidently, women did not have the wherewithal to cover their maternal healthcare costs themselves. One woman affirmed the high cost of maternal healthcare services and the inability to pay for them on her own. This evokes the notion of "give and take" associated with negofeminism. This exchange, however, does not necessarily involve men relinquishing the power that patriarchy affords them such as power over financial resources or power over decision making. What negofeminism offers is a lens to view how women find ways to go around patriarchal contexts to ensure they have access to skilled care and remain healthy during pregnancy. It is important to note that this study did not explore women's economic vulnerabilities because previous studies by the authors in the same communities have already reported on the gender dynamics impacting women's economic power (Yaya, et al., 2019).

Maneuvering control

Findings revealed women's agency in accessing and using maternal health services offered in their communities unbeknownst to their men spouses. During focus group discussions with men in one of the Okpepe communities, men had reportedly never heard about services offered for maternal care. However, group discussions with women from the same community confirmed that not only were women aware of these services, they were also using them. Men reasoned that their spouses were uncomfortable telling them about maternal healthcare services or they felt that the men would not be interested in knowing about them.

"Like sometimes women will attend some of those programs, maybe, some of them may feel reluctant to tell their husbands. My wife didn't tell me anything about it. Maybe my wife received it, but you know sometimes everything that women do may not be what men do." (Man participant, Okpekpe)

While it is not clear the context within which women decided to withhold information from their spouses, women can be argued to have displayed their agency in taking the necessary precautions to safeguard their health during pregnancy. Furthermore, some women indicated that they were solely responsible for deciding when and where to seek maternal healthcare.
"I am the one with the pregnancy, so I am the one to decide to go to the hospital, but then I will tell my husband." (Woman participant, Ewatto)

6.6 Discussion

This paper examined maternal healthcare seeking and wellness in a rural Nigerian context by exploring how negofeminism is deployed in maternal healthcare seeking. By using a theory that is closest aligned with the realities of participants, the negofeminist position centres the African woman's stories and histories and highlights ways in which she negotiates with and subverts patriarchy. Findings show how women navigate patriarchal environments through negotiation, collaboration and maneuvering to yield the best possible maternal health outcomes.

Negofeminism posits that each gender (along the male/female binary) constitutes the critical half that makes the human whole. Furthermore, a common notion in Southern Nigeria where this study is located, is that the maintenance of harmonious gender relationships between men and women is critical to everyone's well-being (Nnaemeka, 2004; Nzegwu, 1995). For instance, women have been shown to collectively hold men responsible for injustices that impacted their lives thus indicating a recognition of the role of men in ensuring women's well-being. Findings indicate that women ascribed the role of decision-maker to their spouses in recognition of men's role and responsibility in ensuring maternal wellbeing. Women described their spouses as the decision-makers even in instances of joint decision-making. Implications of this finding highlight the importance of broadening the focus on women's sole decision-making autonomy and examining the role of joint decision-making in enhancing access to skilled maternal care. Studies

across different African contexts have reported on women's sole decision-making as a proxy for their autonomy or power with the argument that women lack autonomy if they cite their male partners as decision-makers in maternal healthcare (Ganle et al., 2015; P. Osamor & Grady, 2018). However, the focus on sole decision-making can obscure other ways in which women participate and determine their own fate.

Similar to findings from the current study, a Nigeria-based study makes a case for joint decision making as an acceptable autonomous process when it represents women's values and preferences in certain societies. The study affirms that couples' joint decision-making can hold benefits for maternal health outcomes more than decisions made by only women (P. E. Osamor & Grady, 2018). Other studies highlight men's role in maternal healthcare such as their financial and emotional support to navigate barriers related to seeking maternal healthcare. Decision-making with men across low and middle-income countries was shown to increase antenatal attendance, maternal nutrition, skilled birth attendance, and postpartum care (Tokhi et al., 2018).

In addition to drawing attention to men's role in maternal care, this study also explores and challenges the discursive legacies of Western values that can make their way into maternal health research and practice on a global scale (Potvin, 2018). African feminists interrogate the discursive legacy of colonialism manifested in practice by juxtaposing the terminology around 'culture' in a Western vs a non-Western context. Certain acts such as rape or spousal murder are described as 'culture' when they occur in a non-Western context whereas those acts are termed 'acts of violence' not culture when they occur in a Western context (Nnaemeka, 2004). These narratives reiterate the assumed superiority of western lifestyles and informs interventions that implicitly construct culture in a non-Western context as a barrier to maternal healthcare. This simplistic view of culture that excludes the knowledge and complex realities of intended recipients results in well-intentioned maternal health interventions going awry (Bhakuni & Abimbola, 2021; Nzegwu, 1995).

African feminism highlights the notion of culture in an African sense as a dynamic and evolving hybrid of new totalities from different historic and geographic contexts (Nnaemeka, 2004). It shows how women work with men to achieve set goals of maternal health and wellness.

Importantly, it highlights the importance of an engaged community to support maternal health. African feminists posit that in an African setting, individuals are motivated by community validation and will act in ways to earn or retain their community's validation (Nzegwu, 1995). In the current study, men's narratives of 'normal' and 'common' practices of expectant fathers in their communities is an ideal space to explore notions of rigid gender norms and roles. Men reported that they undertook domestic responsibilities such as cooking, washing clothes and child-rearing, to ensure a healthy pregnancy for their spouses. These activities were considered normal for expectant fathers in their communities. The deviation from rigid gender roles could be attributed to communities normalizing these responsibilities and cultural imperatives that prioritize maternal health and wellbeing at the community level which reinforces men's positive behaviour at the household level. In line with African feminists' definition of culture, findings from this study speak to gender norms as being malleable and not generalizable in an African context.

This argument is consistent with findings from a similar study in Sierra Leone that affirms men's high level of involvement in maternal health despite the dominant "absent male involvement" rhetoric in the global health literature. Expectant fathers were involved in gendered labour and caregiving activities (McLean, 2020). Men's involvement also extended to financial responsibility which is an important role in the context of underfunded health systems and lack of access to financial resources for women (Okonofua et al., 2011b; Yaya, Okonofua, Ntoimo, Udenigwe, et al., 2019). Another study, however, reported a contrary finding. Expectant fathers in Tanzania were less likely to undertake gendered labour but were heavily involved in facilitating their pregnant spouse's access to health facilities by supporting their partners financially and securing necessary items for labour and delivery (Maluka & Peneza, 2018). Similarly, findings from Northern Nigeria indicate that while expectant fathers were key decision-makers in maternal health and providers in a financial sense, they rarely deviated from strongly held traditional gender norms (Sharma et al., 2019).

Additionally, findings from this study revealed women's resistance to men's involvement in their pregnancy. Some men were not aware of their spouse's use of maternal services during pregnancy. Some women reported seeking maternal health care on their own terms. These

findings defy the positioning of women in an African context as "passive and oppressed". By maneuvering norms that would have conditioned care seeking on a man's authority, women are indicating their control over their lives and maternal healthcare decisions. This finding was corroborated by a similar study in Ghana where women resisted men's involvement in their pregnancy (Ganle, Dery, et al., 2016). Women stated that the presence of a man limited the care and interaction with their healthcare providers. Women also felt that handling their pregnancy on their own gave them a sense of pride, control and self-actualization. This finding also closely aligns with Nnaemeka (2004)'s stance that feminism is what African women do for *themselves* as well as for others. The emphasis is intentional as it highlights that feminism for African women is not always an altruistic act. African feminism does not appear to support the singular imagery of the selfless African woman but seemingly acknowledges the complexities of African women whose ideologies can go beyond that of negotiation and ways in which they consciously resist.

Strengths and limitations

The strength of this study lies in its use of open-ended qualitative research which allowed the emergence of key issues in maternal health. The use of African feminism as an interpretive tool provided insights into the communities' realities that have been diminished through the lens of dominant but not localized theories. The study draws on diverse perspectives and experiences of men and women as it allowed for an exploration of latent themes, for instance, women's influence over their healthcare even with gender expectations that hold sway in communities.

While this study offers important perspectives on maternal health, the reported findings should be interpreted in light of a number of limitations. The degree to which probing was employed as a technique by the research assistants may have influenced the responses generated by participants. However, it is noteworthy that the use of local research assistants who could converse in the local languages undoubtedly impacted the dynamics between participants and researchers and improved rapport. Another important limitation is that by design, participants were purposefully selected therefore does not represent the views and realities of all men and women in rural areas of Nigeria. The realities of men and women will differ across Nigeria's various geopolitical zones. The study aimed to get information from men and women who

participated in the parent study, therefore, perspectives of fathers and mothers who did not participate in the parent study are not included in this study. Finally, this study could have benefited from deeper integration of an Afrocentric paradigm whereby the use of Afrocentric theory/theories would have informed every stage of the research process including the development of research questions, methodological choices, data collection, data analysis and conclusion.

Policy recommendations and future research

The implications of this study are important for policy development. This study broadens the understanding of maternal healthcare beyond individual (women's) responsibility but extends that responsibility to the community and nation at large. The responsibilization of mothers in maternal healthcare has been noted as a strategy to improve maternal health in African countries (Potvin, 2018). Strongly associated with neoliberal ethics that privileges individual choice and personal responsibility, responsibilization refers to the process of rendering women responsible for their health outcomes without the necessary critique of the systems that constrain women (Mack, 2016; Wakefield & Fleming, 2009).

By situating maternal health as an outcome of individual behaviour and ignoring African women's sociopolitical realities, this narrative risks undermining interventions that aim to improve maternal health. Therefore, the current study can be useful in informing policy and programming that acknowledges women's social embeddedness with their communities.

Moreover, this study highlights the importance of involving men and women in the design and implementation of maternal health interventions in a way that accounts for their gendered roles and gender dynamics. Men's involvement in an African context should also be recognized and supported. Interventions aiming to involve men in maternal health could build on men's already existing constructive roles while providing opportunities to deepen their involvement. This will involve multisectoral strategies to address individual, structural and systemic barriers to men's involvement in maternal health (Tokhi et al., 2018). Joint decision-making as a strategy to improving maternal health was a common theme in this paper. This concept shows promise particularly in contexts where care-seeking reflects a communal nature of decision-making in communities. Efforts to encourage women's use of skilled maternal healthcare can move beyond

a focus on the individual (women) and increase community responsibility for maternal healthcare (Ganle et al., 2015). Furthermore, studies indicate that couple's joint decision-making for maternal healthcare is relatively under researched as there tends to be a focus on shared medical decision-making between patients and healthcare providers (P. E. Osamor & Grady, 2018). There is a need for more research to expand understanding on joint decision-making and evaluate the presence of power imbalances that could impact couple's joint decision-making.

This study can also inform community engagement strategies through its emphasis on shared responsibility and accountability among community members. Interventions should be developed with and led by community members to ensure their acceptability and longevity (Sekhon et al., 2017). Our study captures the perspectives of men who align with their communities' normative expectations during their spouse's pregnancy. Future research can explore the community's responses to men who do not fulfil their spousal and paternal obligations related to maternal health. Future research can explore how negofeminism in African contexts overturns male dominance in other aspects of women's health.

6.7 Conclusion

This paper makes an important contribution in presenting women's influence and resistance by using negofeminism as a theoretical lens to explore maternal health in a rural Nigerian context. The authors acknowledge the complexities of theorizing maternal health including care-seeking and maternal wellness in a cross-cultural context and therefore highlight the importance of interrogating the source of the theory and its positionality through which a social, intellectual and political stance on maternal health is legitimized. Through conversations with men and women, this paper examines how discourses underlying negofeminism are tied to seeking maternal care and maternal health in general. Findings describe ways in which women were able to negotiate authority by ascribing the role of decision-maker to their men spouses while influencing their maternal healthcare decisions. Findings also reify negofeminism's concepts of alliance, community and connectedness by highlighting men's involvement in maternal health. Furthermore, women's resistance to men's involvement in their pregnancy was evidenced thereby challenging assumptions of rural women as passive and oppressed. The importance of

incorporating inclusive approaches to involve women's communities and spouses in maternal health programs cannot be overemphasized.

Despite advances in maternal health, there is much to understand regarding women's health in African contexts. An African feminist approach deepens understanding of processes women navigate and how women are impacted. This approach allows for exploring women's lives beyond pregnancy or childbirth and can also be used to understand women's health throughout the life course. Highlighting women's experiences through African feminism moves away from notions of deficit in women's agency towards a recognition of the structural and institutional influences that can improve maternal health.

Author's contributions*:* OU conceptualized the study, coded and analyzed the data, and prepared the manuscript with input from SY. FO and LN coordinated and directed the data collection phase in Nigeria. All authors read and approved the final manuscript.

Acknowledgements*:* OU acknowledges the support from the Social Sciences and Humanities Research Council of Canada (SSHRC) through the Joseph-Armand Bombardier Graduate Scholarship for her doctoral studies.

Ethical approval*:* A certificate of ethical approval was obtained from the University of Ottawa's Research Ethics Board- file number S-02-21-6573, and from the National Health Research Ethics Committee (NHREC) -file number NHREC/01/01/2007–18/04/2017. Handwritten informed consent was obtained from all participants prior to participation.

Chapter 7. Conclusion

7.1 Summary of research findings

This thesis examines the impact and implications of digital health interventions for maternal health in sub-Saharan Africa. Focusing on rural communities in Edo State, Nigeria, this thesis applied a gender lens and the theory of acceptability to understand enablers and barriers to the use of mHealth and African feminism to understand maternal healthcare seeking and wellness.

The first paper illustrates exclusionary practices of digital health programs through an extensive literature review of digital maternal health programs across sub-Saharan Africa. Taking an intersectional approach, the paper discusses how women are excluded at the intersection of gender, literacy, and disability. Tackling exclusionary practices in digital health is crucial to ensure that no one is left behind. The second paper synthesizes evidence of transformative gender integration in mHealth for maternal health in sub-Saharan Africa. The study highlights gender transformative approaches in mHealth studies in line with the WHO's definition of a gender transformative health programs. Findings explicitly acknowledged how power dynamics, values and norms impact maternal health and the need for mHealth studies to address these factors throughout the course of a mHealth program.

The third paper examined the gender implications of women's use of mHealth technologies. Specifically, this study focused on Text4Life, a mHealth program aimed at improving women's access to skilled pregnancy care in rural Edo, Nigeria. This paper explores women's access to resources to participate in the mHealth program including mobile phone ownership and financial resources. The findings describe markers of social inequality that were either amplified or redressed by the mHealth program and discussed the impact of Text4Life on gender relationships in the community. Overall, it was observed that while mHealth programs are helpful to women in many ways, they are not enough on their own to undo entrenched systems of power through which men control women's access to resources, women's reproductive lives, and social lives. The fourth paper applied the theory of acceptability to investigate the enablers and barriers to the acceptance of the Text4Life program. Findings from the study showed that participants' attitudes towards the intervention, the involvement of the community, participants' understanding of the

intervention, and perceived effectiveness of the Text4Life program were enablers to women's acceptance of Text4Life and enablers to WDC chairpersons' assistance with the program. On the other hand, limited resources and a clash with the community's value system presented barriers to the acceptability of the Text4Life program. The fifth study paper uses African feminism as a theoretical lens to explore maternal healthcare decision-making and wellness in rural Nigeria. Through conversations with men and women, this paper examines how discourses underlying Negofeminism are tied to maternal health. Findings demonstrated how women were negotiating authority and maneuvering control in patriarchal environments to yield the best possible maternal health outcomes.

The findings from this thesis indicate that digital health has been incorporated across the pregnancy care continuum in efforts to address social determinants of health, improve the quality of care and ensure positive maternal health outcomes, however, to achieve meaningful impact, gender and digital inclusion must remain a priority in developing, implementing, and evaluating digital health programs. This will enable a more seamless integration of digital health innovations in health systems across sub-Saharan Africa and make healthcare more accessible and effective. Issues arising from gender inequality cuts across all five chapters of this thesis. Digital health programs are ultimately intended to improve health outcomes, but as findings show, they are inadvertently exacerbating inequality in access to healthcare services in sub-Saharan Africa. Designing digital health programs through an intersectional lens amplifies the needs of often neglected and excluded women such as women with limited literacy skills or women with disabilities. Furthermore, the gender digital divide which is furthered by gender power relations (i.e. access to resources, and social norms on women's use of digital health) is an important consideration in digital health programs in sub-Saharan Africa. Gender transformative approaches in digital health programs are advancing women's access to health services and are even more impactful when the approaches are multisectoral in nature. Acceptability of digital health is influenced by social representations and interactions in which gender plays a key role. Digital health programs that clash with people's value systems including religious and cultural values are less likely to be accepted. It is critical that such issues are understood and addressed early in the digital health program to avoid unintended consequences of mHealth such as gender-based violence. Men's involvement in maternal health can inspire positive changes but if

prevailing notions of gender and masculinity are not well understood, approaches to men's involvement can further entrench unequal gender norms and attitudes.

7.2 Future research

At the core of all the studies was the need to understand and redress overarching factors contributing to ill health and exacerbating health inequities in maternal health through gender transformative approaches. However, potentially unintended consequences, side effects, and negative effects of these approaches can occur, but they are rarely discussed. Future research can investigate the unintended and unanticipated of enacting gender transformative approaches including familial tension because of changes in gender dynamics in relationships. More broadly, future research can investigate similar consequences (for people, relationships, and health organisations) on the use of digital health technologies particularly in primary care for pregnant women. This knowledge will inform future digital health implementation.

This thesis showed that through the Text4Life program, pregnant women were successfully transported to primary health care centres during obstetric emergencies or when in labour. Women were also able to communicate with their healthcare providers. Future research can build on this model of digital health program and establish technology-based approaches for addressing other public health issues such as gender-based violence in under-privileged rural communities. The prevalence of gender based violence in sub Saharan countries such as Nigeria is particularly high, especially in under-served, illiterate, and hard-to-reach rural communities (National population commission Nigeria, 2019). This is also strongly linked with poor sexual and reproductive health outcomes. A major challenge to addressing gender-based violence has been the low rate of reporting of cases to formal sources such as the police or the health systems. Victims are often deterred by social and structural barriers such as the fear of retribution or stigma. Therefore, it continues to be a persisting and unresolved sexual and reproductive health challenge in the country. Future work in digital health and sexual and reproductive health can focus on opportunities for comprehensive and integrated programs to address gender-based violence especially for pregnant women. For instance, digital health can enable alternative means of reporting gender-based violence cases and providing prompt intervention from health care centers. It must be noted that studying vulnerable populations such as victims of gender-based

violence comes with a responsibility to ensure their safety and eliminate the risk of breached privacy on digital health programs.

Furthermore, addressing power imbalances that influence negative aspects of digital health in a sub-Saharan Africa context could be studied from a broader scope. Structural approaches to addressing challenges brought about by digital health are more likely to improve service quality substantially and at scale than are micro-level efforts. For instance, structural reforms have addressed the issue of well intended digital health projects operating in silos but not making lasting impact (Labrique et al., 2018). The ministry of health in Uganda issued a moratorium on digital health intervention that enabled a more seamless integration of digital health programs into the health system, avoided duplication and redundancy of programs and reduced the burden of participation on both end users and healthcare workers. Such practical scenarios could provide insights into best practices for approaches that seek to address issues around gender inequality in digital health such as involving more women in the design of digital health solutions.

7.3 Strengths and limitations

This thesis illuminated the needs of those with the greatest barriers to health technologies thereby contributing to the discussion on digital health social justice with overarching themes on how to achieve equitable opportunities for all women and girls to access, use and benefit from digital health. A significant limitation to the literature and systematic review sections of this thesis is the language restriction. Due to my and my co-author's language limitations, we were only able to include studies written in English language. Implications of this limitation is particularly relevant to the geographic study location, sub-Saharan Africa. This region is linguistically diverse. African scholars acknowledge that any discourse on sub-Saharan Africa overlooking language would be incomplete (Ndhlovu, 2014). By excluding non-English platforms and studies, this work creates a gap in the literature towards addressing digital health inequity for maternal health on a larger scale. The rest of the review was conducted rigorously by following the recommended procedures for identifying, critically appraising, synthesizing and presenting results of studies.

Furthermore, this thesis would have benefited from having an unambiguous commitment to the use of Afrocentric methodology to explore women's interactions with digital health programs. This thesis did not fully integrate an Afrocentric paradigm whereby Afrocentric theory/theories would have informed every stage of the research process including the development of research questions, methodological choices, data collection, data analysis and conclusion. This thesis could have benefited from deeper considerations of how knowledge is constructed and used. For instance, the use of participatory approaches or the application of introspection and retrospection methodological techniques which addresses obstacles to implementing Afrocentric methods and interpreting data fairly. This limit not withstanding, some aspects of the thesis embodied principles of Afrocentrism such as a commitment to grounding the research in the experiences of women and their communities and interpreting some of the data through theories embedded in African feminism. The use of African feminism as an interpretive tool provided insights into the communities' realities that would have been diminished through the lens of dominant but not localized theories.

References

Abajobir, A., de Groot, R., Wainaina, C., Njeri, A., Maina, D., Njoki, S., Mbaya, N., Donfouet, H. P. P., Pradhan, M., Janssens, W., & Sidze, E. M. (2021). The impact of i-PUSH on maternal and child health care utilization, health outcomes, and financial protection: study protocol for a cluster randomized controlled trial based on financial and health diaries data. *Trials*, *22*(1), 1–13. https://doi.org/10.1186/s13063-021-05598-7

Abimbola, S. (2019). The foreign gaze: Authorship in academic global health. *BMJ Global Health*, *4*(5), 1–5. https://doi.org/10.1136/bmjgh-2019-002068

Abimbola, S., Molemodile, S. K., Okonkwo, O. A., Negin, J., Jan, S., & Martiniuk, A. L. (2016). "The government cannot do it all alone": Realist analysis of the minutes of community health committee meetings in Nigeria. *Health Policy and Planning*, *31*(3), 332–345. https://doi.org/10.1093/heapol/czv066

Abramsky, T., Devries, K., Kiss, L., Nakuti, J., Kyegombe, N., Starmann, E., Cundill, B., Francisco, L., Kaye, D., Musuya, T., Michau, L., & Watts, C. (2014). Findings from the SASA! Study: A cluster randomized controlled trial to assess the impact of a community mobilization intervention to prevent violence against women and reduce HIV risk in Kampala, Uganda. *BMC Medicine*, *12*(1), 15–17. https://doi.org/10.1186/s12916-014-0122-5

Abubakar, I., Dalglish, S. L., Angell, B., Sanuade, O., Abimbola, S., Adamu, A. L., Adetifa, I. M. O., Colbourn, T., Ogunlesi, A. O., Onwujekwe, O., Owoaje, E. T., Okeke, I. N., Adeyemo, A., Aliyu, G., Aliyu, M. H., Aliyu, S. H., Ameh, E. A., Archibong, B., Ezeh, A., … Zanna, F. H. (2022). The Lancet Nigeria Commission: investing in health and the future of the nation. *The Lancet*, *399*(10330), 1155–1200. https://doi.org/10.1016/S0140-6736(21)02488-0

Adam, M., Tomlinson, M., Le Roux, I., Lefevre, A. E., McMahon, S. A., Johnston, J., Kirton, A., Mbewu, N., Strydom, S. L., Prober, C., & Bärnighausen, T. (2019). The Philani MOVIE study: A cluster-randomized controlled trial of a mobile video entertainment-education intervention to promote exclusive breastfeeding in South Africa. *BMC Health Services Research*, *19*(1), 1–14. https://doi.org/10.1186/s12913-019-4000-x

Addotey-Delove, M., Scott, R. E., & Mars, M. (2020). Review of patients' perspectives of m-health adoption factors in the developing world. Development of a proposed conceptual

framework. *Informatics in Medicine Unlocked*, *21*, 100460. https://doi.org/10.1016/j.imu.2020.100460

Adebara, O., Adebara, I., Olaide, R., Emmanuel, G., & Olanrewaju, O. (2017). Knowledge, Attitude and Willingness to Use mHealth Technology among Doctors at a Semi Urban Tertiary Hospital in Nigeria. *Journal of Advances in Medicine and Medical Research*, *22*(8), 1–10. https://doi.org/10.9734/jammr/2017/33232

Adjiwanou, V., & LeGrand, T. (2014). Gender inequality and the use of maternal healthcare services in rural sub-Saharan Africa. *Health and Place*, *29*, 67–78. https://doi.org/10.1016/j.healthplace.2014.06.001

Ag Ahmed, M. A., Gagnon, M.-P., Hamelin-Brabant, L., Mbemba, G. I. C., & Alami, H. (2017). A mixed methods systematic review of success factors of mhealth and telehealth for maternal health in Sub-Saharan Africa. *MHealth*, *3*(1), 22–22. https://doi.org/10.21037/mhealth.2017.05.04

Ahumuza, S. E., Matovu, J. K. B., Ddamulira, J. B., & Muhanguzi, F. K. (2014). Challenges in accessing sexual and reproductive health services by people with physical disabilities in Kampala, Uganda. *Reproductive Health*, *11*(1), 1–9. https://doi.org/10.1186/1742-4755-11-59

Ajaegbu, O. O. (2013). Perceived Challenges of Using Maternal Healthcare Services in Nigeria. *Arts and Social Sciences Journal*, *ASSJ-65*, 1–8.

Akeju, D., Okusanya, B., Okunade, K., Ajepe, A., Allsop, M. J., & Ebenso, B. (2022). Sustainability of the Effects and Impacts of Using Digital Technology to Extend Maternal Health Services to Rural and Hard-to-Reach Populations: Experience From Southwest Nigeria. *Frontiers in Global Women's Health*, *3*(February), 1–13. https://doi.org/10.3389/fgwh.2022.696529

Akin-Aina, S. (2011). Beyond an Epistemology of Bread, Butter, Culture and Power: Mapping the African Feminist Movement. *Nokoko Institute of African Studies*, *Fall 2011*(2), 65–89.

Allen, A. (2005). Stanford Encyclopedia of Philosophy Feminist Perspectives on Sex and Gender. *Stanford Encyclopedia of Philosophy*, 1–23.

Alozie, N. O., & Akpan-Obong, P. (2017). The Digital Gender Divide: Confronting Obstacles to Women's Development in Africa. *Development Policy Review*, *35*(2), 137–160. https://doi.org/10.1111/dpr.12204

Amoakoh-Coleman, M., Borgstein, A. B. J., Sondaal, S. F. V., Grobbee, D. E., Miltenburg, A. S., Verwijs, M., Ansah, E. K., Browne, J. L., & Klipstein-Grobusch, K. (2016). Effectiveness of mHealth interventions targeting health care workers to improve pregnancy outcomes in low- and middle-income countries: A systematic review. *Journal of Medical Internet Research*, *18*(8). https://doi.org/10.2196/jmir.5533

Ampt, F H, Lim, M. S. C., Agius, P. A., L'Engle, K., Manguro, G., Gichuki, C., Gichangi, P., Chersich, M. F., Jaoko, W., Temmerman, M., Stoové, M., Hellard, M., & Luchters, S. (2020). Effect of a mobile phone intervention for female sex workers on unintended pregnancy in Kenya (WHISPER or SHOUT): a cluster-randomised controlled trial. *Lancet Global Health*, *8*(12 PG-1534–1545), e1534–e1545. https://doi.org/10.1016/S2214-109X(20)30389-2

Ampt, Frances H., Lim, M. S. C., Agius, P. A., L'Engle, K., Manguro, G., Gichuki, C., Gichangi, P., Chersich, M. F., Jaoko, W., Temmerman, M., Stoové, M., Hellard, M., & Luchters, S. (2020). Effect of a mobile phone intervention for female sex workers on unintended pregnancy in Kenya (WHISPER or SHOUT): a cluster-randomised controlled trial. *The Lancet Global Health*, *8*(12), e1534–e1545. https://doi.org/10.1016/S2214-109X(20)30389-2

Amzat, J. (2015). The Question of Autonomy in Maternal Health in Africa: A Rights-Based Consideration. *Journal of Bioethical Inquiry*, *12*(2), 283–293. https://doi.org/10.1007/s11673-015-9607-y

Aregbeshola, B. S., & Khan, S. M. (2017). primary Health Care in nigeria: 24 Years after Olikoye Ransome-Kuti's Leadership. *Frontiers in Public Health*, *5*(48), 127–131. https://doi.org/doi: 10.3389/fpubh.2017.00048 primary

Aremu, O., Lawoko, S., & Dalal, K. (2011). Neighborhood socioeconomic disadvantage, individual wealth status and patterns of delivery care utilization in Nigeria: A multilevel discrete choice analysis. *International Journal of Women's Health*, *3*(1), 167–174. https://doi.org/10.2147/IJWH.S21783

Arnaert, A., Ponzoni, N., Debe, Z., Meda, M. M., Nana, N. G., & Arnaert, S. (2019). Experiences of women receiving mhealth-supported antenatal care in the village from community health workers in rural Burkina Faso, Africa. *Digital Health*, *5*, 1–8. https://doi.org/10.1177/2055207619892756

Aubel, J. (2021). Grandmothers - A neglected family resource for saving newborn lives. *BMJ Global Health*, *6*(2), 1–9. https://doi.org/10.1136/bmjgh-2020-003808

Balogun, M., Banke-Thomas, A., Sekoni, A., Boateng, G. O., Yesufu, V., Wright, O., Ubani, O., Abayomi, A., Afolabi, B. B., & Ogunsola, F. (2021). Challenges in access and satisfaction with reproductive, maternal, newborn and child health services in Nigeria during the COVID-19 pandemic: A cross-sectional survey. *PLoS ONE*, *16*(May), 1–15. https://doi.org/10.1371/journal.pone.0251382

Bamgbose, A. (2011). African Languages Today: The Challenge of and Prospects for Empowerment under Globalization. *In Selected Proceedings of the 40th Annual Conference on African Linguistics*, 1–14. http://www.lingref.com/cpp/acal/40/paper2561.pdf

Beauchamp, T. L., & Childress, J. F. (1994). *Principles of Biomedical Ethics* (Fourth Edi).

Beaujoin, C., Bila, A., Bicaba, F., Plouffe, V., Bicaba, A., & Druetz, T. (2021). Women's decision-making power in a context of free reproductive healthcare and family planning in rural Burkina Faso. *BMC Women's Health*, *21*(1), 1–11. https://doi.org/10.1186/s12905-021-01411-4

Bhakuni, H., & Abimbola, S. (2021). Epistemic injustice in academic global health. *The Lancet Global Health*, *21*, 1–6. https://doi.org/10.1016/s2214-109x(21)00301-6

Birkmeyer, S., Wirtz, B. W., & Langer, P. F. (2021). Determinants of mHealth success: An empirical investigation of the user perspective. *International Journal of Information Management*, *59*(March), 102351. https://doi.org/10.1016/j.ijinfomgt.2021.102351

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Chaitali Sinha, R. H. (2013). ICTs AND SOCIAL INCLUSION. In B. P. Laurent Elder, Heloise Emdon, Richard Fuchs (Ed.), *Connecting ICTs to development: The IDRC experience* (1st ed., pp. 91–116). © 2013 International Development Research Centre. https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/52228/IDL-52228.pdf#page=170

Chen, H., Chai, Y., Dong, L., Niu, W., & Zhang, P. (2018). Effectiveness and appropriateness of mhealth interventions for maternal and child health: Systematic review. *JMIR MHealth and UHealth*, *6*(1), 1–19. https://doi.org/10.2196/mhealth.8998

Cheruto, S. K. (2020). *How the healthcare-seeking socio-cultural context shapes maternal health clients' mhealth utilisation in a Kenyan context*. University of Cape Town.

Chib, A., Wilkin, H., & Hoefman, B. (2013). *Vulnerabilities in mHealth implementation: a Ugandan HIV/AIDS SMS campaign* (pp. 26–32).

Chib, A., Wilkin, H., Ling, L. X., Hoefman, B., & Van Biejma, H. (2012). You have an important message! Evaluating the effectiveness of a text message HIV/AIDS campaign in Northwest Uganda. *Journal of Health Communication*, *17*(SUPPL. 1), 146–157. https://doi.org/10.1080/10810730.2011.649104

Clouse, K., Phillips, T. K., Noholoza, S., Mogoba, P., Myer, L., Camlin, C., Naidoo, J., Langford, R., Weiss, M., & Seebregts, C. J. (2020). CareConekta: Study protocol for a randomized controlled trial of a mobile health intervention to improve engagement in postpartum HIV care in South Africa. *Trials*, *21*(1 PG-258), 258. https://doi.org/http://dx.doi.org/10.1186/s13063-020-4190-x

Coleman, J., Bohlin, K. C., Thorson, A., Black, V., Mechael, P., Mangxaba, J., & Eriksen, J. (2017). Effectiveness of an SMS-based maternal mHealth intervention to improve clinical outcomes of HIV-positive pregnant women. *AIDS Care - Psychological and Socio-Medical Aspects of AIDS/HIV*, *29*(7), 890–897. https://doi.org/10.1080/09540121.2017.1280126

Corbin Dwyer, S., & Buckle, J. L. (2018). Reflection/Commentary on a Past Article: "The Space Between: On Being an Insider-Outsider in Qualitative Research": http://journals.sagepub.com/doi/full/10.1177/160940690900800105. *International Journal of Qualitative Methods*, *17*(1), 54–63. https://doi.org/10.1177/1609406918788176

Corker, J. (2010). " Ligne Verte " Toll-Free Hotline : Using Cell Phones to Increase Access to Family Planning Information in the Democratic Republic of Congo Peer-Reviewed Case Study. *Public Health Communication & Marketing*, *IV*, 23–37.

Covidence. (2022). *Covidence systematic review software*. Covidence Systematic Review Software, Veritas Health Innovation, Melbourne, Australia. www.covidence.org

Crenshaw, Kimberlé. (1989). Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *University of Chicago Legal Forum*, *1*(8), 465–487. https://doi.org/10.3917/drs1.108.0465

Crenshaw, Kimberle, Stanford, S., Review, L., & Jul, N. (2016). Mapping the Margins : Intersectionality , Identity Politics , and Violence against Women of Color. *Stanford Law Review*, *43*(6), 1241–1299. https://www.scopus.com/record/display.uri?eid=2-s2.0-84926443235&origin=inward&txGid=FE9082C8BF76CA5D0B9B1AAD235670AA.wsnA

w8kcdt7IPYLO0V48gA:1

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems*, *13*(3), 319–339. https://doi.org/10.2307/249008

Day, S., Mason, R., Tannenbaum, C., & Rochon, P. A. (2017). Essential metrics for assessing sex & gender integration in health research proposals involving human participants. *PLoS ONE*, *12*(8), 1–13. https://doi.org/10.1371/journal.pone.0182812

De Vet, H. C. W., De Bie, R. A., Van Der Heijden, G. J. M. G., Verhagen, A. P., Sijpkes, P., & Knipschild, P. G. (1997). Systematic reviews on the basis of methodological criteria. *Physiotherapy*, *83*(6), 284–289. https://doi.org/10.1016/S0031-9406(05)66175-5

Deshmukh, Madhu & Mechael, P. (2013). Addressing Gender and Women's Empowerment In mHealth for MNCH An Analytical Framework. In *mHealtH alliance, Un FoUndation* (Issue March).

Dev, R., Woods, N. F., Unger, J. A., Kinuthia, J., Matemo, D., Farid, S., Begnel, E. R., Kohler, P., & Drake, A. L. (2019). Acceptability, feasibility and utility of a Mobile health family planning decision aid for postpartum women in Kenya. *Reproductive Health*, *16*(97), 1–11. https://doi.org/https://doi.org/10.1186/s12978-019-0767-9

Dillip, A., Alba, S., Mshana, C., Hetzel, M. W., Lengeler, C., Mayumana, I., Schulze, A., Mshinda, H., Weiss, M. G., & Obrist, B. (2012). Acceptability - A neglected dimension of access to health care: Findings from a study on childhood convulsions in rural Tanzania. *BMC Health Services Research*, *12*(1). https://doi.org/10.1186/1472-6963-12-113

Donchin, A. (2004). *Converging Concerns: Feminist Bioethics, Development Theory, and Human Rights*. *29*(2).

Doyle, K., Levtov, R., Barker, G., Bastian, GG Bingenheimer, JB Kazimbaya, S., Nzabonimpa, A., Pulerwitz, J., Sayinzoga, F., Sharma, V., & Shattuck, D. (2018). Gender-transformative Bandebereho couples' intervention to promote male engagement in reproductive and maternal health and violence prevention in Rwanda: Findings from a randomized controlled trial. *PLoS ONE*, *13*(4). https://doi.org/10.1371/journal.pone.0192756

E.Abel, E., & Obeten, E. (2015). Funding E-Health in Nigeria by NGOS/Multinational Organization: Overview and Perspectives. *International Journal of Computer Applications*, *111*(11), 37–41. https://doi.org/10.5120/19586-1346

Ebenso, B., Okusanya, B., Okunade, K., Akeju, D., Ajepe, A., Akaba, G. O., Yalma, R. M., Dirisu, O., Tukur, J., Abdullahi, M. K., Okuzu, O., & Allsop, M. J. (2021). What Are the Contextual Enablers and Impacts of Using Digital Technology to Extend Maternal and Child Health Services to Rural Areas? Findings of a Qualitative Study From Nigeria. *Frontiers in Global Women's Health*, *2*(May), 1–16. https://doi.org/10.3389/fgwh.2021.670494

Edo State Government. (2019). *The people of Edo state*. About Edo State. http://www.edostate.gov.ng/about-edo-2/#

Ells, C., Hunt, M. R., & Chambers-Evans, J. (2011). Relational autonomy as an essential component of patient-centered care. *IJFAB: International Journal of Feminist Approaches to Bioethics*, *4*(2), 79–101. https://doi.org/10.3138/ijfab.4.2.79

Ezenwa-Ohaeto, N. (2019). Reflections on Akachi Adimora-Ezeigbo's 'Snail-Sense Feminism': A humanist perspective. *Preorcjah*, *4*(2), 1–11.

Fàbregues, S., & Molina-Azorín, J. F. (2017). Addressing quality in mixed methods research: a review and recommendations for a future agenda. *Quality and Quantity*, *51*(6), 2847–2863. https://doi.org/10.1007/s11135-016-0449-4

Fantaye, A. W., Okonofua, F., Ntoimo, L., & Yaya, S. (2019). A qualitative study of community elders' perceptions about the underutilization of formal maternal care and maternal death in rural Nigeria. *Reproductive Health*, *16*(164), 1–17. https://doi.org/10.1186/s12978-019-0831-5

Faust, L., Yaya, S., & Ekholuenetale, M. (2017). Wealth inequality as a predictor of HIV-related knowledge in Nigeria. *BMJ Global Health*, *2*(4), e000461. https://doi.org/10.1136/bmjgh-2017-000461

Federal Ministry of Health. (2017). *Digital health landscape Nigeria: An inventory of digital health solutions*.

Federal Ministry of Health Nigeria. (2016). *National Health ICT Strategic Framework*. https://www.health.gov.ng/doc/HealthICTStrategicFramework.pdf

Fee, E. (1982). A Feminist Critique of Scientific Objectivity. *Science for the People Magazine 14, 4*, 5-8,30-32. https://magazine.scienceforthepeople.org/archives-a-feminist-critique-of-scientific-objectivity/

Figueroa, C. A., Luo, T., Aguilera, A., & Lyles, C. R. (2021). The need for feminist

intersectionality in digital health. *The Lancet Digital Health*, *3*(8), e526–e533. https://doi.org/10.1016/S2589-7500(21)00118-7

Filep, B. (2009). Interview and translation strategies: Coping with multilingual settings and data. *Social Geography*, *4*(1), 59–70. https://doi.org/10.5194/sg-4-59-2009

Fisher, J., & Makleff, S. (2022). Advances in Gender-Transformative Approaches to Health Promotion. *Annual Review of Public Health*, *43*, 1–17. https://doi.org/10.1146/annurev-publhealth-121019-053834

Flax, V. L., Ibrahim, A. U., Negerie, M., Yakubu, D., Leatherman, S., & Bentley, M. E. (2017). Group cell phones are feasible and acceptable for promoting optimal breastfeeding practices in a women's microcredit program in Nigeria. *Maternal and Child Nutrition*, *13*(1 PG-e12261), e12261. https://search.ebscohost.com/login.aspx?direct=true&db=lhh&AN=20173133406&site=ehost-live NS -

Flueckiger, R. M., Thierno, D. M., Colaço, R., Guilavogui, T., Bangoura, L., Reithinger, R., Fitch, E. R., Taton, J.-L., & Fofana, A. (2019a). Using short message service (SMS) to remind pregnant women of antenatal appointments in Guinea. *American Journal of Tropical Medicine and Hygiene*, *101*(4), 806–808. https://www.astmh.org/ASTMH/media/2017-Annual-Meeting/ASTMH-2017-Abstract-Book.pdf NS -

Flueckiger, R. M., Thierno, D. M., Colaço, R., Guilavogui, T., Bangoura, L., Reithinger, R., Fitch, E. R., Taton, J. L., & Fofana, A. (2019b). Using short message service alerts to increase antenatal care and malaria prevention: Findings from implementation research pilot in Guinea. *American Journal of Tropical Medicine and Hygiene*, *101*(4), 806–808. https://doi.org/10.4269/ajtmh.19-0202

Flynn-Dapaah, K., & Rashid, A. T. (2008). Gender digital equality in ICT interventions in health: Evidence from IDRC supported projects in developing countries. *Journal of Community Informatics*, *5*(3), 2019. http://ci-journal.net/index.php/ciej/article/view/526/512

Freedman, L. P., Waldman, R. J., de Pinho, H., Wirth, M. E., Chowdhury, a. M. R., & Rosenfield, A. (2005). *Who ' s got the power ? Transforming health systems for women and children Summary version*.

Frellsen, A. (2016). *Developing an App to Make Births Safer*. Improving Heath and Heathcare Worldwide; Institute for Healthcare Improvement.

https://www.ihi.org/communities/blogs/africa-developing-an-app-to-make-births-safer

Fusch, P. I., & Ness, L. R. (2015). *Are We There Yet ? Data Saturation in Qualitative Research Are We There Yet ? Data Saturation in Qualitative Research*. *20*(9), 1408–1416.

Ganle, J. K., Dery, I., Manu, A. A., & Obeng, B. (2016). 'If I go with him, I can't talk with other women': Understanding women's resistance to, and acceptance of, men's involvement in maternal and child healthcare in northern Ghana. *Social Science and Medicine*, *166*(December 2017), 195–204. https://doi.org/10.1016/j.socscimed.2016.08.030

Ganle, J. K., Obeng, B., Segbefia, A. Y., Mwinyuri, V., Yeboah, J. Y., & Baatiema, L. (2015). How intra-familial decision-making affects women's access to, and use of maternal healthcare services in Ghana: A qualitative study. *BMC Pregnancy and Childbirth*, *15*(1), 1–17. https://doi.org/10.1186/s12884-015-0590-4

Ganle, J. K., Otupiri, E., Obeng, B., Edusie, A. K., Ankomah, A., & Adanu, R. (2016). Challenges women with disability face in accessing and using maternal healthcare services in Ghana: A qualitative study. *PLoS ONE*, *11*(6), 1–13. https://doi.org/10.1371/journal.pone.0158361

Garcia-Basteiro, A. L., & Abimbola, S. (2021). The challenges of defining global health research. *BMJ Global Health*, *6*(12), 6–8. https://doi.org/10.1136/bmjgh-2021-008169

Gazmararian, J. A., Yang, B., Elon, L., Graham, M., & Parker, R. (2012). Successful enrollment in text4baby more likely with higher health literacy. *Journal of Health Communication*, *17*(SUPPL. 3), 303–311. https://doi.org/10.1080/10810730.2012.712618

George, A. S., Morgan, R., Larson, E., & LeFevre, A. (2018). Gender dynamics in digital health: overcoming blind spots and biases to seize opportunities and responsibilities for transformative health systems. *Journal of Public Health (Oxford, England)*, *40*(2), ii6–ii11. https://doi.org/10.1093/pubmed/fdy180

Gitobu, C. M., Gichangi, P. B., & Mwanda, W. O. (2018). The effect of Kenya's free maternal health care policy on the utilization of health facility delivery services and maternal and neonatal mortality in public health facilities. *BMC Pregnancy and Childbirth*, *18*(1), 1–11. https://doi.org/10.1186/s12884-018-1708-2

Gkiouleka, A., Huijts, T., Beckfield, J., & Bambra, C. (2018). Understanding the micro and macro politics of health: Inequalities, intersectionality & institutions - A research agenda. *Social Science and Medicine*, *200*(January), 92–98.

https://doi.org/10.1016/j.socscimed.2018.01.025

Government of Nigeria, M. of H. U. N. C. I. D. A. P. U. U. W. W. B. and M. A. F. (2009). *National Integrated Maternal, Newborn and Child Health Strategy*. https://www.unicef.org/nigeria/resources_8474.html

Green, D. (2016). *How Change Happens*. Oxford University Press.

GSMA. (2020a). *Reaching 50 Million Women with Mobile: A Practical Guide*. www.altaiconsulting.com

GSMA. (2020b). *The Digital Exclusion of Women with Disabilities* (Issue June).

GSMA. (2021). *GSMA Connected Women - The Mobile Gender Gap Report 2021*. www.gsmaintelligence.com

Guest, G., Namey, E., & McKenna, K. (2017). How Many Focus Groups Are Enough? Building an Evidence Base for Nonprobability Sample Sizes. *Field Methods*, *29*(1), 3–22. https://doi.org/10.1177/1525822X16639015

Gyuse, A. N., Ayuk, A. E., & Okeke, M. C. (2018). Facilitators and barriers to effective primary health care in Nigeria. *African Journal of Primary Health Care and Family Medicine*, *10*(1), 1–3. https://doi.org/10.4102/phcfm.v10i1.1641

Hackett, K. M., Kazemi, M., & Sellen, D. W. (2018). Social Science & Medicine Keeping secrets in the cloud : Mobile phones , data security and privacy within the context of pregnancy and childbirth in Tanzania. *Social Science & Medicine*, *211*(June), 190–197. https://doi.org/10.1016/j.socscimed.2018.06.014

Hafkin, N. (2002). *Gender Issues in ICT Policy in Developing Countries: An Overview* (EGM/ ICT/2002/EP.1). https://www.un.org/womenwatch/daw/egm/ict2002/reports/Paper-NHafkin.PDF

Haldane, V., De Foo, C., Abdalla, S. M., Jung, A. S., Tan, M., Wu, S., Chua, A., Verma, M., Shrestha, P., Singh, S., Perez, T., Tan, S. M., Bartos, M., Mabuchi, S., Bonk, M., McNab, C., Werner, G. K., Panjabi, R., Nordström, A., & Legido-Quigley, H. (2021). Health systems resilience in managing the COVID-19 pandemic: lessons from 28 countries. *Nature Medicine*, *27*(6), 964–980. https://doi.org/10.1038/s41591-021-01381-y

Hankivsky, O., & Christoffersen, A. (2008). *Intersectionality and the determinants of health : a Canadian perspective*. *18*(3), 271–283. https://doi.org/10.1080/09581590802294296

Harrington, E K, Drake, A. L., Matemo, D., Ronen, K., Osoti, A. O., John-Stewart, G., Kinuthia,

J., & Unger, J. A. (2019). An mHealth SMS intervention on postpartum contraceptive use among women and couples in Kenya: a randomized controlled trial. *American Journal of Public Health*, *109*(6 PG-934–941), 934–941. https://doi.org/10.2105/AJPH.2019.305051

Harrington, E K, McCoy, E. E., Drake, A. L., Matemo, D., John-Stewart, G., Kinuthia, J., & Unger, J. A. (2019). Engaging men in an mHealth approach to support postpartum family planning among couples in Kenya: a qualitative study. *Reproductive Health*, *16*(17 PG-(11-February 2019)), (11-February 2019). https://search.ebscohost.com/login.aspx?direct=true&db=lhh&AN=20193427227&site=ehost-live NS -

Harrington, Elizabeth K., McCoy, E. E., Drake, A. L., Matemo, D., John-Stewart, G., Kinuthia, J., & Unger, J. A. (2019). Engaging men in an mHealth approach to support postpartum family planning among couples in Kenya: A qualitative study. *Reproductive Health*, *16*(1), 1–11. https://doi.org/10.1186/s12978-019-0669-x

Harrison, K. a. (2009). The struggle to reduce high maternal mortality in Nigeria. *African Journal of Reproductive Health*, *13*(3), 9–20.

Hartigan, P., Gomez, E., de Schutter, M., & da Silva, J. (1997). *Workshop on gender, health, and development*. http://www.paho.org/english/hdwmuje.htm

Health Organization Regional Office for Europe, W. (2016). *FROM INNOVATION TO IMPLEMENTATION eHealth in the WHO European Region*. http://www.euro.who.int/en/ehealth

Heard, E., Fitzgerald, L., Wigginton, B., & Mutch, A. (2020). Applying intersectionality theory in health promotion research and practice. *Health Promotion International*, *35*(4), 866–876. https://doi.org/10.1093/heapro/daz080

Hernandez-Ramos, R., Aguilera, A., Garcia, F., Miramontes-Gomez, J., Pathak, L. E., Figueroa, C. A., & Lyles, C. R. (2021). Conducting internet-based visits for onboarding populations with limited digital literacy to an mhealth intervention: Development of a patient-centered approach. *JMIR Formative Research*, *5*(4). https://doi.org/10.2196/25299

Heymann, J., Levy, J. K., Bose, B., Ríos-Salas, V., Mekonen, Y., Swaminathan, H., Omidakhsh, N., Gadoth, A., Huh, K., Greene, M. E., Darmstadt, G. L., Greene, M. E., Hawkes, S., Heise, L., Henry, S., Klugman, J., Levine, R., Raj, A., & Rao Gupta, G. (2019). Improving health with programmatic, legal, and policy approaches to reduce gender inequality and

change restrictive gender norms. *The Lancet*, *393*(10190), 2522–2534. https://doi.org/10.1016/S0140-6736(19)30656-7

Hicks, J. P., Allsop, M. J., Akaba, G. O., Yalma, R. M., Dirisu, O., Okusanya, B., Tukur, J., Okunade, K., Akeju, D., Ajepe, A., Okuzu, O., & Mirzoev, T. (2021). Acceptability and Potential Effectiveness of eHealth Tools for Training Primary Health Workers from Nigeria at Scale: Mixed Methods, Uncontrolled Before-and-After Study. *JMIR MHealth and UHealth*, *9*(9), 1–27. https://doi.org/10.2196/24182

Highet, C., Singh, N., & Salman, A. (2021). *Can Free Phones Close the Digital Gender Divide?* CGAP. https://www.cgap.org/blog/can-free-phones-close-digital-gender-divide

Hong, Q. N., Pluye, P., Fabregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M., Griffiths, F., NICOLAU, B., O'CATHAIN, A., ROUSSEAUh, M., & VEDEL, I. (2018). *MIXED METHODS APPRAISAL TOOL (MMAT) VERSION 2018* (Patent No. Copyright (#1148552)). Canadian Intellectual Property Office.

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*(9), 1277–1288. https://doi.org/10.1177/1049732305276687

Ibeneme, S., Ukor, N., Ongom, M., Dasa, T., Muneene, D., & Okeibunor, J. (2020). Strengthening capacities among digital health leaders for the development and implementation of national digital health programs in Nigeria. *BMC Proceedings*, *14*(Suppl 10), 1–12. https://doi.org/10.1186/s12919-020-00193-1

IDRC. (2021). *Maternal and child health goes digital*. International Development Research Centre. https://www.idrc.ca/en/research-in-action/maternal-and-child-health-goes-digital

Interagency Gender Working Group. (2016). *Understanding and applying the gender equality continuum*.

Isler, J., Sawadogo, N. H., Harling, G., Bärnighausen, T., Adam, M., Sié, A., & McMahon, S. A. (2020). "If he sees it with his own eyes, he will understand": how gender informed the content and delivery of a maternal nutrition intervention in Burkina Faso. *Health Policy and Planning*, *35*(5 PG-536–545), 536–545. https://doi.org/10.1093/heapol/czaa012

Izugbara, C. O., & Wekesah, F. (2018). What does quality maternity care mean in a context of medical pluralism? Perspectives of women in Nigeria. *Health Policy and Planning*, *33*(1), 1–8. https://doi.org/10.1093/heapol/czx131

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), 1. https://doi.org/10.1186/1475-9276-12-85

Jennings, L., Omoni, A., Akerele, A., Ibrahim, Y., & Ekanem, E. (2015). Disparities in mobile phone access and maternal health service utilization in Nigeria: A population-based survey. *International Journal of Medical Informatics*, *84*(5), 341–348. https://doi.org/10.1016/j.ijmedinf.2015.01.016

Job, N., Kuhnert, K.-L., & Engelbrecht, L. (2021). Mobile health and narrative entertainmenteducation to promote exclusive breastfeeding in Western Cape, South Africa. *South African Journal of Clinical Nutrition*, *34*(3 PG-54), 54. https://doi.org/http://dx.doi.org/10.1080/16070658.2021.1968126

Jones, M., Deruyter, F., & Morris, J. (2020). The digital health revolution and people with disabilities: Perspective from the United States. *International Journal of Environmental Research and Public Health*, *17*(2). https://doi.org/10.3390/ijerph17020381

Kalenga, C. Z., Parsons Leigh, J., Griffith, J., Wolf, D. C., Dumanski, S. M., Desjarlais, A., Petermann, L., & Ahmed, S. B. (2020). Sex and gender considerations in health research: a trainee and allied research personnel perspective. *Humanities and Social Sciences Communications*, *7*(1), 1–7. https://doi.org/10.1057/s41599-020-00643-3

Kassebaum, N. J., Bertozzi-Villa, A., Coggeshall, M. S., Shackelford, K. A., Steiner, C., Heuton, K. R., Gonzalez-Medina, D., Barber, R., Huynh, C., Dicker, D., Templin, T., Wolock, T. M., Ozgoren, A. A., Abd-Allah, F., Abera, S. F., Abubakar, I., Achoki, T., Adelekan, A., Ademi, Z., … Lozano, R. (2014). Global, regional, and national levels and causes of maternal mortality during 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013. *The Lancet*, *384*(9947), 980–1004. https://doi.org/10.1016/S0140-6736(14)60696-6

Kola, L., Abiona, D., Adefolarin, A. O., & Ben-Zeev, D. (2021a). Mobile phone use and acceptability for the delivery of mental health information among perinatal adolescents in Nigeria: Survey study. *JMIR Mental Health*, *8*(1), 1–11. https://doi.org/10.2196/20314

Kola, L., Abiona, D., Adefolarin, A. O., & Ben-Zeev, D. (2021b). Mobile phone use and acceptability for the delivery of mental health information among perinatal adolescents in Nigeria: Survey study. *JMIR Mental Health*, *8*(1 PG-e20314), e20314.

https://doi.org/http://dx.doi.org/10.2196/20314

Kwabena, E., Id, A., Budu, E., Sambah, F., Baatiema, L., Appiah, F., Id, A. S., & Ahinkorah, B. O. (2019). Prevalence and determinants of unintended pregnancy in sub-Saharan Africa: A multi- country analysis of demographic and health surveys. *PLoS ONE*, *14*(8), 1–16.

Labrique, A. B., Wadhwani, C., Williams, K. A., Lamptey, P., Hesp, C., Luk, R., & Aerts, A. (2018). Best practices in scaling digital health in low and middle income countries. *Globalization and Health*, *14*, 103. https://doi.org/10.1186/s12992-018-0424-z

Lamont, K., Sliwa, K., Stewart, S., Carrington, M., Pretorius, S., Libhaber, E., Wiysonge, C. S., Adebayo, E. F., & Klipstein-Grobusch, K. (2016). Short message service (SMS) as an educational tool during pregnancy: A literature review. *Health Education Journal*, *75*(5), 540–552. https://doi.org/10.1177/0017896915607910

Larocca, A., Moro Visconti, R., & Marconi, M. (2016). Malaria diagnosis and mapping with m-Health and geographic information systems (GIS): evidence from Uganda. *Malaria Journal*. https://doi.org/10.1186/s12936-016-1546-5

Lee, S. H., Nurmatov, U. B., Nwaru, B. I., Mukherjee, M., Grant, L., & Pagliari, C. (2016). Effectiveness of mHealth interventions for maternal, newborn and child health in low- and middle-income countries: Systematic review and meta-analysis. *Journal of Global Health*, *6*(1). https://doi.org/10.7189/jogh.06.010401

LeFevre, A. E., Pillay, Y., Peter, J., Barron, P., & Benjamin, P. (2018). Taking digital health innovation to scale in South Africa: ten lessons from MomConnect. *BMJ Global Health*, *3*(Suppl 2), e000592. https://doi.org/10.1136/bmjgh-2017-000592

Linda, S., Ommeh, M., Manager, P., Fenenga, C. J., Hesp, C. J., Health, M., Nzorubara, D., Manager, S., & Health, M. (2019). Using mobile transport vouchers to improve access to skilled delivery. *Rural and Remote Health*, *19*(1), 4577. https://doi.org/https://doi.org/10.22605/RRH4577

Lund, S., Hemed, M., Nielsen, B. B., Said, A., Said, K., Makungu, M. H., & Rasch, V. (2012a). Mobile phones as a health communication tool to improve skilled attendance at delivery in Zanzibar: a cluster-randomised controlled trial. *BJOG: An International Journal of Obstetrics and Gynaecology*, *119*(10 PG-1256–1264), 1256–1264. https://doi.org/10.1111/j.1471-0528.2012.03413.x

Lund, S., Hemed, M., Nielsen, B. B., Said, A., Said, K., Makungu, M. H., & Rasch, V. (2012b).

Mobile phones as a health communication tool to improve skilled attendance at delivery in Zanzibar: A cluster-randomised controlled trial. *BJOG: An International Journal of Obstetrics and Gynaecology*, *119*(10), 1256–1264. https://doi.org/10.1111/j.1471-0528.2012.03413.x

Mabetha, K., De Wet-Billings, N. C., & Odimegwu, C. O. (2021). Healthcare beliefs and practices of kin caregivers in South Africa: implications for child survival. *BMC Health Services Research*, *21*(1), 1–12. https://doi.org/10.1186/s12913-021-06357-9

Mac-Seing, M., Zinszer, K., Eryong, B., Ajok, E., Ferlatte, O., & Zarowsky, C. (2020). The intersectional jeopardy of disability, gender and sexual and reproductive health: experiences and recommendations of women and men with disabilities in Northern Uganda. *Sexual and Reproductive Health Matters*, *28*(2), 269–283. https://doi.org/10.1080/26410397.2020.1772654

MacDonald, T., Jackson, S., Charles, M. C., Periel, M., Jean-Baptiste, M. V., Salomon, A., & Premilus, É. (2018). The fourth delay and community-driven solutions to reduce maternal mortality in rural Haiti: A community-based action research study. *BMC Pregnancy and Childbirth*, *18*(1), 1–12. https://doi.org/10.1186/s12884-018-1881-3

Mack, A. N. (2016). The Self-Made Mom: Neoliberalism and Masochistic Motherhood in Home-Birth Videos on YouTube. *Women's Studies in Communication*, *39*(1), 47–68. https://doi.org/10.1080/07491409.2015.1129519

Maluka, S. O., & Peneza, A. K. (2018). Perceptions on male involvement in pregnancy and childbirth in Masasi District, Tanzania: A qualitative study. *Reproductive Health*, *15*(1), 1–7. https://doi.org/10.1186/s12978-018-0512-9

Manda-Taylor, L., Mwale, D., Phiri, T., Walsh, A., Matthews, A., Brugha, R., Mwapasa, V., & Byrne, E. (2017). Changing times? Gender roles and relationships in maternal, newborn and child health in Malawi. *BMC Pregnancy and Childbirth*, *17*(1), 1–13. https://doi.org/10.1186/s12884-017-1523-1

Maykut, P., & Morehouse, R. (1994). Qualitative Data Analysis: An Overview. In *Beginning qualitative research: A philosophic and practical guide.* Falmer Press/Taylor & Francis, Inc.

McLean, K. E. (2020). Men's experiences of pregnancy and childbirth in Sierra Leone: Reexamining definitions of "male partner involvement." *Social Science and Medicine*, *265*,

113479. https://doi.org/10.1016/j.socscimed.2020.113479

Mkabela, Q. (2015). Using the Afrocentric Method in Researching Indigenous African Culture. *The Qualitative Report*, *10*(1), 178–189. https://doi.org/10.46743/2160-3715/2005.1864

Mlambo, C., Sibanda, K., Ntshangase, B., & Mvuyana, B. (2022). ICT and Women ' s Health : An Examination of the Impact of ICT on Maternal Health in SADC States. *Healthcare*, *10*(802), 1–16.

Mogoba, P., Gomba, Y., Brittain, K., Phillips, T. K., Myer, L., Zerbe, A., & Abrams, E. J. (2019). Re-recruiting postpartum women living with HIV into a follow-up study in Cape Town, South Africa. *BMC Research Notes*, *12*(1 PG-461), 461. https://doi.org/http://dx.doi.org/10.1186/s13104-019-4509-4

Mohanty, C. T. (1991). Under Western Eyes. *Third World Women and the Politics of Feminism*, *24*(June 1992), 3–4. https://doi.org/10.1017/CBO9781107415324.004

Morgan, R., George, A., Ssali, S., Hawkins, K., Molyneux, S., & Theobald, S. (2016). How to do (or not to do)... gender analysis in health systems research. *Health Policy and Planning*, *31*(8), 1069–1078. https://doi.org/10.1093/heapol/czw037

Morgan, R., Tetui, M., Muhumuza Kananura, R., Ekirapa-Kiracho, E., & George, A. S. (2017). Gender dynamics affecting maternal health and health care access and use in Uganda. *Health Policy and Planning*, *32*(suppl_5), v13–v21. https://doi.org/10.1093/heapol/czx011

Morgan, T., Williams, L. A., & Gott, M. (2017). A Feminist Quality Appraisal Tool: exposing gender bias and gender inequities in health research. *Critical Public Health*, *27*(2), 263–274. https://doi.org/10.1080/09581596.2016.1205182

MSD. (2021). *How maternal health innovations are closing the digital divide A Merck for Mothers Report 2*.

Mwangome, M., Prentice, A., Plugge, E., & Nweneka, C. (2010). Determinants of appropriate child health and nutrition practices among women in rural Gambia. *Journal of Health, Population and Nutrition*, *28*(2), 167–172. https://doi.org/10.3329/jhpn.v28i2.4887

Nachega, J. B., Skinner, D., Jennings, L., Magidson, J. F., Altice, F. L., Burke, J. G., Lester, R. T., Uthman, O. A., Knowlton, A. R., Cotton, M. F., Anderson, J. R., & Theron, G. B. (2016). Acceptability and feasibility of mHealth and community-based directly observed antiretroviral therapy to prevent mother-to-child HIV transmission in South African pregnant women under Option B+: An exploratory study. *Patient Preference and*

Adherence, *10*((Nachega) Department of Epidemiology, University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA, United States(Nachega) Department of Medicine, Centre for Infectious Diseases, ACTG Clinical Trial Unit (CTU)/Family Clinical Research Unit (F), 683–690. https://doi.org/http://dx.doi.org/10.2147/PPA.S100002

Namasivayam, A., Donatus C Osuorah, R. S., & Diddy, A. (2012). The role of gender inequities in women ' s access to reproductive health care : a population-level Study of Namibia, Kenya, Napel and India. *International Journal of Women's Health*, *4*, 351–364. https://doi.org/10.2147/IJWH.S32569

Nash, J. C. (2008). (2008). Re-thinking intersectionality. *Feminist Review*, *89*, 1–16. https://doi.org/10.1057/fr.2008.4

National population commission Nigeria. (2019). Nigeria Demographic Health Survey 2018. In *The DHS Program ICF Rockville, Maryland, USA*.

Nchanji, Y. K., Levang, P., & Jalonen, R. (2017). Learning to select and apply qualitative and participatory methods in natural resource management research: self-critical assessment of research in Cameroon. *Forests Trees and Livelihoods*, *26*(1), 47–64. https://doi.org/10.1080/14728028.2016.1246980

Ndhlovu, F. (2014). *Language and African Development : Theoretical Reflections on the Place of Languages in African Studies*. *January 2008*. https://doi.org/10.53228/njas.v17i2.240

Ndlovu, L., Mogoba, P., Phillips, T. K., Myer, L., Were, M. C., & Clouse, K. (2019). Smartphone usage and preferences among postpartum HIV-positive women in South Africa. *AIDS Care - Psychological and Socio-Medical Aspects of AIDS/HIV*, *31*(6 PG-723–729), 723–729. https://doi.org/http://dx.doi.org/10.1080/09540121.2018.1563283

Nicolai, S., Hoy, C., Berliner, T., & Aedy, T. (2015). Projecting progress: Reaching the SDGs by 2030. In *ODI*.

Nnaemeka, O. (2004). Nego-Feminism: Theorizing, Practicing, and Pruning Africa's Way. *SIGNS: Journal of Women in Culture and Society*, *29*(2), 357–385.

Ntoimo, L. F. C., Okonofua, F. E., Igboin, B., Ekwo, C., Imongan, W., & Yaya, S. (2019). Why rural women do not use primary health centres for pregnancy care: Evidence from a qualitative study in Nigeria. *BMC Pregnancy and Childbirth*, *19*(1), 1–13. https://doi.org/10.1186/s12884-019-2433-1

Nzegwu, N. (1995). Women, Culture, and Development. In *Women, Culture, and Development:*

A study of Human Capabilities (pp. 1–24). Oxford University Press. https://doi.org/DOI:10.1093/0198289642.003.0021

Obasola, O. I., Mabawonku, I., & Lagunju, I. (2015a). A Review of e-Health Interventions for Maternal and Child Health in Sub-Sahara Africa. *Maternal and Child Health Journal*, *19*(8), 1813–1824. https://doi.org/10.1007/s10995-015-1695-0

Obasola, O. I., Mabawonku, I., & Lagunju, I. (2015b). A Review of e-Health Interventions for Maternal and Child Health in Sub-Sahara Africa. *Maternal and Child Health Journal*, *19*(8), 1813–1824. https://doi.org/10.1007/s10995-015-1695-0

Odeny, T. A., Yuhas, K., Bukusi, E. A., Cohen, C. R., Camlin, C. S., & McClelland, R. S. (2014). Texting improves testing: A randomized trial of two-way SMS to increase postpartum prevention of mother-to-child transmission retention and infant HIV testing. *AIDS*, *28*(15 PG-2307–2312), 2307–2312. https://doi.org/http://dx.doi.org/10.1097/QAD.0000000000000409

Odetola, T. D., & Okanlawon, F. A. (2016). Effects of a nursing intervention using a mobile phone application on uptake of antenatal care, tetanus toxoids and malaria prevention among pregnant women in Nigeria. *Journal of the International Society for Telemedicine and EHealth*, *4*(PG-e13), e13. https://search.ebscohost.com/login.aspx?direct=true&db=lhh&AN=20173220655&site=ehost-live NS -

OECD. (2018). *Bridging the Digital Gender Divide*. https://doi.org/10.4018/978-1-7998-8594-8.ch002

Okigbo, C. C., Adegoke, K. K., & Olorunsaiye, C. Z. (2016). Trends in reproductive health indicators in Nigeria using demographic and health surveys (1990-2013). *Global Public Health*, *12*(6), 1–18. https://doi.org/10.1080/17441692.2016.1245350

Okonofua, F., Lambo, E., Okeibunor, J., & Agholor, K. (2011a). Advocacy for free maternal and child health care in Nigeria-Results and outcomes. *Health Policy*, *99*(2), 131–138. https://doi.org/10.1016/j.healthpol.2010.07.013

Okonofua, F., Lambo, E., Okeibunor, J., & Agholor, K. (2011b). Advocacy for free maternal and child health care in Nigeria-Results and outcomes. *Health Policy*, *99*(2), 131–138. https://doi.org/10.1016/j.healthpol.2010.07.013

Okonofua, F., Ntoimo, L., Johnson, E., Sombie, I., Ojuolape, S., Igboin, B., Imongan, W., Ekwo,

C., Udenigwe, O., Yaya, S., Wallis, A. B., & Adeniran, J. (2023). Texting for life: a mobile phone application to connect pregnant women with emergency transport and obstetric care in rural Nigeria. *BMC Pregnancy and Childbirth*, *23*(1), 1–8. https://doi.org/10.1186/s12884-023-05424-9

Okonofua, F., Ntoimo, L., Ogungbangbe, J., Anjorin, S., Imongan, W., & Yaya, S. (2018). Predictors of women's utilization of primary health care for skilled pregnancy care in rural Nigeria. *BMC Pregnancy and Childbirth*, *18*(1), 1–15. https://doi.org/10.1186/s12884-018-1730-4

Olajubu, A. O., Fajemilehin, B. R., Olajubu, T. O., & Afolabi, B. S. (2020). Effectiveness of a mobile health intervention on uptake of recommended postnatal care services in Nigeria. *PLoS ONE*, *15*(9 september), 1–12. https://doi.org/10.1371/journal.pone.0238911

Oluoch-Aridi, J., Chelagat, T., Nyikuri, M. M., Onyango, J., Guzman, D., Makanga, C., Miller-Graff, L., & Dowd, R. (2020). COVID-19 Effect on Access to Maternal Health Services in Kenya. *Frontiers in Global Women's Health*, *1*(November), 1–9. https://doi.org/10.3389/fgwh.2020.599267

Ommeh, M., Fenenga, C. J., Hesp, C. J., Nzorubara, D., & Rinke de Wit, T. F. (2019). Using mobile transport vouchers to improve access to skilled delivery. *Rural & Remote Health*, *19*(1), 1–6. https://doi.org/10.22605/RRH4577

Omonaiye, O., Nicholson, P., Kusljic, S., & Manias, E. (2018). A meta-analysis of effectiveness of interventions to improve adherence in pregnant women receiving antiretroviral therapy in sub-Saharan Africa. *International Journal of Infectious Diseases*, *74*, 71–82. https://doi.org/10.1016/j.ijid.2018.07.004

Onono, M. A., Wahome, S., Wekesa, P., Adhu, C. K., Waguma, L. W., Serem, T., Owenga, M. A., & Ong'wen, P. (2019). Effects of an expanded Uber-like transport system on access to and use of maternal and newborn health services: Findings of a prospective cohort study in Homa Bay, Kenya. *BMJ Global Health*, *4*(3), 1–8. https://doi.org/10.1136/bmjgh-2018-001254

Onono, M, Odhiambo, G. O., Congo, O., Waguma, L. W., Serem, T., Owenga, M. A., & Wekesa, P. (2019). Narratives of women using a 24-hour ride-hailing transport system to increase access and utilization of maternal and newborn health services in rural western Kenya: a qualitative study. *American Journal of Tropical Medicine and Hygiene*, *101*(5 PG-

1000–1008), 1000–1008. https://doi.org/10.4269/ajtmh.19-0132

Onono, Maricianah, Odhiambo, G. O., Congo, O., Waguma, L. W., Serem, T., Owenga, M. A., & Wekesa, P. (2019). Narratives of women using a 24-hour ride-hailing transport system to increase access and utilization of maternal and newborn health services in rural western Kenya: A qualitative study. *American Journal of Tropical Medicine and Hygiene*, *101*(5), 1000–1008. https://doi.org/10.4269/ajtmh.19-0132

Onono, Maricianah, Odwar, T., Wahome, S., Helova, A., Bukusi, E. A., Hampanda, K., Turan, J., & Abuogi, L. (2021). Behavioral Interventions can Mitigate Adverse Pregnancy Outcomes Among Women Conceiving on ART and Those Initiated on ART During Pregnancy: Findings From the MOTIVATE Trial in Southwestern Kenya. *Journal of Acquired Immune Deficiency Syndromes (1999)*, *86*(1), 46–55. https://doi.org/10.1097/QAI.0000000000002521

Onwujekwe, O., Obi, F., Ichoku, H., Ezumah, N., Okeke, C., Ezenwaka, U., Uzochukwu, B., & Wang, H. (2019). Assessment of a Free Maternal and Child Health Program and the Prospects for Program Re-Activation and Scale-Up using a New Health Fund in Nigeria. *Nigerian Journal of Clinical Practice*, *22*(November), 1070–1077. https://doi.org/10.4103/njcp.njcp

Opoku, D., Busse, R., & Quentin, W. (2019). Achieving sustainability and scale-up of mobile health noncommunicable disease interventions in sub-Saharan Africa: Views of policy makers in Ghana. *JMIR MHealth and UHealth*, *7*(5), 1–25. https://doi.org/10.2196/11497

Osaki, H., Sao, S. S., Kisigo, G. A., Coleman, J. N., Mwamba, R. N., Renju, J., Mmbaga, B. T., & Watt, M. H. (2021). Male engagement guidelines in antenatal care: unintended consequences for pregnant women in Tanzania. *BMC Pregnancy and Childbirth*, *21*(1), 1–10. https://doi.org/10.1186/s12884-021-04141-5

Osamor, P. E., & Grady, C. (2016). Women's autonomy in health care decision-making in developing countries: A synthesis of the literature. *International Journal of Women's Health*, *8*, 191–202. https://doi.org/10.2147/IJWH.S105483

Osamor, P. E., & Grady, C. (2018). Autonomy and couples' joint decision-making in healthcare. *BMC Medical Ethics*, *19*(1), 1–8. https://doi.org/10.1186/s12910-017-0241-6

Osamor, P., & Grady, C. (2018). Decision making autonomy:emperical evidence from Nigeria. *J Biosoc Sci*, *50*(1), 70–85. https://doi.org/10.1017/S0021932017000037.FACTORS

Oshio, P. E. (1990). The Indigenous Land Tenure and Nationalization of Land in Nigeria. *Boston College Third World Law Journal*, *10*(1), 1–1. http://lawdigitalcommons.bc.edu/twlj/vol10/iss1/3

Oyari, F. O. O., Ogbonnaya, L. U., Ota, M. M. O., & Azuogu, B. (2017). How Ready are the Ward Development Committees to Facilitate Universal Health Coverage in Ebonyi State, Nigeria? *Journal of Primary Health Care and General Practice*, *1*(1), 1–6.

Oyeyemi, S. O., & Wynn, R. (2014a). Giving cell phones to pregnant women and improving services may increase primary health facility utilization: A case-control study of a Nigerian project. *Reproductive Health*, *11*(1), 1–8. https://doi.org/10.1186/1742-4755-11-8

Oyeyemi, S. O., & Wynn, R. (2014b). Giving cell phones to pregnant women and improving services may increase primary health facility utilization: A case-control study of a Nigerian project. *Reproductive Health*, *11*(1 PG-8), 8. https://doi.org/http://dx.doi.org/10.1186/1742-4755-11-8

Pacagnella, R. C., Cecatti, J. G., Osis, M. J., & Souza, J. P. (2012). The role of delays in severe maternal morbidity and mortality: Expanding the conceptual framework. *Reproductive Health Matters*, *20*(39), 155–163. https://doi.org/10.1016/S0968-8080(12)39601-8

Pace, R., Pluye, P., Bartlett, G., Macaulay, A. C., Salsberg, J., Jagosh, J., & Seller, R. (2012). Testing the reliability and efficiency of the pilot Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. *International Journal of Nursing Studies*, *49*(1), 47–53. https://doi.org/10.1016/j.ijnurstu.2011.07.002

Page, M. J., Mckenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Mayo-wilson, E., Mcdonald, S., Mcguinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., … Moher, D. (2021). The PRISMA 2020 statement : An updated guideline for reporting systematic reviews. *International Journal of Surgery*, *88*(March), 1–9. https://doi.org/10.1016/j.ijsu.2021.105906

Palitza, K. (2010). *Traditional leaders wield the power, and they are almost all men: The importance of involving traditional leaders in gender transformation.* https://genderjustice.org.za/publication/traditional-leaders-wield-the-power-and-they-are-almost-all-men/

Parkes-Ratanshi, R., Mbazira Kimeze, J., Nakku-Joloba, E., Hamill, M. M., Namawejje, M.,

Kiragga, A., Kayogoza Byamugisha, J., Rompalo, A., Gaydos, C., & Manabe, Y. C. (2020). Low male partner attendance after syphilis screening in pregnant women leads to worse birth outcomes: The Syphilis Treatment of Partners (STOP) randomised control trial. *Sexual Health*, *17*(3), 214–222. https://doi.org/10.1071/SH19092

Patton, M. Q. (1990). Designing qualitative studies. In *Qualitative evaluation and research methods*. https://doi.org/10.1002/nur.4770140111

Pembe, A. B., Mbekenga, C. K., Olsson, P., & Darj, E. (2017). Why do women not adhere to advice on maternal referral in rural Tanzania? Narratives of women and their family members. *Global Health Action*, *10*(1), 1364888. https://doi.org/10.1080/16549716.2017.1364888

Perski, O., & Short, C. E. (2021). Acceptability of digital health interventions: embracing the complexity. *Translational Behavioral Medicine*, *11*(7), 1473–1480. https://doi.org/10.1093/tbm/ibab048

Phillips, T. K., Bonnet, K., Myer, L., Buthelezi, S., Rini, Z., Bassett, J., Schlundt, D., Clouse, K., Africa, S., Centre, W., & Africa, S. (2019). Acceptability of interventions to improve engagement in HIV care among pregnant and postpartum women at two urban clinics in South Africa. *Matern Child Health J.*, *23*(9), 1260–1270. https://doi.org/10.1007/s10995-019-02766-9.Acceptability

Pintye, J., Rogers, Z., Kinuthia, J., Mugwanya, K. K., Abuna, F., Lagat, H., Sila, J., Kemunto, V., Baeten, J. M., John-Stewart, G., & Unger, J. A. (2020). Two-way short message service (SMS) communication may increase pre-exposure prophylaxis continuation and adherence among pregnant and postpartum women in Kenya. *Global Health Science and Practice*, *8*(1), 55–67. https://doi.org/10.9745/GHSP-D-19-00347

Population Reference Bureau. (2017). *2017 World Population Data Sheet*. 2017 World Population Data Sheet. http://www.prb.org/Publications/Datasheets/2017/2017-world-population-data-sheet.aspx

Potvin, J. (2018). Biopolitics, Risk, and Reproductive Justice: the Governing of Maternal Health in Canada' s Muskoka Initiative. In *Electronic Thesis and Dissertation Repository. 5956.https://ir.lib.uwo.ca/etd/5956*. https://ir.lib.uwo.ca/etdhttps://ir.lib.uwo.ca/etd/5956

Prainsack, B. (2018). The "We" in the "Me": Solidarity and health care in the era of personalized medicine. *Science Technology and Human Values*, *43*(1), 21–44.

https://doi.org/10.1177/0162243917736139

Probst, P., Grummich, K., Heger, P., Zaschke, S., Knebel, P., Ulrich, A., Büchler, M. W., & Diener, M. K. (2016). Blinding in randomized controlled trials in general and abdominal surgery: Protocol for a systematic review and empirical study. *Systematic Reviews*, *5*(1), 1–6. https://doi.org/10.1186/s13643-016-0226-4

Purcell-Jones, J. M. A., Haasbroek, M., Van der Westhuizen, J. L., Dyer, R. A., Lombard, C. J., & Duys, R. A. (2019). Overcoming Language Barriers Using an Information Video on Spinal Anesthesia for Cesarean Delivery: Implementation and Impact on Maternal Anxiety. *Anesthesia and Analgesia*, *129*(4), 1137–1143. https://doi.org/10.1213/ANE.0000000000004243

Renwick, L., Pedley, R., Johnson, I., Bell, V., Lovell, K., Bee, P., & Brooks, H. (2022). Mental health literacy in children and adolescents in low- and middle-income countries: a mixed studies systematic review and narrative synthesis. *European Child and Adolescent Psychiatry*, *0123456789*. https://doi.org/10.1007/s00787-022-01997-6

Ronda Zelezny-Green, Vosloo, S., & Conole, G. (2018). *Digital inclusion for low-skilled and low-literate people*. https://www.incode2030.gov.pt/sites/default/files/261791eng.pdf

Ronen, K., Unger, J. A., Drake, A. L., Akinyi, P., Osborn, L., Matemo, D., Malley, O., Kinuthia, J., & John-stewart, G. (2018). SMS messaging to improve ART adherence: perspectives of pregnant HIV-infected women in Kenya on HIV-related message content. *AIDS Care*, *30*(4), 500–505. https://doi.org/10.1080/09540121.2017.1417971.SMS

Ruane-McAteer, E., Amin, A., Hanratty, J., Lynn, F., Corbijn Van Willenswaard, K., Reid, E., Khosla, R., & Lohan, M. (2019). Interventions addressing men, masculinities and gender equality in sexual and reproductive health and rights: An evidence and gap map and systematic review of reviews. *BMJ Global Health*, *4*(5). https://doi.org/10.1136/bmjgh-2019-001634

Rutgers. (2018). *Adopting the gender transformative approach in sexual and reproductive health and rights, and gender-based violence programmes*. https://rutgers.international/resources/rutgers-gta-toolkit-module-1/

Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A. B., Daniels, J., Gülmezoglu, A. M., Temmerman, M., & Alkema, L. (2014). Global causes of maternal death: A WHO systematic analysis. *The Lancet Global Health*, *2*(6), 323–333.

https://doi.org/10.1016/S2214-109X(14)70227-X

Schwartz, S. R., Clouse, K., Yende, N., Rie, A. Van, Basset, J., Ratshefola, M., & Pettifor, A. (2015). Acceptability and feasibility of a mobile phone-based case management intervention to retain mothers and infants from an Option B+ program in postpartum HIV care Sheree. *Matern Child Health J.*, *19*(9), 2029–2037. https://doi.org/10.1007/s10995-015-1715-0.Acceptability

Schwartz, S. R., Clouse, K., Yende, N., Van Rie, A., Bassett, J., Ratshefola, M., & Pettifor, A. (2015). Acceptability and Feasibility of a Mobile Phone-Based Case Management Intervention to Retain Mothers and Infants from an Option B+ Program in Postpartum HIV Care. *Maternal and Child Health Journal*, *19*(9 PG-2029–2037), 2029–2037. https://doi.org/http://dx.doi.org/10.1007/s10995-015-1715-0

Sekhon, M., Cartwright, M., & Francis, J. J. (2017). Acceptability of healthcare interventions: An overview of reviews and development of a theoretical framework. *BMC Health Services Research*, *17*(1), 1–13. https://doi.org/10.1186/s12913-017-2031-8

Sharma, V., Leight, J., Giroux, N., Abdulaziz, F., & Nyqvist, M. B. (2019). "That's a woman's problem": A qualitative analysis to understand male involvement in maternal and newborn health in Jigawa state, northern Nigeria. *Reproductive Health*, *16*(1), 1–11. https://doi.org/10.1186/s12978-019-0808-4

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, *22*(2), 63–75. https://doi.org/10.3233/EFI-2004-22201

Sinha, C., & Schryer-Roy, A. M. (2018). Digital health, gender and health equity: invisible imperatives. *Journal of Public Health (Oxford, England)*, *40*(2), 1–5. https://doi.org/10.1093/pubmed/fdy171

Skinner, D., Delobelle, P., Pappin, M., Pieterse, D., Esterhuizen, T. M., Barron, P., & Dudley, L. (2018). User assessments and the use of information from MomConnect, a mobile phone text-based information service, by pregnant women and new mothers in South Africa. *BMJ Global Health*, *3*(Suppl. 2 PG-e000561), e000561. https://doi.org/10.1136/bmjgh-2017-000561

Solanke, B. L., & Rahman, S. A. (2018). Multilevel analysis of factors associated with assistance during delivery in rural Nigeria: Implications for reducing rural-urban inequity in skilled care at delivery. *BMC Pregnancy and Childbirth*, *18*(1), 1–15.

https://doi.org/10.1186/s12884-018-2074-9

Sondaal, S. F. V., Browne, J. L., Amoakoh-Coleman, M., Borgstein, A., Miltenburg, A. S., Verwijs, M., & Klipstein-Grobusch, K. (2016). Assessing the Effect of mHealth Interventions in Improving Maternal and Neonatal Care in Low- and Middle-Income Countries: A Systematic Review. *PloS One*, *11*(5), e0154664. https://doi.org/10.1371/journal.pone.0154664

Sowon, K., & Chigona, W. (2020). Trust in mHealth: How do Maternal Health Clients Accept and Use mHealth Interventions? *ACM International Conference Proceeding Series*, 189–197. https://doi.org/10.1145/3410886.3410895

Stern, C., Lizarondo, L., Carrier, J., Godfrey, C., Rieger, K., Kirkpatrick, P., & Loveday, H. (2020). Methodological guidance for the conduct of mixed methods systematic reviews. In *JBI_Methodology*. https://doi.org/10.11124/JBISRIR-D-19-00169

Stoljar, N. (2018). Feminist Perspectives on Autonomy. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Winter 201). Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/cgi-bin/encyclopedia/archinfo.cgi?entry=feminism-autonomy

Sunderji, N. (n.d.). Barriers to accelerating the implementation of digital innovations for maternal health in low- and middle-income countries. *Maternity Matters: Prescription for Progress*. https://www.devex.com/news/sponsored/leveraging-digital-solutions-for-quality-maternal-health-care-99701

Tadesse, E. (2020). Antenatal care service utilization of pregnant women attending antenatal care in public hospitals during the COVID-19 pandemic period. *International Journal of Women's Health*, *12*, 1181–1188. https://doi.org/10.2147/IJWH.S287534

Thaddeus, S., & Maine, D. (1994). Too far to walk: Maternal mortality in context. *Social Science and Medicine*, *38*(8), 1091–1110. https://doi.org/10.1016/0277-9536(94)90226-7

The World Bank. (2021). *Literacy rate, adult female (% of females ages 15 and above) - Sub-Saharan Africa*. UNESCO Institute for Statistics. https://data.worldbank.org/indicator/SE.ADT.LITR.FE.ZS?locations=ZG&most_recent_year_desc=false

Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, *8*, 1–10. https://doi.org/10.1186/1471-2288-8-45

Thompson, A., Castle, E., Lubeck, P., & Makarfi, P. S. (2010). Experience implementing OpenMRS to support maternal and reproductive health in Northern Nigeria. *Studies in Health Technology and Informatics*, *160*(PART 1), 332–336. https://doi.org/10.3233/978-1-60750-588-4-332

Tokhi, M., Comrie-Thomson, L., Davis, J., Portela, A., Chersich, M., & Luchters, S. (2018). Involving men to improve maternal and newborn health: A systematic review of the effectiveness of interventions. *PLoS ONE*, *13*(1), 1–16. https://doi.org/10.1371/journal.pone.0191620

Trafford, Z., Swartz, A., Jewett, S., Barron, P., Winch, P. J., LeFevre, A. E., Colvin, C. J., & Bamford, L. (2020). Reported infant feeding practices and contextual influences on breastfeeding: qualitative interviews with women registered to MomConnect in three South African provinces. *International Breastfeeding Journal*, *15*(1 PG-81), 81. https://doi.org/http://dx.doi.org/10.1186/s13006-020-00315-7

Udenigwe, O., & Okonofua, F. E. (2022). Understanding gender dynamics in mHealth interventions can enhance the sustainability of benefits of digital technology for maternal healthcare in rural. *Frontiers in Global Women's Health*, 1–16. https://doi.org/10.3389/fgwh.2022.1002970

Udenigwe, O., Okonofua, F. E., Ntoimo, L. F. C., Imongan, W., Igboin, B., & Yaya, S. (2021a). Perspectives of policymakers and health providers on barriers and facilitators to skilled pregnancy care: findings from a qualitative study in rural Nigeria. *BMC Pregnancy and Childbirth 2021 21:1*, *21*(1), 1–14. https://doi.org/10.1186/S12884-020-03493-8

Udenigwe, O., Okonofua, F. E., Ntoimo, L. F. C., Imongan, W., Igboin, B., & Yaya, S. (2021b). "We have either obsolete knowledge, obsolete equipment or obsolete skills": policy-makers and clinical managers' views on maternal health delivery in rural Nigeria. *Family Medicine and Community Health*, *9*(3), e000994. https://doi.org/10.1136/FMCH-2021-000994

Udenigwe, O., Okonofua, F. E., Ntoimo, L. F. C., & Yaya, S. (2022). Enablers and barriers to the acceptability of mHealth for maternal healthcare in rural Edo , Nigeria. *Dialogues in Health*, *1*(July), 100067. https://doi.org/10.1016/j.dialog.2022.100067

Udenigwe, O., & Yaya, S. (2022). Leaving no woman or girl behind? Inclusion and participation in digital maternal health programs in sub-Saharan Africa. *Reproductive Health*, *19*(1), 1–9. https://doi.org/10.1186/s12978-022-01358-1

UN. (1995). Beijing declaration and platform for action. In *Fourth World Conference on Women* (Vol. 21, Issue 4). https://doi.org/10.1017/CBO9781107415324.004

UN women. (2023). *Power on: How we can supercharge an equitable digital future*. https://www.unwomen.org/en/news-stories/explainer/2023/02/power-on-how-we-can-supercharge-an-equitable-digital-future

UNFPA. (2022). *International Conference on Population and Development, 1994*. International Conference on Population and Development. https://www.unfpa.org/icpd

Unger, J. A., Ronen, K., Perrier, T., DeRenzi, B., Slyker, J., Drake, A. L., Mogaka, D., Kinuthia, J., & John-Stewart, G. (2018). Short message service communication improves exclusive breastfeeding and early postpartum contraception in a low- to middle-income country setting: a randomised trial. *BJOG: An International Journal of Obstetrics and Gynaecology*, *125*(12 PG-1620–1629), 1620–1629. https://search.ebscohost.com/login.aspx?direct=true&db=lhh&AN=20193096424&site=ehost-live NS -

UNICEF. (2022). *A review of Gender-Transformative Approaches and Promising Practices in Health, Nutrition and HIV Programming in Africa*. https://www.unicef.org/media/127671/file/Assessment Report (English).pdf

United Nations. (2015). The Millennium Development Goals Report 2015. *United Nations, New York*, 1–73. https://visit.un.org/millenniumgoals/2008highlevel/pdf/MDG_Report_2008_Addendum.pdf

United Nations. (2020a). Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development. *Work of the Statistical Commission Pertaining to the 2030 Agenda for Sustainable Development*, 1–21. https://unstats.un.org/sdgs/indicators/Global Indicator Framework after 2019 refinement_Eng.pdf%0Ahttps://unstats.un.org/sdgs/indicators/Global Indicator Framework_A.RES.71.313 Annex.pdf

United Nations. (2020b). The Impact of COVID-19 on Women. *United Nations, April*, 21. https://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2020/policy-brief-the-impact-of-covid-19-on-women-en.pdf?la=en&vs=1406

Van Der Kop, M. L., Muhula, S., Ekström, A. M., Jongbloed, K., Smillie, K., Abunah, B.,

Kinagwi, K., Kyomuhangi, L. B., Gelmon, L., Ojakaa, D. I., Lester, R. T., & Awiti, P. O. (2017). Participation in a mobile health intervention trial to improve retention in HIV care: does gender matter? *Journal of Telemedicine and Telecare*, *23*(2), 39–46. https://doi.org/10.1177/1357633X16643457

Van Heerden, A., Norris, S., Tollman, S., Richter, L., & Rotheram-Borus, M. J. (2013). Collecting maternal health information from HIV-positive pregnant women using mobile phone-assisted face-to-face interviews in Southern Africa. *Journal of Medical Internet Research*, *15*(6). https://doi.org/10.2196/jmir.2207

van Stam, G. (2022). Conceptualization and practices in digital health: voices from Africa. *African Health Sciences*, *22*(1), 664–672. https://doi.org/10.4314/ahs.v22i1.77

Varpio, L., Paradis, E., Uijtdehaage, S., & Young, M. (2020). The Distinctions between Theory, Theoretical Framework, and Conceptual Framework. *Academic Medicine*, *95*(7), 989–994. https://doi.org/10.1097/ACM.0000000000003075

Waiswa, P., Kemigisa, M., Kiguli, J., Naikoba, S., Pariyo, G. W., & Peterson, S. (2008). Acceptability of evidence-based neonatal care practices in rural Uganda - Implications for programming. *BMC Pregnancy and Childbirth*, *8*, 1–9. https://doi.org/10.1186/1471-2393-8-21

Wakefield, A., & Fleming, J. (2009). *The SAGE dictionary of policing*. SAGE Publications Ltd. https://dx.doi.org/10.4135/9781446269053.n111

West, D. M. (2015). *Using mobile technology to improve maternal health and fight Ebola: a case study of mobile innovation in Nigeria* (Issue March).

WHARC. (2022). *WHARC | Women's Health and Action Research Centre*. https://wharc-online.org/

WHO, UNICEF, UNFPA, W. B. G. and the U. N. P. D. (2019). Trends in Maternal Mortality : 2000 To 2017. In *WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division*. World Health Organization.

WHO. UNICEF. UNFPA. (2015). *Trends in maternal mortality: 1990 to 2015 Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division*. https://doi.org/10

WHO. (2011). *Gender mainstreaming for program managers; A practical approach,*. http://apps.who.int/iris/bitstream/10665/44516/1/9789241501071_eng.pdf

WHO. (2013). eHealth and innovation in women' s and children' s health: A baseline review. In *Geneva. World Health Organization. Child Health. Geneva. World Health Organization. Health. Geneva. World Health Organization*.

WHO. (2014). *WHO Country Cooperation Strategy 2014–2019 - Nigeria*.

WHO. (2016a). *Atlas of eHealth country profiles: the use of eHealth in support of universal health coverage: based on the findings of the third global survey on eHealth 2015* (Global Observatory for eHealth (ed.)). WHO. https://apps.who.int/iris/bitstream/handle/10665/204523/9789241565219_eng.pdf?sequence=1

WHO. (2016b). Global diffusion of eHealth: Making universal health coverage achievable. In *Report of the third global survey on eHealth*. http://who.int/goe/publications/global_diffusion/en/

WHO. (2016c). Sdg Health and Health-Related Targets. *World Health Statistics: 2016*, 29–41.

WHO. (2019). *WHO guideline: recommendations on digital interventions for health system strengthening*. World Health Organization.

WHO. (2020). *Digital implementation investment guide (DIIG): Integrating digital interventions into health programmes*. World Health Organization.

WHO. (2021). *Global strategy on digital health 2020-2025*. http://apps.who.int/bookorders.

WHO, UNFPA, & WORLDBANK. (2023). Trends in maternal mortality 2000 to 2020: Estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division. In *Sexual and Reproductive Health*. © World Health Organization 2023. https://www.who.int/reproductivehealth/publications/maternal-mortality-2000-2017/en/

World Bank Group. (2019). *Maternal mortality ratio (modeled estimate, per 100,000 live births) | Data*. Maternal Mortality Ratio (Modeled Estimate, per 100,000 Live Births) - Nigeria. https://data.worldbank.org/indicator/SH.STA.MMRT

World Health Organisation. (2011). ICD-10 International Statistical Classification of Diseases and Related Health Problems. In © *World Health Organization 2011*. https://doi.org/10.1016/j.jclinepi.2009.09.002

World Health Organization (WHO). (2011). World Report on Disability. In *World Report on Disability* (Vol. 8, Issue 11). https://doi.org/10.2196/14170

Yaya, S., Ghose, B., Udenigwe, O., Shah, V., Hudani, A., & Ekholuenetale, M. (2019).

Knowledge and attitude of HIV/AIDS among women in Nigeria: a cross-sectional study. *European Journal of Public Health*, *29*(1), 111–117. https://doi.org/10.1093/EURPUB/CKY131

Yaya, S., Okonofua, F., Ntoimo, L., Kadio, B., Deuboue, R., & Imongan, W. (2018). *Increasing women ' s access to skilled pregnancy care to reduce maternal and perinatal mortality in rural Edo State , Nigeria : a randomized controlled trial*. 1–10.

Yaya, S., Okonofua, F., Ntoimo, L., Kadio, B., Deuboue, R., Imongan, W., & Balami, W. (2018). Increasing women's access to skilled pregnancy care to reduce maternal and perinatal mortality in rural Edo State, Nigeria: a randomized controlled trial. *Global Health Research and Policy*. https://doi.org/10.1186/s41256-018-0066-y

Yaya, S., Okonofua, F., Ntoimo, L., Udenige, O., & Bishwajit, G. (n.d.). *Gender inequity as a barrier to women's access to skilled pregnancy care in rural Nigeria: a qualitative study*. https://doi.org/10.1093/inthealth/ihz019

Yaya, S., Okonofua, F., Ntoimo, L., Udenige, O., & Bishwajit, G. (2019). Gender inequity as a barrier to women's access to skilled pregnancy care in rural Nigeria: A qualitative study. *International Health*, *11*(6), 551–560. https://doi.org/10.1093/inthealth/ihz019

Yaya, S., Okonofua, F., Ntoimo, L., Udenigwe, O., & Bishwajit, G. (2019). Men's perception of barriers to women's use and access of skilled pregnancy care in rural Nigeria: a qualitative study. *Reproductive Health 2019 16:1*, *16*(1), 1–12. https://doi.org/10.1186/S12978-019-0752-3

Zayyad, M. A., & Toycan, M. (2018). Factors affecting sustainable adoption of e-health technology in developing countries : an exploratory survey of Nigerian hospitals from the perspective of healthcare professionals. *PeerJ*, 1–15. https://doi.org/10.7717/peerj.4436

Zunza, M., Cotton, M. F., Mbuagbaw, L., Lester, R., & Thabane, L. (2017). Interactive weekly mobile phone text messaging plus motivational interviewing in promotion of breastfeeding among women living with HIV in South Africa: Study protocol for a randomized controlled trial. *Trials*, *18*(1), 1–8. https://doi.org/10.1186/s13063-017-2079-0

Appendices

Appendix A: In-depth interview Guide with WDC chairpersons

Name of Interviewer	Community ID :
Date of Interview ……../……../…… (day/month/year	

Interview start time

____ ____: ____ ____

(hour) (min)

Good afternoon, thank you for taking the time to speak with me today. This is an interview about your experience with and perspectives on the Text4Life platform. I am conducting this research as part of my PhD thesis at the University of Ottawa.

Can I please confirm that I have your permission to record this interview? *[Yes/No]*.

Introductory questions

1. How would you describe your role in maternal and child health?
2. How were you trained to use Text4Life?
3. What are your perspectives on the quality of this training? What could be improved?

RapidSMS design and implementation

4. What role does Text4Life play in your daily work?
5. What challenges have you experienced with using the Text4Life program?
6. Was this challenge resolved? How?

Acceptability of RapidSMS

7. What beneficiaries do you think are reached by the Text4Life?
8. Are there groups of beneficiaries that are being missed?
9. Do you think the Text4Life is consistent with the values of your community?
10. Do you think women and their spouses have the materials and resources required to participate in the Text4Life program?

Impact of Text4Life

11. What impact has Text4Life had on your community?
12. What impact has it had specifically on women's decision to seek pregnancy care from a PHC facility?
13. What impact has it had specifically on women's ability to reach a PHC facility during pregnancy complications?
14. Are there areas where the Text4Life could have impact but it currently does not?

Effectiveness and efficiency of Text4Life

Thinking of the materials and resources allocated to the Text4Life program

15. What are your opinions on the amount of materials and resources?
16. What are your opinions on the use of the allocated materials and resources?
17. In your opinion, how has the Text4Life changed the planning, provision and monitoring of maternal health in your community?

Text4Life sustainability

18. What support do you need to continue or improve your use of the Text4Life program?
19. What challenges do you foresee Text4Life facing in terms of sustainability?
20. How can these challenges be addressed?

Is there any information you would like to share or discuss with me that did not get covered today?

Thank you very much for your time today. We really appreciate your help with this research. We may be in touch again to seek clarification or ask about a topic that was not covered but emerged as important. Would you be available for such follow up? Thank you once again.

Interview end time:

_____:____

(hour) (min)

Appendix B: Focus Group Discussion Guide (Women)

Name of FGD facilitator	FGD facilitator signature
Date of FGD ……../……../……. (day/month/year)	Community ID

FGD Start Time

____ ____: ____ ____

(hour) (min)

Good afternoon, thank you for taking the time to speak with me today. This is a focus group discussion about your experience with and perspectives on the Text4Life program. I am conducting this research as part of my PhD thesis at the University of Ottawa.

Introductory questions

1. In this community, who does a woman typically consult first for general pregnancy care?
2. Who does a woman typically consult during pregnancy complications?
3. Who makes the decision on whom to consult?
4. What do you know about the Text4Life model?

Acceptability of RapidSMS

5. How do you feel about the Text4Life model?
6. How is the Text4Life model consistent with your values? **Probe**: cultural values, religious values
7. Did you have the materials and resources required to participate in the Text4Life program? **Probe**: do you own your own phone? Do you have reliable network access?
8. What changes did you have to make in your life to participate in the Text4Life program?
9. What difficulties have you experienced with using the Text4Life program?

10. Was this difficulty resolved? How?

Impact of Text4Life

11. How has Text4Life changed your pregnancy and childbirth experience?
12. How has the Text4Life platform changed your decision to seek pregnancy care from a PHC facility?
13. How has Text4Life changed your ability to reach a PHC facility during a pregnancy complication?
14. How has Text4Life impacted the care you received at your PHC facility?

Program sustainability

15. Would you use the Text4Life intervention for future pregnancies?
16. What could be changed about Text4Life to bring more benefit to you or your community?
17. How can these improvements be made?

Is there any information you would like to share or discuss with me that did not get covered today?

Thank you very much for your time today. We really appreciate your help with this research.

FGD end time:

_____:____

(hour) (min)

Appendix C: Focus Group Discussion Guide (Men)

Name of FGD facilitator	FGD facilitator signature
Date of FGD ……../……../……. (day/month/year)	Community ID

FGD Start Time

____ ____: ____ ____

(hour) (min)

Good afternoon, thank you for taking the time to speak with me today. This is a focus group discussion about your experience with and perspectives on the Text4Life platform. I am conducting this research as part of my PhD thesis at the University of Ottawa.

Introductory questions

1. In your community, who does a woman typically consult first for pregnancy care?
2. Who makes the decision about whom to consult?
3. What challenges do women face in accessing the PHC facility?
4. As a father, what is your role in maternal and child health?
5. What challenges do you face in accessing the healthcare system?
6. What do you know about the Text4Life model?

Acceptability of RapidSMS

7. How do you feel about the Text4Life model?
8. How is the Text4Life program consistent with your values?
9. Did you or your spouse have the materials and resources required to participate in the Text4Life program? **Probe**: do you own your own phone? Do you have reliable network access?

10. What changes did you or your spouse have to make to participate in the Text4Life program?
11. Have you or your spouse experienced any difficulty with using Text4Life?
12. Was this difficulty resolved? How?

Impact of RapidSMS

13. How has the Text4Life program changed your spouse's pregnancy and childbirth experience?
14. How has the Text4Life program changed your spouse's decision to seek pregnancy care from a PHC facility?
15. How has the Text4Life program changed your spouse's ability to reach a PHC facility during a pregnancy complication?

Program acceptability and sustainability

16. What do you think could be changed about the Text4Life program to bring more benefit to you, your spouse, and your community?
17. How can these improvements be done?

Is there any information you would like to share or discuss with me that did not get covered today?

Thank you very much for your time today. We really appreciate your help with this research.

FGD end time:

_____:____

(hour) (min)

Appendix D: PRISMA 2020 checklist

Section and Topic	Item #	Checklist item	Location where item is reported (Page number)
TITLE			
Title	1	Identify the report as a systematic review.	36
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	36
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	37
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	41
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	41
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	42
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	42, Appendix E
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	43
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	43
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	42
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	42
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	44
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	44
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Appendix F
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	47
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	57
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the	57

Section and Topic	Item #	Checklist item	Location where item is reported (Page number)
		model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	44
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	44
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	46
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Appendix G
Study characteristics	17	Cite each included study and present its characteristics.	47,55
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	46, 55
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	55
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	55-82
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	55-82
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	44
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	83
	23b	Discuss any limitations of the evidence included in the review.	87
	23c	Discuss any limitations of the review processes used.	87
	23d	Discuss implications of the results for practice, policy, and future research.	85

Section and Topic	Item #	Checklist item	Location where item is reported (Page number)
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	37,41
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	37,41
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	37
Competing interests	26	Declare any competing interests of review authors.	37
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

Appendix E: Search strategy

Telemedicine OR telehealth OR mHealth OR mobile Health OR electronic* Health OR eHealth OR cell phone* OR cellular phone* OR mobile phone* OR texting OR message* OR SMS OR audio message* OR Interactive Voice OR digital health

AND

gender OR sex OR women OR female OR relations OR interaction* OR equity OR inequity OR equality OR inequality OR men OR male OR empower* OR gender role* OR autonomy OR violence OR safety OR literacy OR economic OR mobility OR status OR access OR capacity OR communication* OR gender integration

AND

Maternal health OR Pregnan* OR Matern* Matern* services OR birth* OR delivery OR prenatal OR prepartum OR postnatal OR postpartum OR breastfeeding OR obstetric. (title search)

AND

sub-Sahara* Africa OR Africa OR West Africa OR East Africa OR Southern Africa

Appendix F:Inclusion and exclusion criteria		
	Inclusion Criteria	**Exclusion Criteria**
Participants	➢ Women and girls in sub-Saharan countries. ➢ Women and girls who used digital health services for pregnancy, childbirth and postpartum care. ➢ Partners of women or girls who used digital health services for maternal healthcare.	➢ Health workers who used digital health services for work. ➢ Digital health services for children only.
Context	➢ The use of digital health programs to improve maternal health. ➢ Studies that implicitly or explicitly reported observations relating to gender or gender outcomes	➢ Usage of digital health services by other populations (not women themselves). ➢ Digital health used for data collection not intervention purposes. ➢ Discussion of digital health for the purpose of theory building or critique
Comparison / Control Group	➢ No comparison group for this study.	

Outcome of Interest	➢ To present gender transformative dimensions or considerations included in mHealth interventions for maternal healthcare in sub-Saharan African countries.	
Setting	➢ The 42 countries and Island nations in the sub-Saharan African region. They include: Democratic Republic of Congo, Republic of Congo, Central African Republic, Rwanda, Burundi, Sudan, Kenya, Tanzania, Uganda, Djibouti, Eritrea, Ethiopia, Somalia (including Somaliland), Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland Zambia, Zimbabwe, Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Equatorial Guinea, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, Cape Verde, Comoros, Madagascar, Mauritius, São Tomé and Príncipe, Seychelles	➢ Countries not included in the sub-Saharan African region.
Study Design	➢ Qualitative, Quantitative, and mixed methods studies. ➢ Peer reviewed full-text research papers, published in English.	➢ Reviews, editorials and commentaries, discussions, theses or dissertations and other gray literature.

		➢ Articles published in any other languages other than English.

Appendix G: List of excluded studies		
	Author/Year/Country	**Reasons for exclusion**
1.	Abajobir et al., 2021,	Wrong study design
2.	Adam et al., 2019, South Africa	Wrong patient population
3.	Adam et al., 2019, South Africa	Wrong patient population
4.	Afutendem et al., 2019,Cameroon	Wrong study design
5.	Amoah et al., 2016, Ghana	Wrong indication
6.	Andreatta et al., 2011, Ghana	Wrong patient population
7.	Clouse et al., 2020, South Africa	Wrong study design
8.	Clouse et al., 2015, South Africa	Wrong study design
9.	Colaco et al., 2017, Guinea	Wrong outcomes
10.	Cole-Ceesay et al., 2010, Gambia	Wrong intervention
11.	Coleman et al., 2017, South Africa	Wrong indication
12.	Coleman et al., 2020, South Africa	Wrong outcomes
13.	Constant et al., 2016, South Africa	Wrong indication
14.	Daskilewicz et al., 2015, South Africa	Wrong intervention
15.	Dryden-Peterson et al., 2015, Botswana	Wrong indication
16.	Frellsen et al., 2016, Ethiopia, Ghana, and Sierra Leone	Wrong study design
17.	Geldsetzer et al., 2016	Wrong study design
18.	Gilles et al., 2011, Malawi	Wrong study design
19.	Godefay et al., 2016, Ethiopia	Wrong indication
20.	Gomba et al., 2019, South Africa	Wrong study design
21.	Gomperts et al., 2012,	Wrong indication
22.	Hackett et al., 2018, Tanzania	Wrong indication
23.	Haddad et al., 2015, Malawi	Wrong intervention

24.	Jennings et al., 2015, Nigeria	Wrong study design
25.	Job et al., 2021, South Africa	Wrong patient population
26.	Kabongo et al., 2019, South Africa	Wrong study design
27.	Kayongo et al., 2019, Uganda	Wrong intervention
28.	Kilonzo et al., 2017, Kenya	Wrong study design
29.	Kola et al., 2021, Nigeria	Wrong intervention
30.	Laing et al., 2020, Gambia	Wrong outcomes
31.	Lamont et al., 2016	Review article
32.	Lori et al., 2012, Liberia	Wrong patient population
33.	Mbaruku et al., 2018, Tanzania	Wrong outcomes
34.	Mercader et al., 2017, Uganda	Wrong outcomes
35.	Murphy et al., 2014	Review article
36.	Mwase et al., 2020, Uganda	Wrong indication
37.	Nachega et al., 2016, South Africa	Wrong study design
38.	Ndlovu et al., 2019, South Africa	Wrong indication
39.	Obasola et al., 2015	Review article
40.	Odeny et al., 2014, Kenya	Wrong indication
41.	Odetola et al., 2018, Nigeria	Wrong study design
42.	Odetola et al., 2016, Nigeria	Wrong indication
43.	Omonaiye et al., 2020	Review article
44.	Onono et al., 2021, Kenya	Wrong outcomes
45.	Owili et al, 2018, 23 African countries	Wrong intervention
46.	Parkes-Ratanshi et al., 2018, Uganda	Duplicate study
47.	Petow et al., 2012	Wrong indication
48.	Phillips et al., 2019, South Africa	Wrong study design
49.	Pintye et al., 2020, Kenya	Wrong indication
50.	Purcell-Jones et al., 2019, South Africa	Wrong indication

51.	Ramachandran, 2013,	Wrong patient population
52.	Ronen et al., 2018, Kenya	Wrong outcomes
53.	Rotheram-Borus et al., 2011, South Africa	Wrong study design
54.	Sheth et al., 2010, Malawi	Wrong outcomes
55.	Tull et al., 2019, Kenya, Uganda	Wrong study design
56.	Ukachi et al., 2019, Nigeria	Wrong study design
57.	Unger et al., 2018, Kenya	Wrong indication
58.	vanHeerden et al., 2010, South Africa	Wrong patient population
59.	vanHeerden et al., 2013, South Africa	Wrong study design
60.	Vilaplana et al., 2020, Madagascar	Wrong study design
61.	Vrazo et al., 2018	Review article
62.	Willcox et al., 2019, Ghana	Wrong patient population
63.	Zunza et al., 2017, South Africa	Wrong study design