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THE EFFECTIVENESS OF MOBILE HEALTH INTERVENTIONS IN IMPROVING THE
POSTNATAL CARE UPTAKE AND EXCLUSIVE BREASTFEEDING PRACTICES
AMONG FIRST-TIME PARENTS IN WESTERN ETHIOPIA: A RANDOMIZED
CONTROLLED TRIAL

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School of Nursing

The effectiveness of mobile health interventions in improving the postnatal care uptake and exclusive breastfeeding practices among first-time parents in western Ethiopia: a randomized controlled trial

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A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of
Philosophy

July 2025

CERTIFICATE OF ORIGINALITY

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DEDICATION

This work is dedicated to my beloved father, whose memory lives with us forever.

ABSTRACT

Background: Maternal and neonatal mortality rates in Ethiopia are considerably high and continue to challenge the health of mothers and newborns. Despite significant improvements over the last decades, the maternal mortality rate and neonatal mortality rate have remained substantial and far from reaching the sustainable development goal target. Postnatal care (PNC) is a maternal care service intended to address conditions that arise during birth to the first six weeks, during which most maternal and neonatal mortality occurs. However, PNC service utilisation is low, as only one-third of mothers in Ethiopia utilise it. Furthermore, knowledge of obstetric danger signs (ODSs) amongst women and their level of exclusive breastfeeding (EBF) is insufficient, contributing to further challenges. The literature shows that factors related to a lack of knowledge, inadequate social support, difficulties in accessing healthcare counselling and disparities in access to healthcare facilities have contributed to the poor utilisation of PNC services and related outcomes. Whilst previous studies have attempted to assess the effects of mobile health (mHealth) interventions to improve PNC uptake and EBF practices in low-income settings, the findings have been inconsistent and cannot be generalised. Moreover, mHealth interventions addressing mother–father dyads have been unexplored, and most studies lack theoretical guidance.

Aim: This research project aimed to develop mobile phone-based educational message interventions for first-time parents and assess their effectiveness in enhancing PNC service utilisation, knowledge of ODSs, EBF practices, breastfeeding self-efficacy (BSE) and perceived breastfeeding support in western Ethiopia.

Methods: This thesis consists of three phases. The first phase involves developing an mHealth intervention on the basis of the theory of the health belief model and social cognitive theory and the results of a systematic review and meta-analysis of the literature on the effects of mHealth

interventions in enhancing childbirth in health facilities and PNC service utilisation in low-income settings. Validation of the intervention was then conducted. The second phase involves conducting psychometric testing on three outcome measurement scales in the target language. In the third phase, a two-arm parallel randomised controlled trial was conducted to assess the effectiveness of mobile-based educational interventions for 236 first-time parents in four public hospitals in western Ethiopia. The intervention group received an educational mobile message intervention delivered over 12 weeks (two times a week), starting from the gestational age (GA) of 31 weeks to six weeks after childbirth, in addition to routine care. The control group received only routine care. Assessments were taken at baseline (T0) (during pregnancy between 24 weeks of GA and 30 weeks of GA), at 6 weeks after birth (T1), at 12 weeks after birth (T2) and at 6 months after birth (T3), as applicable.

The primary outcome of this study was PNC uptake, which the World Health Organisation recommends utilising four PNC services: at birth, at 48–72 hours, at 7–14 days and at 6 weeks. The secondary outcomes include knowledge of ODSs, EBF practices, BSE, breastfeeding support behaviour, maternal and neonatal mortality incidence and satisfaction with the intervention programme. The effectiveness of the intervention was assessed using generalised estimating equations and binary logistic regression on the basis of the nature of the outcomes.

Results: The results of the randomised controlled trial revealed that mHealth messages effectively improved the uptake of PNC services utilised at 7–14 days postpartum (odds ratio [OR]: 2.72, 95% CI: 1.09–4.34, $p = 0.027$), EBF practices at T2 (OR = 1.90, 95% CI: 1.04–3.47, $p = 0.036$) and significantly improved mothers' overall knowledge of ODSs over time (OR = 2.67, 95% CI: 1.14–6.23, $p = 0.023$), BSE at T1 (MD = 2.14, $d = 0.52$, $p < 0.001$) and T2 (MD = 1.98, $d = 0.35$, $p = 0.016$) and mothers' perceived receipt of breastfeeding support from fathers at T2 (MD = 1.48, d

= 0.40, $p = 0.006$), fathers' perceived provision of breastfeeding support to mothers at T1 (MD = 3.68, $d = 0.35$, $p = 0.014$) and T2 (MD = 3.33, $d = 0.33$, $p = 0.022$), all ranging from small to medium effect sizes. Despite improved outcomes amongst the intervention group, no significant differences were observed for PNC 1 ($p = 0.670$), PNC 2 ($p = 0.117$) or PNC 4 ($p = 0.106$). Similarly, the effectiveness of mHealth education failed to reach a significant level for the EBF rate at 6 weeks ($p = 0.314$) and 6 months ($p = 0.096$) and mothers' perceived receipt of breastfeeding support from fathers at T1 (MD = 0.98, $p = 0.058$). Mortality complications were also not significantly different between the intervention and control groups for mothers and newborns over the study period ($X^2 = 0.29$; $p = 0.590$).

Conclusion: The mobile-based educational intervention significantly improved primary and secondary outcomes with small to medium effect sizes, notably enhancing the third PNC visit, knowledge of ODSs, EBF practices at three months, BSE over time and parents' perceived breastfeeding support behaviours. Therefore, the findings of this study provide empirical evidence that mHealth interventions can improve PNC service utilisation, EBF practices and related outcomes for first-time parents. In addition, the findings can enhance the ongoing efforts to improve the health of mothers and children in low-income settings.

PUBLICATIONS AND CONFERENCE PRESENTATIONS

Publications arising from the thesis

1. Gayesa, R. T., Ngai, F. W., & Xie, Y. J. (2023). The effects of mHealth interventions on improving institutional delivery and uptake of postnatal care services in low- and lower-middle-income countries: a systematic review and meta-analysis. *BMC Health Services Research*, 23(1), 611. <https://doi.org/10.1186/s12913-023-09581-7>
2. Gayesa, R. T., Xie, Y. J., & Ngai, F. W. (2024). Psychometric evaluation of the Afaan Oromo version of the exclusive breastfeeding social support scale among Ethiopian women. *Midwifery*, 138, 104154. <https://doi.org/10.1016/j.midw.2024.104154>
3. Gayesa, R. T., Xie, Y. J., & Ngai, F. W. (2025). Measuring the role of fathers on breastfeeding success: Psychometric properties of Ethiopia's Afaan Oromo version of the partner breastfeeding influence scale. *Journal of Pediatric Nursing*, 80, e264-e271. <https://doi.org/10.1016/j.pedn.2025.01.005>

Other Journal Publications during the PhD study period

1. Gayesa, R.T., Yin, C., Xie, Y.J., Ngai, F.W. (2025). Predictors of the family sense of coherence in pregnant women: A cross-sectional study. *Journal of Public Health*, 1-8. <https://doi.org/10.1007/s10389-025-02548-4>
2. Lam, W., Ngai, V. F., Chung, R. C., Fowler, C., & Gayesa, R. T. (2025). Associations among parental self-efficacy, symptom burden in children with medical complexity, and their use of health services. *BMC Nursing*, 24(1), 1432. <https://doi.org/10.1186/s12912-025-04084-8>

3. Gayesa, R.T., Xie, Y.J., Yin, C., Ngai, F.W. (2025). Prevalence and predictors of postnatal depression among pregnant women: a cross-sectional study. *BMC Public Health (Under Review)*.
4. Gayesa, R. T., Lam, W., Xie, Y. J., & Ngai, F. W. (2025). The mediating role of postpartum depression in the relationship between couple-based interpersonal psychotherapy and postpartum parental bonding: a randomised controlled trial. *Journal of Affective Disorders (Under Review)*

Conference Presentations

1. Gayesa, R.T., Ngai, F.W., Xie, Y.J. The effects of mHealth interventions on improving institutional delivery and uptake of postnatal care services in low- and lower-middle-income countries: a systematic review and meta-analysis [*Oral Presentation*]. Postgraduate Conference on Interdisciplinary Learning, April 2023, Lingnan University, Hong Kong.
2. Gayesa, R.T., Ngai, F.W., Xie, Y.J. The role of fathers in Breastfeeding Success: Validation of Partner Breastfeeding Influence Scale [*Poster Presentation*]. 36th International Nursing Research Congress, July 2025, Seattle, Washington, United States.

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2. Gayesa, R.T. The effectiveness of phone-based educational message intervention targeting women and their husbands on improving postnatal care services uptake in Western Ethiopia: a randomised controlled trial, October 2023, Hong Kong.
3. Gayesa, R.T. Translation and psychometric evaluation of the exclusive breastfeeding social support scale among Afaan Oromo-speaking Ethiopian women, March 2024, Hong Kong.
4. Gayesa, R.T. Measuring the role of fathers on breastfeeding success: psychometric properties of Ethiopia's Afaan Oromo version of the Partner Breastfeeding Influence Scale, October 2024, Hong Kong.
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TABLE OF CONTENTS

CERTIFICATE OF ORIGINALITY.....	ii
DEDICATION	iii
ABSTRACT.....	iv
PUBLICATIONS AND CONFERENCE PRESENTATIONS	vii
ACKNOWLEDGEMENTS	x
TABLE OF CONTENTS	xi
LIST OF TABLES	xix
LIST OF FIGURES	xxii
LIST OF APPENDICES	xxiv
LIST OF ABBREVIATIONS	xxv
CHAPTER ONE: INTRODUCTION.....	1
1.1 Introduction	1
1.2 Background	1
1.2.1 Maternal and child mortality	1
1.2.2 Maternal health service utilisation.....	3
1.2.3 Postnatal care utilisation and exclusive breastfeeding practices	4
1.2.4 Impact of mobile health on maternal health service utilisation and exclusive breastfeeding.....	8
1.3 Significance of the study	10

1.4 Overview of the thesis structure.....	11
CHAPTER TWO: LITERATURE REVIEW	13
2.1 Introduction	13
2.2 Burden of maternal and child health problems in low-income settings.....	14
2.3 Magnitude of postnatal care service utilisation and its determinants.....	18
2.4 Knowledge of obstetric danger signs	21
2.5 Exclusive breastfeeding and its determinants	24
2.6 Husband support for maternal health service utilisation and breastfeeding.....	27
2.7 Role of mobile health in maternal and child health services.....	30
2.7.1 Effects of mHealth on postnatal care uptake	32
2.7.2 Effects of mobile health on exclusive breastfeeding	33
2.7.3 Effects of mobile health on enhancing awareness of obstetric danger signs.....	34
2.8 Gaps in the literature	36
2.9 Theoretical frameworks.....	38
2.9.1 Health belief model	38
2.9.2 Social cognitive theory	40
2.10 Chapter summary	42
CHAPTER THREE: OBJECTIVES OF THE OVERALL STUDY AND CONCEPTUAL FRAMEWORK.....	43
3.1 Introduction	43

3.2 Aim, objectives and design for phase I of the study.....	44
3.3 Aim, objectives and design for phase II of the study	44
3.4 Aim, objectives and conceptual framework for phase III of the study	45
3.4.1 Hypothesis	46
3.4.2 Conceptual framework of the study.....	47
3.4.3 Rationale for using the frameworks of the HBM and SCT	48
3.4.4 Expected behavioural changes based on the HBM and SCT constructs	49
3.5 Chapter summary	51
CHAPTER FOUR: SYSTEMATIC REVIEW AND META-ANALYSIS AND DEVELOPMENT OF THE INTERVENTION (PHASE I).....	52
4.1 Introduction	52
4.2 Background	52
4.3 Methods.....	56
4.3.1 Search strategy.....	56
4.3.2 Inclusion and exclusion criteria.....	57
4.3.3 The outcome of the study	59
4.4 Results	67
4.4.1 Characteristics of included studies	67
4.4.2 Characteristics of Interventions	68
4.4.3 Study outcome	71
4.4.4 Publication Bias	76
4.5 Discussion	77

5.3.7 Ethical Considerations	91
5.3.8 Breastfeeding Self-efficacy Scale -Short Form	91
5.3.9 Exclusive Breastfeeding Social Support Scale	98
5.4 Psychometric Evaluation of Partner Breastfeeding Influence Scale	108
5.4.1 Introduction	108
5.4.2 Specific objective	109
5.4.3 Study design	109
5.4.4 Study participants	109
5.4.6 Data collection techniques.....	109
5.4.7 Statistical analysis and indices of Psychometric testing.....	110
5.4.8 Ethical Considerations	110
5.4.9 Results	111
4.4.10 Discussion.....	120
5.5 Chapter Summary.....	124
CHAPTER SIX: METHODS FOR RANDOMIZED CONTROLLED TRIAL (PHASE III OF THE STUDY).....	125
6.1 Introduction	125
6.2 Study Design	125
6.3 Study setting.....	126
6.4 Eligibility of study participants	128
6.5 Sample size determination	128
6.6 Participant recruitment and baseline data collection.....	129

6.7 Randomisation and blinding of study participants	130
6.8 Interventions.....	130
6.9 Intervention fidelity.....	131
6.10 Measurement of the outcomes.....	132
6.10.1 Uptake of postnatal care	132
6.10.2 Knowledge of obstetric danger signs.....	133
6.10.3 Breastfeeding efficacy and exclusive breastfeeding practice	133
6.10.4 Perception of receiving support for exclusive breastfeeding.....	134
6.10.5 Perception of providing support for breastfeeding amongst husbands.....	134
6.10.6 Incidence of maternal and neonatal mortality	135
6.10.7 Satisfaction with the intervention	135
6.11 Data collection procedure.....	135
6.12 Quality control measures.....	137
6.13 Data analysis	138
6.14 Ethical considerations	139
6.15 Chapter summary	139
CHAPTER SEVEN: RESULTS (PHASE III OF THE STUDY)	141
7.1 Introduction	141
7.2 Participant recruitment	141
7.3 Characteristics of the study participants.....	144
7.3.1 Sociodemographic characteristics of mothers	144

7.3.2 Sociodemographic characteristics of fathers	145
7.3.3 Baseline characteristics of obstetric danger signs	147
7.3.4 Baseline knowledge of obstetric danger signs amongst mothers	148
7.3.5 Baseline breastfeeding self-efficacy amongst mothers.....	149
7.4 Results of the outcomes amongst mothers	149
7.4.1 Primary outcome.....	149
7.4.2 Results of secondary outcomes.....	151
7.5 Results of the secondary outcomes amongst fathers.....	165
7.5.1 Breastfeeding support provided by fathers.....	165
7.5.2 Satisfaction with mobile health interventions amongst mother–father dyads	168
7.6 Chapter summary	170
CHAPTER EIGHT: DISCUSSION	171
8.1 Introduction	171
8.2 Primary outcome	171
8.2.1 Postnatal care uptake	171
8.3 Secondary outcomes.....	175
8.3.1 Knowledge of obstetric danger signs.....	175
8.3.2 Exclusive breastfeeding practices.....	177
8.3.3 Breastfeeding self-efficacy	180
8.3.4 Receiving support for exclusive breastfeeding.....	181
8.3.5 Providing support for breastfeeding	183
8.3.6 Maternal and newborn complications.....	185

8.4 Implications of the study	186
8.4.1 Implications for research	186
8.4.2 Implications for policy and practice	187
8.5 Strengths and Limitations of the Study	188
8.5.1 Strength of the study	188
8.5.2 Limitations of the study	189
8.6 Chapter summary	190
CHAPTER NINE: CONCLUSION AND RECOMMENDATIONS	191
9.1 Conclusion.....	191
9.2 Recommendations	192
APPENDICES	194
REFERENCES	232

LIST OF TABLES

Table 4.1 Data extraction for included studies and summary of their key results.....	58
Table 5.1 Socio-economic and obstetric-related characteristics of the study participants.....	90
Table 5.2 Goodness of fit indices for BSES-SF-AO amongst breastfeeding women.....	93
Table 5.3 Standard estimate for the items of BSES-SF-AO amongst breastfeeding women	93
Table 5.4 The relationship between BSES-SF-AO and socio-demographic variables.....	94
Table 5.5 Goodness of fit indices for EBFSS-AO amongst breastfeeding women.....	99
Table 5.6 Factor loadings of the EBFSS-AO amongst breastfeeding women.....	99
Table 5.7 The relationship of sociodemographic and obstetric characteristics with the EBFSS-AO score.....	101
Table 5.8 Socio-demographic variables of the study participants	109
Table 5.9 Item-total correlation of the PBIS amongst fathers	111
Table 5.10 Exploratory factor analysis showing the factor structure of PBIS-AO among fathers.....	114
Table 5.11 The overall and sub-scale scores based on sociodemographic variables for PBIS-AO.....	117
Table 6.1 Flow of outcome measurement time points.....	134
Table 7.1 Sociodemographic characteristics of mothers in intervention and control groups.....	142

Table 7.2 Baseline sociodemographic differences among intervention and control groups for husbands.....	143
Table 7.3 The baseline knowledge of obstetric danger signs among pregnant women.....	145
Table 7.4 Baseline difference in knowledge of obstetric danger signs and breastfeeding self-efficacy amongst intervention and control groups of mothers.....	146
Table 7.5 Binary logistic regression for the uptake of postnatal care services amongst women.	148
Table 7.6 Frequency and percentage of knowledge of obstetric danger signs post-intervention.....	150
Table 7.7 Generalised estimating equations results of knowledge of obstetric danger signs over the study period.....	151
Table 7.8 Mean and SD of women's breastfeeding self-efficacy over the study period amongst women.....	152
Table 7.9 Generalised estimating equations results of Breastfeeding self-efficacy among mothers over the study period.....	152
Table 7.10 Pairwise comparison of means of Breastfeeding self-efficacy amongst mothers over the study period.....	153
Table 7.11 Mean and SD of breastfeeding support received by women over the study period...	155
Table 7.12 Generalised estimating equations results of EBF support received amongst mothers over the study period.....	156

Table 7.13 Pairwise comparison of means of total perceived EBF support received amongst mothers over the study period.....	157
Table 7.14 The pairwise comparison of mothers' perceived receipt of EBF support for subdomains.....	157
Table 7.15 The exclusive breastfeeding practice amongst women at T1.....	159
Table 7.16 Types of breastfeeding practices amongst women at T2.....	160
Table 7.17 The exclusive breastfeeding practice among women at T3.....	161
Table 7.18 Logistic regression of EBF practice at the three time points among intervention and control groups.....	161
Table 7.19 Mean and SD of fathers' breastfeeding support over the study period.....	163
Table 7.20 GEE results of overall and sub-domains of breastfeeding support provided over the study period.....	164
Table 7.21 Pairwise comparison of mean of overall breastfeeding support provided among groups over the time points.....	166
Table 7.22 Satisfaction with mobile health intervention program among mother-father dyads.....	167

LIST OF FIGURES

Figure 3.1 Conceptual framework of mobile-based educational message intervention on postnatal care uptake, adapted from the health belief model and social cognitive theory.....	48
Figure 4.1 Prisma flow diagram of studies included in the systematic review and meta-analysis.....	56
Figure 4.2 The risk of bias graph for the studies included in the systematic and meta-analysis...	68
Figure 4.3 The risk of bias summary for the studies included in the systematic and meta-analysis	69
Figure 4.4 A forest plot showing the effect of mHealth on improving the utilisation of institutional delivery.....	71
Figure 4.5 A forest plot showing the effect of mHealth on improving the utilisation of postnatal care.....	73
Figure 4.6 A forest plot showing the effect of mHealth on improving exclusive breastfeeding practice.....	73
Figure 4.7 The funnel plot showing the symmetry of included studies reporting institutional delivery outcome.....	74
Figure 4.8 The funnel plot showing the symmetry of included studies reporting exclusive breastfeeding outcome.....	75
Figure 4.9 The funnel plot showing the symmetry of included studies reporting postnatal care utilisation outcomes.....	75

Figure 6.1 Flow diagram of participant enrolment and allocation to intervention and control arms.....	124
Figure 7.1 Consort flow diagram of participants' recruitment and follow-up.....	142
Figure 7.2 Profile plot of the percentage of postnatal care service uptake among mothers over the study period.....	149
Figure 7.3 Profile plot of the percentage of knowledge of obstetric danger signs among mothers over the study period.....	152
Figure 7.4 Profile plot of breastfeeding self-efficacy scores among mothers over the study period.....	154
Figure 7.5 Profile plot of mothers' perceived exclusive breastfeeding support received from fathers over the study period.....	159
Figure 7.6 Profile plot of exclusive breastfeeding rate among mothers over the study period.....	162
Figure 7.7 Profile plot of fathers' perceived breastfeeding support provided to mothers over the study period.....	166

LIST OF APPENDICES

Appendix I Ethical approval letter.....	192
Appendix II Wollega University Institute of Health Science Support letter.....	193
Appendix III Intervention Messages - English version.....	194
Appendix IV Intervention Messages- Afaan Oromo version.....	197
Appendix V Expert feedback request form for intervention validation.....	200
Appendix VI Sample Logbook to mark receiving intervention messages- given to dyads.....	202
Appendix VII Subject Information Sheet English version.....	203
Appendix VIII Consent form for participation in the study-English version.....	206
Appendix IX English Version questionnaire for RCT study- collected from women.....	207
Appendix X Subject Information Sheet for RCT Study- Afaan Oromo Version.....	213
Appendix XI Subject Information sheet- Afaan Oromo version.....	216
Appendix XII Consent form for RCT study- Afaan Oromo version.....	219
Appendix XIII Afaan Oromo Version questionnaire for RCT study- Collected from women....	220
Appendix XIV The Breastfeeding support questionnaire collected from husbands-Afaan Oromo version.....	227

LIST OF ABBREVIATIONS

ANC	Antenatal Care
BSE	Breastfeeding self-efficacy
CFI	Comparative Fit Index
CI	Confidence Interval
CSA	Central Statistical Authority
EBF	Exclusive Breastfeeding
EBFSS	Exclusive breastfeeding social support scale
EMDHS	Ethiopian Mini Demographic Health Survey
ETB	Ethiopian Birr
GEE	Generalized Estimating Equations
HBM	Health Belief Model
ICD	International Classification of Diseases
IVR	Interactive Voice Response
LLMICS	Low and Lower-Middle-Income Countries
MD	Mean Difference
ODS	Obstetric Danger Signs
OR	Odds Ratio
PBIS	Partner breastfeeding influence scale

PNC	Postnatal Care
RCT	Randomized Controlled Trial
RMSEA	Root Mean Square Error of Approximation
SCT	Social Cognitive Theory
SDG	Sustainable Development Goals
SMS	Short Message Service
SRMR	Standard Root Mean Square Error
SSA	Sub-Saharan Africa
TLI	Tucker-Lewis Index
UNICEF	United Nations Children's Fund
USD	United States Dollars
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter presents background information on the burden of maternal and child health problems in developing regions and the factors contributing to these problems. It also highlights health service usage, particularly the challenges related to postnatal care (PNC) service uptake and challenges in the practice of exclusive breastfeeding (EBF). Moreover, the role of husband support for mothers in utilising health services and breastfeeding, and the use of mobile health (mHealth) in enhancing postnatal service utilisation and EBF are discussed. This chapter also presents the significance of the overall study in improving the health of mothers and newborns.

This chapter is organised into four sections. Section 1.1 introduces the chapter. Section 1.2 presents background information on maternal and child mortality and the role of maternal health service utilisation in reducing maternal, neonatal and child mortality. This section also describes the impact of mHealth on improving the utilisation of PNC services and EBF practices. The research gap of the present study is also highlighted. Section 1.3 presents the significance of the study. Section 1.4 highlights the overall thesis structure.

1.2 Background

1.2.1 Maternal and child mortality

Maternal death, as stated by the World Health Organisation (WHO) in the ICD-10, is the death of a woman during pregnancy, or within 42 days of termination of pregnancy, regardless of the duration and location of the pregnancy, from any cause associated with or worsened by the pregnancy or its treatment but not from accidental or incidental causes (WHO, 2012). Amongst all maternal deaths, approximately 75% are due to direct obstetric causes, such as obstetric

haemorrhage, hypertensive disorders of pregnancy, postpartum infections and childbirth complications (WHO, 2024c). In lesser magnitude, indirect causes, which include preexisting problems such as mental disorders, HIV and diabetes aggravated by pregnancy, also contribute to maternal mortality worldwide (Lytle et al., 2018; Storm et al., 2014). Maternal mortality has remained high globally, though it dropped by 34% between 2000 and 2020. The burden of this death is notable in low- and lower-middle-income countries (LLMICs), as approximately 95% of preventable pregnancy and childbirth deaths were recorded in these countries in 2020 (WHO & UNICEF, 2023).

In low-income settings, the maternal mortality rate was 430 per 100,000 live births, whereas in high-income countries, this figure was as low as 13 deaths per 100,000 live births in 2020. In terms of neonatal mortality, children born in developing countries, mainly sub-Saharan Africa (SSA), are ten times more likely to die in the first month than are children born in high-income countries (WHO, 2022b). Infectious disorders such as acute respiratory infections, diarrhoea and malaria, preterm birth problems, birth asphyxia, trauma and congenital disabilities are the leading causes of death for children under five years of age. Access to essential interventions, such as skilled childbirth, high-quality PNC, breastfeeding, good nutrition, immunisation and treatment for common childhood illnesses, can considerably reduce these problems (WHO, 2024a).

With regard to the health of mothers, Ethiopia has faced greater challenges, with an estimated 412 maternal deaths from 100,00 live births amongst SSA countries (CSA, 2016; WHO & UNICEF, 2023). Much like maternal mortality, neonatal and child mortality in Ethiopia were a notable concern, with 30 deaths per 1,000 live births associated with neonatal asphyxia and infection. In 2019, more than three-quarters of deaths amongst children under five years of age were attributed to five leading causes: neonatal disorders (40.7%), diarrheal diseases (13.2%), lower respiratory

infections (10.3%), congenital disabilities (7.0%) and malaria (6.0%). Although all regional states in Ethiopia have observed a decline in under-5, infant and neonatal mortality rates over the past three decades, the majority of sustainable development goal (SDG) targets have been unfulfilled (Tessema et al., 2023).

1.2.2 Maternal health service utilisation

Maternal health care services, including antepartum, intrapartum and postpartum care, are amongst the key interventions used to reduce the maternal mortality ratio (ACOG, 2019). These health services are also crucial for lowering neonatal and child mortality. For example, the incidence of neonatal mortality was 52% lower amongst births that occur at health facilities than amongst home births in low- and middle-income countries (LMICs) (Chaka et al., 2020). In the same way, quality provision of PNC can reduce the chance of neonatal mortality by 26% compared to those who do not receive any PNC (Singh et al., 2022). This trend implies that maternal and child deaths are preventable by upgrading available healthcare solutions during pregnancy, childbirth and the postpartum period (WHO, 2024b). Thus, enhancing the use of maternal and child health services is essential to prevent deaths and complications during pregnancy, childbirth and the postpartum period (USAID, 2015). Moreover, the health of the mother and child is deeply intertwined and needs to be addressed together, and this can be best achieved via a continuum-of-care strategy from pregnancy to the postpartum period (Lassi et al., 2013).

PNC is a key element of the continuum of care given to mothers and newborns starting right after childbirth. This service is aimed at promoting health, preventing diseases and early detection and management of complications amongst mothers and newborns (Wojcieszek et al., 2023). Consequently, the PNC service has the potential to significantly contribute to the global target of the SDGs, which aims to “reduce maternal mortality to below 70 per 100,000 live births, neonatal

deaths to at least 12 per 1,000 and under-five mortality to at least 25 per 1,000 live births” (UN, 2016). Without adequate utilisation of existing healthcare services, the risk of these complications could be high (Souza et al., 2024).

A woman’s health during pregnancy, delivery and postpartum guarantees the best possible health and well-being for the mother and child. Antenatal care (ANC), access to health facilities during childbirth and PNC are essential services within the maternal and newborn care continuum. Amongst maternal service components, PNC is the least utilised service point regardless of its critical role in abating women and newborn deaths. PNC’s key role is related to its service provision period in which the rate of maternal and newborn death is likely high (Sagawa et al., 2021; Tefera et al., 2021). PNC services include examination of both the mother and newborn, in addition to providing various counselling services such as EBF, family planning, hygiene, and nutrition. Amongst the services, early initiation and EBF play significant roles in the health of newborns, suggesting that interventions during this time are imperative for fostering EBF practices (Triadmajani et al., 2024).

1.2.3 Postnatal care utilisation and exclusive breastfeeding practices

Ideally, PNC is provided to the mother and newborn from immediately after childbirth to six weeks postpartum (Aderoba & Adu-Bonsaffoh, 2022). The literature shows that routine PNC coverage of 90% will prevent 10 to 27% of newborn deaths, implying that improving PNC service uptake could save nearly 310,000 newborn lives in Africa each year (Adegboyega et al., 2023; Hampshire et al., 2021). The postpartum period is regarded as a critical period, as the majority of maternal and newborn deaths take place during the first 42 days of childbirth. Yet, this phase often gets less attention pertaining to the provision of continuous, quality care and support (WHO, 2025). Despite the Safe Motherhood initiative’s attention to ensuring the availability and uptake of postnatal

services, this area of the maternal care continuum continues to be underserved (Belachew & Taye, 2016; Sacks & Langlois, 2016). Failure to attend maternal health services, particularly PNC, is a multifaceted problem for healthcare systems in low- and middle-income countries (WHO, 2018).

Many studies have shown that postpartum services are essential to the maternal, neonatal and infant care as well as pivotal to achieving the SDGs, which are targeted at reducing maternal mortality rates and eliminating preventable newborn deaths (McCauley et al., 2022; WHO, 2022d). The WHO recommends four PNC visits. The first PNC contact is made immediately after childbirth in the health facility, and ongoing support is provided for at least the next 24 hours. Meanwhile, the initial contact for the first PNC should be done within 24 hours of birth if the child is born at home. Three additional visits between 48 and 72 hours, 7–14 days and 42 days after childbirth are recommended with continuous care and follow-up (WHO, 2022d).

Early PNC has the potential to reduce the significant number of maternal and newborn deaths that occur within the first 24 hours following delivery; it is also a vital service point to treat complications associated with childbirth for the mother and the newborn. Furthermore, this is an important time to provide a woman and her accompanying family with crucial information on caring for themselves and their child (WHO, 2015). PNC is an intervention package that includes a proper physical examination of the mother and baby, counselling on danger signs of the mother and newborn, early initiation of breastfeeding and counselling on EBF, contraception counselling and child immunisations (McCauley et al., 2022).

PNC services are also a critical period when challenges related to breastfeeding are addressed. Worldwide, more than 800,000 child deaths may be prevented each year with the increasing trend of breastfeeding (UNICEF, 2024b). In addition, breastfeeding initiation reduced infant death

between the ages of 7 and 365 days by 26% (Li et al., 2022). Breastfeeding is also known to reduce newborn fatalities from necrotising enterocolitis (Li et al., 2022), and according to available literature, breastfeeding decreases global infant mortality by 13% and sudden infant death by 36%. The later evidence also showed that breastfeeding lessens the reliance on baby formula, reducing expenses associated with medical care and early child mortality (Brahm & Valdés, 2017).

Ethiopia has faced challenges in terms of maternal and infant health due to the limited uptake of PNC services, in which EBF-related counselling and support services were also underserved. These challenges have contributed to a substantial proportion of maternal and newborn mortality and morbidity taking place in Ethiopia (The DHS Program & ICF, 2019). In Ethiopia, despite encouraging improvements, only one-third of women receive postpartum care within two days of delivery, which may be a contributing factor to the high maternal mortality rate in the country, according to the '2019 Mini Demographic Health Survey' (MDHS) (The DHS Program & ICF, 2019). This survey further showed that only 34% of women received a PNC check-up within the first two days after birth in 2019, of which 48% were in urban areas and less than one-third in rural areas. A meta-analysis of evidence similarly identified that only less than one-third of women received at least one postnatal visit (Chaka et al., 2019). Amongst home births, only 3% postpartum services (Ayele et al., 2019).

Numerous study findings in Ethiopia showed various sets of factors influencing PNC usage and its related outcomes. The main factors reported by these studies include lack of knowledge on pregnancy-related complications and benefits of PNC; having attended few ANC schedules in the previous pregnancy; inaccessibility to healthcare provider counselling; no prior history of birth at health facility, and lack of sufficient partner support, in addition to sociodemographic factors such

as educational status (Akibu et al., 2018; Berhe et al., 2019; Somefun & Ibisomi, 2016; Tesfahun et al., 2014; Titaley et al., 2009; Woldasemayat et al., 2022).

As reported in these studies, being aware of ODS was a significant predictor of PNC uptake. However, the level of knowledge about these danger signs amongst women in Ethiopia is relatively low. According to meta-analysis evidence, women's knowledge of ODSs during pregnancy, childbirth and the postnatal period was 48%, 43% and 32%, respectively (Geleto et al., 2019). The knowledge level of women and families about warning signs during the perinatal period is vital because it aids early detection and management of impending obstetric complications (McCauley et al., 2022). Hence, addressing the knowledge gap of expectant mothers and their families is essential as it could enhance the use of PNC services. Technology-based intervention strategies, such as mHealth, can be employed to reach families and provide them with health information.

In Ethiopia, many mothers underutilise PNC, and EBF is also not optimal (Muluneh, 2023). First-time parents are particularly prone to this trend due to their limited knowledge of PNC and EBF benefits and insufficient understanding of ODSs (Triadmajani et al., 2024). First-time expectant mothers and their partners may have limited knowledge and experience with pregnancy danger signs and the benefits of available health care services. Besides, the husbands may not have sufficient awareness of their role in providing support. Therefore, targeting husbands together with pregnant mothers is key, as their different forms of support are paramount. According to studies, new mothers often have limited knowledge of any danger signs that can occur during pregnancy, childbirth or postpartum, and if they know, they are unaware of what actions they need to take (Logsdon et al., 2018). In addition, first-time mothers are often younger and are at risk of adverse outcomes, including social, economic and health burdens, because of early motherhood (Hoffmann et al., 2020). New parents require advice on recognising ODS, utilising healthcare services

effectively and practising optimum breastfeeding to prevent adverse health outcomes during the perinatal period. For this reason, informing new mothers and their families is critical to help them use the PNC services. Moreover, the literature revealed that healthcare providers do not adequately consider the support that families provide, including informational and psychological support, leading to less effective engagement in PNC uptake (Finlayson et al., 2023). This situation should be changed by engaging family members and giving them flexible contact options to meet the family's health needs (Finlayson et al., 2023). Thus, easily accessible technology-based interventions, such as mHealth, should be assessed if they can improve knowledge, attitudes and behaviours related to PNC uptake and EBF practices.

1.2.4 Impact of mobile health on maternal health service utilisation and exclusive breastfeeding

Usually, mHealth is used to describe the utilisation of wireless communication tools to support public health and clinical practice (Pal et al., 2021); it is regarded as a 'health-enabling tool' that benefits the healthcare system by increasing access to quality healthcare and lowering healthcare costs. Mobile phones, personal digital assistants and smartphones are examples of mobile technology used in healthcare delivery (Fortuin et al., 2016).

Currently, mHealth technology is valuable for disease prevention, promoting lifestyle changes and managing chronic disease conditions. Whilst more research is necessary, available evidence shows that these technology-based interventions can facilitate behavioural changes in promoting health and preventing diseases (Changizi & Kaveh, 2017; Hicks et al., 2023). The accessibility of phones and the use of mHealth are potential solutions to many challenges that developing nations, including Ethiopia, face in healthcare delivery systems (WHO, 2011). Over the last decade, evidence has shown that mHealth, such as text and phone call reminders, has been used to increase

adherence to healthcare appointments, improve access to healthcare and enhance adherence to therapy and follow-up, thereby increasing the efficiency of health service delivery across different settings (Downer et al., 2006; Marcolino et al., 2018). For instance, a systematic review carried out in LMICs demonstrated that reminders using mHealth interventions and digital tools given to healthcare workers have enhanced ANC attendance and timely child immunisation. Nonetheless, their impact remained indecisive on facility childbirth and infant feeding practice outcomes (Knop et al., 2024). Various other studies in the same setting have shown the positive effect of mHealth in improving maternal–child health by enhancing service utilisation throughout the maternal care continuum (Nuhu et al., 2023). Nevertheless, further investigations on the effectiveness of mHealth may still be needed, in which interventions are tailored in accordance with the culture and specific situations of the study population.

As the use of mobile phones has been expanding recently in Ethiopia, mHealth could bring a promising prospect for strengthening the healthcare system and improving service delivery. About 77.39 million active cellular mobile connections were present in Ethiopia in 2024, constituting about 60% of the country’s entire population (Kemp, 2024). Since about five people live in one household in Ethiopia on average, (ILO, 2021), each household would own at least two mobile phones on average. This rapid growth in mobile usage would widen the opportunities for the healthcare system to promote health and prevent illness despite several barriers to accessing healthcare.

With the gap associated with low utilisation of PNC and suboptimal EBF practice in the era of rapidly growing mobile phone usage in Ethiopia, exploring the effectiveness of mobile phone-based interventions in addressing these challenges is paramount. Hence, the effectiveness of mHealth must be further investigated due to limited evidence on the potential effects of these

interventions on PNC service uptake and EBF practices in Ethiopia (Atnafu et al., 2017; Kebede et al., 2019). The evidence that mHealth interventions, such as reminder messages, are effective in enhancing the uptake of ANC and PNC is limited, and they do not sufficiently address the role of family support in healthcare service uptake and EBF. Given the husband's significant role in Ethiopian households as the family head, chief decision maker and primary support provider, every intervention to improve the family's health should involve the husband (Tadele et al., 2019). Moreover, mHealth intervention strategies focusing on mother–father dyads have been unexplored thus far. Thus, this study aims to develop a mobile phone-based educational message intervention targeting new parents and test its effectiveness in improving the utilisation of PNC services and related outcomes, specifically in terms of knowledge of danger signs, EBF practices, and husband support behaviour in western Ethiopia.

1.3 Significance of the study

In Ethiopia, evidence concerning the effectiveness of mHealth interventions in promoting health service utilisation, such as PNC services and EBF practices throughout the maternal care continuum, remains limited. This study aimed to evaluate the effectiveness of mobile-based educational interventions in enhancing PNC, EBF and related outcomes amongst first-time parents. The intervention in this study is guided by theoretical frameworks and is focused on new parents, which is mainly overlooked by previous studies. This study has the potential to have a significant influence on public health and clinical practice by depicting how mHealth interventions can improve the health of mothers and their infants. The present study's findings may also enhance how parents access healthcare information despite the barriers and support them in making decisions in seeking healthcare. The cost-effectiveness of mHealth interventions and their scalability to broader health problems and diverse population groups are also significant aspects

of the study's contribution. The results of this study can have substantial implications for clinical services, as it could help monitor adherence to recommended guidelines and keep healthcare providers informed for the early identification and management of complications amongst mothers and newborns. Additionally, this study can provide policymakers with empirical evidence to devise an appropriate strategy in the ongoing efforts of strengthening uptake of PNC, EBF practices and knowledge of ODS amongst new parents. Moreover, it could add further evidence to the existing body of knowledge, assisting future researchers interested in investigating mHealth and maternal healthcare utilisation.

1.4 Overview of the thesis structure

This thesis is organised into nine chapters. Chapter One presents the introduction to the current study, including background information on the problem related to poor utilisation of PNC and inadequate EBF practice, the rationale of the mHealth intervention and the significance of the study. Chapter Two presents a detailed literature review of the problem, including the magnitude and determinants of PNC utilisation, EBF, knowledge of ODSs and the effects of mHealth interventions. This chapter also presents the gaps identified in the literature and outlines the conceptual framework that guides mHealth interventions. Chapter Three presents the overall design of this research project in three phases, the objectives of each phase and the adapted conceptual framework to carry out the study. Chapter Four presents phase I of the study, which includes a systematic review and meta-analysis of the literature to inform the development of mHealth educational message interventions in lower-income settings. It also presents the detailed development and validation of the intervention. Chapter Five presents phase II of the study project, which includes a brief description of the validation of three outcome measurement scales. Chapter Six presents the study methods used to conduct the randomised controlled trial (RCT) (Phase III

of the study), which assesses the effectiveness of the intervention. Chapter Seven presents the RCT findings on the effectiveness of mHealth interventions for all the outcomes. In Chapter Eight, the RCT findings, the strengths and limitations of the overall study are briefly elaborated. Chapter Nine is the final chapter, presenting the study's conclusion and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the existing body of literature on maternal and child health problems in low-income settings, with particular emphasis on the factors contributing to these problems and the actions taken and efforts made to address them. Challenges related to poor utilisation of maternal health services, particularly PNC, and their associated factors are thoroughly reviewed. Since mothers' knowledge of ODSs during pregnancy, childbirth and the postpartum period is a critical factor influencing health service utilisation, the magnitude of women's knowledge and factors associated with their knowledge attainment are presented. Another key component of PNC services reviewed in this chapter is the issue of EBF practice and challenges related to non-adherence to recommended EBF practices. Moreover, the role of mHealth interventions in improving the identified challenges is thoroughly reviewed, and gaps from the review are identified in the present chapter.

This comprehensive review narrates the literature published in English, particularly that conducted in lower-income settings. Several databases were searched, including PubMed, Medline, Scopus, Google Scholar and Google. The evidence sources used for the review were WHO and UNICEF guidelines and reports, as well as primary studies and systematic reviews on maternal and newborn challenges during postpartum. Although most of the included literature were published in the last 10 years, evidence from earlier periods was also utilised when relevant.

This chapter is organised into ten sections. Section 2.1 introduces the chapter. Section 2.2 discusses the burden of maternal and child health issues. Section 2.3 outlines challenges related to the use of PNC services and their determinants. Section 2.4 discusses the level of knowledge regarding ODSs. Section 2.5 highlights the challenges associated with EBF during the postpartum period.

Section 2.6 highlights the impact of fathers' support on the utilisation of mothers' health services and breastfeeding. Sections 2.7 to 2.9 review the effects of mHealth interventions on improving PNC, knowledge of ODSs and EBF practices. Section 2.10 summarises the chapter.

2.2 Burden of maternal and child health problems in low-income settings

Maternal health includes women's health before, during, and after childbirth, and each of these stages must be pleasant to ensure that the mother and her unborn child have the best health and well-being. Reducing preventable deaths and reaching the SDGs depends on the health of women, infants, and young children (WHO, 2022a). The world has made a substantial effort in maternal and infant care, resulting in a nearly 50% decrease in neonatal mortality in the years between 1990 and 2020. Yet, a considerable number of mothers and newborns continue to die due to pregnancy and childbirth complications which are largely preventable (WHO, 2023b). Many countries struggle to increase maternal and newborn survival rates and reduce stillbirths because not everyone has access to affordable and high-quality healthcare services. During the first month of life, more than 6,500 babies die every day, and in 2020, infant deaths reached 2.4 million worldwide. Besides, about 810 women die each day from pregnancy or childbirth complications that could have been avoided. Between 2020 and 2030, close to 48 million under-five children are projected to die, with neonates accounting for half of these deaths (UNICEF, 2020b).

Susceptibility to mother and newborn complications differs across many countries, indicating disparities worldwide. For example, the maternal and newborn deaths in LMICS constitute the majority, particularly in SSA and South Asia (WHO & UNICEF, 2022). The SSA alone accounts for more than two-thirds of maternal mortalities (WHO, 2024b). In SSA, a woman's lifetime risk of maternal death is 1 in 37, whereas it is 1 in 4800 in Europe and North America (Forum, 2022; WHO & UNICEF, 2022). Despite improvements in recent decades, newborn mortality is still

higher in this region than in any other part of the world. In 2022, SSA had 27 neonatal deaths per 1000 live births, followed by Central Asia and Southern Asia, with 21/1000 live births (WHO, 2024a).

Amongst SSA countries, Ethiopia is where maternal and infant mortality rates remain high, which is attributed to different causes. According to the Ethiopian Demographic Health Survey (EDHS), pregnancy and delivery complications resulted in 412 maternal deaths out of 100,000 live births and a total of 1000 infants, 48 of whom died before their first birthday was celebrated (CSA, 2016). Recent evidence from the United Nations Children's Fund (UNICEF) also revealed that the maternal mortality ratio in Ethiopia has declined to 267/100,000 live births and 34 infant deaths per 1000 infants (UNICEF, 2023c). This evidence shows that the burden of maternal and newborn death is still quite substantial in Ethiopia, despite significant efforts and improvements made in the health of women and newborns by the government, signifying requirement of further endeavours.

Most frequent causes of maternal and newborn deaths emanate from complications that develop during pregnancy, labour or the postpartum period (UNICEF, 2023b). These include haemorrhage and hypertensive disorders of pregnancy in mothers and sepsis, prematurity, infections and birth asphyxia in infants (Goldenberg et al., 2018; Tesfay, Tariku, Zenebe, Dejene, et al., 2022; Tesfay, Tariku, Zenebe, & Woldeyohannes, 2022). Preterm birth and intrapartum complications such as birth asphyxia and infections account for nearly 80% of all deaths worldwide (UNICEF, 2020a). Despite these improvements, neonatal and infant mortality rates are still substantial (UNICEF, 2023c). Interventions to prevent early neonatal death significantly contribute to lowering the overall neonatal mortality rate (UNICEF, 2020b).

The WHO and UNICEF guidelines indicate that skilled birth and postpartum follow-up care are critical to the health of mothers and babies (UNICEF, 2022). Essential newborn care, including thermal care, cord care and prompt breastfeeding, is a critical component that skilled birth attendants provide. Moreover, skilled birth could make emergency care readily available in the event of potentially deadly complications. This denotes that an infant that is unbreathing when born will die in minutes unless urgently intervened (UNICEF, 2022). In Ethiopia, however, more than half (52%) of deliveries were unattended by skilled birth attendants, and only 59% of newborns under six months were exclusively breastfed in 2019 (The DHS Program & ICF, 2019).

UNICEF further suggests that after childbirth, maternal and child healthcare should continue for some time, during which the mother and the newborn should pursue ongoing follow-up care. On top of that, the WHO recommends receiving PNC within a day after birth, whichever place the baby is born (WHO, 2015). The mother and newborn should also have at least three more postnatal appointments with a skilled provider, ideally on day 3 (48–72 hours after birth), between days 7–14 and once more six weeks following delivery (UNICEF, 2022). During postnatal visits, women should be counselled for newborn danger signs, such as inadequate feeding, rapid breathing, severe chest in-drawing, fever, hypothermia or jaundice, which are all signs of danger. Moreover, mothers are provided with information on how to recognise and respond to these signs and the advantages of EBF and vaccination (UNICEF, 2022). Therefore, health interventions provided to women during pregnancy, childbirth and postpartum have dual benefits in terms of preventing maternal and neonatal mortality.

Ethiopia has implemented various maternal health initiatives and programmes to achieve sustainable development and transformation goals (MOH, 2022). These initiatives have increased ANC access and quality, increased skilled birth attendance at health facilities, increased

postpartum health care coverage and increased caesarean section service coverage (MOH, 2022). Despite these encouraging developments, maternal and child health still necessitates ongoing efforts on the part of all stakeholders in Ethiopia (WHO & UNICEF, 2022). Accelerated efforts are needed to close coverage gaps and reach the 2030 Agenda goal of universal health coverage.

Enhancing the utilisation of PNC services is a key strategy for reducing maternal and newborn mortality; however, this strategy often receives inadequate attention. Given that almost two-thirds of maternal deaths in Ethiopia occur during the postpartum phase, it is generally anticipated that the use of PNC services should be greater (Tesfay, Tariku, Zenebe, & Woldeyohannes, 2022). In 2019, only 34% of women stated receiving postpartum care within the first two days of birth, and the rate was much lower in rural areas (The DHS Program & ICF, 2019). The postpartum period is a critical time when multiple services can be provided to save the lives of mothers and newborns. Mothers are evaluated immediately after childbirth for bleeding, changes in vital signs, bowel movement, urination and other danger signs (McCauley et al., 2021). A newborn would also be evaluated for breathing problems and given the necessary cord care. Before discharge, EBF starts early, and BCG and polio vaccinations are given. Furthermore, the woman was advised to have regular postnatal check-ups until six weeks postpartum and to receive immediate medical attention if any danger signs appeared on her or the newborn. Counselling on good hygienic practices, nutrition, the use of family planning services and EBF for the first six months can also be given (Moldenhauer, 2022). The levels of PNC services, knowledge and practice of EBF and awareness of danger signs of mothers and newborns are far below the optimal levels in Ethiopia, which need to be addressed.

2.3 Magnitude of postnatal care service utilisation and its determinants

PNC services are essential to the maternal care continuum for safe motherhood (Save the Children, 2007). According to the WHO, every mother should receive immediate PNC within 24 hours of childbirth and three additional PNC contacts until six weeks postpartum (WHO, 2015). PNC services aim to identify problems and promote and maintain the health of mothers in which healthcare providers address any postpartum issues, such as providing appropriate treatment for impending complications (Adane et al., 2020; Beyene et al., 2022; WHO, 2015). A Positive postnatal experience is the WHO's marked endpoints for all expectant mothers and their infants. This can be attained by the presence of a supportive environment in which families get valuable information, assistance and reassurance from healthcare workers (WHO, 2022d).

In high-income countries, the highest quality of care provided during pregnancy and the availability of qualified and adequate skilled birth attendants has resulted in a greater number of childbirths at health facilities and a reduced rate of maternal and neonatal death (Shaw et al., 2016). A pooled result from 23 SSA countries showed that the standard provision of postpartum care was lower than that of European countries, except for South Africa (Zhao et al., 2023). This evidence generally denotes that low-income countries have very low PNC service utilisation rates compared with developed nations (Muriuki et al., 2022).

PNC use has been poor in SSA countries, according to other various studies conducted in the region. For instance, only 37.3% of Nigerian women received early PNC services within two days after childbirth (Egbewale et al., 2024). In addition, other studies showed comparable figures such that the PNC uptake was about 37.5% in urban Ghana (Dickson et al., 2023), 39% in Kenya (Nuwabaine et al., 2024) and 43.8% in Namibia (Moyo et al., 2024). Furthermore, a meta-analysis of studies from 36 sub-Saharan African countries that involved women who gave birth 5 years

before the survey revealed that the level of PNC uptake was 52.48%, but the subgroup analysis revealed lower rates in Eastern African countries, at 31.71% (Tessema et al., 2020). Ethiopia is one of the included countries in the study where the uptake of PNC services is low, despite minimal variation across study settings. According to this meta-analysis, maternal educational status, employment, media exposure, ANC visits, place of delivery and access to healthcare influence the utilisation of the service (Tessema et al., 2020).

A 2019 report from an Ethiopian national demographic survey revealed that the overall prevalence of PNC utilisation within two days of childbirth was 34%, and it varied across urban (48%) and rural (29%) areas (The DHS Program & ICF, 2019). Consistent findings have been reported in various parts of Ethiopia, such as southern Ethiopia (25.8%), where women visit healthcare facilities to receive PNC services within one week after birth (Worku et al., 2024); South Gondar Zone, where the early utilisation of PNC services is 36.4% (Fenta et al., 2022); and Gurage Zone of Ethiopia, where the prevalence of early PNC service usage is 23.3% (Yosef et al., 2023). A multilevel analysis of PNC utilisation in four regions in Ethiopia also revealed that 36.8% of mothers received PNC within 6 weeks of childbirth, whereas 34.1% received it within 7 days (Tiruneh et al., 2020). According to these studies, women's level of education, prior knowledge about PNC, history of ANC use and level of knowledge of ODS are significant predictors of non-utilisation of PNC. In addition, those women who didn't receive the PNC services responded that they were unaware of its benefits (Beyene et al., 2022). In line with prior literature, various sociodemographic variables, including the history of prenatal care usage, distance from health facility and husband's educational status, the women's uptake of PNC in Ethiopia (Darega et al., 2016; Mamuye, 2020).

A community-based case-control study in western Ethiopia revealed that women's place of childbirth, mothers' awareness of danger signs and prior use of ANC were significant predictors of PNC service usage (Heyi et al., 2018). In addition, cross-sectional studies conducted in other parts of Ethiopia have shown that being occupied with family obligations and sociocultural customs during the postpartum period, such as a belief that the delivered mother is expected to stay indoors to reduce the chance of inflammation ('Mich'), and it is believed that she lacks adequate strength to walk out (Belachew & Taye, 2016). A lack of awareness of PNC services, no previous history of institutional delivery, an inability to make decisions and a lack of awareness of danger signs are all negatively associated with PNC utilisation amongst postpartum women (Limenih et al., 2016; Woldasemayat et al., 2022; Wudineh et al., 2018).

Studies have emphasised variables that can favourably influence the use of PNC services. For example, a multilevel analysis revealed that community-level contacts and promotional health campaigns, such as health workers' home visits and family conversations, were positive determinants of PNC attendance (Tiruneh et al., 2020). Besides, multiparous women were more likely to comply with full utilisation of PNC, according to a study in Central Ethiopia (Akibu et al., 2018). Moreover, being informed about PNC positively impacts its utilisation (Amsalu et al., 2022).

In summary, the evidence from a meta-analysis revealed that the pooled magnitude of PNC service utilisation in Ethiopia was 32% (Chaka et al., 2019). The key factors affecting of PNC uptake were mothers' decision-making ability, a history of ANC use, having more than two ANC visits and receiving services from a qualified care provider. An understanding of ODSs, urban residence and better monthly income were positively associated with PNC utilisation (Chaka et al., 2019). In general, multiple factors related to sociodemographic factors, such as the ability of women to make

decisions, the presence of partner support, their levels of knowledge of PNC, ODSs, influence from families and previous exposure to health facility services, such as ANC, were determinant factors for the uptake of PNC services. Thus, interventions targeting modifiable factors, such as improving their level of awareness, promoting family support and promoting the health benefits of PNC, should be addressed.

2.4 Knowledge of obstetric danger signs

ODSs are indicators that the mother or newborn may have serious issues that require immediate medical attention (Better Health Channel, 2018). Several warning signals may appear during pregnancy, childbirth or postpartum (Amenu et al., 2016). All expectant mothers, partners and families should know the signs of emergencies and problems and when to seek medical attention from trained healthcare providers. The WHO recommends that a woman should see a medical facility immediately if any warning signals from vaginal bleeding, convulsions or fits, severe headaches with impaired vision, fever, severe abdominal discomfort or quick or difficult breathing occur during pregnancy or after giving birth (WHO, 2013a). The presence of foul-smelling vaginal discharge, severe vaginal bleeding and high fever during the postpartum period are also danger signs that need immediate health care attention (JHPIEGO, 2004). However, many Ethiopian women and their significant others are unaware of these danger signs due to various sociodemographic and institutional factors.

Numerous studies have evaluated the knowledge of ODSs and their determinant factors in Ethiopia, revealing that their knowledge level is often suboptimal. For example, research in Shashamane town, Ethiopia, indicated that nearly 60% of the participants had a poor understanding of obstetric warning signs (Wassihun et al., 2020). This study further revealed that participants' history of ANC visits and childbirth at health facilities was positively associated with their

knowledge of ODS (Wassihun et al., 2020). Other studies conducted in northern Ethiopia also revealed that the knowledge levels of pregnant women on ODSs were unsatisfactory (Akililu Solomon, 2015; Asferie & Goshu, 2022; Negese et al., 2019). These studies also revealed that receiving ODSs counselling, urban residence, a history of ANC visits and the educational status of women were positively associated with their knowledge.

A community-based study in western Ethiopia has shown that approximately one-third of women had adequate knowledge of ODSs that occur during pregnancy, intrapartum and postpartum, mentioning at least one ODS in each phase (Teshoma Regasa et al., 2020). According to this study, exposure to health information sources such as the media was one element in improving the knowledge of ODS (Teshoma Regasa et al., 2020), a finding similar to that of research conducted in Debre Berhan, Ethiopia (Nurgi et al., 2017). Amongst women who experienced any danger signs after childbirth, those who had inadequate knowledge were significantly higher compared to those who had adequate knowledge, according to a study conducted in the rural district of Southern Ethiopia (Terefe et al., 2020).

According to research findings conducted at different sites in Ethiopia, sociodemographic variables, such as educational status, urban residence, income and distance to health facilities, are strong determinants of knowledge of danger signs. For example, research conducted in the Gedeo Zone, southern Ethiopia, revealed that the level of awareness of ODSs was very low (21.9%), and factors such as time spent travelling to health facilities, secondary or above educational status of the husband and urban residence were significantly correlated with women's knowledge of ODSs (Hibstu & Siyoum, 2017). In another study conducted in northern Ethiopia, many women were unaware of these signs. Only 37.5% of them were aware of danger signs, and knowledge of ODSs

was significantly correlated with formal education, urban residence, the time it took to visit a health facility, two or more prior pregnancies and receiving health education (Woldeamanuel et al., 2019).

In the eastern part of Ethiopia, only 15.5% of pregnant women are aware of danger signs. Urban residence, grand multiparity and ANC utilisation are positively linked with being aware of ODS during the maternal health continuum (Maseresha et al., 2016). Contrary to this literature, higher proportion of knowledge of ODSs was observed according to study by Bililign et al. This study reported that percentages of mothers who knew the ODSs of pregnancy, birth and postpartum were approximately 46.7%, 27.8% and 26.4%, respectively (Bililign & Mulatu, 2017). Moreover, mothers with secondary or higher education had greater odds of being aware of prenatal danger symptoms and postpartum danger signs, having a job, giving birth in a hospital and the number of ANC visits as additional statistically significant predictors (Bililign & Mulatu, 2017).

In summary, the results of a systematic review and meta-analysis of women's knowledge of ODS in Ethiopia during pregnancy, birth and postpartum were 48%, 43% and 32%, respectively (Geleto et al., 2019). This study further revealed that factors influencing women's knowledge of obstetric risk signs include maternal age, education, income, usage of health services, proximity to a facility and women's autonomy (Geleto et al., 2019). Factors such as parity, exposure to media, husband's education and exposure to health education were also identified as key determinants linked to awareness of ODS in this systematic review. Hence, addressing these factors could be essential for improving the level of awareness of pregnant and labouring women, which will help them in seeking health care related to complications during pregnancy, childbirth and the postpartum period before further damage.

2.5 Exclusive breastfeeding and its determinants

Early initiation of breastfeeding is a vital component of immediate postpartum care in which both mother and newborn benefit (FIGO, 2023). To mention a few, it supports both exclusive and continued breastfeeding and supports the mother's health in reducing the risk of type 2 diabetes, cardiovascular diseases and postpartum weight management. Breastfeeding is an integral part of the 2030 SDG, which contributes to the goal of ending hunger and malnutrition (FIGO, 2023).

Feeding only breast milk for the first six months is one of the best-recommended approaches by WHO, ensuring the infant's survival (WHO, 2023a). EBF involves giving a baby only breast milk for the first six months with no other liquids or water with the exception of prescribed supplements, oral rehydration, or minerals (Bhattacharjee et al., 2021). Globally, fewer than half of newborns under 6 months of age are exclusively breastfed, which contradicts WHO recommendations. Breast milk is the greatest diet for infants because it contains antibodies that aid in preventing many common paediatric diseases, gives infants all the energy and nutrients they require in the first six months and provides more than half of their nutritional needs in the second half of the first year (WHO, 2023a).

In Ethiopia, according to the MDHS, 59% of infants under 6 months are given only breast milk, marking that approximately 41% of infants are not exclusively breastfed. In addition, the percentage of mothers who exclusively breastfeed their children declines over time and reaches 36% in 4–5 months, and the median length of EBF is only 3 months (The DHS Program & ICF, 2019). This proportion of non-EBFs is considered high where the economic cost of formula feeding is unaffordable and where breast milk is the only reasonable source of nutrition for infants younger than six months in Ethiopia. However, parents' use of different methods or combinations of methods exposes infants to health risks, including malnutrition. In addition to breast milk, 14%

of babies aged 0 to 5 months also receive plain water, nonmilk liquids, other milk and additional foods, and approximately 6% of them are not breastfed at all (Ahmed et al., 2019; The DHS Program & ICF, 2019).

Many studies have been conducted in different parts of Ethiopia, and the magnitude varies across settings. A cross-sectional study in Tigray, Ethiopia, revealed that the EBF level was 70.2%, which was significantly higher than the national average. Being young and having a history of PNC utilisation positively affects the practice of EBF (Teka et al., 2015). Similarly, in southern Ethiopia, more than three-fourths of infants are exclusively breastfed, even though the remaining infants are fed cow milk, formula, water, fruits and semisolids (Lenja et al., 2016).

According to three studies conducted in North and Western Ethiopia, mothers who completed primary school, gave birth in a health facility, acquired prenatal and postpartum care, had four or more ANC visits and had postnatal follow-up were more likely to practice EBF than mothers who did not adopt it (Asemahagn, 2016; Hunegnaw et al., 2017; Kumera & Haidar, 2021). Factors related to parity, employment, family support and household income are also strong determinants of EBF, according to a study conducted in northeastern Ethiopia (Safayi et al., 2021; Tewabe et al., 2016). These studies further revealed that mothers who acquired breastfeeding advice during pregnancy or childbirth were more likely to breastfeed their children than their counterparts who did not. Factors such as urban residence, mother's educational status, full ANC visit, caesarean births and deliveries at health facilities were considered determinants of EBF practices according to evidence from further analysis of EMDHS (Mekebo et al., 2022). Similarly, other findings in Ethiopia showed that husband education, facility delivery, receiving support from the husband, having had a PNC follow-up and access to counselling about breastfeeding from health care

providers were all factors that were significantly associated with women's level of EBF (Jebena & Tenagashaw, 2022; Shitie et al., 2022; Yimer et al., 2021).

Maternal confidence in her capacity to breastfeed and her knowledge of the benefits of EBF for the baby are other important predictors of EBF practices, in addition to institutional and sociodemographic factors (Otsuka et al., 2014). In another study, BSE was positively correlated with EBF (He et al., 2022). Interventions for increasing BSE are crucial for enhancing breastfeeding outcomes. A study conducted on predictors of EBF in Addis Ababa has shown that only 39.1% of the respondents have high BSE and that their level of BSE was a strong predictor of EBF practice amongst respondents (Minas & Ganga-Limando, 2016). A community-based cross-sectional study conducted by Gizaw et al. in 2022 revealed that EBF self-efficacy levels were associated with a history of ANC use and breastfeeding knowledge, which could affect mothers' intention to breastfeed exclusively (Gizaw et al., 2022). According to previous studies, the level of awareness of EBF is a significant predictor of EBF practices. However, the level of knowledge about EBF is still suboptimal in Ethiopia. For example, a study conducted in the Gurage Zone, Ethiopia, revealed that the overall knowledge status of EBF amongst women was 58.3% (Shitu et al., 2021).

In general, several sociodemographic, institutional, and socioeconomic factors, awareness levels and access to information have affected mothers' practices and efficacy of EBF in Ethiopia. Interventions targeted at these determinant factors must be devised to reduce the gap in lactating mothers' knowledge and BSE to enhance EBF practices.

2.6 Husband support for maternal health service utilisation and breastfeeding

Social support is an assistance from social networks that can affect an individual's health in two ways: direct effects and stress buffering (Cohen & Wills, 1985). According to the direct effects perspective, social support can improve health regardless of the stressful environment. Furthermore, social support improves an individual's health regardless of the presence or absence of stressors by enhancing the sense of belongingness and stability, resulting in improved self-esteem and reduced stress (Al-Mutawtah et al., 2023; Cohen & Wills, 1985); it also provides favourable emotions, security, dependability and an understanding of self-worth. This social support helps individuals avoid negative experiences, which facilitates positive physical and mental health (Cohen & Wills, 1985).

On the other hand, the stress-buffering pathway proposes that social support can help intervene in dire situations where an individual perceives that coping mechanisms are not immediately accessible. In this perspective, social support entails two possible stress-buffering ways. In the first place, the perceived receipt of social support reduces physical and psychological responses by lessening appraisal reactions making the individual perceive less stressful situations (Cohen & Wills, 1985; Lam, 2024). Secondly, perceived support may intervene between the experience of stress and pathological consequences by providing a solution to the problem, leading to less reactive behaviour to the perceived stress (Cohen & Wills, 1985; Wethington & Kessler, 1986). Overall, social support is reported to help improve health outcomes via direct impacts or stress-buffering effects (Reblin & Uchino, 2008).

During pregnancy and after, husbands are vital allies of their wives who can offer various types of support (Daniele, 2021). Pregnancy is naturally stressful, and the anticipation of childbirth, adapting to motherhood and breastfeeding challenges can worsen anxiety (Coussons-Read, 2013;

Horsch & Ayers, 2016). This increased worry may lead to stress and depression in expectant mothers. Therefore, support from their husbands during this period is critical to provide them with physical, emotional and informational support during this time (van Lonkhuijzen et al., 2023). In health promotion and disease prevention activities, husbands can assist in enhancing healthcare-seeking behaviour and supporting their wives during childbirth and breastfeeding (Thepha et al., 2024; Tokhi et al., 2018).

Several studies have shown the role of the husband's support during the perinatal period. This support may encompass accompanying the woman to health facilities during pregnancy, childbirth or postpartum. For example, a national survey in India revealed that women who obtained support from their husbands were more likely to utilise frequent ANC contacts and facility delivery (Paul, 2022). Evidence from a systematic review has also shown that interventions involving husbands positively impact women's service utilisation during the perinatal period and improve complication readiness and maternal nutrition (Tokhi et al., 2018). Other studies from Ethiopia and Burkina Faso have shown that husband support improved adherence to health service utilisation (Daniele et al., 2018; Mohammed et al., 2019). In general, husband involvement is a crucial factor that can enhance women's health service utilisation (Yargawa & Leonardi-Bee, 2015).

Another aspect that husbands could provide for their spouses was support for optimum breastfeeding. According to various studies conducted in Indonesia, the support of husbands in terms of emotional, practical and physical aspects has improved EBF practices (Prasetyawati & Kartikasari, 2021). A Turkish study corroborated prior findings that women who obtained support from their spouses had higher breastfeeding rates (Durmazoglu et al., 2021). Evidence on the basis of a systematic review also exhibited the positive effect of the husband's presence on EBF practices

(Widiantoro et al., 2024). This evidence suggests that the husband is a significant factor with crucial implications for the health of their partners across different cultural settings.

In Ethiopia, as in many other countries, the impact of husbands' support on health service utilisation, breastfeeding and other socioeconomic factors is paramount. The husband's role in their wife's decision-making process is important, as it can significantly influence a woman's intention to seek healthcare. According to research findings on fathers' roles in enhancing maternal and infant healthcare, husbands have various roles, including being decision-makers, offering financial support, assisting their wives with workloads and advising and supporting them during breastfeeding (USAID/ENGINE, 2014). The findings further showed that maternal PNC service uptake, preparedness for childbirth, complication readiness and breastfeeding intentions are strongly predicted by their partners' beliefs more than their own. According to a study in Wolaita Sodo, Ethiopia, husbands' involvement enhances women's birth preparedness and readiness for complications during childbirth (Tadesse et al., 2018).

Similarly, family involvement with health care providers during pregnancy positively influenced PNC service utilisation (Tiruneh et al., 2020). Despite its importance, the level of husband involvement in supporting maternal service usage is considered unsatisfactory. For example, the husband's involvement in PNC utilisation was relatively low in a study conducted in Bishoftu (34.1%) (Gesisa et al., 2024). Another study in Ethiopia reported that overall male partner involvement in PNC service utilisation was 20.8% (Abie et al., 2023). Thus, enhancing father involvement is important in promoting women's service uptake. Husband support was also associated with increased EBF practices amongst mothers. According to a survey conducted by Tewabe et al. in 2016, women with support from their partners were nearly three times more likely to practice EBF than their counterparts were (Tewabe et al., 2016). Another Ethiopian study

conducted in 2024 revealed that husbands' support positively affects BSE and EBF practices after male partners targeted breastfeeding education (Abageda et al., 2024a, 2024b).

In general, the husband's support is an important factor that should be considered to enhance the utilisation of health care services, practice EBF and develop positive behavioural changes that improve the mother's and child's health. Healthcare interventions to enhance women's and newborns' health should involve husbands for the maximum benefit of health outcomes during the perinatal period, a critical moment when women's and newborns' health needs attention and support.

2.7 Role of mobile health in maternal and child health services

The WHO Global Observatory defines mHealth as a 'medical and public health practice supported by mobile technology, such as mobile phones, patient monitoring devices, personal digital assistants and other wireless devices' (Resnick, 2019). Digital technologies are increasingly used to deliver healthcare services and promote public health (Alawiye, 2024). As of 2023, the number of mobile phone subscriptions reached approximately 8.9 billion worldwide (Statista, 2024). By the end of 2021, approximately 515 million individuals in SSA had mobile service subscriptions, accounting for 46% of the region's population, an increase of approximately 20 million from 2020 (GSM, 2022).

Cellular phones are portable, offering more flexibility and productivity than landline phones do, enabling users to leapfrog fixed-line systems and providing users with enhanced opportunities for internet access (CILLIERS, 2020). Although mobile phone ownership and wireless network coverage are non-universal or evenly distributed in low-income countries, mHealth interventions can still improve health outcomes in these limited settings (Caroline Free et al., 2010). Ethiopia is

one of the top five African nations with the highest number of mobile phone subscribers today, with a significant increase in mobile subscription rates. The number of subscribers is expected to increase by 10.3% in 2023, according to the Ethiopian government's dominant telecom provider, Ethio-telecom (Burkitt-Gray, 2022; Further Africa, 2022). With Safaricom's recent market entry in Ethiopia, the rate of mobile subscriptions is anticipated to rise even further (Safaricom, 2022). In 2024, approximately 70 million active cellular mobile connections were in Ethiopia, equal to 60% of the country's total population (Kemp, 2023).

Digital technologies have the prospect of transforming public health by changing people's engagement with health healthcare services (Yeung et al., 2023). In this regard, mHealth can support in achieving positive behavioural changes to prevent the development of diseases and their complications (Free et al., 2013). The literature shows that mHealth is an alternative healthcare system in developing countries. It is also considered a new paradigm that combines the advancement of wireless communications and network technology with the concept of 'connected healthcare', which enables access anytime and anywhere (Motamarri et al., 2014). As a result of the rapid development and adoption of mobile technologies, the number of consumers who regularly use mHealth applications as a form of health information technology is increasing (Monica Fallon et al., 2019). According to studies, mHealth interventions, especially those made available via voice and text messages, are linked to increased use of preventative maternal healthcare services, such as ANC and PNC service utilisation (Adanikin et al., 2014; Atnafu et al., 2017; Doan et al., 2020; Fedha, 2014; Olajubu et al., 2020) , and awareness of danger signs associated with pregnancy and childbirth (Masoi & Kibusi, 2019). Various studies have also shown that mHealth interventions can enhance knowledge and promote the practice of EBF in developing regions (Qian et al., 2021). Nevertheless, given the varying patient demographics, cultural

diversity and environmental and behavioural factors, the accessibility and efficacy of mHealth initiatives in improving pregnant women's use of preventive maternal healthcare services may vary (Feroz et al., 2020).

2.7.1 Effects of mHealth on postnatal care uptake

Mobile health applications are currently receiving attention for healthcare services in developing countries (Hall et al., 2014). According to previous studies, mobile-based interventions have promising effects on improving facility delivery rates and PNC services. For example, research by Lund et al. in 2012 and Omole et al. in 2018 revealed that phone-based short messages and reminder messages for mothers improved facility delivery and PNC services (Lund et al., 2012; Omole et al., 2018). A systematic review evaluating the role of mHealth in PNC uptake revealed that mobile phone messages increased the utilisation of PNC in rural settings (Mbuthia et al., 2019). The review further revealed that mHealth could influence factors hindering PNC uptake, such as environmental factors and participants' intentions and skills, resulting in PNC improvement (Mbuthia et al., 2019). A study in Kenya also revealed that mobile phone reminders significantly improved the second and third postnatal visits (Ngigi et al., 2022). Unlike prior studies, two studies carried out in Malawi and Bangladesh showed the non-significant effect of mHealth interventions on PNC uptake, although the intervention increased the rates of ANC attendance and skilled childbirth (Kachimanga et al., 2025; Tang et al., 2019). Overall, mobile phone-assisted interventions were found to enhance the use of PNC services in the majority of studies, yet mixed findings were observed in other studies. Further exploration is required to reach into generalisable findings

2.7.2 Effects of mobile health on exclusive breastfeeding

One of the crucial but also challenging tasks of a mother after childbirth is the early initiation of breastfeeding and EBF for the first six months. This task is also challenging, which requires various support interventions. A scoping review in Malaysia revealed that mHealth interventions for postnatal mothers significantly differed in BSE and EBF practices (Nor & Wee, 2023). A systematic review of RCTs also revealed that the odds of EBF practice were three times greater amongst mothers who received mHealth interventions than amongst those who received only usual care (Qian et al., 2021). According to a different meta-analysis, weekly text messaging interventions that address the prenatal and postnatal phases increase the EBF rate at less than three months, three to four months and six months (Fan et al., 2024). Further studies indicated that both one-way and two-way messaging approaches had increased the rate of EBF and sustained breastfeeding (Unger et al., 2018). Nonetheless, app-based mHealth intervention failed to improve EBF at 3 and 6 months following birth (Ziebart et al., 2025). Another mixed effect of mHealth intervention was revealed in the study conducted in the USA. According to this research, the odds of EBF practice were higher among the intervention group for black parents but no difference among nonblack parents (Bender et al., 2022).

Studies have also explored how mHealth impacts BSE for successful breastfeeding practices. Self-efficacy of breastfeeding pertains to mothers' confidence in performing optimal breastfeeding behaviour, and this confidence can be boosted by mHealth interventions (Putri & Anggraeni, 2023). Accordingly, research carried out amongst postpartum women pointed out the positive effects of mHealth on women's BSE, knowledge, attitudes and breastfeeding practices (Seyyedi et al., 2021). In addition, a meta-analysis of the impact of mHealth on mothers' and infants' health revealed that it positively influences BSE (Lee et al., 2016). In general, mHealth interventions

have a positive effect on providing breastfeeding information, thereby improving BSE and positive breastfeeding outcomes. Nonetheless, other findings also showed that mHealth is incapable of contributing to significant changes in breastfeeding practices (Ziebart et al., 2025).

2.7.3 Effects of mobile health on enhancing awareness of obstetric danger signs

ODSs usually occur during the perinatal period among expectant mothers and the symptoms are linked with pregnancy or its effects (Emagneneh et al., 2025). Parents' understanding of these signs is decisive because it helps them to anticipate likely complications and seek immediate medical attention. This trend could help prevent perinatal complications (Hibstu & Siyoum, 2017). Therefore, educating women and their families about these warning signs and symptoms and what to do if they appear are crucial, especially for parents who are unfamiliar with the pregnancy situation.

Studies have shown that providing health information via mHealth has increased women's knowledge of ODS. A study in Kenya revealed that women who received phone-based educational messages had good knowledge of the danger signs of pregnancy (Jones et al., 2020). A Tanzanian study similarly revealed that the mobile messaging system increased women's awareness of danger signs and improved their readiness for childbirth (Masoi & Kibusi, 2019). Mobile phones are a very good option for healthcare providers and beneficiaries, particularly in health promotion and disease prevention activities. Moreover, further studies should be conducted on their effectiveness in diverse cultural settings to incorporate them into the healthcare system and maximise their benefits.

2.7.4 Acceptability of mobile health interventions in low-income settings

The acceptability and usefulness of mHealth interventions are critical for bringing about behavioural changes in resource-limited settings. Consequently, studies revealed that they were feasible and acceptable amongst women, in which the mHealth intervention focused on enhancing the health of mothers and children. A qualitative study conducted in South Africa to identify acceptability, participants' experiences, intervention use and feedback on a text message intervention revealed that maternal text messages were highly acceptable (Coleman et al., 2020). According to this study, participants shared messages for friends and family because they felt that the mHealth messages were supportive. Another pilot RCT conducted in Uganda amongst 120 adult pregnant women to evaluate the preliminary efficacy of mHealth support interventions revealed that patient-centred and tailor-made messaging services that leverage social support networks were a feasible, acceptable and effective strategy to enable pregnant women in rural southwestern Uganda to access maternity care services that are available and transmit crucial targeted health-related information (Atukunda et al., 2023). A qualitative study from Burkina Faso also revealed that women valued mHealth-supported ANC visits because they were able to detect pregnancy complications early on, receive reassurance during times when they were concerned about their health and help their spouses become involved in their care (Arnaert et al., 2019).

Similarly, a mixed study conducted in two Ethiopian cities (Addis Ababa and Gimbi), designed to assess the information quality, and user satisfaction with regard to mHealth interventions revealed that mHealth interventions were effective tools for improving maternal and child health in Ethiopia (Alders, 2018). This study employed interviews and focused group discussions to gather information from pregnant women and healthcare providers and to obtain their feedback. Accordingly, mHealth intervention strategies, such as SMS messages and interactive voice response (IVR), were ideal, acceptable, feasible and cost-effective approaches for enhancing

maternal and child health service improvements. The study further recommended that SMS-based interventions are more effective than IVR because SMS messages can be received anytime, even when phones are off; women must answer their phones and keep them charged when using IVR (Alders, 2018).

2.8 Gaps in the literature

Although maternal services such as PNC were crucial components that can address maternal and neonatal mortalities, their utilisation has remained low in Ethiopia. The knowledge of potential complications that may arise during pregnancy, childbirth or the postpartum period was also unsatisfactory. Moreover, the awareness and practices related to EBF practices were suboptimal.

Three gaps were identified from the literature review. The first is gaps related to the low service utilisation of PNC services and inadequate EBF rates. The factors identified include a knowledge gap in the benefits of PNC and EBF, a lack of knowledge about danger signs, a lack of partner support, the forgetting of PNC appointments, the perception of feeling well and sociocultural factors that may discourage parents from visiting postpartum health visits. These factors could be addressed by culturally tailored educational interventions, which can be facilitated by family support. MHealth interventions have shown promising effects and are feasible and acceptable in low-income countries, although further studies are needed to improve these outcomes and establish a definitive generalisation.

The second gap is related to lack or inadequate support from family or spouses in PNC service uptake and breastfeeding practices. The literature suggests that support from a husband or family is crucial for EBF and the utilisation of maternal services (Kebede et al., 2022; Tri Budiati et al., 2022). The husband's support is low in Ethiopia despite its importance. Moreover, prior studies

mainly focused only on women, ignoring the role of husbands despite their pivotal role in supporting maternal and newborn healthcare services. This phenomenon may have contributed to the inability of policymakers in developing countries to adopt available research as input, which necessitates the execution of further primary research on enhancing PNC and related outcomes. Moreover, including husbands and wives together in the mHealth intervention is vital as it could strengthen support and foster positive behavioural changes. Researchers may, therefore, consider interventions that are specifically tailored, theoretically guided and involve women and their husbands to bring about the necessary behavioural changes in these outcomes.

The third gap is the inconclusive evidence on how effectively mHealth can increase PNC usage, EBF practices and knowledge of ODSs. Although many studies have demonstrated the positive effects of mHealth, gaps are still found in low-income settings. For example, according to a review by Chen et al. in 2018, nearly half of the studies included in the review had mixed results concerning the effectiveness of mHealth in improving maternal and child health (Chen et al., 2018). Another study indicated that whilst mHealth improved breastfeeding, the use of contraception and the health of newborns did not positively correlate with postpartum follow-up attendance (Maslowsky et al., 2016). In addition, a meta-analysis recently carried out among studies from LLMICs demonstrated the positive effect of mHealth on key maternal, neonatal and infant health services uptake, such as birth at health institutions, PNC attendance and EBF practices. Yet, the study noted the heterogeneity of the results, which needs caution to generalise and requires more investigation (Gayesa et al., 2023). The review also revealed that interventional studies in low-income nations were rarely guided by theoretical frameworks. Thus, to address the identified gaps, developing tailor-made mHealth interventions that encompass the wife and husband are found to be necessary. Applicable theoretical frameworks should also be adapted to

guide interventions related to the knowledge and practices of mothers in PNC uptake, EBF practices and related outcomes.

2.9 Theoretical frameworks

As described in the earlier literature review, several studies have shown that the uptake of PNC services and EBF practices is affected by different factors, which can be modifiable and non-modifiable (Tefera et al., 2021; Tiruneh et al., 2020). The modifiable factors were related to women's and men's literacy levels, knowledge and perceptions about PNC services, ODSs, access to counselling or health education services, distance or cost of transportation and family support (Safayi et al., 2021; Shitie et al., 2022; Tewabe et al., 2016; Tiruneh et al., 2020). Therefore, these modifiable factors should be addressed using tailor-made interventions aiming at increasing the rate of PNC visits and EBF practices.

Theoretical models of behavioural change help to identify determinants, and plan interventions aimed at achieving desired behavioural change (Montanaro, 2011). Interventions can be used to promote healthy lifestyles and enhance the uptake and effective use of public services. Standard and well-known behavioural change theories, such as the health belief model (HBM), the theory of planned behaviour (TPB), social cognitive theory (SCT) and the transtheoretical model, have been utilised over the years. Although the choice of theories depends on the expected behavioural change, many have similar or overlapping theoretical constructs (Montanaro, 2011; Walsh & Groarke, 2019).

2.9.1 Health belief model

The HBM was initially developed in the 1950s to evaluate why people were disengaged in disease prevention programmes (Rosenstock et al., 1994). This model was later widely used to study

health-related behavioural responses amongst people, including adherence to healthcare counselling (Jones et al., 2014). The model has six dimensions that influence health behaviour: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, perceived self-efficacy and cues to action (Alyafei A & Easton-Carr R, 2024). According to the HBM, people take precautions to avoid becoming sick if they believe that they are vulnerable to a condition (perceived susceptibility), if they believe that it could have severe consequences (perceived severity), if they believe that a specific course of action may lessen the severity or lead to other positive outcomes (perceived benefits), and if they perceive that obstacles exist, preventing them from the desired health action (perceived barriers). Later, scholars added self-efficacy to the model, a belief that a person can successfully perform the desired behaviour despite the barriers. However, in actual application, self-efficacy is rarely included in HBM studies (Jones et al., 2015). Individual cues to action are another HBM component that encourages individuals to take action, such as seeking information from others, the media, healthcare providers or internal physiological cues (Karen Glanz et al., 2008).

The HBM describes the individual's perception of benefits and barriers to practising a particular behaviour and adherence to treatment plans that protect or improve health (Daniati et al., 2021). HBM has been used most frequently for health issues that are preventive and asymptomatic when perceptions are more important than explicit signs and symptoms (Khorsandi et al., 2017). According to the HBM, patients are more likely to need preventive or therapeutic advice from their healthcare provider if they believe that they are at risk for the condition, believe that the illness is a serious one and are confident that the advantages of the suggested course of treatment will outweigh the expenses or barriers to pursuing it and assert that they can complete the suggested treatment. Furthermore, the HBM proposes that patients are more likely to adhere to advice if they

are exposed to cues to action, such as written or mobile reminders or public notices, such as posters and radio commercials for health services (McKellar & Sillence, 2020).

Several behavioural change studies have employed the HBM for health promotion and disease prevention to date, and it is currently widely used. For example, studies aimed at increasing adherence to medications amongst stroke survivors (Kamal et al., 2015) and improving EBF (Pan, 2017) and breast cancer awareness (Nasution et al., 2021) have significantly improved awareness and the expected behavioural outcome through the guidance of this model. Perception of mental illness and mental service utilisation amongst college students (Nobiling & Maykrantz, 2017), service utilisation amongst older adults (Agyemang-Duah & Rosenberg, 2023), breastfeeding behaviour amongst diabetic mothers (Qian et al., 2023) and breastfeeding patterns (Parsa et al., 2015). In addition, the HBM has been used to evaluate outcomes related to maternal service utilisation, such as PNC and EBF practices (Nelson et al., 2021; Salehe et al., 2025). Despite being widely used, the HBM has its own limitations. For example, the impact of social pressure and the perception of personal control or self-efficacy was excluded in the HBM despite its importance in behavioural changes (Norman & Conner, 2017). Self-efficacy was later proposed by Rosenstock et al. (1988) for incorporation into the HBM (Rosenstock et al., 1988), but it has been largely overlooked in many HBM-guided studies.

2.9.2 Social cognitive theory

SCT, developed by Albert Bandura, is a comprehensive model for understanding human behaviour; in 1977, he explained how behaviour is acquired as a social learning theory, and in 1986, he modified the framework to become an SCT (Whitham et al., 2013). According to this SCT, human functioning is the interplay of classic triads of personal, environmental and behavioural factors. These factors interact reciprocally such that human behaviour can affect and

be affected by personal and environmental factors via reciprocal determinism (Lo Schiavo et al., 2019). Bandura particularly emphasised the mutual interdependence of these three factors and suggested that each influences the other in a reciprocal feedback loop, which previous theorists tended to ignore (Little, 2018).

Personal factors such as goals, perceptions, and self-efficacy play a pivotal role in the initiation and maintenance of motivational outcomes. Of these factors, self-efficacy is a central concept of SCT, showing one's ability to execute a behaviour successfully. An individual's perception of progress towards goals and other environmental factors, such as social comparisons with peers and feedback, can influence this self-efficacy (Schunk & DiBenedetto, 2020). Particularly, the social environment such as people's ideas, beliefs and attitudes, is a key attribute of environmental factors that influence an individual's self-efficacy significantly (Schunk & DiBenedetto, 2020). Moreover, people are often motivated to learn modelled actions that they believe will help them achieve their goals. These models can be parents, peers, teachers, media figures or anyone whose behaviour can be observed. These environments can be instructional and provide feedback that fosters self-efficacy in practising behaviour (Bandhu et al., 2024; Schunk & DiBenedetto, 2020).

Social support is a person's social-environmental component that helps increase self-efficacy and motivation (Skarin et al., 2019). The behavioural elements influencing motivational outcomes include activity choice, effort level, perseverance, success and environmental control. Within reciprocal determinism, these components function as motivational outcomes and influencers (Schunk & DiBenedetto, 2020). According to Bandura, behaviour is not a byproduct of environmental or personal factors but rather the other way around; that is, behaviour can influence an individual's cognitive process and environment (Little, 2018). In the reciprocal triad of SCT, self-efficacy is the vital component that drives human behaviour. It refers to a person's confidence

in their ability to complete a task or reach a specific objective. A strong sense of self-efficacy is associated with a greater understanding of personal control and a stronger motivation to sustain the behaviour; it also explains that people tend to behave on the basis of their sense of competence or past success (Burke et al., 2009; Nabavi, 2012). Various previous researchers have used SCT to guide health interventions aimed at achieving positive behavioural changes, such as in chronic self-management of diabetes (Kaveh et al., 2022), EBF practices (Amoo et al., 2022) and ANC uptake (Ariyani et al., 2022).

2.10 Chapter summary

This chapter presents a detailed review of the literature and identifies key gaps in previous studies. Gaps in awareness related to PNC, EBF and ODS were identified. The roles of mHealth interventions and associated gaps pertaining to their effectiveness were also briefly discussed. Moreover, the theoretical framework for guiding mHealth interventions to address the identified gaps was discussed.

CHAPTER THREE: OBJECTIVES OF THE OVERALL STUDY AND CONCEPTUAL FRAMEWORK

3.1 Introduction

This chapter outlines the aim, objectives and phases of the whole project. The overall study aims is to determine whether a theory-based mHealth intervention, developed on the basis of evidence from systematic reviews and meta-analyses and measured using validated outcome scales, is effective in improving PNC uptake and EBF practices among first-time parents. This thesis project was conducted in three phases. In Phase I, a systematic review of literature on the effect of mHealth on institutional delivery and PNC was conducted, and a mobile health intervention was developed based on this review and was then validated. In Phase II, the outcome measurement scales were translated into the target language and tested for psychometric properties. Phase III is a major part of the study in which an RCT study was conducted on 236 first-time parents to test the effectiveness of the mHealth intervention (developed in phase I) in improving PNC service utilisation, knowledge of ODSs, EBF practices, breastfeeding self-efficacy (BSE) and perceived breastfeeding support in western Ethiopia using validated scales done in phase II.

This chapter is organised into five sections. Section 3.1 introduces the chapter. Section 3.2 presents the aim, objectives and design of the first phase of the thesis project. Section 3.3 outlines the aim, objectives and design of the second phase of the project. Section 3.4 discusses the aim, objectives and conceptual framework adapted to undertake the third phase of the study project. Section 3.5 presents a summary of the chapter.

3.2 Aim, objectives and design for phase I of the study

Aim

The overall aim of Phase I was to systematically review the available primary interventional studies on the effect of mobile health intervention programs and to develop an mHealth intervention based on the review and validation of the developed intervention.

Objectives

- To review primary interventional studies focusing on the effect of mHealth intervention on improving the facility childbirth, postnatal care utilisation and related outcomes such as EBF.
- To develop and validate the mobile health intervention messages on the basis of the systematic review and meta-analysis, and theories of HBM and SCT

Study design

The study design employed in this phase was a systematic review and meta-analysis of studies conducted in low- and lower-middle-income countries (LLMICs) to guide the development of the intervention

3.3 Aim, objectives and design for phase II of the study

Aim

To validate outcome measuring scales used to assess the breastfeeding-related outcomes

Objectives

- To validate measurement instruments in Afaan Oromo (the target language) for outcomes related to breastfeeding, which include the 'Breastfeeding Self-Efficacy Scale: Short Form' (BSES-SF)

(Dennis, 2003), the ‘Exclusive Breastfeeding Social Support (EBFSS) Scale’ (Boateng et al., 2018) and the ‘Partner Breastfeeding Influence Scale’ (PBIS) (Rempel et al., 2017).

Study design

A cross-sectional study was conducted to validate the outcome-measuring scales

3.4 Aim, objectives and conceptual framework for phase III of the study

Aim

This study aims to evaluate the effectiveness of mobile-based educational message interventions in enhancing the uptake of PNC services, knowledge of ODS, rate of EBF practices and related outcomes such as breastfeeding support behaviours amongst first-time parents.

Objectives

The specific objectives of the RCT are outlined as follows: the first objective is of the primary outcome, while the second through sixth objectives are of the secondary outcomes.

1. To determine the effectiveness of mobile-based educational message interventions targeting first-time parents on the uptake of PNC services (primary outcome) in public hospitals in western Ethiopia.
2. To investigate the effectiveness of mobile-based educational message interventions targeting first-time parents for improving EBF practices and BSE amongst mothers in public hospitals in western Ethiopia.
3. To evaluate the effectiveness of mobile-based educational message interventions aimed at enhancing women’s knowledge of ODSs in public hospitals in western Ethiopia

4. To examine the effectiveness of mobile-based educational message interventions in enhancing mothers' perceptions of receiving breastfeeding support from fathers in public hospitals in western Ethiopia
5. To examine the effectiveness of mobile-based educational message interventions in enhancing fathers' perceptions of providing breastfeeding support to mothers in public hospitals in western Ethiopia
6. To evaluate satisfaction with the mHealth intervention programme amongst intervention groups of women and husbands in public hospitals in western Ethiopia

3.4.1 Hypotheses

The hypotheses of the randomised controlled trial are presented below.

1. Mobile-based educational interventions significantly improve the uptake of PNC services amongst the intervention group compared with the control group, which receive only the routine care.
2. Mobile health educational intervention significantly enhances EBF practices and BSE amongst the intervention group compared with the control group immediately after intervention and postintervention follow-up.
3. Mobile-based educational interventions significantly increase the knowledge of ODSs for the intervention group compared with the control group, which receives only routine care immediately after intervention and postintervention follow-up.

4. Mobile-based educational intervention significantly improves the mothers' perceptions of receiving breastfeeding support from fathers amongst the intervention groups compared with the control groups immediately after intervention and postintervention follow-up.

5. Mobile-based educational intervention significantly improves the fathers' perceptions of providing breastfeeding support to mothers amongst the intervention groups compared with the control groups immediately after intervention and postintervention follow-up.

Study design

A two-arm, parallel-group, individually randomised controlled trial was employed.

3.4.2 Conceptual framework of the study

For this phase of the study, a conceptual framework was developed on the basis of two theoretical frameworks: the health belief model (HBM) and the social cognitive theory (SCT). The HBM describes the individual's perceptions of benefits and barriers to practising a particular behaviour, as well as adherence to treatment and behaviours that protect or improve health (Daniati et al., 2021). The SCT, on the other hand, describes the reciprocal interaction of human behaviour with personal and environmental factors (Whitham et al., 2013). Both theoretical frameworks were used to develop a conceptual framework that guides the present study. A brief description of these two theoretical frameworks is provided in Chapter 2, Section 2.9. In this phase of the study (RCT), the mobile educational intervention aims to improve knowledge and motivation related to the perceived benefits of recommended PNC visits and EBF, as well as the perceived threat associated with not practising this desired behaviour. This effect could enhance health motivation and result in improved PNC uptake and EBF practice. Individual cues to action related to receiving counselling and educational messages can also contribute to behavioural change. Therefore, the mHealth

intervention used in this study targeted the constructs of the HBM to achieve the desired behaviour. Using SCT constructs, behavioural changes can be achieved by modifying environmental and personal determinants. In SCT, the environment's social support components influence an individual's self-efficacy, which then affects behavioural outcomes. Thus, self-efficacy can directly and indirectly affect human behaviour by mediating processes such as social support, outcome expectations and self-regulation (Nabavi, 2012). In this regard, social support, including spousal support, is a key environmental factor influencing women's decisions to seek healthcare and recommended breastfeeding practices. This support acts on self-efficacy by providing encouragement, necessary resources and social validation for sustained behavioural change (Lin et al., 2023). Therefore, a conceptual framework that combines both the HBM and SCT was developed to guide the intervention development, which led to desired behavioural changes (Figure 3.1).

3.4.3 Rationale for using the frameworks of the HBM and SCT

For this study, the HBM and SCT were considered appropriate for guiding a phone-based educational intervention aimed at improving PNC uptake for the following reasons. Compared with other behavioural theories, mothers' perceptions of and knowledge of the potential complications of non-utilisation of PNC services can be better addressed by an intervention guided by HBM constructs. A good reason is that mothers' perceived susceptibility to health threats, such as postpartum complications, the perceived severity of those complications, the perceived severity of non-EBF and the benefits of seeking PNC and EBF, can influence their decision to seek care. Secondly, mHealth communication can provide interventions that address HBM constructs to enhance PNC uptake and improve EBF outcomes. Thirdly, with the recent addition of self-efficacy and cues to action to the oldest HBM model, mHealth educational intervention can address these

theoretical constructs, which ultimately lead to the expected behavioural changes, including the uptake of PNC services, improved EBF self-efficacy and enhanced knowledge of ODSs. SCT addresses the limitation of the HBM in the role of families (partners) in providing motivation and feedback for behavioural change, thereby enhancing the self-efficacy of women to promote the desired behaviour. In addition, the conceptual framework developed from these two behavioural theories would guide the content, features and expected outcome of the intervention. Moreover, mHealth intervention can be well delivered to participants on the basis of the developed conceptual framework. Thus, a conceptual framework which combines the theoretical dimensions of the HBM and SCT was developed to guide mHealth interventions and improve PNC service uptake, EBF practices and related outcomes (Figure 3.1).

3.4.4 Expected behavioural changes based on the HBM and SCT constructs

With these interventions, the expected behavioural changes include paying attention to PNC appointment schedules, identifying potential danger signs of concern for the mother, enhancing BSE, practising EBF and developing supportive behaviours. The expected outcomes include improved PNC uptake, increased knowledge of maternal danger signs, increased EBF rates and increased self-efficacy for EBF. As husbands are also a target of intervention, partner support is expected to improve outcomes.

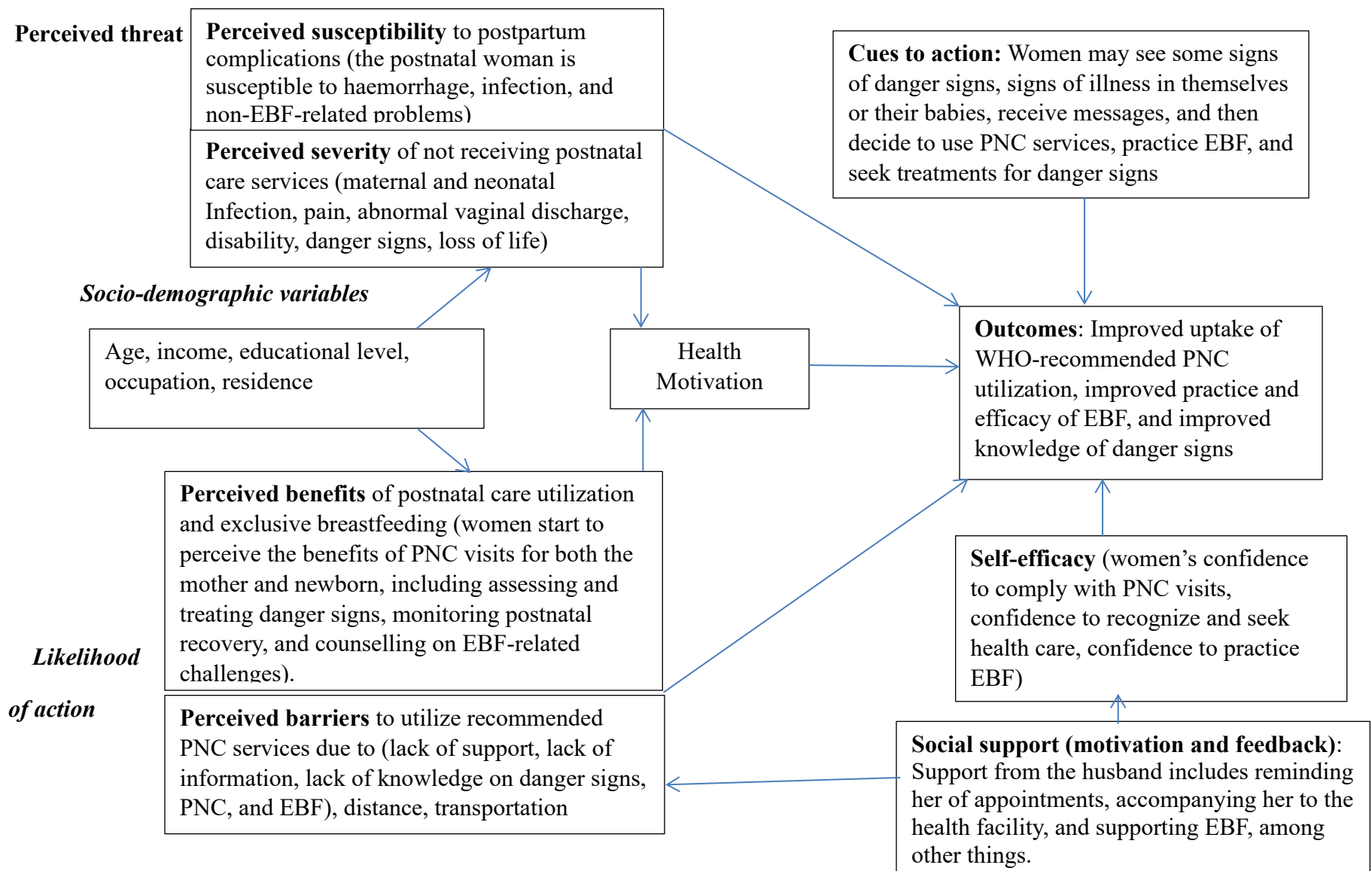


Figure 3.1: Conceptual framework of mobile-based educational message intervention on postnatal care uptake, adapted from the health belief model and social cognitive theory

3.5 Chapter summary

In this chapter, the three phases of the overall project and the aim and objectives of each phase, as well as the conceptual framework adapted to guide the development of the intervention, have been presented. The first phase of the study project was the development and validation of the intervention based on the evidence of a systematic review and meta-analysis. The second phase of the study is validation of outcome measurement scales, particularly those measuring breastfeeding-related outcomes. The third and major phase of the study was the RCT study to assess the effectiveness of mHealth intervention among first-time parents in improving PNC uptake, EBF, ODSs and breastfeeding support behaviours.

CHAPTER FOUR: SYSTEMATIC REVIEW AND META-ANALYSIS AND DEVELOPMENT OF THE INTERVENTION (PHASE I)

4.1 Introduction

This chapter presents two major parts. The first part covers a systematic review and meta-analysis of the impact of mobile health on enhancing the rate of childbirth at health facilities and post-natal care service utilisation. The articles included in this review and meta-analysis were original studies conducted in low- and lower-middle-income countries to generate systematically synthesised evidence from studies in these countries. The findings of this review have been published (Gayesa et al., 2023). The second part of this chapter presents the development and validation of the intervention protocol based on the findings of the systematic review and meta-analysis.

This chapter has nine sections: Section 4.1 introduces the chapter's overview. Section 4.2 presents the background information of the systematic review. Section 4.3 discusses the methodology used in conducting the systematic review. Section 4.4 presents the study's results. Section 4.5 briefly explains the findings. Sections 4.6 and 4.7 present the study's implications and conclusion, respectively. In Section 4.8, the second part of the chapter, which is the development and validation of the intervention protocol, is briefly presented. Section 4.9 summarises the chapter.

4.2 Background

Maternal and infant mortality is a global health issue, although it disproportionately challenges lower-income nations like those in sub-Saharan Africa and South and Southeast Asia (Boerma et al., 2023; Roser & Ritchie, 2024). In these countries, access to quality services during pregnancy, childbirth, and postpartum is limited (UNICEF, 2019). Additionally, the utilisation of these

services is low, and there may be a lack of awareness about the benefits of the existing health system (Sarikhani et al., 2024). A continuum of care models encompassing integrated care service provision from pregnancy to postpartum can significantly improve mother and newborn health (Buli et al., 2022). Adequate provision of this continuum of care needs to connect and sustain mothers with the existing healthcare system by mobilising them to improve health-seeking behaviour and effective use of the antepartum, intrapartum, and postpartum health services.

According to studies, most maternal mortality occurs during postpartum, particularly in the first week. For example, a systematic review of the timing of maternal death revealed that nearly two-thirds of postpartum maternal deaths occurred within the first week (Dol et al., 2022). This implies that mothers' access to skilled childbirth has major implications for their survival and their newborns (Das et al., 2021). Hence, the use of available delivery services has the potential to reduce morbidity and mortality for both (UNICEF, 2024a). Moreover, effective service utilisation of facility delivery and postnatal care can reduce the chance of neonatal mortality rate by 26% compared to those who did not receive any PNC (Singh et al., 2022). This evidence shows the critical role of PNC use as many maternal deaths occur because of haemorrhage and infection from immediately after childbirth to six weeks postpartum (Dol et al., 2022).

Despite the benefits, postnatal care has been one of the most neglected health services in the continuum of maternal care (WHO, 2024e). According to UNICEF projections, approximately 141 million childbirths in sub-Saharan Africa are expected to occur without the assistance of skilled health personnel between 2022 and 2030 (UNICEF, 2024a). Several factors contribute to inadequate service utilisation by women during the continuum of care in low-income countries. Significant disparity in childbirth at health institutions exists, with the lowest rates in low-income

countries and among women living in rural areas, who are uneducated and economically poor (Doctor et al., 2018; Hasan et al., 2021). Other studies, on the other hand, revealed that women may still deliver at home despite access to health facilities (Tekeba et al., 2025). This suggests that empowering women and enhancing awareness of the benefits of healthcare service utilisation is crucial (Tekeba et al., 2025). According to studies, three broad factors could influence the women's receipt of skilled childbirth. These include individual, community, and institutional-level factors (Kifle et al., 2018; Sarikhani et al., 2024). More specifically, factors related to knowledge and attitude towards the service, autonomy and decision-making, and accessibility to the service and health system's weaknesses were the most commonly identified (Sarikhani et al., 2024).

With technological advancements such as mobile technology in recent years, mobile healthcare aimed at educating, mobilising, and motivating mothers enhances their awareness, attitude, and supportive role, which can increase health service utilisation during the critical period of the maternal care continuum. One review article has showed a fundamental benefit of health communication in connecting the patient with healthcare providers for quality healthcare service. According to this review, mobile technology has recently been used for this purpose, offering several benefits, including time management, convenience, and cost-effectiveness (Sharma et al., 2022). In line with this review, other study similarly revealed that SMS and application-based solutions are widely used in mobile health (Abaza & Marschollek, 2017). Although short message services are dominant worldwide, developed countries frequently use app-based mobile solutions for creating awareness, health status monitoring and providing point-of-care support (Abaza & Marschollek, 2017). These circumstances suggest that SMS-based mobile health services could be

more practical and acceptable in low-income settings than app-based, which often require smartphone ownership, which is not prevalent in these settings.

The rate of mobile service penetration in developing countries is increasing and becoming instrumental for various purposes in health care delivery. These include, but are not limited to, chronic disease follow-up, disease screening, monitoring medication adherence and other health promotion services (Marcolino et al., 2018; Osei & Mashamba-Thompson, 2021). In developing countries, mobile health interventions have been shown to improve clinical outcomes, medication adherence, and the cost-effectiveness of healthcare provision (Hurt et al., 2016). The effectiveness of mobile technology in enhancing maternity and child health has also been examined in different settings. Accordingly, the results have shown that mobile health has a promising future, though further research is still required.

Although the positive effects of mobile health are being reported, other literature presents some contradictory findings. According to a systematic review conducted recently, approximately 43% of the articles included in the review reported the mixed effect of mobile health on maternal and child healthcare services (Chen et al., 2018). Other primary studies also demonstrated no significant impacts on maternal health service utilisation (Adam et al., 2021; Adanikin et al., 2014; Jones et al., 2020; Kebede et al., 2019). In contrast, a meta-analysis aimed at determining the effect of mHealth on ANC visits and birth at health facilities revealed promising positive effects of mHealth interventions. Nevertheless, there was a significant disparity in their impact amongst the studies (Rahman et al., 2022). The disparity in the effect of mobile health interventions suggests that many more studies are still recommended to determine their impact with modifications to interventions.

Previous studies have not assessed the impact of mHealth on related maternal and child outcomes, such as exclusive breastfeeding and the knowledge of danger signs of the mother and newborn. Therefore, this meta-analysis intended to evaluate the impact of mHealth interventions on improving the rate of childbirth at health facilities, postnatal care service utilisation, knowledge of obstetric danger signs, and exclusive breastfeeding (EBF) practices among women in LLMICs.

4.3 Methods

4.3.1 Search strategy

This study employed the PICO framework to guide the search strategy. PICO refers to population, intervention, control, and outcome. In this context, the population refers to pregnant or labouring mothers, as well as postnatal women. The intervention includes mHealth interventions such as mobile educational messages, SMS/voice reminder messages, or a combination of both. The control refers to the standard maternal care that healthcare professionals provide during the maternal care continuum. The review outcomes were measured by the level of postnatal care utilisation (complete or incomplete), the rate of childbirth at health institutions, or delivery by skilled birth attendance. The level of exclusive breastfeeding or breastfeeding self-efficacy was also an outcome of this study.

We searched for primary studies conducted until October 2022 from common electronic databases such as Web of Science, PubMed, EMBASE, CINAHL, Medline, Cochrane Library, Google Scholar, and Google. According to the Pico framework, the population included in the search term were “mother* OR families* OR women OR woman OR pregnant* OR parent*. The search terms used for intervention were mobile health OR mHealth OR sms OR mobile phone* OR mobile telephone* OR cellphon* OR cell phon* OR text messag* OR “short message service*” OR”

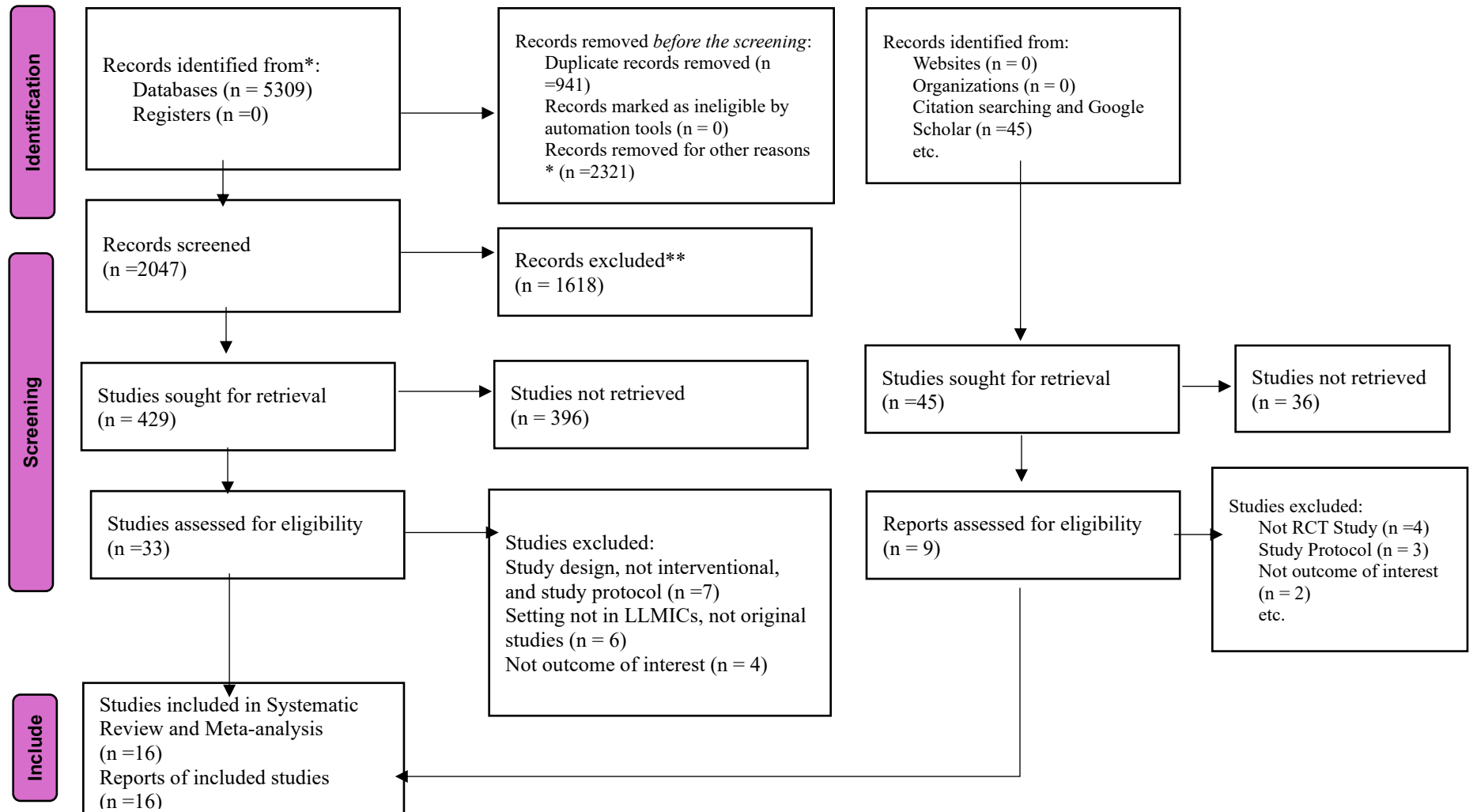
“ehealth” OR “e-health” OR “smartphone*” OR “smart phone*” OR “mobile device*” OR “electronic device*” OR “phone intervention*” OR “telephon* intervention*” OR “online” OR “mobile app” OR “reminder” OR “reminder messag*”.

The search terms for outcome were “postnatal care” OR “post-natal care” OR “maternal care” OR “maternity care” OR “postpartum care” OR “Postnatal Care”[Mesh] OR “institutional delivery” OR “facility delivery, OR “knowledge”, “Health Knowledge, Attitudes, Practice”[Mesh] OR “health care seeking” OR “exclusive breastfeeding” OR “breastfeeding” OR “Breast Feeding”[Mesh] OR “self-efficacy” OR “utilisation” OR “uptake” OR “behaviour” OR “skill*”.

The search results were limited to English-language studies and primary articles of randomized controlled studies in LLMICs.

4.3.2 Inclusion and exclusion criteria

This systematic review and meta-analysis included studies that fulfilled the following requirements. 1) It should be done in lower- and lower-middle-income countries. 2) Studies should employ randomised controlled, quasi-experimental, or experimental trials with historical cohorts. 3) Studies should be conducted on pregnant women or postnatal mothers. 4) Studies should also fulfil the following criteria, such that they should employ mHealth as intervention and standard care as control. In addition, they should report either of the following outcomes such as facility delivery rate, postpartum care uptake, EBF practice, and awareness of ODSs in their findings. Studies that fail to fulfil either of the set criteria, such as those published in English and study protocols. Moreover, the present review and meta-analysis used the PRISMA flow diagram to illustrate the specific steps involved in the review process (Figure 4.1)



* Excluded by title and abstracts; ** Not relevant to the main topic, no mHealth intervention

Figure 4.1 Prisma flow diagram of studies included in the systematic review and meta-analysis

4.3.3 The outcome of the study

i. Data Abstraction

Data were extracted from primary articles and put into a tabular Excel sheet. The extracted data includes: 1) basic information related to the study, such as the author's name, year of publication, and the country of study; 2) target population; 3) type, frequency, and duration of the mHealth intervention; 4) the study design and the sample size 5) the primary and secondary outcomes and 6) the summary of the study's findings (Table 4.1).

ii. Quality appraisal of the included studies

A critical appraisal of the studies was carried out using Cochrane risk bias tools for RCT and risk of bias for non-randomised studies of interventions (Higgins JPT et al., 2019). Accordingly, the quality of the included articles was assessed using seven elements of bias assessment. These biases were selection bias, which encompasses random sequence generation and allocation concealment, detection bias and reporting bias. In addition, the remaining biases, including attrition bias and other biases, were independently assessed by the principal investigator and co-investigators

Table 4.1 Data extraction for included studies and summary of their key results

Author and year	Country	Study participants and design	Sample size	Mode and dose of intervention for the Intervention arm	Control arm	Outcomes of the study (primary and secondary)	Summary of key results
Kebede et al 2019 (Kebede et al., 2019)	Ethiopia	Postpartum mothers, RCT	Intervention = 350; Control = 350	Text or voice call reminders 48 hours and 24 hours before scheduled postnatal care contact.	Routine care	Postnatal care visit uptake	Text reminder increases adherence to recommended PNC visits
Omole et al 2018 (Omole et al., 2018)	Nigeria	Pregnant mothers, RCT	Intervention = 260; Control = 248	Text messages related to pregnancy were sent until six weeks postpartum	Common health promotion text messages	Proportion of Antenatal care and facility childbirth	Text messages enhanced ANC visits and institutional childbirth among interventions compared to the control group
Olajubu et al 2020 (Olajubu et al., 2020)	Nigeria	Pregnant mothers, quasi-experimental	Intervention = 190; Control = 190	Educational and reminder text message (during pregnancy: Between 35 th week and birth: two messages per week) (Postpartum: Week 1: three messages; Weeks 2–6: two messages per week) Reminder for Postnatal visits: one day ahead of schedule	Routine care	Postnatal care visit uptake	Mobile educational messages enhanced postnatal care uptake ten times more likely in the intervention group than in the control group (AOR: 10.87, 95% CI: 4.48-26.37).

				Contents of educational text messages: PNC, breastfeeding, self-care, danger signs, cord care, immunisation			
Shiferaw et al. 2016 (Shiferaw et al., 2016)	Ethiopia	Pregnant women, non-randomised controlled trial	Intervention = 613; Control= 568	Reminders for ANC and PNC appointment dates 1 week and 3 days ahead of the appointment, and educational texts on ODSs	Continued with routine care	Antenatal care visits, institutional childbirth, and postnatal care service uptake	Enhanced ANC visits, institutional childbirth, and improved postnatal care visits
Fedha et al. 2014 (Fedha, 2014)	Kenya	Pregnant mothers, prospective RCT	Intervention = 191; Control= 206	Phone reminder two weeks before ANC appointment and update pregnancy recommendations	Continued with routine care	Proportion of ANC utilisation and level of facility childbirth	Tele support enhanced antenatal care and utilisation of the facility for childbirth
Lund et al. 2012 (Lund et al., 2012)	Zanzibar/Tanzania	Pregnant mothers, Cluster RCT	Intervention = 1311; Control= 1239	SMS message and mobile voucher once every forty nights during early gestation and twice a week after 36 weeks	Routine care	Proportion of skilled birth attendance	mHealth intervention produced a significant Improvement in skilled birth attendance for urban women (OR, 5.73; 95%CI: 1.51, 21.81)
Atnafu et al. 2017(Atnafu et al., 2017)	Ethiopia	Pregnant mothers, Community-based randomised	Intervention = 2160; Control= 1080	During pregnancy: Mobile text message at 14, 24, 30, 36 weeks. After childbirth: Text messages at 6,10, 14 weeks,	Routine care	The proportion of Antenatal care contacts and birth attendance by	SMS text messages increased the proportion of antenatal care utilisation and childbirth with a skilled birth attendant

		controlled trials		and 9 months for immunisation Message contents: antenatal care appointment date, expected delivery date, and postnatal care appointments; immunisation and vaccine schedules and contraceptive store status		skilled health professionals	
Jones et al. 2020 (Jones et al., 2020)	Kenya	Postnatal mothers, RCT, 4-arms (1 control and three intervention)	Intervention 1=222 Intervention 2=223 Intervention 3=229 Control=227	Text messages related to ODSs, general postnatal care issues, and contraceptive use. Intervention dosage: Four danger sign-related text messages were sent daily from day 2 to day 4 after postpartum discharge, one PNC-related message every three days from day 6 to day 36, and one contraceptive-related message every day from day 30 to day 45.	Routine care	Knowledge of danger signs of mother or newborn, postnatal care-seeking behaviour, and contraceptive utilisation rate	A text message positively affects postnatal care-seeking behaviour and improves contraceptive utilisation and knowledge of danger signs in mothers and newborns.
Flax VL et al., 2017 (Flax et al., 2014)	Nigeria	Pregnant mothers, Cluster randomised controlled trial	Intervention =196 Control=194	Intervention type: breastfeeding learning sessions,	Routine group meeting, no	Measurement of early initiation and exclusive breastfeeding	The odds of EBF at six months (OR: 2.40; 95% CI: 1.40, 4.0) and early breastfeeding initiation (OR: 2.60; 95% CI: 1.60, 4.10) were higher in the

				text, voice messages, songs and dramas in group meetings. Contents: early initiation and EBF messages	text or voice message		intervention arm compared to the control arm.
Unger JA et al 2018 (Unger et al., 2018)	Kenya	Pregnant mothers, 3-arm randomised controlled trial	Intervention 1=93, Intervention 2= 91, Control= 94	Weekly customised text messages on the basis of maternal characteristics and the timing of pregnancy or postpartum	Routine care	Facility delivery, EBF, and contraceptive use	There was no significant difference in institutional delivery, but mobile-based SMS has improved EBF practice and early postpartum contraceptive use.
Bangal et al 2017(Bangal et al., 2017b)	India	Pregnant mothers, Prospective randomised controlled trial	Intervention =170 Control=15 SBA Intervention = 185 Control= 190	Mobile voice calls and text reminders at constant intervals	Routine antenatal and postnatal care	ANC visits, the proportion of childbirth at health facilities, and postnatal visits	Mobile health interventions significantly improved mothers' utilisation of ANC, iron tablet consumption, TT vaccinations, childbirth at health facilities, and uptake of postnatal care services.
Ogaji et al 2020 (Ogaji et al., 2021)	Nigeria	postpartum mothers, Prospective randomised controlled trial	Intervention = 67 Control= 64	Mobile-based reminders for mothers in the intervention arm on the advantages of EBF practice for their newborns, and obtaining their feedback on any difficulties	Routine care	Duration and rate of EBF practice	Mobile phone-based support has improved the rates and duration of EBF EBF support via mobile has improved EBF practice and sustained breastfeeding
Adam et al.	South Africa	Pregnant mothers,	Intervention = 423	Mothers in the intervention arm were provided access to a	Routine care	The primary outcome was	There were no statistically significant differences between

2021(Adam et al., 2021)		cluster randomised controlled trial	Control=501	video-installed mobile phone demonstrating the EBF techniques and were provided with related information		EBF practices in the first and fifth months. Secondary outcomes include mothers' knowledge of BF, early BF initiation, and complementary feeding.	the two trial arms at 5 months for any of the major outcomes, including EBF in the last 24 hours. There was no considerable knowledge difference at the fifth month, but a small and significant improvement at the first month.
Hmone et al. 2017 (Pan, 2017)	Myanmar	Pregnant mothers, randomised controlled trial	Intervention = 143 Control= 137	Mobile text messages focusing on promoting exclusive breastfeeding practice	General message on pregnancy support but not related to BF	Primary outcome: the rate of EBF practice between 1-6 months; secondary outcome: the median duration of EBF and BF self-efficacy.	The text message significantly improved the EBF rate over the six months of follow-up combined and at each monthly follow-up visit. Mothers in the intervention group demonstrated higher breastfeeding self-efficacy over the follow-up periods.
Adanikin et al. 2014 (Adanikin	Nigeria	Postpartum mothers, interventional	Intervention = 1126	Text message appointment reminder	Routine care	Rate of postnatal care	A 50% decrease in PNC appointment non-attendance

et al., 2014)		design with historic control group	Control=97 1			service attendance	was attributed to text message reminders.
Seyyedi et al. 2021(Seyyedi et al., 2021)	Iran	Postpartum mothers, randomised controlled trial	Intervention = 40 Control= 40	Smartphone-based educational message	Routine care	Breastfeeding self-efficacy, knowledge, attitude, and practice of breastfeeding	The educational message significantly enhanced maternal knowledge of breastfeeding and breastfeeding self-efficacy.

iii. Data Analysis and Synthesis

Data were analysed using Review Manager (RevMan version 5.4) for primary articles that reported outcomes in numbers. Studies that did not present data in numbers were discussed, along with the pooled findings of the other included studies and relevant literature on the basis of their summary results. The I^2 test statistics determined the studies' heterogeneity and indicated no heterogeneity at 25%, moderate heterogeneity at 50%, and substantial heterogeneity at 75% (Higgins JPT et al., 2019). A sensitivity analysis was performed using a leave-one-out approach to assess the impact of individual studies on the overall results. Due to the variability amongst the studies included for major outcomes, both random and fixed-effect models were utilised. The subgroup analysis was conducted on the basis of characteristics of the interventions.

iv. Ethical Considerations

Since published primary articles were used, ethical considerations did not apply to this systematic review and meta-analysis. Nonetheless, the protocol for undertaking this review was registered in PROSPERO with the ID CRD42022366738 before the review commenced.

4.4 Results

4.4.1 Characteristics of included studies

After thoroughly examining the articles on the basis of the eligibility criteria, sixteen studies were finally included in the current review. The included studies were published between 2012 and 2022, with sample sizes between 91 and 2160, with a total of about 14,410 participants. Thirteen papers used RCTs, two articles were quasi-experimental studies, and one study used an interventional design with a historic control group. These studies were conducted in Nigeria (5), Ethiopia (3), Kenya (3), South Africa (1), India (1), Myanmar (1), Tanzania (1), and Iran (1).

Amongst the studies assessed for eligibility, three were excluded because they were study protocols (Caroline Free et al., 2010; Gelano et al., 2018; Mekonnen et al., 2019), two were not conducted in LLMICs (Maslowsky et al., 2016; Shorey et al., 2019), three did not report the required outcome (Ariyani et al., 2022; Colaci et al., 2016; Herring, 2017), and three were not primary articles (Changizi & Kaveh, 2017; Fortuin et al., 2016; McLean et al., 2016).

4.4.2 Characteristics of Interventions

The studies utilised mobile health interventions to examine their effect on either one or multiple outcomes of interest. Consequently, seven reported the impact of the intervention on proportion of childbirth at health institutions (Atnafu et al., 2017; Bangal et al., 2017a; Fedha, 2014; Lund et al., 2012; Omole et al., 2018; Shiferaw et al., 2016; Unger et al., 2018); six investigated its impact on postnatal care utilisation (Adanikin et al., 2014; Bangal et al., 2017a; Jones et al., 2020; Kebede et al., 2019; Olajubu et al., 2020; Shiferaw et al., 2016); six reported the impact of mHealth on exclusive breastfeeding practices (Adam et al., 2021; Flax et al., 2014; Hmone, 2017; Ogaji et al., 2021; Seyyedi et al., 2021; Unger et al., 2018); and two studies examined its effect on knowledge of obstetric danger signs (ODSs) (Adam et al., 2021; Jones et al., 2020). The included studies enrolled participants at different stages of pregnancy or postpartum. Most studies recruited the participants during late gestation, while others recruited them during the early postpartum period. The variation in participant enrolment varied due to differences in the outcome of interest across the studies. The span of intervention also varies across studies. For outcomes related to childbirth at healthcare institutions, the mHealth intervention was administered starting from GA of 14 weeks during pregnancy for some studies and from GA of 35 weeks during pregnancy for other studies. For postnatal care outcomes, the intervention began in some articles at 35 weeks of pregnancy and was administered immediately postpartum in other studies.

i. Components of the interventions

Four studies used short messages (SMS) or voice call reminders as an intervention (Adanikin et al., 2014; Atnafu et al., 2017; Bangal et al., 2017a; Kebede et al., 2019), nine used a tailored educational message (Adam et al., 2021; Flax et al., 2014; Hmone, 2017; Jones et al., 2020; Lund et al., 2012; Ogaji et al., 2021; Omole et al., 2018; Seyyedi et al., 2021; Unger et al., 2018), and three combined a reminder and educational message (Fedha, 2014; Olajubu et al., 2020; Shiferaw et al., 2016). Though the content of the messages varied across studies, their intervention components were derived from the Mobile Alliance for Maternal Action (MAMA) message (Coleman et al., 2020), WHO recommendations for postnatal care services (WHO, 2015, 2022c), and other relevant literature. The time points for measuring outcomes varied across the outcomes, with recruitment occurring during pregnancy and evaluation of the outcome for institutional delivery taking place during childbirth. Meanwhile, the measurement points for PNC service utilisation were during the first day after birth, the third day, the 10th day, and the sixth week. For exclusive breastfeeding practice, measurement points were taken at 48 hours postpartum, after 10 weeks, 16 weeks, and 6 months.

ii. Assessment of risk of bias

Overall, the studies included had a moderate level of quality. Except for two articles, the included studies have a low-risk bias in their random sequence generation. However, roughly one-third of the studies were prone to selection bias due to the non-disclosure of allocating subjects to intervention and control arms. Most of the examined studies did not disclose blinding of the outcome assessment (detection bias). Attrition bias was not mentioned in almost half of the studies included (Figure 4.2 and Figure 4.3). Lastly, the GRADE recommendations assessed the current review and meta-analysis's overall quality of evidence (Guyatt et al., 2011).

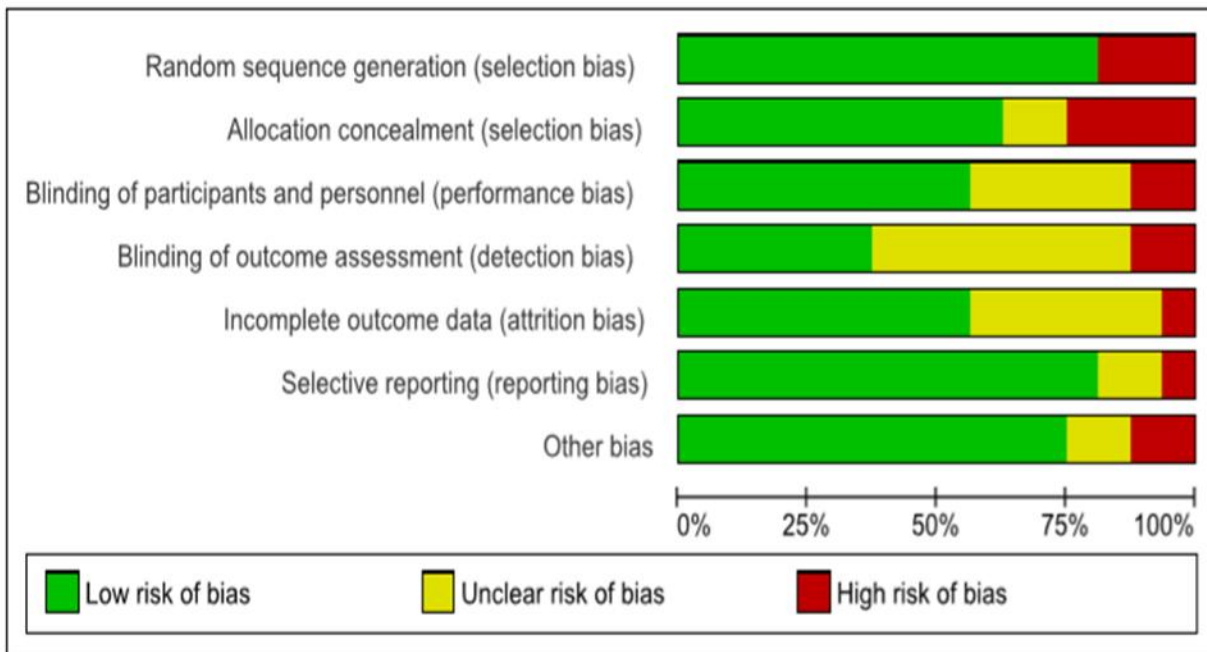


Figure 4.2 The risk of bias graph for the studies included in the systematic and meta-analysis

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Adam et al 2021	+	+	+	+	+	+	?
Adanakin et al 2014	-	?	?	?	+	-	-
Atnafu et al 2017	+	+	+	?	+	+	+
Bangal et al 2017	+	?	?	?	?	+	-
Fedha et al 2014	+	+	?	?	?	+	+
Flax VL et al 2014	+	+	?	+	+	+	+
Hmone et al 2017	+	+	+	?	+	+	+
Jones 2020	+	+	?	?	+	+	+
Kebede et al 2019	+	+	-	+	+	+	+
Lund et al 2012	+	-	+	-	?	+	+
Ogaji et al 2020	+	-	-	?	+	+	+
Olajubu AO et al 2020	-	-	+	?	?	+	+
Omole 2018	+	+	+	+	+	?	?
Seyyidi et al 2021	+	+	+	+	-	+	+
Shiferaw et al 2016	-	-	+	+	?	?	+
Ungar JA et al 2018	+	+	+	-	?	+	+

Figure 4.3 The risk of bias summary for the studies included in the systematic and meta-analysis

4.4.3 Study outcome

The main purpose of the review was to assess the impact of mHealth interventions on the utilisation of postnatal care services and the extent of facility delivery among women in LLMICs. The

secondary objective was to investigate how mHealth interventions influenced the rate of exclusive breastfeeding practice and awareness of maternal and neonatal warning signs among this group in low- and lower-middle-income countries.

4.4.3.1 Childbirth at the health facility

Seven of the included articles examined the impact of mHealth interventions on the rate of childbirth at health facility outcomes. Amongst these studies, six reported a significant positive effect of the mHealth intervention program, while one found no significant impact. A meta-analysis was conducted on five articles that reported outcomes in figures to estimate the effect size. Accordingly, the mHealth intervention program has increased the rate of childbirth at health facilities by 121% (OR = 2.21, 95% CI: 1.69-2.89) compared to participants who received only standard care. The analysis also showed that the I^2 statistic value of ($I^2 = 79\%$, $P < 0.001$) indicates considerable heterogeneity amongst the studies. Thus, a random-effects model should be used to account for the variation amongst the studies. The sensitivity analysis using the leave-one-out approach was done to identify the influence of a single study on the overall outcome. Accordingly, the result showed an insignificant difference in the odds of intervention effects, ranging from an odds ratio of 1.83 to 2.45, with the higher odds attributed to a study conducted by Atnafu et al (Atnafu et al., 2017). The subgroup analysis revealed no significant difference in the rate of childbirth at health facilities between the intervention and control arms on the basis of the characteristics of mHealth interventions ($p = 0.18$) (Figure 4.4).

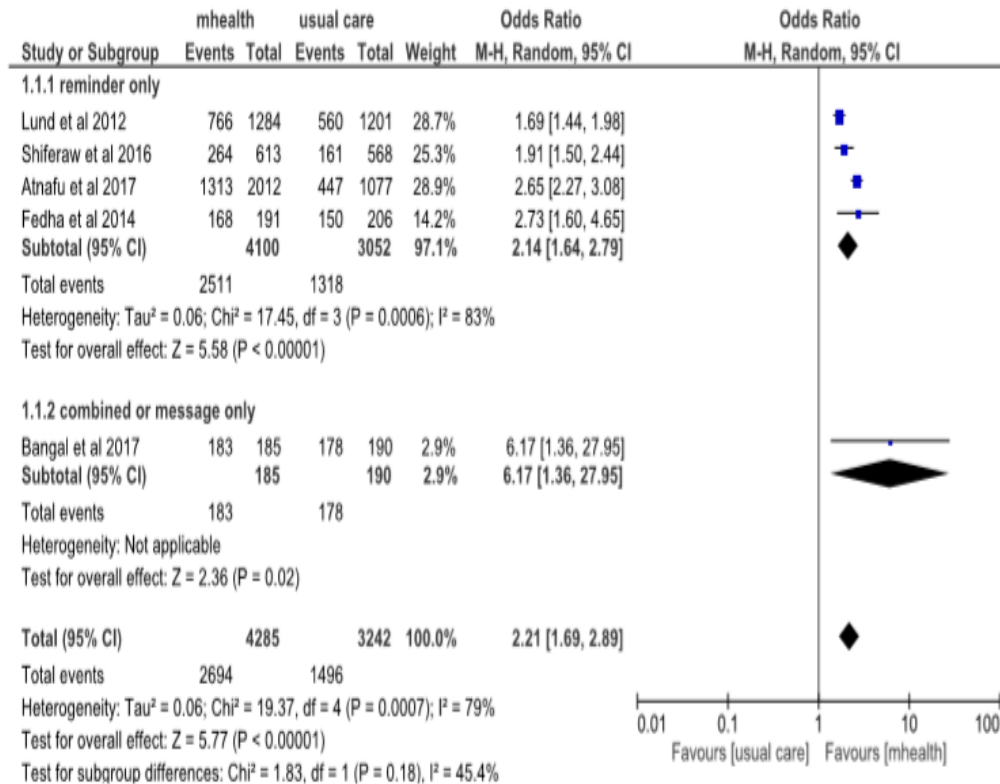


Figure 4.4 A forest plot showing the effect of mHealth on improving the utilisation of institutional delivery

4.4.3.2 Postnatal care utilisation and knowledge of obstetric danger signs

Six articles from the included studies explored the impact of mHealth interventions on postnatal care utilisation. Five articles were included in the meta-analysis, while the other was excluded because the study did not present its results in figures. Consequently, the meta-analysis of five included studies showed that the mobile health intervention had significantly enhanced the odds of postnatal care utilisation amongst the intervention group compared to their counterparts. Moreover, women who received educational messages or phone-based reminders were about four times more likely to utilise the postnatal care services than those receiving standard care (OR=4.13

(95%CI: 1.90-8.97)). The random effects model was employed in this study due to the significant heterogeneity observed ($I^2 = 96\%$, $p < 0.001$). One article that did not meet the criteria for inclusion in the meta-analysis also showed that an mHealth intervention significantly improved postpartum healthcare-seeking behaviour and awareness of the ODSs among mothers who received a telephone-based educational short message, in addition to their routine care (Adanikin et al., 2014).

The influence of a single study on the overall outcome was also examined for outcomes related to the postnatal care service. Accordingly, the odds ratios of 2.65 and 5.6 were contributed by two studies conducted by Bangal et al., 2017, and Adanikin et al., 2014, respectively (Adanikin et al., 2014; Bangal et al., 2017a), showing considerable effect due to the difference in sample size from other included studies. The subgroup analysis was conducted on the basis of the characteristics of the intervention. It did not reveal any significant differences between the intervention and control groups on the outcome related to postnatal care utilisation ($p=0.73$) (Figure 3.5).

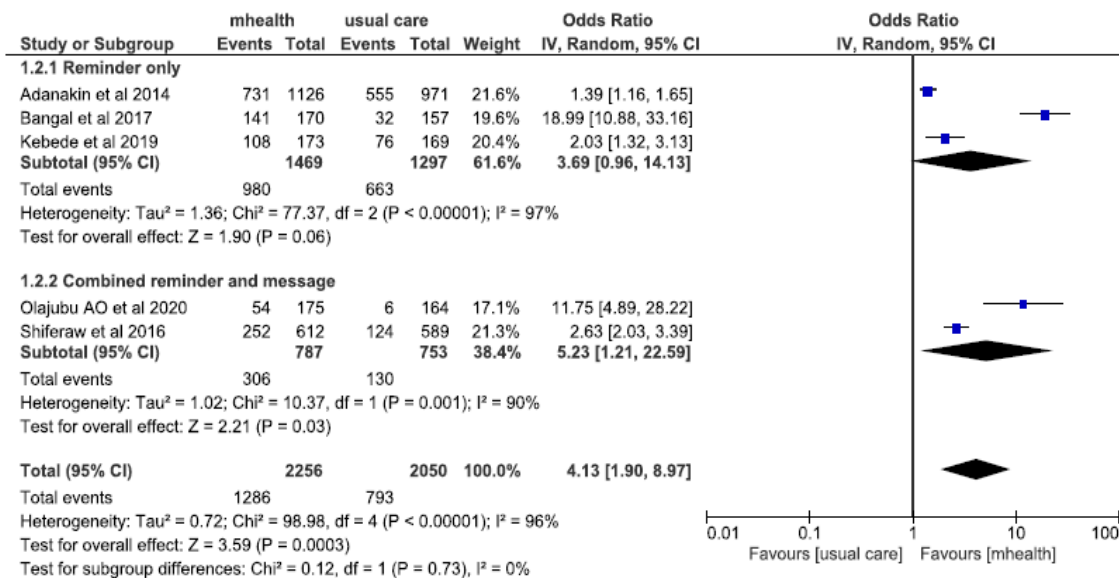


Figure 4.5 A forest plot showing the effect of mHealth on improving the utilisation of postnatal care

4.4.3.3 Exclusive breastfeeding practice

Amongst the included articles, six assessed the impact of the mHealth intervention program on the level of exclusive breastfeeding practice. A meta-analysis was conducted for four studies, and the results showed that exclusive breastfeeding among participants who received an mHealth intervention increased by 125% compared to the control group who received only the standard care (OR = 2.25, 95% CI: 1.46-3.46). Concerning the heterogeneity of the included studies, the I^2 statistics revealed a moderate heterogeneity amongst the studies ($I^2 = 56\%$, $p = 0.08$); therefore, a random-effects model was employed (Figure 4.6). Similar findings were reported by Seyyedi et al., who found that the educational message from a smartphone app greatly improved maternal understanding of exclusive breastfeeding and breastfeeding self-efficacy. However, research by Adam et al. found that mHealth did not significantly impact exclusive breastfeeding.

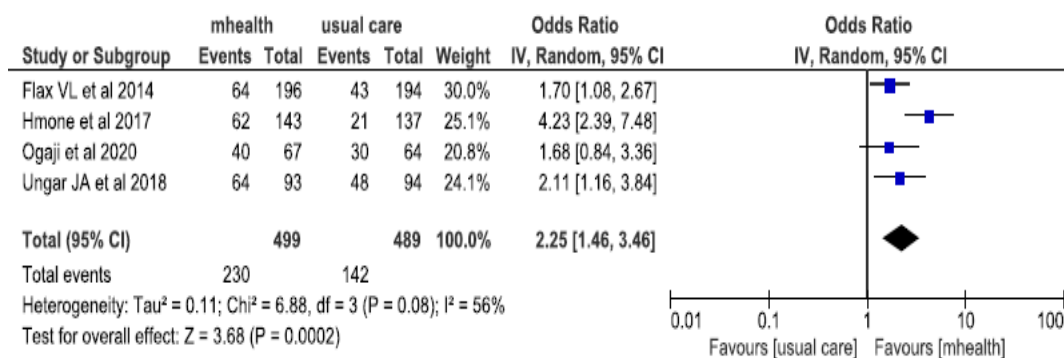


Figure 4.6 A forest plot showing the effect of mHealth on improving exclusive breastfeeding practice

4.4.4 Publication Bias

A funnel plot was used to check the publication bias amongst the included studies. The funnel plots for institutional delivery (Figure 4.7) and exclusive breastfeeding outcomes (Figure 4.8) were symmetrical and showed no publication bias. However, the funnel plot for postnatal care outcomes was asymmetrical, showing publication bias (Figure 4.9).

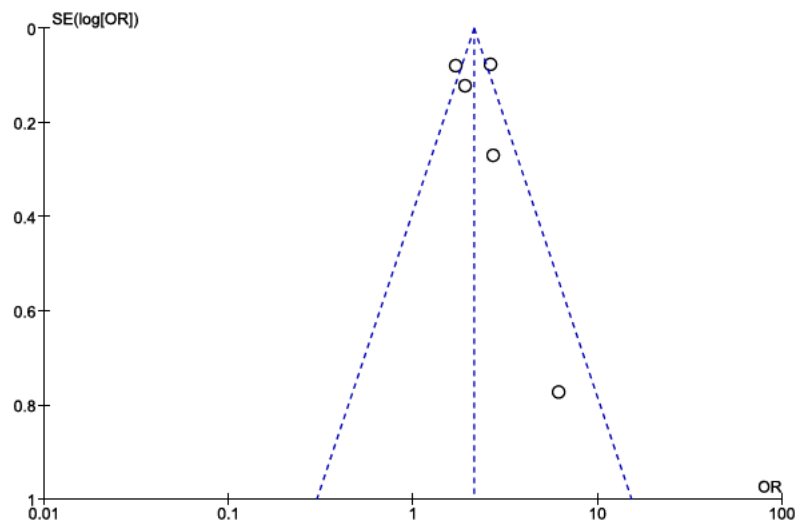


Figure 4.7 The funnel plot showing the symmetry of included studies reporting institutional delivery outcome

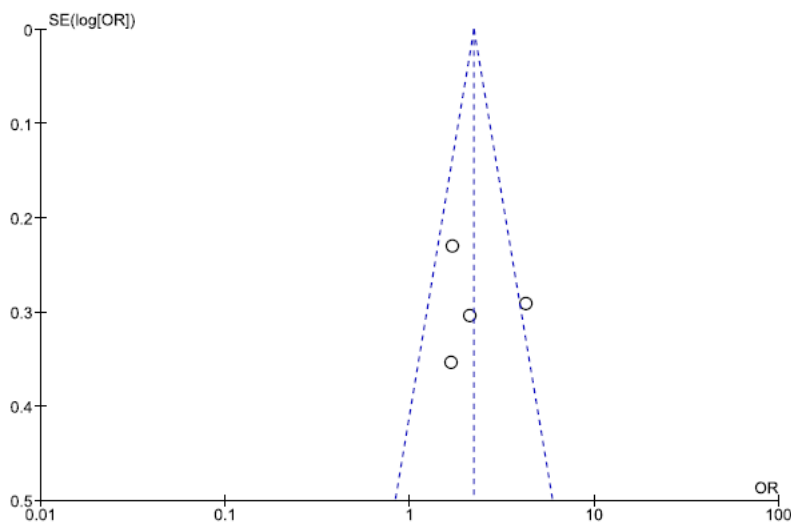


Figure 4.8 The funnel plot showing the symmetry of included studies reporting exclusive breastfeeding outcome

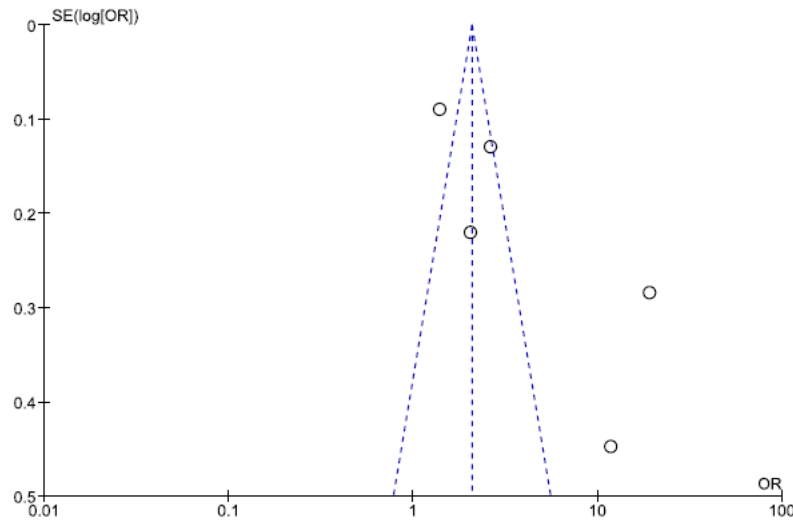


Figure 4.9 The funnel plot showing the symmetry of included studies reporting postnatal care utilisation outcomes

4.5 Discussion

The current study aimed to investigate the effect of mobile health interventions on the utilisation of health facilities for childbirth, uptake of postnatal care, exclusive breastfeeding practices, and women's knowledge of obstetric danger signs in low-income settings. The growing trend in the consumption of mobile technologies has recently improved health communications, behaviour changes, and the utilisation of healthcare services (Goncalves-Bradley et al., 2020). It has been suggested that mobile health communication will reduce maternal deaths in low-income nations where access to health information is comparatively limited. However, a comprehensive analysis of the magnitude of mHealth interventions in improving institutional delivery, postnatal care, and associated outcomes, such as exclusive breastfeeding practices, is minimal. Therefore, this study

focused on analysing and synthesising evidence on the effect of mobile-based interventions in enhancing postnatal care, exclusive breastfeeding, and facility delivery to better understand their overall impact on improving the service uptake during a mother's continuum of care.

The present review and meta-analysis showed that those women who received either mobile educational messages or reminders had a higher rate of uptake of skilled birth attendance compared with their counterparts. In line with this finding, another meta-analysis in LMICS showed a similar trend in which recipients of mHealth intervention exhibited a higher rate of ANC attendance and delivery at health facility (Wagnew et al., 2018). Similar to prior findings, the mobile-based intervention had produced a significant effect in increasing the odds of women giving birth at health facilities, according to a meta-analysis by Rahman et al. Nevertheless, the effect size of the improvement was small, and thus further research was needed (Rahman et al., 2022). The positive impact of mHealth was not limited to low-income countries as women in high-income nations also utilise services provided for pregnancy care, childbirth and postpartum care even more. For example, according to studies in Singapore and Timor-Leste, the odds of uptake of perinatal services were higher among those participants targeted for mHealth intervention compared to others (Shorey et al., 2019; Thompson et al., 2019). This could be because quality access to healthcare information, access to developed infrastructure, and a high level of education and awareness might have improved women's knowledge and influenced their behaviour to seek skilled birth care from healthcare professionals.

This study also examined the role of mobile health in enhancing women's awareness of obstetric danger signs and their use of postnatal care. Accordingly, the meta-regression analysis revealed that women who received mobile-based educational intervention and standard care were more

likely to follow the WHO-recommended uptake of postnatal care guidelines than those who received standard care alone. This finding aligns with a review study by Mbuthia et al., which found that women can frequently identify and report danger signs, follow recommended PNC visits, exclusively breastfeed their newborns, and possess self-efficacy if they are supported with mobile health interventions (Mbuthia et al., 2019). A comparable finding was noticed in the Singaporean study, where a supportive educational program delivered through mobile phones enhanced postpartum parental outcomes (Shorey et al., 2017). Women in the intervention group in the current study had substantially higher knowledge of danger signs than women who only received a standard maternal continuum of care (Jones et al., 2020). On the contrary, the knowledge of ODSs amongst South African women did not show significant improvement with mHealth interventions (Adam et al., 2021). This dissimilarity may be attributed to the sociocultural variations amongst the participants.

Regarding exclusive breastfeeding practices, the present study also systematically examined the impact of mobile educational messages on enhancing exclusive breastfeeding practices. Therefore, the pooled effect of the meta-regression of the four included articles has demonstrated that SMS educational messages have considerably increased the exclusive breastfeeding rate. This result is consistent with two previous studies which have shown the significant effect of mobile-based interventions in enhancing EBF practice, improving women's attitudes, increasing BSE and reducing infant health problems (Lee et al., 2016; Qian et al., 2021). A study in Iran also found that the educational message, delivered using a smartphone app, significantly improved mothers' understanding of EBF and their BSE. This can be due to participants' greater confidence in the intervention providers and the effect of the mHealth intervention on promoting exclusive breastfeeding practices. In addition to the standard care for subjects in the intervention group, most

articles in the current review incorporated SMS reminders and instructional messages to provide health information as part of the intervention.

In the present systematic review and meta-analysis, most of the articles included in the analysis utilised mobile phone educational messages and reminders as interventions to deliver healthcare information, besides routine care, to participants in the intervention group. Reminder texts alone were used in just four studies. According to these findings, combined reminder and educational message or reminder alone had positively influenced the participants' use of health services, though variation exists with regard to the effect size. However, a subgroup analysis on the basis of the characteristics of the interventions revealed no significant difference in the impact of mHealth interventions on maternal care service usage outcomes.

4.6 Implications for future studies

In this study, the role of mHealth in enhancing the uptake of skilled childbirth and PNC in addition to EBF practices in LLMICS. Given that the existing data in these settings were limited to a few countries, additional primary investigations are required to draw definitive conclusions. Moreover, since the studies included did not involve partners, despite their role in maternal and child health, future researchers should consider including partners in the intervention to enhance the effectiveness of the mobile health intervention.

4.7 Conclusion and recommendations

The present study demonstrated that mobile health interventions implemented during and after childbirth significantly increased healthcare utilisation. Although the interpretation needs caution due to the number of studies included and significant heterogeneity, the mHealth intervention has been found to have a positive impact on most of the outcomes assessed in this study. Therefore,

further exploration of mHealth's effectiveness is warranted by modifying interventions such as making them theory-based and involving partners for better intervention outcomes.

4.8 Development and validation of the intervention

The intervention programmes were developed on the basis of the postnatal care and breastfeeding counselling recommendations of the WHO and the recommendations of the Ethiopian Ministry of Health and other relevant literature (Alders, 2018; Coleman et al., 2020) in a culturally acceptable manner for the study population (MOH-Ethiopia, 2020; WHO, 2013a, 2015, 2023a). Furthermore, the intervention development was guided by the theories of the HBM and SCT (Figure 3.1). The findings of a systematic review and meta-analysis on the effects of mHealth interventions on improving PNC service outcomes (Gayesa et al., 2023) were used to guide the details of the intervention. The intervention includes informative messages and calls to action tailored to participants. The delivery time of the messages was designed according to the woman's GA and postnatal period. The intervention focused on promoting and reminding PNC visits, providing educational messages on EBF practices, enhancing self-efficacy for successful breastfeeding and highlighting the role of husband support. The focus was on the health consequences of ignoring PNC services and EBF. The messages also addressed ODSs and encouraged prompt healthcare visits if any of these signs occurred.

4.8.1 Goal of the intervention

This mobile educational message intervention aimed to improve PNC service utilisation, EBF practices, BF self-efficacy, breastfeeding support behaviour and knowledge of ODSs. Before this development, a systematic review and meta-analysis aimed at identifying the effectiveness of mHealth interventions was conducted as input for intervention development (Gayesa et al., 2023).

Despite significant heterogeneity, the study revealed that mobile educational messages effectively improved maternal service utilisation and EBF practices. Moreover, the included studies were nontheoretically grounded and focused solely on women, overlooking the social environment, including their partners or husbands. Thus, the current intervention was developed to enhance PNC service utilisation, knowledge of ODSs, EBF practices and related outcomes guided by the HBM and SCT, which are briefly discussed in Chapters 2 and 3. Moreover, husbands were involved in the current study.

4.8.2 Contents of the intervention

The contents of the interventions were designed to provide information on the benefits of utilising PNC services and EBF practices and the burdens of ignoring them. Moreover, ODSs of pregnancy, childbirth and postpartum and a call to action if these signs occurred were included in the educational intervention programme. In addition, partner support benefits were incorporated into the intervention programme (Appendix III). These educational messages can increase awareness of PNC service provisions, EBF practice, BSE and knowledge of ODS and improve partner support behaviour, which can help the target population modify their behaviour to improve their health and well-being (Araujo-Soares et al., 2019). The evidence suggests that providing health information can encourage individuals, society and communities to adopt healthy and positive behavioural habits. This may leads to changes in people's attitudes, knowledge, norms, beliefs and behaviours (Nancy & Dongre, 2021). Besides, the intervention messages involved sending the same message to the husbands, which was targeted at providing information and encouraging them to support their wives in utilising PNC services and successful breastfeeding. The SMS messages were initially developed in English and then translated into Afaan Oromo by experts in women's health who are fluent in the language (Appendix IV).

4.8.3 Intervention dosage

The intervention dosage is related to the duration of the intervention and the number of educational messages delivered during the intervention period. A systematic review and meta-analysis on the effects of mHealth interventions on PNC utilisation in low- and lower-middle-income countries was conducted before intervention development and was used to determine the intervention dosage needed to achieve the desired behavioural changes (Gayesa et al., 2023). Furthermore, studies have revealed that the commencement of interventions, such as providing health information on danger signs, breastfeeding and benefits of PNC services during late pregnancy, is efficacious in improving PNC service uptake and breastfeeding practices (Olajubu et al., 2020; Shiferaw et al., 2016). One to two messages per week at constant intervals were effective in other studies (Olajubu et al., 2020; Omole et al., 2018). A study has also shown that reminding mothers of PNC is effective (Shiferaw et al., 2016). Considering this evidence, tailored SMS messages were developed according to women's GA and time after childbirth. In this study, the mother–father dyads in the intervention group received tailor-made mobile educational messages two times a week in addition to routine PNC services. Throughout the intervention period, 24 educational messages were delivered: 12 during late pregnancy, between 31 and 37 weeks, and the remaining 12 after childbirth, up to 6 weeks.

The participants in the control group continued to receive routine care at their respective health institutions. According to the Ethiopian Ministry of Health's recommendations, routine care during pregnancy includes ANC, which encompasses treatments addressing risk identification, prevention and treatment of diseases associated with pregnancy or other conditions and health promotion and education. Additionally, routine care after birth covers PNC services that encompass monitoring a

woman's and newborn's health status; counselling on postpartum care; hygiene and breastfeeding; and return visits (MOH-Ethiopia, 2020).

4.8.4 Format of the intervention

The intervention format was a mobile-based short message service for the wife and husband. Although the content remained the same for both participants, the pronouns were changed for husbands, particularly in messages where husbands are expected to provide support to their wives. Previous studies have shown that mobile text messages have several advantages; for example, receiving mobile text messages is a relatively easy technology and has become popular worldwide (Head et al., 2013). In addition, text messages can be stored and used as a reference anytime; they are cost-effective, and health information can be delivered even to rural areas as far as mobile networks are available (Alders, 2018).

These messages were sent to the participants and managed centrally by intervention managers, including the principal investigator and research assistant. Text messaging subscriptions were made through Ethi-telecom, the country's primary telecommunication provider.

4.8.5 Validation of the intervention messages

The intervention messages were initially prepared in English and guided by the HBM and SCT. The content validity of the messages was validated by a panel of experts in the field, comprising one obstetrician–gynaecologist, two clinical midwife specialists and one assistant professor of maternal and reproductive health nursing. All the experts were familiar with the language and culture of the study area. The experts rated the relevance and appropriateness of the message's content on a 4-point Likert scale ranging from 'not relevant' to 'very relevant' and from 'not appropriate' to 'very appropriate', respectively (Appendix V). Furthermore, expert

recommendations were provided on the basis of the targeted outcome of the intervention. The content validity index ranged from 0.5 to 1, with an overall content validity index of 0.969. A content validity index above 0.78 is generally acceptable (Polit et al., 2007). Messages with lower relevance scores were amended until they were deemed sufficient by experts. Moreover, the experts commented on the intervention messages; they also suggested improvements, such as incorporating newborn danger signs into the messages and adjusting the timing of message delivery to be more appropriate for women's GA. The validated messages were subsequently translated by one Afaan Oromo language expert and one Clinical Midwife expert. After the translated messages were compiled, ten pregnant women were given printed copies of the text messages to comment on the clarity and understandability of the content in the target language and provide overall feedback. One-on-one interviews were conducted to obtain comments. The pregnant women suggested comments related to replacing unclear phrases or words with simpler phrases or words. The intervention messages were then finalised after feedback from the participants was considered. The finalised Afaan Oromo version of SMS educational messages were used as an intervention for the study trial.

4.8.6 Feasibility and acceptability of the mHealth intervention among the target population

Mobile phone interventions are popular worldwide (Marcolino et al., 2018; Yang & Van Stee, 2019). Despite the barriers related to mobile ownership and infrastructure, such as electricity, in rural areas, mHealth has become common and has shown promising effectiveness in improving healthcare promotion and disease prevention in these countries (Mekonnen et al., 2021). At the same time, enablers of mHealth usage, such as the increasing trend in literacy levels and the perceived usefulness of interventions in developing countries, have shown an advantageous impact on improving healthcare provision and health information communication (Aboye et al., 2024). In

Ethiopia, studies have shown that mobile messaging is feasible and acceptable (Mekonnen et al., 2021). The current research focuses on mHealth messages amongst Afaan Oromo speakers in Ethiopia. The feasibility and acceptability of the mHealth intervention amongst these populations were previously assessed in Addis Ababa City and the town of Gimbi amongst Afaan Oromo speakers, who demonstrated the intervention's acceptability. This qualitative study examined the acceptability of SMS messages for pregnant women, healthcare workers and system implementers. SMS messages are relevant and helpful. Moreover, participants reported greater satisfaction with the intervention (Alders, 2018). Therefore, another feasibility and acceptability study of mHealth interventions was non-compulsive.

4.9 Chapter summary

In this chapter, two key parts of the study have been presented. The first one was the systematic review of literature regarding the effects of mHealth on key maternal and infant-related outcomes. This part aims to synthesise available evidence, identify gaps and guide the intervention development. The review showed the positive effect of mHealth on maternal health service uptake, including delivery at health facilities and PNC. The second part of this chapter has presented a detailed description of intervention development and validation carried out on the basis of the systematic review. Twenty-four educational messages were developed and delivered over 12 weeks during pregnancy, and postpartum.

CHAPTER FIVE: TRANSLATION AND PSYCHOMETRIC PROPERTIES OF OUTCOME MEASUREMENT SCALES (PHASE II)

5.1 Introduction

In this PhD project, secondary outcomes related to breastfeeding were assessed using scales designed to measure breastfeeding-related outcomes. However, existing scales used to measure these outcomes were unavailable in the targeted language in Ethiopia, requiring validation. Hence, this chapter presents a detailed explanation of the cross-cultural adaptation of the three scales primarily used to measure outcomes linked to breastfeeding among women and their husbands. These scales are the BSES-SF and EBFSS, which were validated amongst breastfeeding women, and PBIS, amongst fathers of breastfeeding children. Comprehensive descriptions of the psychometric properties of both the EBFSS and PBIS have been published (Gayesa et al., 2024; Gayesa et al., 2025).

This chapter is organised into five sections. Section 5.1 introduces the chapter and highlights the validated outcome measurement scales. Section 5.2 presents the translation procedures of the three scales. Section 5.3 discusses the psychometric evaluation of the outcome measures among women (BSES-SF and EBFSS). Section 5.4 presents the psychometric assessment of outcome measures among fathers (PBIS). Section 5.5 summarises the chapter.

5.2 Translation of the three outcome measures

Translation and adaptations of measurement scales were guided by the guidelines for cross-cultural adaptation of outcome measures (Beaton et al., 2000). The original developers of the scales have permitted the adaptation of these scales in the Afaan Oromo language. The cross-cultural

adaptation was done in consecutive stages. In the first stage, two target language experts translated the instruments from English to Afaan Oromo: a health professional and an expert in Afaan Oromo. Then, the principal researcher of the current study combined the two forward translations, along with the forward translators as needed. The combined translated document was then given to two English language specialists, who conducted a backward translation to ensure the consistency. The team of seven experts, which included a midwife, a nurse who is an expert in nutrition, an Afaan Oromo language expert, and forward and backward translators, was then asked to review the translated version to make sure it was consistent with the original tool and that the translation was consistent in terms of conceptual, semantic, and idiomatic equivalencies. After obtaining the comments from the expert panel and incorporating them, they were invited to rate the items' relevance to the local context using the content validity index (CVI) on a 4-point scale ranging from 1 to 4 respectively denoting not relevant, somewhat relevant, quite relevant, and very relevant (Yusoff, 2019). Finally, fifteen postpartum mothers completed two pre-final Afaan Oromo versions, whilst fifteen fathers completed the other scale to obtain input on the tools' cultural suitability and clarity (Hall et al., 2018). After refining, all three scales underwent psychometric testing to determine validity and reliability.

5.3 Psychometric Evaluation of BSES-SF and EBFSS

5.3.1 Specific Objectives

To test the psychometric properties of the BSE-SF and EBFSS scales among breastfeeding mothers in Western Ethiopia

5.3.2 Study design

A cross-sectional study was conducted at two health centres in Nekemte city, and a retest was conducted four weeks later.

5.3.3 Study participants

The study participants for adaptation of the two scales were lactating mothers who had recently (within three months) given birth to a single child at the time of data collection, and those aged 18 and above who could read and write the target language (Afaan Oromo). The study participants were recruited using convenience sampling during their scheduled visit to the health centres for child immunisation.

5.3.4 Sample Size Determination

The minimum required sample for the psychometric testing of the scales was determined by the rule of thumb, which suggests using ten participants per item (Nicholas D. Myers et al., 2011). Hence, the required sample size for the two scales, with 16 items and 14 items, was 160 participants, as the one with the larger sample size was used. Four weeks later, a retest was administered to a random subsample of 48 subjects during their return visit to their respective health centres.

5.3.5 Data collection techniques

Four midwives were hired to collect data from the lactating mothers during their regular child immunization schedule at the two health centres in Western Ethiopia. After checking for eligibility, mothers were requested to provide their written informed consent. Data on their self-efficacy about recommended breastfeeding practices and the support they were getting from their partners were

then collected through face-to-face interviews. Besides this, information related to sociodemographic characteristics, parity, and mode of childbirth was collected.

5.3.6 Statistical analysis and the indices of the psychometric evaluation

The collected data were entered into EpiData Version 3.1 software, which was then exported to IBM Statistical Package for the Social Sciences (SPSS) Windows Version 28, for the analysis. The validity and reliability of both scales (BSES-SF and EBFSS) were evaluated as they indicate ultimate components of psychometric assessment, to ensure the accuracy, consistency, and stability of both scales. The internal consistency of the items was evaluated using Cronbach's alpha to measure the reliability of the scales. Cronbach's alpha measures internal consistency, which insinuates how closely the test items are linked to one another (Tavakol & Dennick, 2011). Test-retest reliability with an intraclass correlation coefficient (ICC) was used to assess the instrument's stability over time (Koo & Li, 2016).

The construct validity of both scales was evaluated using a confirmatory factor analysis (CFA) with maximum likelihood estimation. A construct validity of a scale identifies the scale's ability to measure the desired theoretical construct, which can be assessed using the CFA analysis, which shows how well the data supports the predicted factor structure (Tavakol & Wetzel, 2020). CFA was conducted using Jamovi 2.4.11 statistical software (Jamovi, 2023), and indices of model fit, such as the Standardised Root Mean Square Residual (SRMR), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Comparative Fit Index (CFI), were computed accordingly. Independent t-tests and one-way ANOVA were employed to find out the relationship between the participants' sociodemographic variables and the Afaan Oromo version of the scales.

5.3.7 Ethical Considerations

Ethical clearance was secured from the Hong Kong Polytechnic University (PolyU) Institutional Review Board (HSEARS20230828006) (Appendix I). Moreover, a letter of support was obtained from Wollega University (IHSRPTTAD/005/2016) before commencement of the study (Appendix II). The study administrators then granted permission for the study to proceed. Before data collection, the study participants also provided written informed consent. Enrolment in the study was voluntary, and confidentiality of information was preserved throughout the study.

5.3.8 Breastfeeding Self-efficacy Scale -Short Form

5.3.8.1 Introduction

One of the most widely used measurement scales to determine maternal BSE is the 14-item Breastfeeding Self-Efficacy Short Form (BSES-SF). This scale consists of 14 items used to assess the confidence of a woman in implementing the recommended breastfeeding practices. All items are given a score from 1 to 5, where 1 implies not at all confident, whereas 5 implies always confident. Then the scores were summed to obtain results ranging from 14 to 70. The uppermost values indicate greater confidence, whilst the lowest scores indicate lesser breastfeeding confidence. Although the scale was first established as a 33-item scale, it was later shortened to 14 items. The shorter version was widely accepted and adapted to various languages, having an acceptable Cronbach's alpha value of 0.90 to 0.92 (Amini et al., 2019; Oliver-Roig et al., 2012; Sandhi et al., 2022).

BSES-SF is not adapted to the Oromo language and cultural context, though the language is widely spoken (Wikipedia, 2024). Hence, this study intends to translate the BSES-SF into the Afaan

Oromo language and find out its psychometric properties among breastfeeding mothers in Ethiopia.

5.3.8.2 Results

Sociodemographic characteristics

As indicated in Table 5.1, 160 lactating mothers were recruited, having a mean (SD) age of 26.5 (4.5) years. Most respondents identified themselves as Protestant Christians (70.6%), and the majority belonged to the Oromo ethnic group (96.9%). Amongst the participants, nearly two-thirds had completed at least secondary education. A significant proportion of mothers were housewives (73.8%), and nearly two-thirds of the participants were multiparous.

Table 5.1 Socio-economic and obstetric-related characteristics of the study participants

Characteristics	Frequency	Percent
Religion		
Protestant Christianity	113	70.60
Orthodox Christianity	28	17.50
Muslim	18	11.30
Others ^a	1	0.60
Ethnicity		
Oromo	155	96.90
Amhara	4	2.50
Others ^b	1	0.60
Marital status		
Married/living together	155	96.90
Divorced/separated	5	3.20
Educational status		
No formal education	20	12.50
Primary school (grades 1-8)	38	23.80

Secondary school (grades 9-12)	48	30.00
Tertiary (College/University)	54	33.80
Occupation		
Unemployed (Housewife)	118	73.80
Employed	42	26.20
Monthly Income in Ethiopian Birr		
<=1300	22	13.80
1301–2200	12	7.50
2201–3600	22	13.80
3601–6500	43	26.90
>6500	61	38.10
Parity		
Primiparous	57	35.60
Multiparous	103	64.40
Mode of childbirth		
Vaginal delivery	122	76.30
Caesarean section	38	23.70

a: Wakefata; b: Gurage; 1 Ethiopian Birr ~ 0.0074 US Dollars

Reliability estimate

The scale's internal consistency was assessed by Cronbach's alpha, item-total correlation, and ICC. The scale's reliability analysis has resulted in a Cronbach's alpha of 0.95, which shows excellent reliability (Taber, 2017). The item-total correlation was all positive and ranged from 0.615 to 0.845. The mean total score of the translated version of the scale was 59.5 ± 10.5 . When an item is deleted, there is no increase in Cronbach's alpha by more than 0.10, which suggests retention of all items. In addition, the retest reliability, evaluated using the ICC, was assessed on a randomly

selected subsample of 48 mothers and resulted in a value of 0.969. This value is regarded as an excellent reliability coefficient, as it exceeds 0.90 (Koo & Li, 2016).

Content validity

Content validity is one of the measures of validity, assessing how well the scale encompasses all relevant elements of the construct it is devised to measure (Fink, 2010). In the present study, content validity was evaluated by seven experts involved in the scale's validation, who independently rated the relevance of each item. The item ratings of all experts were then combined and computed to determine the item-level and scale-level content validity indexes (CVI). Consequently, the item-level content validity index of the scale produced a value ranging from 0.86 to 1.00, whereas the scale-level content validity index yielded a value of 0.989. These values suggest that the validated Afaan Oromo version of the scale produced a good level of CVI, as a value of at least 0.83 is generally acceptable for six to eight expert raters (Yusoff, 2019).

Construct validity

Factor analysis

The BSES-SF has been widely adapted into various languages worldwide and has been shown to have a one-factor structure. As the items in the scale are closely related to a single domain called self-efficacy, a CFA analysis was supposed to be appropriate to assess how well the data in this study conform to the established model. Accordingly, CFA was conducted using Jamovi Version 2.4.11 software, a free and open-source statistical program. The results indicate that the model fit indices of the CFA analysis support a one-factor structure with acceptable model fit indices. As indicated in Table 5.2, the estimated model-data fit indices are the relative chi-square, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standardised Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA). Hence, the relative chi-square (χ^2/df)

of the analysis resulted in a value of 2.18, which is an acceptable level below 3.0 (Karin Schermelleh-Engel & Moosbrugger, 2003). The remaining fit indices have similarly resulted within the acceptable index ranges, such that both the CFI and TLI were greater than 0.90 (Xia & Yang, 2019), while the SRM was less than 0.08 (Xia & Yang, 2019). However, the RMSEA resulted in a value slightly above the acceptable range of 0.08, which can be tolerated up to a value of 0.10, considered marginal (Kim et al., 2016) (Table 5.2).

Table 5.2 Goodness of fit indices for BSES-SF-AO among breastfeeding women

Model	χ^2	df	χ^2/df	CFI	TLI	SRMR	RMSEA
One factor	168	77	2.18	0.946	0.936	0.0386	0.0859
Acceptable range			<3	>0.9	>0.9	≤0.08	≤0.08

The factor loadings

The factor loadings of the BSES-SF items were determined using standard estimates, ranging from 0.639 to 0.867. Factor loadings indicate how strongly and in which direction items are related to latent factors (Table 5.3)

Table 5.3 Standard estimate for the items of BSES-SF-AO among breastfeeding women

	Items	Estimate	SE	Z	p-value	Standard estimate
1.	I can always determine that my baby is getting enough milk	0.850	0.0619	13.74	< 0.001	0.867
2.	I can always successfully cope with BF	0.712	0.0631	11.29	< 0.001	0.762
3.	I can always BF without a formula	0.732	0.0803	9.12	< 0.001	0.651
4.	I can always ensure that my baby is properly latched	0.745	0.0621	12.01	< 0.001	0.795
5.	I can always manage the BF situation to my satisfaction	0.746	0.0609	12.24	< 0.001	0.805

6.	I can always manage to BF even if my baby is crying	0.779	0.0624	12.48	< 0.001	0.816
7.	I can always keep wanting to breastfeed	0.786	0.0580	13.54	< 0.001	0.859
8.	I can always comfortably BF with my family members present	0.628	0.0635	9.88	< 0.001	0.692
9.	I can always be satisfied with my BF experience	0.743	0.0571	13.00	< 0.001	0.838
10.	I can always deal with that. BF can be time-consuming	0.689	0.0774	8.90	< 0.001	0.639
11.	I can always finish feeding before switching to other	0.740	0.0729	10.16	< 0.001	0.706
12.	I can always continue to BF my baby	0.745	0.0704	10.58	< 0.001	0.728
13.	I can always manage to keep up with BF demands	0.788	0.0601	13.10	< 0.001	0.842
14.	I can always tell when my baby is finished BF	0.755	0.0655	11.52	< 0.001	0.773

BF: Breastfeeding

The relationship of BSES-SF-AO scores with sociodemographic variables

The scale shows no significant difference in scores on the basis of age, sex of the child, income, educational status, mode of delivery, occupation, and parity.

Table 5.4 The relationship between BSES-SF-AO and socio-demographic variables

Variables	Frequency	Mean or Pearson r	SD	Between-group p- value
Age	160	r= 0.038	-	0.630
Sex of a child				
Male	95	4.24	0.814	0.553
Female	65	4.31	0.695	
Income (Ethiopian Birr)				
<=1300	22	4.32	0.758	0.312
1301–2200	12	3.82	0.635	
2201–3600	22	4.39	0.467	
3601–6500	43	4.26	0.687	
>=6500	61	4.30	0.910	
Marital status				
Married	155	4.28	0.767	0.449
Divorced	2	4.18	0.152	
Separated	3	3.71	0.945	
Mode of delivery				
Vaginal delivery	122	4.29	0.679	0.534

Caesarean section	28	4.20	1.006	
Educational status				
No formal education	20	4.45	0.614	0.71
Primary	38	4.25	0.588	
Secondary	48	4.23	0.686	
University or above	54	4.24	0.976	
Occupation				
Housewife	118	4.24	0.759	
Employed	42	4.34	0.793	0.472
Parity				
Primipara	57	4.19	0.936	0.361
Multipara	103	4.31	0.656	
<i>I ETB ~0.0074 USD</i>				

5.3.8.3 Discussion

In this study, the BSES-SF was translated into Afaan Oromo and tested for psychometric properties. Accordingly, the findings have shown that the BSES-SF-AO is a valid and reliable instrument for evaluating breastfeeding self-efficacy among Afaan Oromo-speaking women in Ethiopia. The scale has demonstrated excellent reliability with a unidimensional factor structure similar to the original scale (Dennis, 2003) and with many other versions of the scale, including the Persian (Amini et al., 2019), Portuguese (Zubaran et al., 2010), Arabic (Radwan et al., 2023) and Malawian (Chipojola et al., 2023) versions. The internal consistency of the Afaan Oromo version is slightly higher than that of the Malawian, Portuguese, and Turkish versions (Alus Tokat et al., 2010) but nearly similar to the Spanish (Oliver-Roig et al., 2012), and Hong Kong versions (Ip et al., 2012). The difference could be due to differences in socio-demographic and study settings among participants.

This scale did not find any significant differences in breastfeeding self-efficacy among Afaan Oromo-speaking women on the basis of age ($p = 0.630$), occupation ($p = 0.472$), educational status

($p = 0.71$), income ($p = 0.312$), and parity ($p = 0.361$). Similarly, the scale in Portuguese version did not find any significant differences in BSE on the basis of socioeconomic and educational statuses (Zubaran et al., 2010). Moreover, the Brazilian study found no significant relationship between BSE and maternal occupation, educational attainment, marital status, income, or number of pregnancies (Dodt et al., 2012). Contrary to the former findings, the mother's age and parity were significantly correlated BSE scores in the Malawian version (Chipojola et al., 2023). This variation may be attributed to disparities in cultural norms, perceptions and attitudes concerning motherhood and preparedness for infant feeding practices.

5.3.8.4 Conclusion

The current study indicated that the Afaan Oromo version of the BSES-SF demonstrates acceptable reliability and validity among Afaan Oromo language speakers. This ensures that healthcare providers and researchers can utilise the scale to evaluate interventions in breastfeeding practices and therapeutic evaluations.

5.3.9 Exclusive Breastfeeding Social Support Scale

5.3.9.1 Introduction

To effectively assess the effect of family support on the successful practice of EBF, a validated and reliable instrument adapted to the language and cultural context of the study group is critical. Researchers employ various instruments for measuring social support received while breastfeeding. There was also no standard instrument to assess partner support for successful exclusive breastfeeding. Scholars such as Boateng and others proposed the concept of partner support in exclusive breastfeeding, and after incorporating relevant items, developed the Exclusive Breastfeeding Support Scale (EBFSS) from an existing scale. EBFSS is a 16-item scale designed

to assess women's perceptions of receiving support from their partners to exclusively breastfeed their children for the first six months (Boateng et al., 2018). This scale is a self-reported measure adapted from the 30-item Hughes Breastfeeding Social Support Scale, initially developed to assess perceptions of overall breastfeeding support in the United States (Hughes, 1984). The EBFSS has three key constructs. The first is instrumental support, which refers to the partner's practical help in completing tasks. Emotional support is a second construct of the scale, referring to the partner's caring behaviour that facilitates the success of EBF. The third construct is informational support, which provides valuable information on exclusive breastfeeding practices. The reliability coefficients of the subscales were 0.79 for instrumental support, 0.85 for emotional support, and 0.83 for informational support (Boateng et al., 2018). In Ethiopia, no study instrument has been adapted to assess social support for exclusive breastfeeding in any of the most widely spoken languages and cultures.

5.3.9.2 Results

Sociodemographic characteristics

About 160 women participated in this study. The mean (SD) age of the participants was 26.5 (4.5) years, and most of them were housewives. Table 5.1 provides a detailed description of the sociodemographic characteristics of the participants, as these individuals have also participated in the psychometric testing of the BSES-SF in the Afaan Oromo language.

Reliability estimate

The scale's reliability coefficients were specified using Cronbach's alpha values and ICC scores. The Cronbach's alpha for the overall score was 0.95, whilst it was 0.89 for instrumental, 0.92 for emotional and 0.93 for informational subscales, signifying excellent reliability (Taber, 2017). The

established rule of thumb often used for Cronbach's alpha scores is that values of 0.70 and above are considered acceptable, 0.80 and above are good, and 0.90 and above are considered excellent (Michalos, 2014). Furthermore, no change of more than 0.10 was observed when an item was deleted, which resulted in retention of all items. In addition, the ICC of the scale was calculated after examining the retest reliability on a randomly selected subsample of 48 mothers. This resulted in a value of 0.94, demonstrating excellent stability of the scale over time. The ICC value is regarded as an excellent reliability coefficient if it exceeds 0.90 (Koo & Li, 2016).

Content validity

The content validity index for the Afaan Oromo version of the scale (EBFSS-AO) was assessed at both the item level and overall scale levels. The validity at the item level ranged from 0.86 to 1.00, whereas the content validity at the scale level was 0.98. A content validity index of 0.83 or above is acceptable for the number of raters involved in this study (Yusoff, 2019).

Construct validity

Confirmatory factor analysis

The construct validity of the EBFSS-AO was investigated using a Confirmatory Factor Analysis (CFA) to confirm whether it had a three-factor structure, similar to the original scale (Boateng et al., 2018). The original scale had three components: informational, emotional, and instrumental EBF support subscales. The instrumental subscale is measured by five items, the emotional subscale by eight, and the informational subscale by three. As described in Table 5.5, the model fit of the EBFSS-AO scale was assessed using goodness-of-fit indices, including the Root Mean Square Error of Approximation (RMSEA), relative chi-square, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Standardised Root Mean Square Residual (SRMR). Except for the

RMSEA score, all other goodness-of-fit indices were within the permissible range. Hence, the relative chi-square was 2.76, which is regarded as acceptable according to the literature if it is less than 3.0 (Karin Schermelleh-Engel & Moosbrugger, 2003). In addition, CFI and TLI fit indices were above 0.9 (Xia & Yang, 2019), and SRMR was below 0.08, which is acceptable (Xia & Yang, 2019). On the other hand, the RMSEA score has deviated slightly from the acceptable range of 0.08 despite its closeness to the marginal value of 0.10 (Kim et al., 2016). Generally, the scale has demonstrated a three-factor structure, with nearly all model fitness indices aligning with the original scale.

Table 5.5. Goodness of fit indices for EBFSS-AO among breastfeeding women

Fit indices	χ^2	df	χ^2/df	CFI	TLI	SRMR	RMSEA
CFA	279	101	2.76	0.917	0.902	0.061	0.105
Acceptable range	-	-	<3	>0.90	>0.90	≤0.08	≤0.08

Factor loadings

The standard estimates were calculated to explain the factor loadings of each item in relation to the underlying constructs of the scale. Therefore, the factor loadings range from 0.744 to 0.923 for instrumental support, 0.701 to 0.881 for emotional support, and 0.816 to 0.878 for informational support, all exceeding 0.70, indicating a strong correlation between each item and its respective construct (Centre for Academic Success, 2007) (Table 5.6).

Table 5.6. Factor loadings of the EBFSS-AO among breastfeeding women

Factor	Items	Estimate	SE	Z	P	Standard estimate
Instrumental EBF support	1. Did tasks	0.467	0.0435	10.73	<0.001	0.744
	2. Prepared meals	0.722	0.0482	14.99	<0.001	0.923

	3. Did laundry	0.726	0.0486	14.95	<0.001	0.921
Emotional EBF support	4. Approved of me exclusively breastfeeding my baby	0.562	0.0402	13.98	<0.001	0.881
	5. Told me I was doing well caring for my baby	0.541	0.0409	13.22	<0.001	0.851
	6. Made me feel confident even when I made mistakes	0.505	0.0488	10.35	<0.001	0.721
	7. Listened to me talk about the new baby	0.412	0.0359	11.45	<0.001	0.776
	8. Believed that I am a good mother	0.479	0.0422	11.36	<0.001	0.771
	9. Showed concern about my own physical condition and health	0.420	0.0423	9.94	<0.001	0.701
	10. Showed concern when I felt sad or depressed	0.427	0.0356	12.00	<0.001	0.802
	11. Praised me for my efforts to exclusively breastfeed	0.503	0.0478	10.52	<0.001	0.730
	12. Answered my questions about breastfeeding	0.644	0.0470	13.69	<0.001	0.869
	13. Gave me advice and suggestions about how to exclusively breastfeed	0.648	0.0466	13.92	<0.001	0.878
Informational EBF support	14. Told me where I could get help if I had questions about breastfeeding or caring for my baby	0.647	0.0475	13.60	<0.001	0.866
	15. Showed me how to breastfeed	0.687	0.0528	13.01	<0.001	0.844
	16. Taught me how to take care of myself	0.611	0.0495	12.35	<0.001	0.816

Additionally, the covariances between subscales were computed and explained using the standard estimate. This estimate was positive and shows the overall construct validity among components, indicating that the measured constructs were different, but they are related dimensions of social support that contribute to the overall construct validity (Wen-Chung Wang et al., 2006). Accordingly, the covariance between the instrumental and emotional subscales was 0.667, between the instrumental and informational subscales was 0.691, and between the emotional and informational subscales was 0.815.

The association between EBFSS-AO and sociodemographic characteristics

The relationship between sociodemographic and obstetric characteristics and the EBFSS-AO was examined using one-way ANOVA and a t-test as applicable. The instrumental subscale's EBFSS score ranges from 5.58 to 7.85, the emotional subscales from 15.58 to 21.62, and the informational subscales from 8.25 to 12.72. The participants' age showed a negative association with the EBFSS score, although this was not statistically significant ($r = -0.065$, $p = 0.412$). EBFSS-AO scores for each subscale (instrumental, emotional, and informational) did not significantly differ on the basis of the child's sex, parity, occupation, or educational status. Nonetheless, the EBFSS-AO score varied significantly on the basis of participants' monthly income, favouring those with higher incomes across all three subscales ($p < 0.01$) (Table 5.7).

Table 5.7 The relationship of sociodemographic and obstetric characteristics with the EBFSS-AO score

Variables	Frequency (%)	Instrumental support	Emotional support	Informational support	Total score
Mean (SD)					
Occupation					
Housewife	118 (73.8)	7.45 (1.99)	20.93 (4.13)	12.00 (3.42)	40.38 (8.68)
Employed	42 (26.3)	7.26 (2.06)	21.21 (3.68)	12.04 (3.25)	40.48 (7.82)
p-value		0.58	0.69	0.93	0.93
Infant gender					
Male	95 (59.4)	7.47 (1.96)	20.98 (3.74)	11.75 (3.37)	40.21 (8.14)
Female	65 (40.6)	7.30 (2.08)	21.04 (4.41)	12.38 (3.36)	40.73 (8.91)
p-value		0.60	0.91	0.24	0.69
Monthly Income (ETB)					
≤1300	22 (13.8)	7.72 (1.93)	21.59 (4.06)	12.72 (3.28)	42.04 (8.66)
1301–2200	12 (7.5)	5.58 (2.15)	15.58 (6.59)	8.25 (3.91)	29.41 (11.94)
2201–3500	22 (13.8)	7.27 (2.27)	21.09 (3.54)	11.54 (3.36)	39.90 (7.92)
3501–6500	43 (26.7)	7.18 (1.85)	21.30 (2.79)	12.11 (2.72)	40.60 (6.03)
>6500	61 (38.1)	7.85 (1.83)	21.62 (3.55)	12.59 (3.29)	42.06 (7.80)
p-value		0.006	<0.001	0.001	<0.001
Educational status					
No formal educ.	20 (12.5)	7.15 (2.27)	19.45 (5.71)	11.35 (4.23)	37.95 (11.84)

Primary	38 (23.8)	7.23 (2.17)	20.60 (4.20)	11.84 (3.46)	39.68 (8.75)
Secondary	48 (30.0)	7.45 (1.92)	21.39 (3.43)	11.97 (3.07)	40.83 (7.48)
College or above	54 (33.8)	7.57 (1.88)	21.51 (3.51)	12.40 (3.23)	41.5 (7.49)
p-value		0.80	0.19	0.65	0.39
Parity					
Primipara	57 (35.6)	7.68 (1.76)	21.19 (3.90)	12.08 (3.51)	40.96 (8.16)
Multipara	103 (64.4)	7.25 (2.12)	20.90 (4.08)	11.97 (3.30)	40.12 (8.61)
p-value		0.31	0.66	0.83	0.54
Mode of delivery					
Vaginal delivery	122 (76.3)	7.55 (1.97)	21.04 (4.09)	12.19 (3.27)	40.80 (8.55)
Caesarean section	38 (23.8)	6.92 (2.05)	20.86 (3.80)	11.42 (3.64)	39.21 (8.06)
p-value		0.09	0.81	0.21	0.31

ETB: Ethiopian Birr; 1 ETB ~ 0.0074 USD

5.3.9.3 Discussion

Mothers' success with EBF is often determined by whether they received appropriate support from their partners or family (Schnell, 2020). If mothers receive sufficient help from their relatives or partners, EBF practice is more likely to improve. To address challenges associated with EBF practices, the usage of a validated scale, which is specifically designed to assess the form and extent of support received, is critical. There is a lack of reliable and valid tools for determining the degree of EBF social support in Ethiopia, and no validated instrument is available to assess the level of EBF social support, especially amongst the Afaan Oromo-speaking population. Therefore, this study aimed to translate and evaluate the psychometric properties of the EBFSS among Ethiopian women who speak the Afaan Oromo language. Furthermore, this is the first scale adopted in Ethiopia to assess how women perceive their partners' help in exclusively breastfeeding.

The EBFSS-AO scale has a three-factor structure consistent with the original scale identified using factor analysis. These support components were instrumental, emotional, and instrumental support (Boateng et al., 2018). This EBFSS-AO scale was also found to be consistent with the Persian

version, which identified three distinct structures by both exploratory and confirmatory factor analysis (Mashayekh-Amiri et al., 2023). On the other hand, the factor loadings were higher for the EBFSS-AO scale than those for the original and Persian versions (Boateng et al., 2018; Mashayekh-Amiri et al., 2023). The alignment of the three-factor structure across various versions of the scale indicates that the scale can produce consistent validity and reliability scores in various settings and cultures.

The reliability test of the EBFSS-AO scale exhibited high reliability with an intraclass correlation coefficient of 0.94 and a Cronbach's alpha of 0.95. This figure is comparable to the Persian version of the scale although it is comparatively higher than the original scale (Mashayekh-Amiri et al., 2023). The reliability coefficient and ICC were 0.86 and below 0.70, respectively, in the original scale. In contrast, the Persian version yielded 0.90 and 0.97, respectively (Boateng et al., 2018; Mashayekh-Amiri et al., 2023). The difference in reliability coefficient with the original scale could be attributed to socio-cultural differences, which can influence how people perceive and respond to questionnaire items.

In the present study, reliability estimates were determined for each subscale. Instrumental support is the first component of the EBFSS and depicts the perceived support received in terms of physical help, including household chores. Previous evidence has shown that instrumental support is a vital factor for initiating and maintaining exclusive breastfeeding for the first six months (Theodorah & Mc'Deline, 2021). Regarding the reliability coefficient of the subscale, the current study found that the instrumental support subscale yielded a Cronbach's alpha of 0.89. This outperformed both the original and Persian versions' scales, with subscale reliability coefficients ranging from 0.78 to 0.79. This disparity could be attributable to cultural differences among participants, which can

affect how the participants understand the meaning and relevance of ideas reflected in the scale. Age, educational attainment, and parity did not significantly affect the instrumental breastfeeding support score except for income.

Mothers with higher incomes were more likely to receive higher instrumental support from their partners than those in middle-income categories. Parents with high incomes may have better access to information and resources that enable them to seek the benefits of exclusive breastfeeding, prioritise it, and thus be more willing to engage in supportive behaviours. The Persian version of the scale has shown that higher-income lactating mothers received greater instrumental and informational support from their partners, which is similar to the result in the current study (Mashayekh-Amiri et al., 2023). Couples with low-income categories, on the other hand, may view exclusive breastfeeding as a cost-effective option and tend to engage in supportive behaviour.

The second component of the scale is emotional support, which encompasses relief from breastfeeding worries and encouragement of EBF practices. These aspects of assistance can contribute to maintaining EBF (Dietrich Leurer & Misskey, 2015; Negarandeh et al., 2021). The reliability estimate of the EBSSS-AO version showed that the emotional support component produced a Cronbach's alpha of 0.92, indicating excellent reliability. This value was higher than those reported in the original and the Persian versions of the emotional support component (Boateng et al., 2018; Mashayekh-Amiri et al., 2023). This support component did not vary on the basis of the participants' sociodemographic characteristics, such as age, occupation, and educational status. However, it is significantly associated with monthly income categories, which is similar to the instrumental component of the scale. A Canadian study found that participants' educational status had a significant impact on their EBFSS scores (Laugen et al., 2016). This

difference could be related to cultural and socioeconomic differences between developed and developing countries.

The scale's third construct is informational support. It represents the advice received on breastfeeding and guidance when facing challenges (Katherine R. Shealy et al., 2005). In line with other subscales, this informational support component also yielded an excellent reliability score with Cronbach's alpha of 0.93. This value is superior to the original scale. Monthly income was the only factor significantly affecting this study's informational EBF support score similar to the instrumental and emotional subscales. This finding is consistent with a systematic review that found income to be one of the factors influencing the promotion of exclusive breastfeeding (Widianoro et al., 2024). The mothers' age, occupation, and educational attainment did not significantly affect the level of informational breastfeeding support.

The overall mean value for EBF support meant that women have received satisfactory support from their spouses in the present study. These findings corroborate prior research carried out in Ethiopia (Abera et al., 2017). According to two study findings in Indonesia, the majority of women received diverse forms of support from their husbands pertaining to EBF practice such as informational, emotional, and physical support (Fadjriah et al., 2021; Pakilaran et al., 2022). On the other hand, a study from Indonesia found that most women reported receiving less support from their partners, which affected their exclusive breastfeeding practices (Susilawati, 2019). The favourable partner support behaviour reported in this study may be due to Ethiopians' often strong social networks, where families support one another (Yayeh et al., 2024). This support can extend to exclusive breastfeeding practices in which mothers are encouraged by their partners and other community members to practice EBF.

The overall EBFSS-AO scale and its subscales have generally shown excellent validity and reliability. The only significant variable linked to both overall and subscale scores was income. The higher reliability score of the scale suggests that the EBFSS-AO can be a dependable tool in clinical settings for measuring the mothers' perceived level of receiving support from fathers.

5.3.9.4 Conclusion

This study has generally shown the validity and reliability of the EBFSS-AO in assessing women's perceptions of receiving support on EBF from their partners in Ethiopia. Accordingly, it is a valuable scale for researchers and healthcare professionals to determine the degree and types of support obtained for EBF practice.

5.4 Psychometric Evaluation of Partner Breastfeeding Influence Scale

5.4.1 Introduction

Assessing fathers' perceptions of how they support their partners in breastfeeding practice is essential to investigating and addressing the challenges related to breastfeeding support provision among fathers. The PBIS is one of the scales researchers use to examine the level of partner support in breastfeeding. It is a 33-item scale that examines five aspects of support, including breastfeeding savvy, breastfeeding helping, breastfeeding appreciation, breastfeeding presence, and breastfeeding responsiveness, on a 5-point Likert scale (Rempel et al., 2017). It is a 33-item scale that examines five aspects of support on a 5-point Likert scale. The five constructs of the scale are breastfeeding savvy, breastfeeding helping, breastfeeding appreciation, breastfeeding presence, and breastfeeding responsiveness, which have a Cronbach's alpha of 0.87, 0.79, 0.86, 0.88, and 0.77, respectively. Each item is rated from 1 (not at all supporting) to 5 (supporting very often) to indicate how frequently individuals practice each task. The higher score indicates greater

supportive behaviour in breastfeeding, whereas the lower score indicates less supportive behaviour (Rempel et al., 2017).

5.4.2 Specific objective

To test the psychometric properties of the Afaan Oromo version of the partner breastfeeding influence scale (PBIS-AO) among fathers who had a breastfeeding child in Western Ethiopia

5.4.3 Study design

A cross-sectional study was conducted, with a retest administered four weeks later, in the town of Nekemte, Western Ethiopia.

5.4.4 Study participants

The participants should be 18 years or older and had a child under six months old who were being breastfed. They should also be able to read and understand the target language, Afaan Oromo.

5.4.5 Sample size determination

The sample size required for the psychometric testing was established using the general rule of 10 participants per item. The PBIS comprises 33 items, so a convenience sample of 330 individuals was enrolled (Nicholas D. Myers et al., 2011).

5.4.6 Data collection techniques

Four experienced data collectors were hired and trained for one day before data collection. The data were collected via an interviewer-administered questionnaire from eligible participants at their homes. The questionnaire consisted of two parts: the socioeconomic and the PBIS scale, which included a list of questions designed to assess perceived support for breastfeeding. Four

weeks after the initial data collection, a retest questionnaire was administered to a random subsample of 97 participants.

5.4.7 Statistical analysis and indices of Psychometric testing

This scale utilised exploratory factor analysis (EFA) using principal component analysis to test its psychometric properties. EFA was particularly used because it is a crucial step for further scale validation, and the scale has also not been widely tested in many languages and cultures, including the Afaan Oromo. To examine the internal consistency of the scale, Cronbach's alpha was calculated, and the ICC was used to determine the scale's test-retest reliability. Independent t-tests and one-way ANOVAs were employed to examine the association between the participants' sociodemographic characteristics and the Afaan Oromo version of the scale. The mean difference was also examined using the Mann-Whitney U test where appropriate.

5.4.8 Ethical Considerations

Ethical approval was acquired from the Hong Kong Polytechnic University, and a support letter was also obtained from Wollega University (Appendix I and II, respectively). The administrators of selected Nekemte sub-cities, locally known as Kebeles (the lowest government administrative unit), have also permitted the undertaking of the study. The study participants provided written informed consent before data collection. The study was conducted with voluntary participation, and confidentiality of the data was ensured.

5.4.9 Results

Socio-demographic Characteristics

Among all participants, 320 successfully responded, resulting in a 96.9% response rate. The age of the participants ranged from 24 to 57, with a mean (SD) of 35.9 (7.3) years. Most respondents were from the Oromo ethnic group (91.6%) and more than half of them were Protestant Christians (57.8%). Nearly three-fourths of participants (74.1%) were employed, and more than one-third had attended college or university (Table 5.8).

Table 5.8 Socio-demographic variables of the study participants

Variables	Frequency	Percent
Educational status		
No formal education	93	29.10
Primary education	21	6.60
Secondary education	87	27.20
Tertiary education	119	37.20
Religion		
Protestant Christian	185	57.80
Orthodox Christian	92	28.80
Muslim	28	8.80
Catholic Christian	6	1.90
Wakefata	9	2.80
Ethnicity		
Oromo	293	91.60
Amhara	21	6.60
Others ^a	6	1.90
Occupational status		
Employed	237	74.10
Unemployed	83	25.90
Monthly Income (ETB)		

<=1300	37	11.60
1301–2200	41	12.80
2201–3600	66	20.60
3601–6500	89	27.80
>6500	87	27.20
Number of children		
One	58	18.10
Two and above	262	81.90

^a =Gurage, Tigre; ETB: Ethiopian Birr; 1ETB ~ 0.0074 USD

Reliability estimate

The corrected-item-total correlation, Cronbach's alpha, and ICC were used to determine the internal consistency. The overall scale demonstrated a Cronbach's alpha of 0.96. The overall scale demonstrated a Cronbach's alpha of 0.96. The subscales have yielded varying Cronbach's alpha values: 0.88 for breastfeeding savvy, 0.92 for helping, 0.89 for appreciation, 0.89 for breastfeeding presence, and 0.74 for responsiveness. There was no increase in Cronbach's alpha above 0.10 when an item was deleted. Four weeks after the initial test, data were collected from a random subsample of 97 participants. A two-way mixed-effects model was used to determine the ICC of the scale amongst these participants.

Content validity

Seven experts from diverse backgrounds were involved in validating the tool and independently evaluated the scale's content validity. The content validity was examined at both the item and scale levels. Accordingly, the scale-level content validity index was 0.98, while the item-level content validity index ranged from 0.86 to 1.00.

Construct validity

i. Item-total correlation

The item-total correlation was computed to determine whether the items related to the overall scale. Accordingly, these correlations for the items were all positive, ranging from 0.631 to 0.824, except for two items (Table 5.9). These two items were items 3 and 29 from the Breastfeeding Savvy and Appreciation subscales, respectively, and both recorded an item-total correlation statistic of less than 0.30. Accordingly, both were removed from the Afaan Oromo version of the scale because they were poorly associated with the other items. Item 3 assesses whether fathers read literature to learn more about breastfeeding, and Item 29 asks how fathers support their spouses when they entertain or visit other people. EFA was then conducted on the 31 retained items.

Table 5.9. Item-total correlation of the PBIS among fathers

Item representation	Domains and descriptions of the items	Item-total correlation
Breastfeeding savvy		
Item 1	Discuss with your partner about how long to continue breastfeeding	0.554
Item 2	Discuss with your partner about how ideas for trying to solve breastfeeding problems or different ways to make breastfeeding to work better	0.644
Item 3	Learn more about breastfeeding by reading books or articles on breastfeeding	0.282
Item 4	Tell your partner your opinion about how long you think that she should breastfeed	0.651
Item 5	Speak up in support of your partner when someone makes a negative breastfeeding comment	0.634

Item 6	Help your partner get assistance from others for solving breastfeeding problems or improving breastfeeding	0.611
Item 7	Remind your partner of the benefits of breastfeeding for her and for your baby	0.660
Item 8	Show patience and a willingness to wait for your opportunity to feed the baby	0.698
Item 9	Support your partner's attendance at a breastfeeding support group	0.530
Breastfeeding helping		
Item 10	Help out with or take care of other childcare tasks with the baby	0.682
Item 11	Give something up in order to make breastfeeding easier	0.678
Item 12	Help out with other household tasks and responsibilities to free up your partner's time and energy	0.641
Item 13	Help with breastfeeding at night	0.690
Item 14	Care for your baby during and after breastfeeding is done	0.786
Item 15	Try to improve your partner's health and nutrition	0.682
Item 16	Give your partner a break from the baby	0.764
Appreciation		
Item 17	Encourage your partner to do her best when it comes to breastfeeding and let her know that she is not less of a mother if she feels like quitting	0.768
Item 18	Praise your partner for breastfeeding and let her know that what she is doing is a beautiful, worthwhile thing	0.667
Item 19	Let your partner know that breastfeeding is natural and/or give her the message that she is breastfeeding because she wants the best for her baby	0.742
Item 20	Listen to and encourage your partner when she is feeling frustrated or discouraged about breastfeeding	0.705
Item 21	Show appreciation that your partner is breastfeeding	0.491

Item 22	Tell your partner that you value and support her mothering decisions and intuitions around breastfeeding	0.767
Breastfeeding presence		
Item 23	Try to improve the breastfeeding experience by getting equipment or supplies ready for breastfeeding	0.642
Item 24	Act attentively toward your partner during breastfeeding	0.774
Item 25	Quietly share time and watch or hold your partner during breastfeeding	0.665
Item 26	Physically help with breastfeeding-related activities	0.697
Item 27	Help create a quiet, pleasant environment for breastfeeding	0.716
Item 28	Show pleasure and satisfaction while your partner is breastfeeding	0.721
Responsiveness		
Item 29	Make it easy for your partner to breastfeed while entertaining company or visiting others	0.293
Item 30	Respond sensitively and positively to sexual issues	0.605
Item 31	Be patient and understanding of the time it takes to breastfeed, and don't get upset if the other housework is not done	0.719
Item 32	Show your comfort with breastfeeding in public and help her feel comfortable too	0.599
Item 33	Pay attention to how much and how your partner wants to participate in breastfeeding	0.743

ii. Factor analysis

The factor structure of the 31-item Afaan Oromo version of PBIS (PBIS-AO) was examined using EFA using a principal component analysis. The Varimax rotation with Kaiser normalisation was employed, resulting in a Kaiser-Meyer-Olkin (KMO) statistic of 0.96 and a Bartlett's Test of Sphericity of 7205.350 ($p < 0.001$), indicating sampling adequacy and the appropriateness of the

factor analysis. A five-factor scale structure has been established, with eigenvalues above one, explaining 67.8% of the variance.

As discussed in Table 5.10, the factor loadings of the items were also examined, and all were above 0.30, indicating an acceptable level of correlation with their respective domains. Almost all the items loaded onto their respective subscales, conforming to the original scale, except for item 28, which loaded onto the responsiveness subscale instead of the breastfeeding presence subscale. Hence, the item was taken to the responsive subscale because its core concept of depicting happiness and satisfaction when the mother is breastfeeding can be taken as a positive reinforcement and emotional support. On the other hand, those items which cross-loaded to other subscales in addition to their respective original constructs were retained in the original place for clarity and ease of interpretation.

Table 5.10 Exploratory factor analysis showing the factor structure of PBIS-AO among fathers

SN	Item representations and their domains	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Breastfeeding savvy						
1.	Item 1			0.814		
2.	Item 2			0.753		
3.	Item 4			0.673		
4.	Item 5	0.339		0.468		
5.	Item 6			0.517		0.533
6.	Item 7			0.625	0.349	
7.	Item 8	0.437	0.381	0.424	0.324	
8.	Item 9			0.351		0.684

Breastfeeding helping					
9.	Item 10	0.759			
10.	Item 11	0.746			
11.	Item 12	0.738			
12.	Item 13	0.646		0.334	0.312
13.	Item 14	0.569	0.362		0.449
14.	Item 15	0.462	0.389	0.336	0.417
15.	Item 16	0.561		0.383	0.379
Appreciation					
16.	Item 17		0.330	0.351	0.614
17.	Item 18				0.689 0.417
18.	Item 19	0.310			0.669
19.	Item 20	0.350			0.636
20.	Item 21		0.350		0.496 0.510
21.	Item 22		0.384	0.366	0.545
Breastfeeding presence					
22.	Item 23		0.552		0.317
23.	Item 24	0.392	0.475		0.303 0.435
24.	Item 25		0.440		0.681
25.	Item 26	0.417	0.414		0.617
26.	Item 27		0.673		0.304
Responsiveness					
27.	Item 28	0.301	0.701		
28.	Item 30		0.737		
29.	Item 31	0.465	0.574		
30.	Item 32		0.604		
31.	Item 33	0.335	0.564	0.379	0.303

The total and subscale scores of the PBIS-AO by sociodemographic variables

This study examined the association of fathers' provision of support in breastfeeding with their demographic characteristics. Consequently, fathers' age had a negative correlation with their perceived score of providing breastfeeding support ($r = -0.16$, $p = 0.004$). Likewise, fathers' provision of support had a significant negative correlation with the number of children they had ($r = -0.2$, $p < 0.001$).

The t-test findings indicated that employed fathers offered higher overall breastfeeding support than those unemployed, except for the responsiveness subscale ($t = 2.75$, $p = 0.006$) (Table 5.11). The ANOVA test results showed that fathers with no formal education were less supportive of breastfeeding than fathers with at least a primary education for the overall breastfeeding support ($F = 20.47$, $p < 0.001$). With regard to the breastfeeding savvy domain, fathers who had at least a college degree were found to be more supportive in providing information related to breastfeeding than those fathers who didn't attend any formal education ($F = 25.00$, $p < 0.001$). Breastfeeding presence was another dimension of father support. Fathers with no formal education provided less breastfeeding support presence compared with those who had completed primary education ($F = 25.11$, $p < 0.001$). The third subscale found to be associated with the level of education was breastfeeding appreciation. Accordingly, fathers with no formal education provided less breastfeeding support than those who had completed secondary education and college/university ($F = 10.18$, $p < 0.001$). For the breastfeeding presence subscale, fathers with no formal education were less likely to support their partners in breastfeeding than those who had at least completed secondary education ($F = 5.36$, $p = 0.001$). The Responsive subscale was another dimension that had a significant relationship with the father's educational status. Fathers with no formal education

provided less breastfeeding support than those in other educational statuses ($F = 14.04$, $p < 0.001$) (Table 5.11).

Participants with higher earnings (>6500 ETB) and those with lower incomes also differed significantly in terms of total breastfeeding support ($F = 4.82$, $p = 0.001$). For subscales, employed fathers were more supportive, as evidenced by their higher scores on breastfeeding savvy, helping, and responsiveness, compared to unemployed fathers. However, no statistically significant difference was observed in breastfeeding presence and breastfeeding appreciation on the basis of fathers' employment status. Moreover, the present study revealed that the ethnicity of the participants did not significantly affect the overall support provided by fathers or in each domain of support ($p > 0.05$) (Table 5.11).

Table 5.11. The overall and sub-scale scores by sociodemographic variables for PBIS-AO

Variables	Frequency (%)	BF Savvy	BF helping	BF Appreciation	BF presence	BF Responsiveness	Total score
Mean (SD)							
Employment							
Employed	237 (74.06)	25.10 (6.08)	22.65 (5.98)	18.52 (4.85)	15.01 (4.36)	15.64 (4.19)	96.89 (22.45)
Unemployed	83 (25.94)	22.39 (5.53)	20.82 (4.94)	17.25 (4.75)	13.69 (3.87)	15.08 (3.80)	89.2 (20.03)
p-value		0.001	0.044	0.041	0.010	0.269	0.006
Level of education							
No formal education	93 (29.06)	20.59 (3.53)	18.37 (2.92)	16.06 (3.21)	13.33 (2.61)	13.39 (2.49)	81.74 (12.70)
Primary	21 (6.56)	23.90 (6.27)	22.38 (6.98)	17.57 (5.41)	14.05 (5.43)	16.52 (5.03)	94.43 (36.57)
Secondary	87 (27.19)	24.77 (6.99)	23.03 (5.76)	18.87 (5.26)	14.99 (4.82)	15.79 (4.28)	97.46 (24.15)
College or above	119 (37.19)	27.14 (5.64)	24.49 (5.82)	19.46 (4.98)	15.58 (4.43)	16.74 (4.17)	103.4 (20.79)
p-value		<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Monthly income (in Ethiopian Birr)							

<=1300	37 (11.56)	23.05 (6.55)	21.76 (6.73)	17.76 (5.10)	14.16 (4.67)	14.68 (4.08)	91.41 (24.16)
1301– 2200	41 (12.81)	24.22 (5.82)	21.88 (5.56)	18.00 (4.60)	14.22 (4.17)	15.34 (3.81)	93.66 (21.30)
2201– 3600	66 (20.63)	23.18 (6.04)	20.77 (5.79)	17.24 (4.73)	14.30 (4.04)	14.58 (4.19)	90.08 (22.73)
3601– 6500	89 (27.81)	23.60 (5.31)	20.72 (4.73)	18.36 (4.61)	14.34 (3.99)	15.21 (4.08)	92.22 (19.61)
>6500	87 (27.19)	26.74 (6.23)	25.05 (5.50)	19.01 (5.13)	15.70 (4.50)	16.90 (3.88)	103.39 (21.54)
p-value		0.001	<0.001	0.242	0.131	0.003	0.001
Ethnicity							
Oromo	293 (91.56)	24.62 (6.19)	22.40 (5.89)	18.32 (4.91)	14.83 (4.31)	15.58 (4.14)	95.74 (22.37)
Amhara	21 (6.56)	21.62 (3.84)	19.43 (3.63)	16.33 (3.83)	12.62 (3.28)	14.05 (3.32)	84.05 (15.77)
Others	6 (1.88)	22.50 (4.97)	21.00 (4.34)	18.50 (4.46)	13.83 (3.71)	16.17 (3.55)	92.00 (18.07)
p-value		0.068	0.066	0.192	0.064	0.232	0.060

ETB: Ethiopian Birr; 1 ETB ~ 0.0074 USD

4.4.10 Discussion

Lactating mothers are often challenged by the task of breastfeeding which can be tiresome unless they get support. The source of support could be from their close families, community or healthcare providers. The support from their husbands is particularly important due to their roles in holding the greater responsibility in the family and being regarded as the household head (Bengough et al., 2022). During and after childbirth, fathers could have a variety of roles in supporting their wives in various ways including physical, emotional, and by being a source of motivation and encouragement (Elliott, 2018). Several studies have demonstrated a positive correlation between partner support and successful breastfeeding (Mannion et al., 2013; Regina Ng Wan Leng et al., 2019; Tohotoa et al., 2009).

In Ethiopia, like many other countries in the world, fathers are typically regarded as the household heads and primary support providers for their wives (Owino & Yigezu, 2023). Therefore, validation of suitable measurement scale in the context of the target participants' language and culture is key to accurately measure the level of support that fathers provide. Thus, this study validated the PBIS in the Afaan Oromo language for this purpose.

The EFA analysis employed in this study identified five factors in the Afaan Oromo version of the scale that resemble the original scale (Rempel et al., 2017). The rotation used in the factor analysis produced a Bartlett's Test of Sphericity value of 7205.350 ($p < 0.001$) and KMO score of 0.96, indicating the appropriateness and adequacy of the sampling (Brett William et al., 2010). The scale's item-total correlation was analysed. Accordingly, item 3 of the breastfeeding Savvy and item 29 of the breastfeeding appreciation were eliminated because they produced lower association with the rest of the items in the scale. These items may not be strong indicators of fathers' support in the target population.

Item-3 is related to the habit of fathers in reading articles about breastfeeding, while Item-29 assesses the fathers' support of breastfeeding in public and entertainment places. Given their relative lack of interest and motivation to read books and magazines specific to breastfeeding, participating fathers may not perceive it as an important task, which might have affected the association of this item to the remaining items in the scale (Shitu et al., 2021). The absence of association between the other item may also be attributed to the unwillingness of fathers to encourage their wives to breastfeed in public entertainment places due to cultural factors.

In this study, the PBIS-AO was found to have a Cronbach's alpha of 0.96, indicating higher internal consistency. Though this value exceeds the original scale (Taber, 2017); it is consistent with the

Turkish version of the scale (Buldur, 2019). The difference with the original scale in reliability values may be attributed to individual variations across cultures and settings which can affect how respondents perceive and reply to the item questionnaires. Meanwhile, Cronbach's alpha for the individual subscales is relatively comparable to that of the original and Turkish versions, except for the breastfeeding helping subscale (Buldur, 2019). The stability of the PBIS-AO over time, tested after four weeks, was also found to be very good, resulting in an ICC of 0.90 (Koo & Li, 2016).

The number of children in this study affected husbands' giving of breastfeeding support, such that husbands with a single child were more supportive than those with multiple children. This finding is consistent with a study conducted in Türkiye (Hilal Kurt Sezer et al., 2023). The possible reason is that families with multiple babies have to divide their time, resulting in less individualised breastfeeding support and attention. Age was another factor identified in this study such that younger fathers were more likely to provide breastfeeding support compared with those who were older. This finding is similar to previous literature that showed the higher perception of younger fathers in supporting breastfeeding practices (Samuelson, 2023). In a the same manner, a Singaporean study discovered a negative relationship between the age of father and their support of breastfeeding (Regina Ng Wan Leng et al., 2019). The possible reason for younger fathers to be more supportive is that they are possibly new to the role of fatherhood and have a higher commitment to support breastfeeding which helps them bond with their newborns. Nevertheless, research conducted in Türkiye did not find any effect of age on breastfeeding support provision (Hilal Kurt Sezer et al., 2023).

Fathers' employment status was another factor affecting breastfeeding support provision in this study. Employed fathers were more supportive than unemployed fathers in overall breastfeeding support and in each support category. A study conducted in Singapore and Türkiye also revealed comparable findings, which showed that fathers with higher incomes were more supportive (Hilal Kurt Sezer et al., 2023; Regina Ng Wan Leng et al., 2019).

This study also indicated that fathers with higher educational levels were more supportive than those with lower educational status categories. Similar findings were reported by studies conducted in Singapore, the USA, and Türkiye, which found that college-educated fathers were more likely to support breastfeeding their children (Hilal Kurt Sezer et al., 2023; Regina Ng Wan Leng et al., 2019; Samuelson, 2023). This could be because fathers with higher levels of education are more likely to understand the benefits of breastfeeding and are more supportive (Ljungberg et al., 2024). The breastfeeding support provision consisted of providing information, physical assistance, and appreciation.

The monthly income of fathers was another factor in which those fathers who had a better monthly income provided greater breastfeeding support than those who had lower monthly incomes. This trend was similarly revealed by a study conducted in Singapore, which showed fathers' monthly household income significantly impacted their perception of providing breastfeeding support (Regina Ng Wan Leng et al., 2019). Therefore, a stable monthly income could be crucial for fathers to relieve their financial stress and help them provide meaningful assistance and make the breastfeeding journey more successful.

5.4.11 Conclusion

In this study, the PBIS-AO has exhibited excellent reliability and validity to evaluate the perceived breastfeeding support provided by Ethiopian fathers. It is a valuable instrument for researchers and healthcare professionals to determine the provision of breastfeeding support. Furthermore, this study has provided valuable insights into the potential dimensions of the scale in the Ethiopian context. On the other hand, for a comprehensive evaluation of the scale, confirmatory factor analysis may be recommended along with other validity measures such as divergent validity.

5.5 Chapter Summary

In this chapter, three scales were translated and tested for psychometric properties in the Afaan Oromo version. These scales were BSES-SF, EBFSS, and PBIS. The results of the tool validation have shown that the Afaan Oromo version of the three translated scales demonstrated acceptable reliability and validity.

CHAPTER SIX: METHODS FOR RANDOMIZED CONTROLLED TRIAL (PHASE III OF THE STUDY)

6.1 Introduction

This chapter outlines the detailed methodology employed in conducting the randomised controlled study trial, which is the primary component of this PhD project. After the required tools were validated in the target language (as discussed in Chapter 5), the methodology of phase III, which aimed to assess the effectiveness of a mobile-based intervention on the required outcomes, is briefly discussed in this chapter.

This chapter is organised into 15 sections. Section 6.1 introduces the chapter. Sections 6.2-6.14 discuss the techniques employed, including study design, participant recruitment, sample size determination, data collection and analysis, and ethical considerations. Section 6.15 summarises the chapter.

6.2 Study Design

This study employed a two-arm, parallel-group, individually randomised controlled design with a 12-week intervention period. The outcome assessment was conducted at baseline, at six weeks, at three months, and six months postpartum. Mother–father dyads were randomised to the intervention group of mobile-based educational text messages and the control group of routine care. The RCT design was used in this study because it is the gold standard for evaluating the effectiveness of an intervention in achieving the desired outcome of behavioural change (Hariton & Locascio, 2018). Additionally, the ‘Consolidated Standards of Reporting Trials’ (CONSORT) diagram was utilised in the study to describe the participant flow from recruitment to follow-up

(Figure 6.1). The study protocol was prospectively registered in the Chinese Clinical Trial Registry (ChiCTR2300078042).

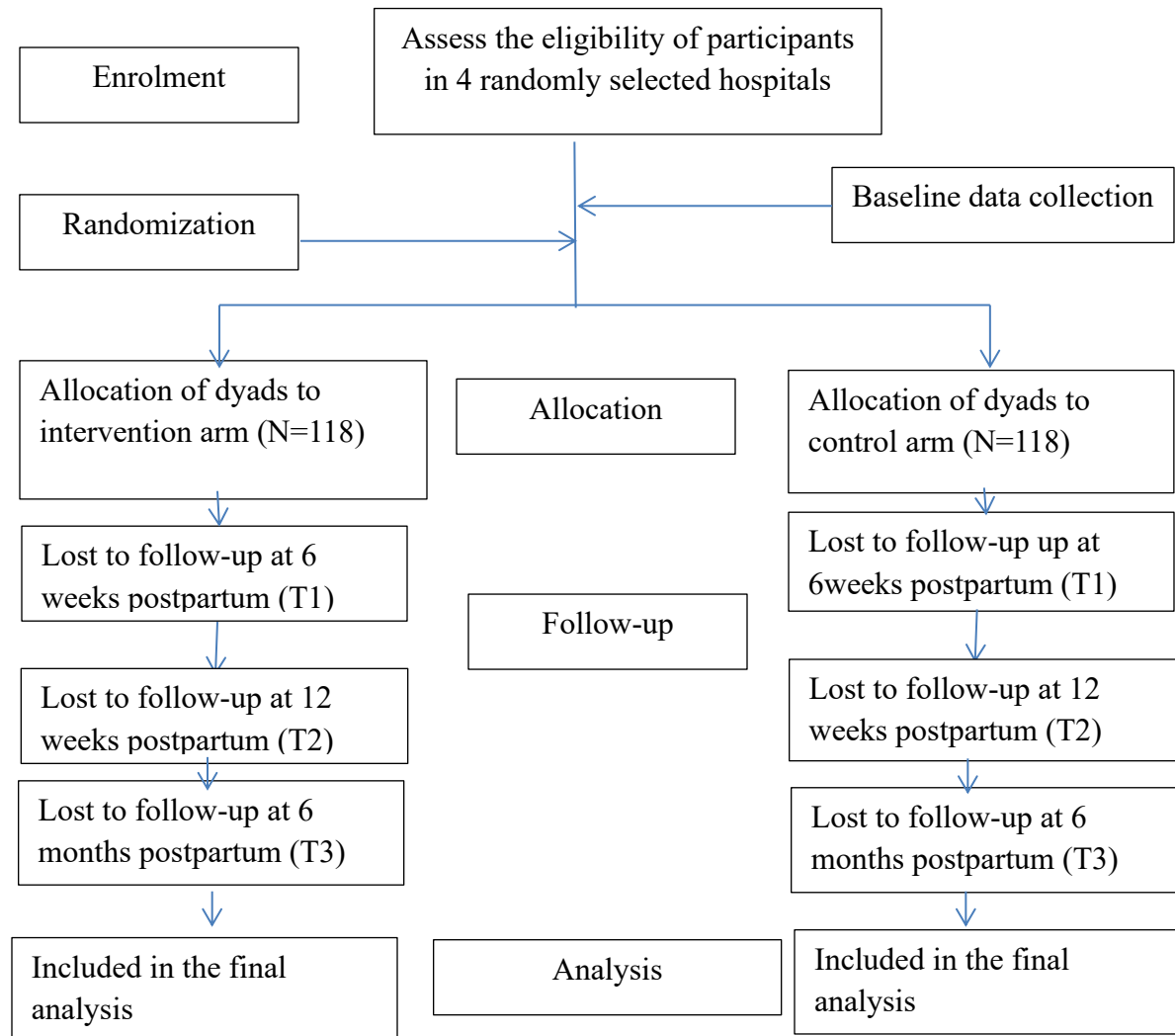


Figure 6.1 Flow diagram of participant enrolment and allocation to the intervention and control arms

6.3 Study setting

The present study was conducted in the East Wollega Zone, western Ethiopia. Nekemte is the capital of this zone and is located 331 kilometres from the country's capital, Addis Ababa. According to the Ethiopian Statistical Services (ESS), the population of the East Wollega Zone is

1,806,001, with 897,957 males and 908,044 females (ESS, 2022). The study was carried out in four randomly selected public hospitals: Nekemte Specialised Hospital (NSH), Wollega University Referral Hospital (WURH), Sibu Sire Hospital and Arjo Hospital.

NSH is situated at the heart of Nekemte town and offers comprehensive health services through a team of over 270 healthcare professionals, including senior physicians, general practitioners, nurses, midwives, and other healthcare professionals. WURH, situated on the outskirts of the town, offers a range of health services supported by a team of over 350 clinical healthcare personnel, including senior physicians, general practitioners, anaesthetists, nurses, midwives, medical laboratory technologists and pharmacists. Arjo Primary Hospital is located approximately 49 kilometres southwest of Nekemte. It offers various health services with about 99 healthcare personnel, including senior physicians, integrated emergency surgical officers (IESOs), nurses, midwives, medical laboratory technologists and pharmacists. The Sire Primary Hospital is located 46 kilometres east of Nekemte. It provides a range of health services with over 65 health professionals, comprising senior physicians, IESOs, nurses, midwives, medical laboratory technologists, pharmacists and environmental health personnel.

The number of ANC contacts was anticipated to increase with the recent implementation of the recommended eight ANC contacts. The number of pregnant women attending the hospital varies depending on the hospital's capacity, location and available resources. On the basis of the hospitals' information, the estimated average ANC follow-up rate ranges from 170 to 230 in the Arjo and Sibu Sire hospitals, whereas the estimated monthly follow-up rates are 800 to 1000 in WURH hospitals and 900 to 1500 in NSH hospitals. The average monthly delivery rate and initial postnatal

contact range from 350 to 400 in NSH and WURH hospitals and from 70 to 110 in Arjo and Sibu Sire hospitals.

Despite differences in human resources, capacity and patient loads, all four hospitals provide maternal and child health services, making them eligible for inclusion in the study. This situation is particularly important for enhancing the study's representativeness.

6.4 Eligibility of study participants

Pregnant women and their partners in the selected hospitals were eligible for the study if the dyads owned a mobile phone (i.e. any basic phone that could support receiving SMS messages), could read and understand the Afaan Oromo language and had a gestational age (GA) between 24 and 30 weeks with a primigravid singleton pregnancy. Participants were excluded if they refused to participate or planned to change their healthcare facility during the study period. Those women who were underage (younger than 18 years), admitted with high-risk pregnancy complications, such as multiple pregnancies, were diagnosed with congenital malformation of a baby, had evidence of gestational diabetes, preeclampsia/eclampsia and antepartum haemorrhage ascertained by a midwife or physician and had mental incapability, were excluded.

6.5 Sample size determination

The sample size of the study participants was determined by an online sample size estimator tool (clinicalcalc.com) for randomised controlled trials for two independent population proportions. The following aspects were considered: a confidence interval of 95%, type I error (α) of 5%, power of the study ($1-\beta$) of 80%, the ratio of intervention to control of 1:1 and a baseline PNC uptake of at least one visit (32%) in line with a study in Ethiopia (Chaka et al., 2019) and assuming an average projected rise in PNC utilisation by mHealth interventions of 20% on the basis of

interventional research conducted in Ethiopia and Nigeria (Adanikin et al., 2014; Kebede et al., 2019; Shiferaw et al., 2016). After adjusting for a 20% attrition rate, the minimum sample size required for the study was 236 pairs of pregnant women and their husbands, which included 118 mother–father dyads in each group.

6.6 Participant recruitment and baseline data collection

The required sample size was allocated to these four hospitals on the basis of the monthly average number of pregnant women visiting each hospital for ANC. Accordingly, 92 dyads were recruited from NSH, 88 from WURH, 28 from Sibu Sire Hospital and 28 from Arjo Hospital. In accordance with the eligibility criteria, participants were approached by midwives working at the ANC care outpatient unit during their regular ANC visits via a consecutive sampling method. This means that every eligible participant who meets the inclusion criteria and consents to participate was included in the study until the required sample size was reached for each hospital. Pregnant women attending ANC visits with their accompanying husbands were recruited during the last trimester of pregnancy. Husbands were supposed to participate with them during these ANC visits. Husbands unavailable during enrolment were contacted by phone to obtain their oral consent. Subsequently, written consent and baseline data were collected by health extension workers assigned as data collectors in the community setting in the following days. Baseline data were then collected from the mother–father dyads. After baseline data collection, the participants were assigned to the intervention and control groups via a computer-generated randomisation process that was independently prepared.

6.7 Randomisation and blinding of study participants

Individual-level randomisation was used to assign participants to the intervention and control groups at a 1:1 ratio at each hospital. Blocked randomisation with a four-block size was employed to balance the number of participants in the intervention and control groups. An independent statistician who was not part of the study team used Excel to generate a blocked randomisation list with unique codes and group assignments. Then, unique codes and group assignments were placed in sequentially numbered sealed envelopes accessible only to the study team. Given that the number of participants enrolled from each hospital varied on the basis of caseload, the sample size was proportionally distributed, and a randomisation procedure was conducted for each hospital. Once written consent was obtained, the data collector gathered baseline data from eligible participants and then directed them to another research assistant who would reveal their group assignment from a numbered envelope. The participants in the intervention group were informed of their group assignment and the starting period of their educational message immediately before leaving the ANC clinic. They were further reminded with a short message. The participants of the control groups were informed of the time of the outcome measures and were advised to continue their usual care before leaving the ANC clinic. Given the study's nature, blinding intervention providers and study participants was impractical. However, efforts were made to mask the follow-up data collectors.

6.8 Interventions

After the random allocation of participants to the intervention and control groups, those in the intervention group received twice-weekly messages for 12 weeks, starting from the GA of week 31 to 6 weeks after childbirth, in addition to routine care. This means 12 messages during late

pregnancy, between 31 and 37 weeks, and the remaining 12 from childbirth, up to 6 weeks. The detailed descriptions of intervention development and validation were briefly discussed in Phase I of this study under section 4.8 in Chapter 4, and the list of messages in English and Afaan Oromo versions was presented in Appendices III and IV. These intervention messages were sent to the mother-father dyads every week on Wednesday and Saturday between 9:00 and 17:00, considering the spacing between days and a mix of weekend and working days. Although the periods may vary among individual participants, as a general rule, these times are assumed to be suitable for participants, as they are likely to be awake and more likely to use their phones and read messages (Olena, 2021).

The participants in the control group continued to receive routine care at their respective health institutions. According to the Ethiopian Ministry of Health's recommendations, routine care during pregnancy includes ANC, which encompasses treatments addressing risk identification, prevention and treatment of diseases associated with pregnancy or other conditions and health promotion and education. Additionally, routine care after birth covers PNC services that encompass monitoring a woman's and newborn's health status; counselling on postpartum care, hygiene and breastfeeding; and return visits.

6.9 Intervention fidelity

Intervention fidelity refers to the degree to which a specific intervention program is executed as intended, a critical factor in effectiveness research (An et al., 2020). It is key to the successful translation of specific interventions into real-life settings (Breitenstein et al., 2010). Employing different forms of strategies is key to ensuring intervention fidelity (Horner, 2012). In this study, the delivery of this message was monitored by the instant delivery report and notification of

delivery failures. Participants' receipt of the messages whether they read and understand the intervention messages, was monitored by phone call inquiry at two time points: at birth for messages delivered during pregnancy and at the sixth week for messages delivered during the postpartum period. Additionally, the intervention participants were provided with a logbook to record the messages received and any remarks they had about the messages (Appendix VI). Moreover, during the intervention period, phone calls were made to verify that the messages were being delivered successfully and to track the time of childbirth.

6.10 Measurement of the outcomes

The primary and secondary outcomes of the study were assessed by original scales and their respective measurement instruments (Appendices VII–X). This study used the Afaan Oromo version of the translated and psychometrically tested scales (Appendices XI–XIV).

6.10.1 Uptake of postnatal care

The primary outcome of the present study is the level of uptake of PNC services. The uptake of PNC services was measured in accordance with WHO recommendations. Using a predesigned checklist format, the frequency of PNC visits was assessed to determine if the woman had received the recommended PNC services at these time points (Appendix VIII). The checklist is derived from ANC, labour, and PNC integrated cards. The PNC assesses maternal vital signs and uterine contractions for assessing postpartum haemorrhage, provides counselling on danger signs and offers immunisation, family planning and breastfeeding support. The women were also interviewed to determine if they had visited the health facility for PNC and received services. Patient records were reviewed when additional information was needed during the follow-up.

6.10.2 Knowledge of obstetric danger signs

Knowledge of ODSs is a secondary outcome. A six-item ODS questionnaire in the Afaan Oromo language, previously published in studies (Bogale & Markos, 2015; Teshoma Regasa et al., 2020), was used to measure knowledge of ODSs. The knowledge level of women in the intervention and control groups was assessed on the basis of their responses at baseline during enrolment and immediately after completing the intervention. The level of their knowledge of ODS was determined on the basis of women's spontaneous mention of at least two danger signs for pregnancy, birth and postpartum each (Akililu Solomon, 2015; Dangura, 2020; Maseresha et al., 2016).

6.10.3 Breastfeeding self-efficacy and exclusive breastfeeding practice

BF self-efficacy was measured at baseline, the 6th week and the 12th week postpartum. The data on BF self-efficacy were collected via the 14-item BSES-SF (Amini et al., 2019), which was validated in the Afaan Oromo language as part of this study. The detailed scale validation is discussed in Chapter 5. The BSES-SF has 14 items to assess women's confidence in practising recommended breastfeeding practices. Each item is scored on a five-point Likert scale ranging from 1 ('not at all confident') to 5 ('always confident'). This scale was first developed by Dennis and Faux in 1999; it comprises 33 items and was later shortened to 14 items by Dennis in 2003 (Dennis, 2003).

EBF practices were assessed via a structured interview at 6 weeks, 12 weeks and 6 months postpartum, and whether the child was receiving only breastmilk or additional food in addition to breast milk during the assessment time points of the study period was determined. This item was

adapted from the Ethiopian Demographic and Health Survey EBF practice questionnaire (CSA, 2016).

6.10.4 Perception of receiving support for exclusive breastfeeding

Women's perceptions of receiving support from their husbands on EBF were examined via the EBFSS scale, Afaan Oromo version (16 items) (Gayesa et al., 2024). The detailed scale validation is discussed in Chapter 5. The original scale was developed by Boateng et al. and is a 3-dimensional instrument comprising instrumental, emotional and informational subscales, with Cronbach's alpha reliability coefficients of 0.79, 0.85 and 0.83, respectively (Boateng et al., 2018). The items are rated on a three-point Likert scale ranging from 1 ('no help at all or much less than you would like') to 3 ('as much as you would like'). Scores range from 16 to 48, with higher scores indicating more significant support from their husbands in EBF practices. In this study, the outcome related to the support received for EBF practice was measured at 6 and 12 weeks after childbirth.

6.10.5 Perception of providing support for breastfeeding amongst husbands

The 'Partner Breastfeeding Influence Scale' in the Afaan Oromo version (31 items) was used to assess the perceived breastfeeding support provided by the husbands (Gayesa et al., 2025). The original scale was developed by Rempel et al. (Rempel et al., 2017). The scale comprises five subscales, each with acceptable reliability scores. A detailed description of the original scale and its scale validation in the Afaan Oromo version is discussed in Chapter 5. The validated scale was used in this study to measure fathers' perceptions of providing breastfeeding support to mothers. The outcome was measured at 6 and 12 weeks after childbirth.

6.10.6 Incidence of maternal and neonatal mortality

At the 6th week and 12th week postpartum, the proportion of maternal and neonatal mortality was evaluated by inquiring with the spouses about the status of the mother and newborn and reviewing their medical records, where needed. A modified questionnaire from the WHO was used to measure maternal mortality (WHO, 2013b).

6.10.7 Satisfaction with the intervention

Satisfaction with the intervention was collected at the 12th week postpartum from the dyads in the intervention group using a modified programme satisfaction questionnaire (8 items) (Ngai & Lam, 2023).

6.11 Data collection procedure

At each hospital, two BSc degree holders in midwifery working at the hospital were hired to recruit participants, collect baseline information and conduct follow-up data collection. The baseline data were collected immediately after consent was obtained from the participants. Using structured interviews, postintervention data were collected within a week of the last message (T1) at the patients' respective hospitals and community settings. The remaining follow-up data were collected at 12 weeks (T2) and 6 months (T3) after childbirth. Community health workers were hired to collect follow-up data at the participants' homes or the nearest 'kebele' (i.e. the lowest administrative government unit, where community health workers are usually stationed) when the dyads could not visit the hospital by prior arrangement with the respondents via a phone call. If the dyads were unable to provide their responses at either the hospital or home by repeated trials, but were only available by phone, their responses from the telephone interview were considered. The principal investigator supervised the overall data collection procedure.

The participants were interviewed to evaluate the uptake of the recommended scheduled visits at the 6th week after childbirth. In addition, PNC was collected from patient cards where needed. By contrast, data on knowledge of ODSs were collected via face-to-face interviews at baseline (T0) and immediately after the intervention was completed (T1) using an ODS questionnaire. Data on EBF self-efficacy were collected at baseline (T0), immediately after the intervention was completed (T1) and at the six-week follow-up after the intervention was completed (T2) using the BSES-SF. Data on EBF practices were collected through the use of a breastfeeding practice item, partner breastfeeding support using the PBIS and perceived EBF social support via the EBFSS scale; these data were collected at two time points immediately after completion of the intervention (T1) and at the 6-week follow-up after completion of the intervention (T2). In addition, EBF data were collected in the 6th month after childbirth. Satisfaction with the intervention was assessed at 12 weeks postpartum by face-to-face interviews using a modified programme satisfaction questionnaire.

Table 6.1 Flow of outcome measurement time points

Outcomes	Measurements	Data collected from	Time point
Postnatal care uptake	PNC utilisation questionnaire and checklist	Mother	T1*
Obstetric danger signs	ODS questionnaire	Mother	T0, T1
Exclusive Breastfeeding Practice	EBF questionnaire	Mother	T1, T2, T3
Breastfeeding self-efficacy	BSES-SF	Mother	T0, T1, T2

Perceived breastfeeding support received	EBFSS scale	Mother	T1, T2
Perceived breastfeeding support provided	PBIS	Father	T1, T2
Incidence of maternal and neonatal mortality	Modified Maternal Mortality Assessment Questionnaire	Mother, Father	T1, T2
Satisfaction with the intervention programme	Modified Programme Satisfaction Questionnaire	Mother, Father	T2

**Postnatal care utilisation encompasses four contact time points between birth and 6 weeks and is assessed at T1 via the combined participant interview questionnaire and checklist.*

T0: baseline; T1: at six weeks postpartum; T2: at 12 weeks postpartum; T3: at 6 months postpartum

6.12 Quality control measures

The trial's daily progress was managed by a team comprising the principal investigator and the research team, which included a midwife and research assistants at each study site. Tools were validated in the target language to ensure the reliability and validity of the study outcomes. The intervention protocol was prepared on the basis of the available evidence, and the effectiveness of the interventions was systematically reviewed from previous literature. Moreover, the fidelity of the intervention was assessed by phone calls made to participants at birth and six weeks after childbirth to ensure that they received the messages. In addition, the delivery of the messages was ensured on the basis of the mobile delivery report, and the logbook was provided to the dyads such that they could monitor the receipt of the messages (Appendix VI).

6.13 Data analysis

SPSS software, version 29.0, was used for data analysis. The primary investigator and research assistant separately entered the coded data into EpiData to verify the accuracy of the data entry. Basic sociodemographic characteristics were examined through descriptive statistics. Generalised estimating equations (GEEs) and binary logistic regression were applied to compare the effectiveness of the intervention in improving the outcome variables. As an extension of the generalised linear model, GEE enables the analysis of repeated measurements and other correlated observations, such as clustered data (Ballinger, 2016). This means GEE is devised to account for the data correlation, and they are robust to certain types of misspecification (Ditlhong et al., 2018). This model can handle missing data under the assumption that the data are ‘missing completely at random’ or ‘missing at random’. Furthermore, the GEE model is accustomed in longitudinal studies in which dropouts and missing observations are anticipated (Ditlhong et al., 2018). In this study, the autoregressive (AR(1)) correlation structure was employed as it considers the correlated nature of data that decreases over time and is observed in the same individuals. An intention-to-treat (ITT) analysis was employed to ensure that the groups were analysed according to their initial assignment. PNC uptake was subsequently compared between the intervention and control groups, and binary logistic regression was used to determine the effect of mHealth interventions on each PNC visit and evaluate differences in EBF practices between groups. Furthermore, knowledge of ODSs, BSE, perceptions of providing breastfeeding support and perceptions of receiving breastfeeding support were analysed via the GEE model. The interaction effect of group and time was examined where applicable. A significant association of variables was determined at a p value less than or equal to 0.05. The comparability of groups on the basis of sociodemographic

characteristics was assessed via independent sample t-tests for continuous variables, and the chi-square test and Fisher's exact test for categorical variables.

6.14 Ethical considerations

An ethical approval letter was obtained from the Hong Kong Polytechnic University Institutional Review Board with reference number HSEARS20230828006 (Appendix I). An approval letter was also obtained from Wollega University (IHSRPTTAD/005/2016) (Appendix II). Permission to conduct the study was also secured from the included hospitals. Brief information was provided to the participants before their enrolment in the study (Appendix VII). Written informed consent was obtained from the women and their partners before the commencement of the study (Appendix VIII). The confidentiality of the study participants' information was maintained throughout the study by anonymising the data during analysis, using unique identifiers instead of names, storing the data securely with limited access and ensuring that the data were unshared with third parties. The participants were enrolled voluntarily and could withdraw from the study if they felt uncomfortable. Moreover, the study participants were informed of the study's purpose, an overview of the procedure and the benefits and risks associated with the survey before their enrolment. The study did not involve the collection of biological samples from the participants.

6.15 Chapter summary

This chapter outlines the methods used to evaluate the effectiveness of mHealth educational interventions in improving the uptake of PNC services, EBF practices and related outcomes. A two-arm parallel-group randomised controlled trial was employed. Pregnant women, along with their husbands, were randomly allocated to the intervention and control arms. The intervention arm received educational messages on the benefits of PNC services, EBF and partner support.

Educational messages also include the danger signs of the mother and newborn during pregnancy and postpartum, and recommended actions for seeking immediate healthcare attention. A total of 24 educational intervention messages were delivered over 12 weeks, from the 31st week of pregnancy to six weeks postpartum. The control arm received only routine care. Outcomes were measured at baseline, postintervention and follow-up. The GEE model was used to determine the main effect of the intervention and the interaction effect between the group and time. At the same time, binary logistic regression was employed to assess the impact of the intervention on categorical outcomes.

CHAPTER SEVEN: RESULTS (PHASE III OF THE STUDY)

7.1 Introduction

This chapter examines the effectiveness of mHealth educational messages in improving the uptake of PNC and EBF practices amongst first-time parents. It begins with participant recruitment, with a detailed description provided by a CONSORT flow diagram. The sociodemographic characteristics of mothers and their husbands are briefly described in the text and table. The outcome measures related to PNC uptake, knowledge of ODSs, BSE, EBF practices, mothers' perceptions of receiving EBF support, fathers' perceptions of providing breastfeeding support and satisfaction with the mHealth intervention programme are discussed. Additionally, the differences in outcomes between study groups over the study period are briefly presented. The chapter concludes with a summary.

This chapter is organised into six sections. Section 7.1 introduces the chapter. Section 7.2 outlines the recruitment and follow-up procedures of the study participants. Section 7.3 presents the sociodemographic and baseline data of the study participants. Section 7.4 provides the results of the outcome measures amongst mothers over time. Section 7.5 presents the results of outcome measures amongst fathers over time and satisfaction with the intervention programme amongst dyads in the intervention group. Section 7.6 summarises the chapter.

7.2 Participant recruitment

Participant recruitment was conducted from late February to early April 2024, and a follow-up assessment was conducted until late December 2024. After the eligibility criteria were verified, 236 couples were recruited, and their consent to participate in the study was obtained. Subjects were recruited from four public hospitals in the East Wollega Zone: NSH, WURH, Arjo Hospital

and Sibule Hospital. Amongst the 778 participants screened during the study period, 236 couples fulfilled the inclusion criteria and agreed to participate. Husbands unavailable during recruitment were contacted by phone, eligibility criteria were checked, and oral consent was obtained. Amongst the 778 screened participants, 542 (69.66%) were excluded for not being first-time mothers ($n = 350$), not being in the required GA ($n = 153$), not being accessible by phone ($n = 18$), not interested in the study ($n = 5$), being unable to read and write Afaan Oromo ($n = 8$), being underage (3), not living with a husband ($n = 3$) or not having singleton pregnancies (2) (Figure 7.1). Amongst the 236 eligible couples, 118 were randomly assigned to intervention and control groups to receive mobile educational messages and routine care, respectively. A total of 106 (89.8%) mothers and 111 (94.06%) fathers received all the text messages successfully. The remaining twelve mothers and seven fathers received only 7–15 messages due to changes in phone lines, issues with phone batteries or power-related problems. During follow-up assessments, all participants were approached for data collection. The participants were lost to follow-up to complete the assessments for various reasons, such as busy schedules, address changes, defective phones, maternal death and stillbirth at various time points (Figure 6.1). At T1 (6th week after birth), 110 (93.22%) mothers and 102 (86.44%) fathers in the intervention group and 102 (86.44%) mothers and 91 (77.12%) fathers in the control group completed the assessment. At T2 (12th week after birth), 94 (79.66%) mothers and 100 (84.7%) fathers in the intervention group and 94 (79.66%) mothers and 89 (75.42%) fathers in the control group completed the assessment. At T3 (6th month after birth), 87 (73.73%) mothers in the intervention group and 81 (68.64%) mothers in the control group completed the assessment. Regardless of the loss to follow-up, all initially randomised couples were included in the analysis, adhering to the protocol of ITT analysis.

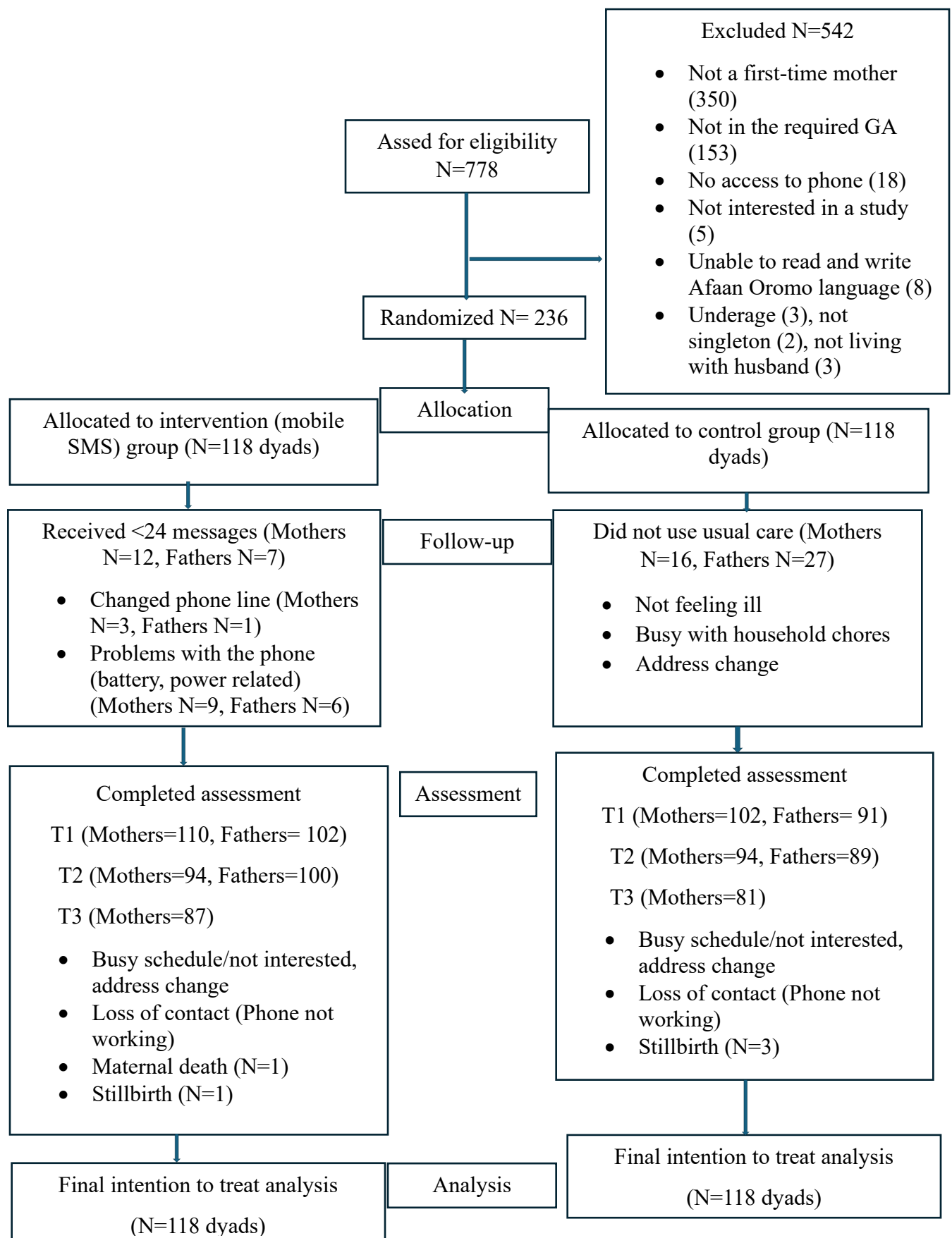


Figure 7.1 CONSORT flow diagram of participant recruitment and follow-up

7.3 Characteristics of the study participants

7.3.1 Sociodemographic characteristics of mothers

Table 7.1 presents the sociodemographic characteristics of the participants in the intervention and control groups. No significant difference between the intervention and control groups was observed in terms of sociodemographic characteristics. The age of the participating mothers ranged from 18 to 30 years, with a mean (SD) of 21.9 (± 2.47) years amongst all participants. The mean (SD) ages of the individuals in the intervention and control groups were 22.05 (± 2.30) and 21.75 (± 2.63), respectively. Nearly all the mothers were from the Oromo ethnic group and followers of the protestant-Christianity religion. Fewer than half of the mothers (43.6%) had completed college or university education, and nearly all mothers (97%) reported that their pregnancies were planned (Table 7.1).

Table 7.1 Sociodemographic characteristics of mothers in the intervention and control groups

Characteristics	Total (N = 236)	Intervention (N = 118)	Control (N = 118)	Value	P-value
Age (Mean $\pm$ SD)	21.90 (± 2.47)	22.05 (± 2.30)	21.75 (± 2.63)	0.922 ^a	0.358
Ethnicity					
Oromo	231(97.9)	115 (97.5)	116 (98.3)	-	1.00 ^b
Others	5 (2.1)	3 (2.5)	2 (1.7)		
Religion					
Protestant	196 (83.1)	100 (84.7)	96 (81.4)	1.055 ^c	0.788
Orthodox	29 (12.3)	12 (10.2)	17 (14.4)		
Muslim	9 (3.8)	5 (4.2)	4 (3.4)		
Others	2 (0.8)	1 (0.8)	1 (0.8)		
Education level					

Primary Education	46 (19.5)	17 (14.4)	29 (24.6)	4.317 ^c	0.116
Secondary Education	87 (36.9)	44 (37.3)	43 (36.4)		
Tertiary education (college or university)	103 (43.6)	55 (46.6)	46 (39.0)		
Monthly income (ETB)					
≤1300	163 (69.1)	83 (70.3)	80 (67.8)	4.8430 ^c	0.304
1301–2200	27 (11.4)	11 (9.3)	16 (13.6)		
2201–3600	11 (4.7)	4 (3.4)	7 (5.9)		
3601–6500	23 (9.7)	11 (9.3)	12 (10.2)		
>6500	12 (5.1)	9 (7.6)	3 (2.5)		
Occupation					
Housewife	168 (71.2)	86 (72.9)	82 (69.5)	1.558 ^c	0.816
Gov't employee	24 (10.2)	12 (10.2)	12 (10.2)		
Private employee	12 (5.1)	7 (5.9)	5 (4.2)		
Merchant	15 (6.4)	6 (5.1)	9 (7.6)		
Others	17 (7.2)	7 (5.9)	10 (8.5)		
The Pregnancy was planned					
Yes	229 (97.0)	116 (98.3)	113 (95.8)	-	0.446 ^b
No	7 (3.0)	2 (1.7)	5 (4.2)		

a: Independent t test; b: Fisher's exact test; c: chi-square statistics; ETB: Ethiopian Birr (1 ETB is ~0.0074 USD)

7.3.2 Sociodemographic characteristics of fathers

As shown in Table 7.2, the mean (SD) age of the fathers involved in the study was 27.67 (3.65), and the intervention and control groups did not differ significantly in terms of age ($p = 0.403$). Most study participants were from the Oromo ethnic group and were Protestant Christians. Approximately 85% of the participants had completed at least secondary education.

Table 7.2 Baseline sociodemographic differences amongst the intervention and control groups for husbands

Characteristics	Total (n = 236)	Intervention (n = 118)	Control (n = 118)	Value	p-value
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Age (Mean ± SD)	27.67 (3.65)	27.47(3.03)	27.86 (4.18)	−0.838 ^a	0.403
Ethnicity					
Oromo	232 (98.3)	116 (98.3)	116 (98.3)	-	0.689 ^b
Other	4 (1.7)	2 (1.7)	2 (1.7)		
Religion					
Protestant	202 (85.6)	104 (88.1)	98 (83.1)	2.71 ^c	0.439
Orthodox	26 (11.0)	10 (8.5)	16 (13.6)		
Muslim	7 (3.0)	4 (3.4)	3 (2.5)		
Catholic	1 (0.4)	0 (0.0)	1 (0.8)		
Education level					
Primary education	37 (15.7)	14 (11.9)	23 (19.5)	2.715 ^c	0.257
Secondary education	101 (42.8)	54 (45.8)	47 (39.8)		
Tertiary education	98 (41.5)	50 (42.8)	48 (40.7)		
Monthly Income (ETB)					
≤1300	34 (14.4)	16 (13.6)	18 (15.3)	2.60 ^c	0.627
1301–2200	31 (13.1)	14 (11.9)	17 (14.4)		
2201–3600	37 (15.7)	16 (13.6)	21 (17.8)		
3601–6500	68 (28.8)	34 (28.8)	34 (28.8)		
>6500	66 (28.9)	38 (32.2)	28 (23.7)		
Occupation					
Farmer	35 (14.8)	15 (12.7)	20 (16.9)	3.74 ^c	0.443
Gov't employee	65 (27.5)	31(26.3)	34 (28.8)		
Private employee	76 (32.2)	41(34.7)	35 (29.7)		
Merchant	37 (15.7)	22 (18.6)	15 (12.7)		
Others	23 (9.7)	9 (7.6)	14 (11.9)		

a: Independent t test; b: Fisher's exact test, c: chi-square statistics; ETB: Ethiopian Birr; 1 ETB ~0.0074 USD

7.3.3 Baseline characteristics of obstetric danger signs

The intervention and control groups did not differ significantly at baseline. Amongst all the participants, approximately 68 (28.8%) reported at least one danger sign during pregnancy. By contrast, 69 (29.2%) and 59 (25.0%) mentioned at least one ODS during childbirth and postpartum, respectively. Vaginal bleeding (excessive bleeding during birth) and severe headache were the most frequently mentioned signs during pregnancy, childbirth and postpartum (Table 7.3).

Table 7.3 Baseline knowledge of obstetric danger signs amongst pregnant women (n = 236)

Obstetric danger signs	Knowledge of the obstetric danger signs of		
	Pregnancy	Childbirth	Postpartum
	Frequency (%)	Frequency (%)	Frequency (%)
Vaginal bleeding (excessive during birth)	39 (16.53)	54 (22.88)	46 (19.49)
Severe headache	37 (15.68)	24 (10.17)	23 (9.75)
Blurred vision	17 (7.20)	NA	20 (8.47)
Convulsions	8 (3.39)	14 (5.93)	6 (2.54)
Swelling of the face or leg	12 (5.08)	NA	2 (0.85)
Fever	9 (3.81)	14 (5.93)	10 (4.23)
Unconsciousness	5 (2.12)	20 (8.47)	6 (2.54)
Difficulty breathing	12 (5.08)	NA	6 (2.54)
Severe weakness	14 (5.93)	NA	10 (4.23)
Severe abdominal pain	2 (0.85)	1 (0.42)	2 (0.85)
Decreased/increased foetal movement	13 (5.51)	NA	NA
Premature rupture of membrane (PROM)	12 (5.08)	NA	NA
Labor >12 hrs.	NA	9 (3.81)	NA
Placenta delivery >30min	NA	7 (2.97)	NA

Foul-smelling vaginal discharge	NA	NA	8 (3.39)
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NA: The danger sign is inapplicable to the category

Amongst all the participants, 50 (21.2%) were knowledgeable about danger signs during pregnancy, whereas 38 (16.1%) and 41 (17.4%) were knowledgeable about danger signs during childbirth and the postpartum period, respectively. Only 28 (11.9%) women spontaneously mentioned a total of six danger signs (two danger signs for each pregnancy, childbirth or postpartum). Participants are considered knowledgeable if they spontaneously identify at least two danger signs during each pregnancy, childbirth and the postpartum period (Akililu Solomon, 2015; Dangura, 2020; Maseresha et al., 2016; Mihret & Wondimu, 2023; Nigussie et al., 2019). Knowledge of danger signs did not differ significantly between the intervention and control groups at baseline (Table 7.4).

7.3.4 Baseline knowledge of obstetric danger signs amongst mothers

As shown in Table 7.4, the overall baseline knowledge of ODSs or each component related to pregnancy, childbirth, and postpartum did not significantly differ between the intervention and control groups.

Table 7.4 Baseline differences in knowledge of obstetric danger signs amongst mothers in the intervention and control groups

Knowledge of danger signs	Total N = 236	Intervention N = 118	Control N = 118	Value	p-value
Overall knowledge					
Yes	28 (11.9)	13 (11.0)	15 (12.7)	0.162 ^a	0.687
No	208 (88.1)	105 (89.0)	103 (87.3)		

Knowledge during pregnancy					
Yes	50 (21.2)	24 (20.3)	26 (22.0)	0.102 ^a	0.750
No	186 (78.8)	94 (79.7)	92 (78.0)		
Knowledge during birth					
Yes	38 (16.1)	20 (16.9)	18 (15.3)	0.125 ^a	0.723
No	198 (83.9)	98 (83.1)	100 (84.7)		
Knowledge during Postpartum					
Yes	41 (17.4)	22 (18.6)	19 (16.1)	0.266 ^a	0.606
No	195 (82.6)	96 (81.4)	99 (83.9)		

a = chi-square statistics

7.3.5 Baseline breastfeeding self-efficacy amongst mothers

The participants' mean (SD) BSE score at baseline was 49.77 (10.62), with no significant difference between the intervention and control groups ($t = -0.447$, $p = 0.656$). The mean (SD) score of BSE for the intervention group was 49.46 (10.87), whereas for the control group, it was 50.08 (10.40).

7.4 Results of the outcomes amongst mothers

7.4.1 Primary outcome

i. Postnatal care uptake

Table 7.5 shows the uptake of PNC services amongst women. Nearly all intervention participants (94.5%) and control participants (93.1%) received their first postnatal checkup (PNC) within 24 hours of childbirth. There was no significant difference in the utilisation of the first postnatal

service, which is usually received within 24 hours after birth. Six (5.5%) and seven (6.9%) children in the intervention and control groups, respectively, did not receive their first PNC within the first 24 hours after birth. For both groups, the proportion of PNC service utilisation decreased over time from the first visit to the fourth visit. With respect to the individual time points, a significant difference was observed at the third PNC visit, which was received between the 7th and 14th days after childbirth (odds ratio [OR] = 2.175, 95% CI: 1.091–4.337; P = 0.027). No significant difference was observed between the two groups at the second PNC visit (48–72 hours after birth) or the fourth postnatal visit (6 weeks after birth). Figure 7.2 shows the changes in PNC service uptake percentages for each PNC visit during the study period.

Table 7.5 Binary logistic regression for the uptake of postnatal care services amongst women

PNC Visits	Group	PNC uptake	No PNC uptake	Odds ratio	95%CI		p-value
PNC 1	Intervention	104 (94.5)	6 (5.5)	1.277	0.415	3.935	0.670
	Control	95 (93.1)	7 (6.9)	1.00			
PNC 2	Intervention	23 (20.9)	87 (79.1)	1.810	0.862	3.799	0.117
	Control	13 (12.7)	89 (87.3)	1.00			
PNC 3	Intervention	30 (27.3)	80 (72.7)	2.175	1.091	4.337	0.027
	Control	15 (14.7)	87 (85.3)	1.00			
PNC 4	Intervention	22 (20.0)	88 (80.0)	1.875	0.875	4.018	0.106
	Control	12 (11.8)	90 (88.2)	1.00			

PNC: postnatal care; PNC 1: within 24 h of birth; PNC 2: 48–72 h of birth; PNC 3: 7–14 days after birth; PNC 4: at 6 weeks after birth

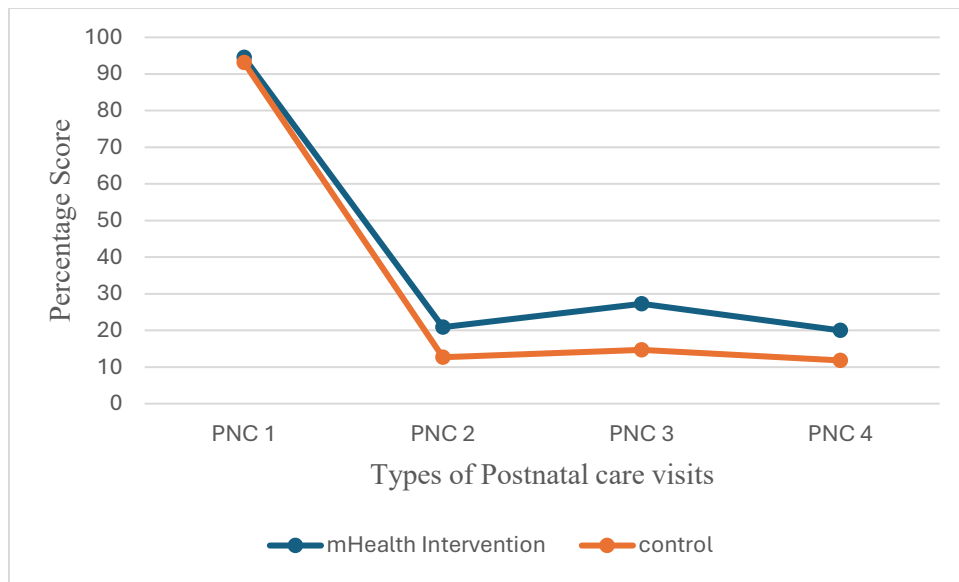


Figure 7.2 Profile plot of the percentage of postnatal care service uptake amongst mothers over the study period

7.4.2 Results of secondary outcomes

i. Obstetric danger signs

Following a 12-week intervention, the overall knowledge of ODS amongst all women was 29.7%. Amongst the intervention group, the mobile educational message significantly and positively improved overall knowledge and each component of knowledge of ODSs during pregnancy, childbirth and postpartum periods. The overall knowledge of ODS amongst the intervention group was 37.3%, and amongst the control group, it was 21.6%. Compared with the baseline, the knowledge of ODSs was greater in both intervention and control groups at T1; however, a significant increase in the knowledge level of ODSs was observed amongst the intervention group compared with the control group (37.3% vs 21.6%). Table 7.6 presents the frequency and percentage of ODSs during pregnancy, childbirth and postpartum for the intervention and control groups.

Table 7.6 Frequency and percentage of knowledge of obstetric danger signs postintervention

Parameters	Total (N = 212)	Intervention (N = 110)	Control (N = 102)
Overall knowledge			
Yes	63 (29.7)	41 (37.3)	22 (21.6)
No	149 (70.3)	69 (62.7)	80 (78.4)
Knowledge of ODS pregnancy			
Yes	122 (57.0)	73 (66.4)	49 (48.0)
No	90 (42.5)	37 (33.6)	53 (52.0)
Knowledge of ODS birth			
Yes	83 (39.2)	54 (49.1)	29 (28.4)
No	129 (60.8)	56 (50.9)	73 (71.6)
Knowledge of ODS Postpartum			
Yes	115 (54.2)	73 (66.4)	42 (41.2)
No	97 (45.8)	37 (33.6)	60 (58.8)

Table 7.7 shows the GEE employed with binary logistic regression to determine the group effect and the group-by-time interaction effect of the mobile intervention on enhancing knowledge of ODSs. The odds of knowledge of ODS were 2.667 times greater amongst the intervention group than amongst the control group at T1 (OR = 2.667; 95% CI: 1.143, 6.225; P = 0.023). The GEE results revealed significant group-by-time differences in overall knowledge and each component of knowledge of ODSs during the pregnancy, childbirth and postpartum periods. Figure 7.3 shows the change in the overall knowledge of ODSs at two assessment time points.

Table 7.7 Generalised estimation equation results for knowledge of obstetric danger signs over the study period

Parameter	β	Exp (β)	95% Wald CI for Exp (β)		p-value
Overall knowledge of ODS					
Group effect	−0.162	0.850	0.386	1.875	0.687
Group*time effect	0.981	2.667	1.143	6.225	0.023
Knowledge of pregnancy ODS					
Group effect	−0.102	0.903	0.484	1.688	0.750
Group*time effect	0.883	2.419	1.124	5.208	0.024
Knowledge of childbirth ODS					
Group effect	0.126	1.134	0.566	2.272	0.723
Group*time effect	0.797	2.218	1.016	4.842	0.046
Knowledge of postpartum ODS					
Group effect	0.177	1.194	0.608	2.345	0.607
Group*time effect	0.860	2.363	1.062	5.259	0.035

ODS: Obstetric danger sign; Exp (β) = odds ratio

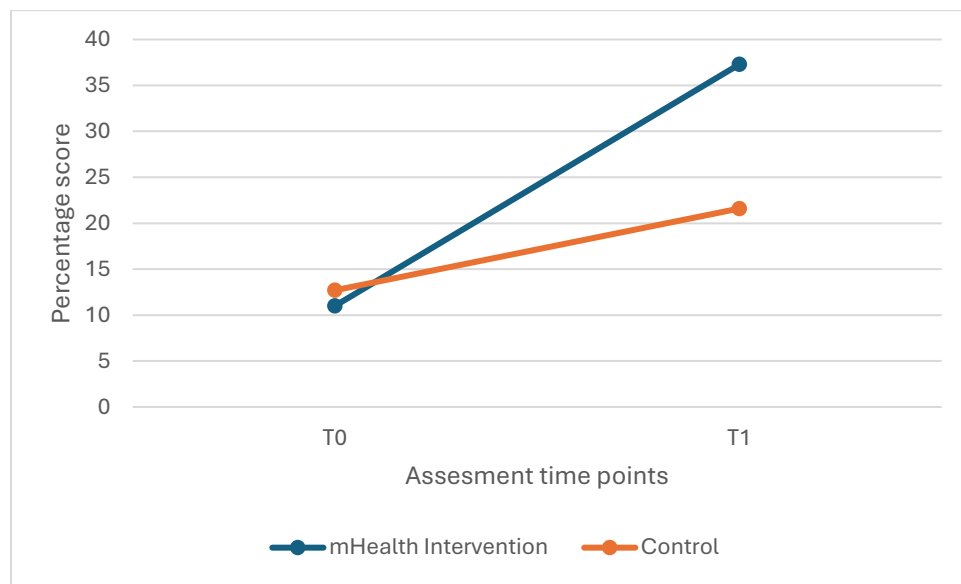


Figure 7.3 Profile plot of the percentage of knowledge of obstetric danger signs amongst mothers over the study period

ii. Breastfeeding self-efficacy

As shown in Table 7.8, the mean BSE score improved over time amongst all participants, with a mean (SD) of 49.77 (10.62) at T0, 53.82 (4.30) at T1 and 54.23 (5.81) at T2. Both the intervention and control groups presented an increase in the mean BSE score over time from T0 to T2.

Table 7.8 Mean and SD of women's breastfeeding self-efficacy amongst women across the study period

Time	Total score Mean (SD)	Intervention group Mean (SD)	Control group Mean (SD)
T0	49.77 (10.62)	49.46 (10.87)	50.08 (10.40)
T1	53.82 (4.30)	54.85 (4.65)	52.71 (3.59)
T2	54.23 (5.81)	55.23 (6.18)	53.23 (5.26)

T0: at baseline during pregnancy; T1: 6th week postpartum; T2: 12th week postpartum

Table 7.9 shows the GEE results. BSE improved significantly over time amongst the intervention group at T1 ($\beta = 2.754$, 95% CI: 0.128, 5.381, $p = 0.040$) but was not statistically significant at T2 ($\beta = 2.602$, 95% CI: -0.175, 5.379, $p = 0.066$).

Table 7.9 Generalised estimating equations results of breastfeeding self-efficacy amongst mothers over the study period

Parameter	β	95% Wald Confidence Interval		Wald Chi-Square	p-value
Group effect	-0.619	-3.322	2.084	0.201	0.654
Group*Time 1	2.754	0.128	5.381	4.225	0.040
Group*Time 2	2.602	-0.175	5.379	3.372	0.066

T1: 6th week postpartum; T2: 12th week postpartum

A pairwise comparison was also made between the intervention and control groups at all time points. Accordingly, there was a significant mean difference between the intervention and control groups at T1 (MD = 2.136, 95% CI: 1.03–3.24, $p < 0.001$, $d = 0.52$) and T2 (MD = 1.98, 95% CI: 0.367–3.60, $p = 0.016$, $d = 0.35$), favouring the intervention group (Table 7.10). Figure 7.4 illustrates the changes in BSE scores amongst mothers over the study period.

Table 7.10 Pairwise comparison of means of breastfeeding self-efficacy amongst mothers over the study period

Pairwise comparison	Group vs time	Mean difference	Standard error	95% Wald CI for the mean difference		p-value	Cohen's d
T0	Intervention vs Control	−0.619	1.38	−3.32	2.08	0.654	
T1	Intervention vs Control	2.14	0.564	1.03	3.24	<0.001	0.52
T2	Intervention vs Control	1.984	0.825	0.367	3.60	0.016	0.35
Intervention	T0 vs T1	5.4423	0.98418	3.5134	7.3713	<0.001	
	T0 vs T2	5.7892	1.03388	3.7628	7.8155	<0.001	
	T1 vs T2	0.3468	0.59108	−0.8117	1.5053	0.557	
Control	T0 vs T1	2.6879	0.90951	0.9053	4.4705	0.003	
	T0 vs T2	3.1870	0.96899	1.2878	5.0862	0.001	
	T1 vs T2	0.4991	0.49412	−0.4694	1.4675	0.312	

T0: at baseline during pregnancy; T1: 6th week postpartum; T2: 12th week postpartum

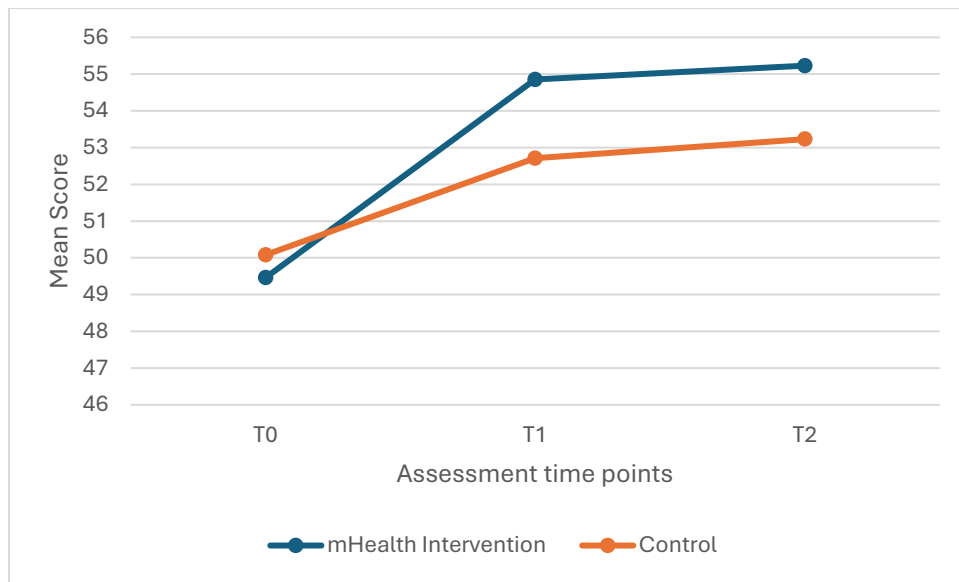


Figure 7.4 Profile plot of breastfeeding self-efficacy scores amongst mothers over the study period

iii. Perceived exclusive breastfeeding support received

Table 7.11 shows the mothers' perceptions of EBF support received from their husbands. Although the overall mean (SD) of total EBF support decreased slightly from 39.98 (3.80) at T1 to 39.76 (3.81) at T2, the mean (SD) EBF support received by the intervention group increased from T1 to T2, whereas it decreased in the control group.

With respect to the support subdomains, whilst the support received for the instrumental domain increased from T1 to T2 for the whole sample, a slight decrease was observed for emotional and informational EBFs over the study period. Compared with those in the control group, instrumental and emotional support increased in the intervention group over the study period. On the other hand, the informational support received decreased for both intervention and control groups during this time.

Table 7.11 Mean and SD of breastfeeding support received by women over the study period

Time	Total	Intervention group	Control group
	Mean (SD)	Mean (SD)	Mean (SD)
Overall score			
T1	39.98 (3.80)	40.45 (3.96)	39.47 (3.58)
T2	39.76 (3.81)	40.50 (3.85)	39.02 (3.63)
Instrumental support			
T1	6.94 (1.07)	7.09 (1.07)	6.78 (1.05)
T2	7.01 (1.07)	7.19 (1.05)	6.82 (1.07)
Emotional support			
T1	20.94 (2.51)	21.15 (2.59)	20.71 (2.41)
T2	20.86 (2.32)	21.17 (2.15)	20.55 (2.46)
Informational support			
T1	12.09 (1.75)	12.200 (1.72)	11.98 (1.78)
T2	11.89 (2.01)	12.14 (2.09)	11.65 (1.91)

T1: 6th week postpartum; T2: 12th week postpartum

Table 7.12 presents the GEE results for perceived EBF support received amongst mothers. No significant difference was observed between the intervention and control groups over time ($\beta = 0.504$; 95% CI: -0.757 - 1.764 , $p = 0.433$). Table 7.13 shows the results of the pairwise comparison between the intervention and control groups at two time points in addition to the GEE analysis. The effect of mHealth on mothers' perceptions of breastfeeding support was greater in the intervention group than in the control group at T1 but did not reach statistical significance (MD =

0.975; 95% Wald CI: -0.035, 1.985; $p = 0.058$). However, at T2, the mHealth intervention significantly outperformed usual care in terms of the overall perception of breastfeeding support received amongst mothers (MD = 1.479; 95% Wald CI: 0.414, 2.543, $p = 0.006$, $d = 0.40$). With respect to support subdomains, mothers in the intervention group perceived receiving greater instrumental support from their spouses than mothers in the control group did, with a small effect size ($\beta = 0.307$; 95% CI: 0.022, 0.591, $p = 0.035$, $d = 0.29$). Figure 7.5 shows the changes in the score of perceived breastfeeding support received amongst mothers from fathers at two time points.

Table 7.12 Generalised estimating equation results of exclusive breastfeeding support received amongst mothers over the study period

Parameter	β	95% Confidence Interval		Wald Chi-Square	p-value	Cohen's d
Total breastfeeding support received						
Group effect	0.975	−0.035	1.985	3.581	0.058	
Time effect	−0.449	−1.213	0.314	1.331	0.249	
Group*time effect	0.504	−0.757	1.764	0.614	0.433	
Instrumental support						
Group effect	0.307	0.022	0.591	4.470	0.035	0.29
Time effect	0.035	−0.203	0.272	0.083	0.774	
Group*time effect	0.066	−0.256	0.388	0.160	0.689	
Emotional support						
Group effect	0.449	−0.222	1.119	1.721	0.190	
Time effect	−0.147	−0.650	0.356	0.328	0.567	
Group*time effect	0.173	−0.575	0.921	0.206	0.650	
Informational support						
Group effect	0.220	−0.250	0.689	0.841	0.359	
Time effect	−0.349	−0.676	−0.022	4.383	0.036	

Group*time effect	0.333	−0.229	0.896	1.348	0.246
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Table 7.13 Pairwise comparison of means of total perceived exclusive breastfeeding support received amongst mothers over the study period

Pairwise comparison	Group vs time	Mean difference	Standard error	95% Wald CI for the mean difference	P value	Cohen's d
T1	Intervention vs Control	0.975	0.515	−0.035 1.985	0.058	
T2	Intervention vs Control	1.479	0.543	0.414 2.543	0.006	0.40
Intervention	T1 vs T2	0.055	0.512	−0.949 1.057	0.915	
Control	T1 vs T2	−0.449	0.389	−1.213 0.314	0.249	

T1: 6th week postpartum; T2: 12th week postpartum

Table 7.14 shows the results of the pairwise comparisons of the intervention and control groups for each support domain. Accordingly, the intervention produced significantly greater instrumental support at six weeks ($d = 0.29$, $p = 0.035$) and 12 weeks ($d = 0.35$, $p = 0.015$). However, no significant difference was observed between the two groups at T1 (6 weeks) for the remaining subdomains of breastfeeding support (emotional and informational). At T2 (12 weeks), support received on the emotional and informational aspects was greater amongst the intervention group, although it did not reach a statistically significant level ($p = 0.061$ and $p = 0.055$, respectively) (Table 7.14).

Table 7.14. Pairwise comparison of means of mothers' perceived receipt of exclusive breastfeeding support for subdomains

Pairwise comparison	Group vs time	Mean difference	Standard error	95% Wald CI for the mean difference		p-value	Cohen's d
Instrumental support							
T1	Intervention vs Control	0.307	0.145	0.022	0.591	0.035	0.29
T2	Intervention vs Control	0.372	0.154	0.071	0.673	0.015	0.35
Intervention	T1 vs T2	0.101	0.111	−0.117	0.318	0.365	
Control	T1 vs T2	0.035	0.121	−0.203	0.272	0.774	
Emotional support							
T1	Intervention vs Control	0.449	0.342	−0.222	1.119	0.190	
T2	Intervention vs Control	0.622	0.332	−0.028	1.272	0.061	
Intervention	T1 vs T2	0.026	0.282	−0.528	0.580	0.926	
Control	T1 vs T2	−0.147	0.257	−0.650	0.356	0.567	
Informational support							
T1	Intervention vs Control	0.219	0.239	−0.250	0.689	0.359	
T2	Intervention vs Control	0.553	0.288	−0.012	1.118	0.055	
Intervention	T1 vs T2	−0.016	0.233	−0.474	0.442	0.946	
Control	T1 vs T2	−0.349	0.167	−0.676	−0.022	0.036	

T1: 6th week postpartum; T2: 12th week postpartum

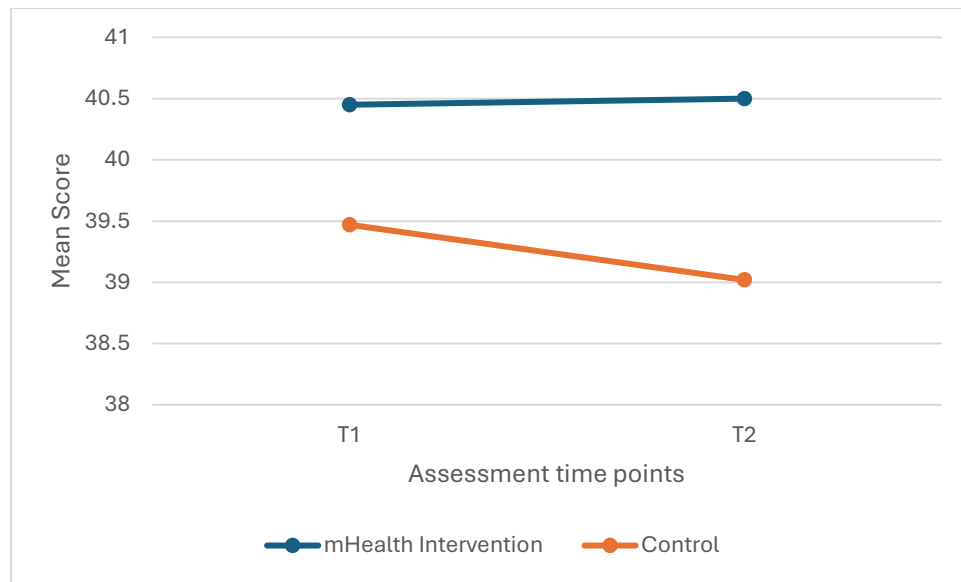


Figure 7.5 Profile plot of mothers' perceived overall EBF support received from fathers over the study period

iv. Outcomes related to exclusive breastfeeding practices

In this study, the trend of EBF practices declined over time for both the intervention and control groups. In the intervention group, the EBF rate was 88.5% at T1, 70.2% at T2 and 31.0% at T3. In the control group, the EBF rate was 83.3% at T1, 55.3% at T2 and 19.8% at T3. Table 7.15 shows that the overall EBF practice amongst women at T1 was 182 (85.8%), whilst approximately 19 (9.0%) were feeding breastmilk and other types of milk, such as formula. Moreover, the rate of EBF amongst the intervention group was higher than that amongst the control group, with 97 (88.2%) compared with 85 (83.3%) in the control group (Table 7.15).

Table 7.15 Exclusive breastfeeding practices amongst women at T1 (6 weeks)

Types of feeding	Total (N = 212)	Intervention (N = 110)	Control (N = 102)
EBF	182 (85.8)	97 (88.2)	85 (83.3)

BF and plain water only	4 (1.9)	2 (1.8)	2 (1.9)
BF and non-milk feeding	1 (1.0)	0 (0.0)	1(0.5)
BF and other milk	19 (9.0)	10 (9.1)	9 (8.8)
BF and complementary feeding	6 (2.8)	1(0.9)	5 (4.9)

EBF: Exclusive breastfeeding; BF: Breastfeeding

No participant responded 'no breastfeeding at all' in this study.

The overall rate of EBF practice amongst women at T2 was 118 (62.8%), whilst approximately 34 (18.1%) practised breastfeeding and complementary feeding together (Table 7.16). Moreover, the percentage of EBF in the intervention group was greater than that in the control group, with 66 (70.2%) compared with 52 (55.3%) in the control group.

Table 7.16 Types of breastfeeding practices amongst women at T2 (3 months)

Types of feeding	Total (N = 188)	Intervention (N = 94)	Control (94)
EBF	118 (62.8)	66 (70.2)	52 (55.3)
BF and plain water only	20 (10.6)	7 (7.4)	13 (13.8)
BF and non-milk feeding	3 (1.6)	1 (1.1)	2 (2.1)
BF and other milk	13 (6.9)	5 (5.3)	8 (8.5)
BF and complementary feeding	34 (18.1)	15 (16.0)	19 (20.2)

No participant responded 'no breastfeeding at all' in this study.

The overall EBF practice of women at T3 (at the 6th month) was 43 (25.6%), whilst 105 (62.5%) were breastfeeding and complementary feeding (Table 7.17). Moreover, the percentage of EBF in

the intervention group was greater than that in the control group, with 27 (31.0%) compared with 16 (19.8%) in the control group.

Table 7.17 Types of breastfeeding practices amongst women at T3 (6 months)

Types of feeding	Total (N = 168)	Intervention (N = 87)	Control (N = 81)
EBF	43 (25.6)	27 (31.0)	16 (19.8)
BF and plain water only	9 (5.4)	5 (5.7)	4 (4.9)
BF and non-milk feeding	4 (2.4)	2 (2.3)	2 (2.5)
BF and other milk	7 (4.2)	6 (6.9)	1 (1.2)
BF and complementary feeding	105 (62.5)	47 (54.0)	58 (71.6)

The effect of mHealth interventions on EBF practices between the intervention and control groups was also examined using binary logistic regression at T1, T2 and T3 (Table 7.18). The odds of EBF practices amongst the intervention group were approximately 1.49 times greater than those of the control group at T1. Meanwhile, the intervention group had 1.9 times greater odds of practising EBF than did the control group at T2 (OR: 1.9, 95% CI: 1.044–3.044, $p = 0.036$). At T3, the intervention group was 1.8 times more likely to practice EBF than the control group was (OR: 1.83, 95% CI: 0.898–3.722, $p = 0.096$). Figure 7.6 shows the changes in the percentage of EBF practices over time during the study period.

Table 7.18 Logistic regression of exclusive breastfeeding practices at the three time points amongst the intervention and control groups

Time point	Group	EBF N (%)	No EBF N (%)	Odds ratio	95% CI	p-value
Time 1 (at 6th week)	Intervention	97 (88.2)	13 (11.8)	1.49	0.685 3.251	0.314
	Control	85 (83.3)	17 (16.7)	1.00		
Time 2 (at 12th week)	Intervention	66 (70.2)	28 (29.8)	1.90	1.044 3.471	0.036
	Control	52 (55.3)	42 (44.7)	1.00		
Time 3 (at 6th month)	Intervention	27 (31.0)	60 (69.0)	1.83	0.898 3.722	0.096
	Control	16 (19.8)	65 (80.2)	1.00		

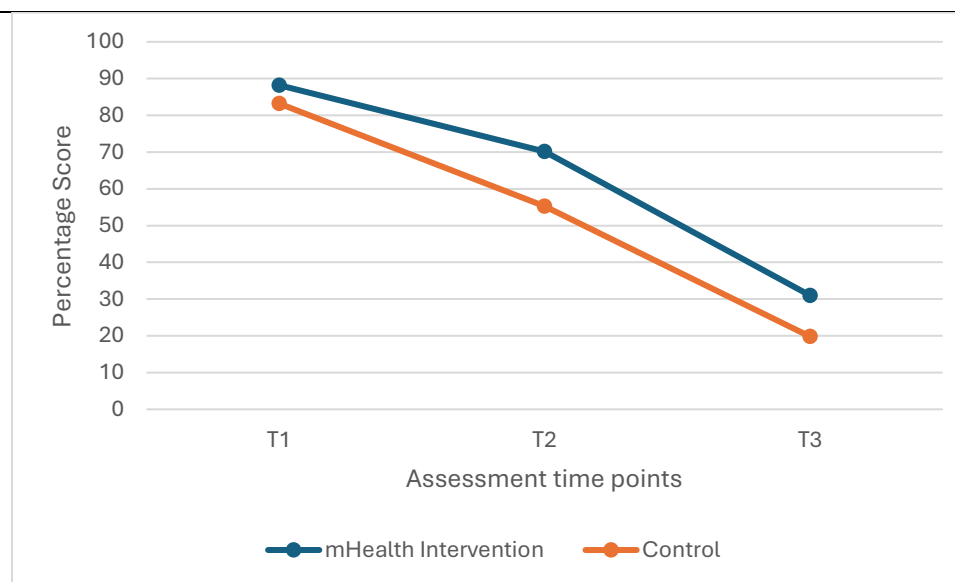


Figure 7.6 Profile plot of EBF rates amongst mothers over the study period

v. Incidence of mortality amongst mothers or newborns

The mortality amongst women and newborns was also assessed over the study period. Accordingly, one maternal death and one stillbirth occurred in the intervention group. Three stillbirths occurred

in the intervention group. The intervention and control groups were not significantly different in terms of mortality complications among mothers and babies ($X^2 = 0.29$; $p = 0.590$).

7.5 Results of the secondary outcomes amongst fathers

7.5.1 Breastfeeding support provided by fathers

Overall, the provision of breastfeeding support improved amongst the intervention group from 115.89 (10.92) at T1 to 116.47 (10.38) at T2. Similarly, the mean (SD) breastfeeding support amongst the control group was 112.21 (10.04) at T1 and 113.13 (9.92) at T2 (Table 7.19).

Table 7.19 Mean and SD of fathers' breastfeeding support over the study period

Time	Mean (SD)	Intervention group Mean (SD)	Control group Mean (SD)
Overall score			
T1	114.16 (10.65)	115.89 (10.92)	112.21 (10.04)
T2	114.90 (10.28)	116.47 (10.38)	113.13 (9.92)
Subscale score			
Breastfeeding Savvy			
T1	29.68 (3.23)	30.15 (3.46)	29.16 (2.89)
T2	29.70 (3.36)	30.30 (3.53)	29.02 (3.04)
Breastfeeding helping			
T1	26.16 (3.41)	26.73 (3.60)	25.53 (3.07)
T2	26.40 (3.62)	26.71 (3.59)	26.04 (3.64)
Breastfeeding appreciation			

T1	21.95 (2.90)	22.28 (2.74)	21.58 (3.04)
T2	22.06 (2.80)	22.41 (2.75)	21.66 (2.83)
Breastfeeding Presence			
T1	18.00 (2.77)	18.13 (2.84)	17.86 (2.70)
T2	18.21 (2.72)	18.28 (2.80)	18.12 (2.63)
Breastfeeding responsiveness			
T1	18.35 (2.24)	18.61 (2.13)	18.05 (2.33)
T2	18.53 (2.33)	18.76 (2.20)	18.28 (2.45)

T1: 6th week postpartum; T2: 12th week postpartum

Table 7.20 shows the GEE results for the partner's provision of breastfeeding support. The overall breastfeeding support provided by fathers was significantly greater in the intervention group than in the control group at T1 ($\beta = 3.68$, 95% CI: 0.742, 6.625, $p = 0.014$). The GEE results further indicate that partner support for savvy and helping with respect to breastfeeding was significantly greater in the intervention group than in the control group. However, no significant group-by-time effect was observed for overall breastfeeding support or each support category over the study period. Figure 7.7 shows the change in the mean score of perceived breastfeeding support provided by fathers to mothers at two time points.

Table 7.20 GEE results of overall and subdomains of breastfeeding support provided over the study period

Parameter	β	95% Confidence Interval		Wald Chi-Square	p-value
Breastfeeding supports the overall score					
Group effect	3.683	0.742	6.625	6.023	0.014
Time effect	1.000	−0.792	2.792	1.195	0.274

Group*time effect	−0.352	−2.742	2.038	.083	0.773
Breastfeeding savvy					
Group effect	0.982	0.091	1.874	4.664	0.031
Time effect	−0.121	−0.560	0.318	0.293	0.588
Group*time effect	0.321	−0.393	1.035	0.778	0.378
Breastfeeding helping					
Group effect	1.198	0.260	2.136	6.271	0.012
Time effect	0.542	−0.006	1.091	3.755	0.053
Group*time effect	−0.561	−1.284	0.161	2.318	0.128
Breastfeeding appreciation					
Group effect	0.702	−0.114	1.518	2.845	0.092
Time effect	0.105	−0.494	0.704	0.118	0.731
Group*time effect	0.029	−0.733	0.791	0.005	0.941
Breastfeeding presence					
Group effect	0.270	−0.507	1.047	0.465	0.495
Time effect	0.268	−0.296	0.833	0.867	0.352
Group*time effect	−0.117	−0.858	0.624	0.096	0.757
Breastfeeding responsiveness					
Group effect	0.553	−0.077	1.183	2.960	0.085
Time effect	0.225	−0.230	0.680	0.941	0.332
Group*time effect	−0.055	−0.627	0.516	0.036	0.849

Table 7.21 shows the results of the group and time pairwise comparisons of overall breastfeeding. Compared with the control intervention, the mHealth intervention had a significant effect on the provision of overall breastfeeding support amongst fathers in the intervention group at T1 and T2.

Table 7.21 Pairwise comparison of means of overall breastfeeding support provided amongst groups over time

Pairwise comparison	Group and time	Mean difference	Standard error	95%CI		p-value	Cohen's d
T1	Intervention vs Control	3.683	1.501	0.742	6.625	0.014	0.35
T2	Intervention vs Control	3.331	1.457	0.475	6.188	0.022	0.33
Intervention	T1 vs T2	0.648	0.807	-0.933	2.229	0.422	
Control	T1 vs T2	0.999	0.914	-0.792	2.792	0.274	

T1: 6th week postpartum; T2: 12th week postpartum

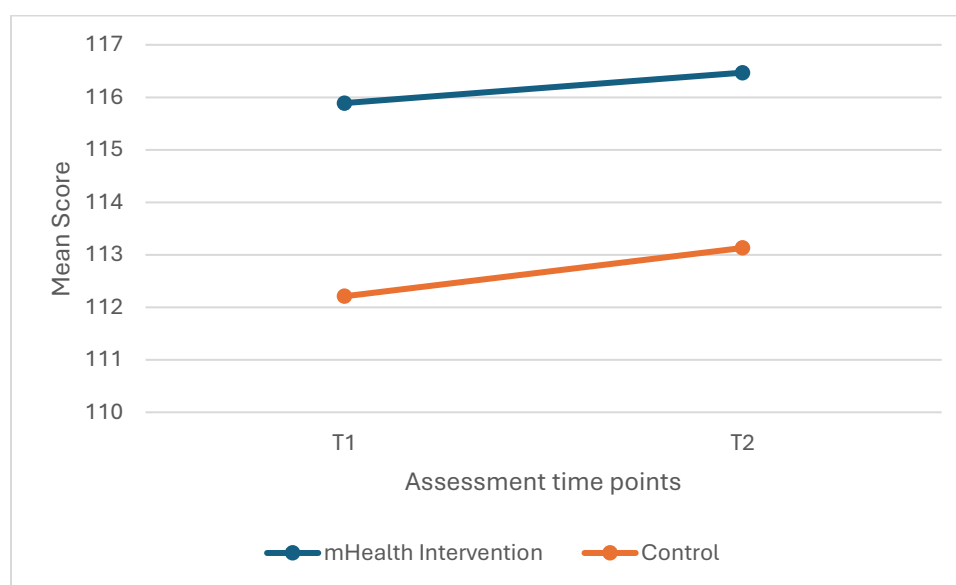


Figure 7.7 Profile plot of fathers' perceived breastfeeding support provided to mothers over the study period

7.5.2 Satisfaction with mobile health interventions amongst mother–father dyads

This study evaluated satisfaction with the mHealth programme amongst mothers and fathers in the intervention group (Table 7.22). The mean score for overall satisfaction with the mHealth

intervention amongst mothers was 3.53 (0.24), indicating greater satisfaction with the intervention.

The mean (SD) programme satisfaction ranged from 3.36 (0.57) to 3.63 (0.47) amongst mothers.

This study also assessed fathers' satisfaction with mHealth interventions. The overall mean (SD) score for fathers was 3.38 (0.24), ranging from 3.24 (0.59) to 3.47 (0.50), indicating greater satisfaction with the intervention.

Table 7.22 Satisfaction with the mobile health intervention programme amongst mother–father dyads

	Items	Mothers (N = 94)		Fathers (N = 100)	
		Mean	SD	Mean	SD
1.	The frequency of the message	3.56	0.50	3.39	0.49
2.	The time of the messaging service	3.48	0.50	3.33	0.47
3.	The duration of the messaging programme	3.53	0.50	3.35	0.48
4.	The content of the SMS programme	3.53	0.50	3.45	0.50
5.	The teaching methods of the programme	3.58	0.49	3.47	0.50
6.	The knowledge provided as being personally what you needed	3.63	0.47	3.41	0.49
7.	Your participation in the programme	3.36	0.57	3.24	0.59
8.	Overall, your general feeling about the programme was	3.54	0.50	3.39	0.51

7.6 Chapter summary

In this study, 236 first-time mother–father dyads were recruited to investigate the effectiveness of an mHealth intervention in improving the uptake of PNC services, EBF practices and related outcomes. The study’s results showed that mobile intervention improved the uptake of PNC services, knowledge of ODSs, EBF practices, BSE and breastfeeding support behaviours, with small to medium effect sizes. Satisfaction with the mobile intervention programme was rated as good amongst the mothers and fathers in the intervention group.

CHAPTER EIGHT: DISCUSSION

8.1 Introduction

In this chapter, key findings concerning the effectiveness of mHealth interventions in enhancing the uptake of PNC services, improving knowledge of ODSs, and promoting EBF practices and breastfeeding support behaviours amongst first-time parents are briefly discussed. The findings are compared with those of the previous relevant literature and guidelines. Moreover, the study's key strengths, limitations and implications for research, policy and practice are thoroughly discussed.

This chapter is divided into six sections. Section 8.1 introduces the chapter. Sections 8.2 and 8.3 discuss the results of the primary and secondary outcomes, including PNC uptake, knowledge of ODSs, EBF practices, BSE and breastfeeding support behaviours. In section 8.4, the implications of the current study for policy, research and practice are presented. Section 8.5 presents the strengths and limitations of the study. Section 8.6 summarises the chapter.

8.2 Primary outcome

8.2.1 Postnatal care uptake

This study's main objective was to investigate the effectiveness of a mobile-based educational message intervention in enhancing the uptake of PNC services amongst first-time mothers. The WHO recommends that women receive the first PNC service immediately after birth if childbirth occurs in a health facility or within 24 hours of birth if the child is born at home (WHO, 2015). The second PNC service should be given between 48 and 72 hours after birth, whereas the third PNC service should be provided between 7 and 14 days after birth. The fourth and final PNC service must be provided at 42 days after birth (McCauley et al., 2022; WHO, 2015). This study

revealed that nearly all intervention participants (94.5%) and control participants (93.1%) received their first postnatal checkup (PNC) within 24 hours of childbirth. Amongst the participants, 6 (5.5%) in the intervention group and 7 (6.9%) in the control group failed to receive their first postnatal service on the first day. The higher utilisation of PNC is similar to that reported in a study conducted in Malawi, in which approximately 85% of women accessed PNC services (Sagawa et al., 2021), and a systematic review of PNC services in 36 SSA countries (Tessema et al., 2020). Another study in Malawi revealed that the level of PNC uptake within 48 hours of birth was 90%, which is consistent with the present findings (Nyondo-Mipando et al., 2023). However, the proportion of PNC utilisation in the current study is greater than that in previous studies in Ethiopia. For example, according to the 2019 MDHS, the proportion of PNC utilisation within two days of childbirth is 34%, which can increase to 48% in the urban population and 29% in rural areas (The DHS Program & ICF, 2019). The difference could be attributed to the time variation of more than five years; the national data included all the peripheral regions where the level of health service utilisation is relatively lower, unlike the current study, which recruited participants from health facilities who were on follow-up for ANC services and were at least able to read and write. These factors may have contributed to a higher rate of childbirth in health facilities and the receipt of the first PNC service. Furthermore, the current finding could be lower than evidence in higher-income countries, as nearly all women and their infants in developed countries receive postpartum PNC (Tefera et al., 2021).

Concerning the effect of the intervention on the utilisation of each PNC service amongst the intervention and control groups, no significant difference was observed in the uptake of the first PNC service, which is typically received within 24 hours after birth. The proportion of women who used the first PNC service was slightly greater amongst those who received the mHealth

intervention. However, it did not result in a significant difference from those who received only routine care. This result is consistent with a study conducted in Kenya, which revealed no significant difference in postpartum care-seeking behaviours for newborn assessment between the intervention and control groups (Jones et al., 2020). The absence of difference between the intervention and control groups regarding the first PNC utilisation may be attributed to the current increasing trend of institutional childbirth, which facilitates the provision of the first PNC service even amongst the control groups (Olajubu et al., 2020). Similarly, greater utilisation of the first PNC was reported in a study conducted in Nigeria, which aimed to assess the role of mHealth interventions in PNC utilisation. According to this study, a greater proportion of intervention participants utilised the first PNC service than did the control group (Olajubu et al., 2020).

The second postnatal visit should occur within two to three days after childbirth. In this study, the odds of the use of a second PNC service were greater in the intervention group than in the control group, although the difference was not statistically significant. This finding differs from that of a study in Nigeria in which mothers who received mobile education exhibited significantly greater utilisation of second PNC visits than did those who received only routine care (Olajubu et al., 2020). This difference could be attributed to the sociocultural difference between the two populations in terms of their attitudes towards visiting health institutions immediately after childbirth. Mothers may tend to stay home unless they are feeling sick, and this attitude may vary across different settings.

With respect to the third PNC uptake, a significant difference was observed between the intervention and control group in utilising this point of PNC contact (OR = 2.175, 95% CI: 1.091–4.337; $p = 0.027$). Accordingly, the odds of uptake of the third PNC, typically received between

the 7th and 14th days, were two times greater in the intervention group than in the control group in this study. This finding is consistent with a study conducted in Nigeria and Addis Ababa, which reported that higher odds of PNC service utilisation were observed amongst the intervention group (Adanikin et al., 2014; Kebede et al., 2019). The improvement to this visit suggests that culturally tailored educational messages can increase people's awareness and practice of visiting health facilities to receive services. One systematic review and one RCT-based study, which both assessed the effect of mHealth interventions, revealed comparable findings with earlier literature in which the intervention group exhibited higher odds of PNC uptake compared with their counterparts (Gayesa et al., 2023; Olajubu et al., 2020). The uptake of PNC in the 6th week was also greater in the intervention group than in the control group but did not significantly differ from that in the control group. This can be further improved by connecting the service provision to lower-level health facilities such as health centres and integrating it with child immunisation schedules, which usually commence from the 6th week after childbirth.

In general, although the participants' overall uptake of PNC services decreased from the first visit to the fourth visit, those who received the mHealth intervention exhibited greater utilisation of PNC than those who received only usual care. Thus, the mHealth intervention has helped sustain PNC uptake compared with usual care but has not significantly changed some PNC visits. This finding implies that further modification of the intervention by triangulating mobile educational interventions with home visits or expanding service provision in community settings may be necessary. Overall, the results of this study showed that the impact of the mHealth intervention on each postnatal visit helps policymakers and stakeholders determine which time points need improvement via additional interventions. A key point in PNC visits is that each postnatal visit has implications for reducing different complications. For example, studies have shown that most

postpartum maternal deaths due to haemorrhage, embolism and eclampsia occur in the first week of childbirth and that maternal deaths due to infection occur after one week to six weeks postpartum (Dol et al., 2022). In addition, most neonatal deaths occur in the first week after birth (WHO, 2024d). This finding suggests that each PNC visit has the potential to prevent different forms of maternal and neonatal complications during the postpartum period, which has strong implications for the overall improvement of the health of mothers and newborns.

8.3 Secondary outcomes

8.3.1 Knowledge of obstetric danger signs

The mobile intervention in this study profoundly enhanced the knowledge of ODS amongst first-time mothers. Compared with the baseline knowledge of ODSs, the intervention group demonstrated greater overall knowledge of ODS, and danger signs related to pregnancy, childbirth and the postpartum period. First-time parents are typically unfamiliar with the physiology of pregnancy and childbirth, as well as the warning signs that should be proactively observed during these times. However, if they are given information about typical pregnancy signs and symptoms and the abnormal signs and symptoms that they must monitor during this period, their knowledge and seeking treatment for danger signs could increase.

In this study, the intervention group was provided with a message of key ODSs that can occur during pregnancy, childbirth and postpartum, which can indicate the likelihood of severe maternal complications. The participants from this group were also instructed to visit health institutions if they faced these signs. Accordingly, the women in the intervention group demonstrated significantly greater overall knowledge of ODSs and knowledge of each component of pregnancy, childbirth and the postpartum period than their counterparts did. Studies have shown that providing

health care information that is particularly tailored can enhance knowledge, which then improves the health literacy of the group (Caeiros et al., 2024). The study further noted that effective communication is key in increasing health literacy by empowering people and communities to access, understand and make educated decisions about their health (Caeiros et al., 2024). The findings of the present study are consistent with those of other studies conducted in Tanzania, which revealed that mHealth messages have improved women's knowledge of ODS (Masoi & Kibusi, 2019). A study carried out in Uganda to improve maternal and child health care knowledge has shown that mobile application-based health interventions have enhanced maternal health knowledge, despite not reaching statistical significance (Musiimenta et al., 2022). In the same way, an Iranian-based study revealed the promising and positive effect of mHealth interventions on increasing knowledge related to pregnancy-related complications (Eskandari et al., 2019). Our findings are consistent with those of another study that revealed that reminder calls and paper checklists of symptoms significantly improve the knowledge of danger signs that can occur postpartum, regardless of their educational status and parity (Butt et al., 2014). mHealth educational intervention coupled with social support was also found to improve the women's knowledge of ODSs in the Indian study (El Ayadi et al., 2025). This evidence implies the crucial role of social support in increasing the effectiveness of mHealth.

In general, whilst knowledge alone may be insufficient for behavioural change, it is regarded as a crucial component and precursor to attitude change and behavioural modifications (Arlinghaus & Johnston, 2018). This scenario suggests that those with knowledge are more likely to change their behaviour. Thus, in this study, the health information delivered over the phone could improve the health literacy regarding PNC services and lead to behavioural changes.

8.3.2 Exclusive breastfeeding practices

Globally, approximately 48% of women were feeding their babies exclusively breastmilk in 2023 (UNICEF, 2023a), and the target is to reach 70% by 2030 (UNICEF, 2021). The EBF rate in Ethiopia is 59% (The DHS Program & ICF, 2019). In comparison to this data, the EBF rate in Ethiopia was higher than the global average. Nevertheless, given the cost-effectiveness and its wide range of benefits, extra effort is still needed to increase the EBF rate and reach the global target. The present study examined the effectiveness of an mHealth intervention programme in enhancing EBF practices. Accordingly, the levels of EBF were assessed at six weeks, three months and six months. At these intervals, the rate of EBF declined over time in the intervention and control groups. In the intervention group, the EBF rate was 88.5% at six weeks, 70.2% at 3 months and 31.0% at 6 months. In the control group, the EBF rate was 83.3% at six weeks, 55.3% at 3 months and 19.8% at 6 months. Nonetheless, EBF practices were more frequent in the intervention group than in the control group at all time points.

In this study, both intervention and control groups recorded a higher proportion of EBF rates at six weeks postpartum. In addition, no significant difference was observed at this time point. This result could be attributed to the closeness of the measurement time point to birth, when mothers are usually expected to feed only breast milk, irrespective of their treatment groups. In line with our study, no significant effect of mHealth intervention was seen for the EBF rate at 1 month after childbirth (Adam et al., 2021; Nabulsi et al., 2019). Additionally, a Nigerian study, which employed a combination of group counselling and dramas, besides mHealth intervention, couldn't result in a significant difference between the intervention and control group at early postpartum (1 month) (Flax et al., 2014). A good explanation is that parents naturally understand that they should

start feeding their baby with the mother's breast milk unless the mother encounters difficulties with breastfeeding because of challenges in milk flow, particularly amongst new mothers.

Despite a nonsignificant difference in EBF practices at the 6th week, the mHealth intervention significantly outperformed routine care at three months in this study, demonstrating the intervention's effectiveness over time. At three months, participants in the intervention group who received educational messages and routine care had nearly two times greater odds of practising EBF than did those in the control group, and this difference was statistically significant. The significant effect in this study is consistent with a systematic review and meta-analysis conducted to evaluate the impact of mHealth, in which mHealth interventions improved the odds of EBF rates at two months and three months after childbirth (Qian et al., 2021). In addition, various other studies revealed that the odds of EBF practice at 3-4 months were higher amongst recipients of educational messages compared with those assigned to routine care (Gebremariam et al., 2023; Unger et al., 2018).

The participants in the control group who did not exclusively breastfeed their infants provided complementary feeding (20.2%), followed by plain water only (13.8%) in addition to breastfeeding at three months of age. Conversely, in the intervention group, those who did not practice EBF offered their babies complementary feeding (16.0%), followed by plain water only (7.4%), in addition to breastfeeding. This finding shows that parents still tend to give their children water or additional food, often assuming that their babies may feel thirsty and that breast milk is insufficient. Moreover, parents are sometimes tempted to introduce additional food to babies to help them adapt to feeding and stimulate their appetite later in infancy.

At six months, the EBF rate in both the intervention and control groups decreased compared with the previous measurements at six weeks and 3 months. However, the EBF rate in the intervention group remained higher than that in the control group, although the difference did not reach statistical significance. In contrast to the present study, other literature showed the positive effect of mHealth in increasing EBF practice. For example, a Chinese study investigating the effects of smartphone-based interventions, which include parenting classes and counselling, indicated improved EBF practices at one month and six months postpartum, besides increasing maternal breastfeeding knowledge (Huang et al., 2024). Other studies done in China and Nigeria showed a significant overall effect of mHealth on the EBF rate at six months (Flax et al., 2014; Qian et al., 2021). The dissimilarity of the effectiveness of mHealth at six months with previous studies may be due to increased infant feeding cues with respect to the child's age, family influence and parents' sensitivity to the advice of their social circle in Ethiopia. These factors might have collectively influenced the non-adherence to the EBF recommendations until the 6th month among first-time parents.

Generally, the mobile-assisted breastfeeding educational message has shown a significant positive effect in increasing the rate of EBF among first-time parents. Nonetheless, there were still a notable number of parents in the intervention group who introduced complementary feeding before six months of age. Therefore, further strengthening the intervention by incorporating peer support with regular reflection on their experiences amongst women and working on their challenges may improve the maintenance of EBF until the 6th month.

8.3.3 Breastfeeding self-efficacy

Another outcome assessed in this study was the BSE of the mothers. BSE refers to a woman's confidence and belief in her ability to breastfeed effectively. This confidence is often associated with breastfeeding initiation, duration and exclusivity (McGovern et al., 2024). In the present study, BSE gradually improved in the intervention and control groups from baseline to postintervention over the study period. At baseline, the mean BSE scores did not significantly differ between the intervention and control groups (49.46 ± 10.87 vs 50.08 ± 10.40), respectively. This figure is consistent with a study conducted amongst Iranian mothers, which reported a mean (SD) score of 50.8 ± 8.91 (Amini et al., 2019), $(51.72 (\pm 7.69))$ amongst Canadian mothers (Dennis et al., 2011) and (55.37 ± 12.84) amongst Turkish mothers (Ozdemir et al., 2022). The baseline BSE score is usually expected to be low due to insufficient knowledge and experience, especially amongst new parents.

In the present study, the intervention and control groups showed significant differences in BSE over time, with the mHealth intervention outperforming usual care, with small to medium effect sizes at 6 and 12 weeks postpartum. The intervention programme contains messages that help the participants enhance their confidence and increase breastfeeding efficacy. BSE also increased amongst the control group, perhaps due to performance accomplishments (Kramuschke et al., 2025). However, the change in BSE was significantly greater in the intervention group than in the control group, indicating that the mobile intervention significantly outperformed routine care in increasing mothers' BSE. Moreover, the intervention produced a significant change in the 6th week, with a medium effect size ($MD = 2.14$, $d = 0.52$, $p < 0.001$) and a small effect size in the 12th week ($MD = 1.98$, $d = 0.35$, $p = 0.016$). Our findings are consistent with those of a study conducted by Tseng et al., despite a lower mean difference, which revealed that a breastfeeding education

intervention improved BSE amongst first-time mothers, with mean differences of 7.9 and 8.1 at months 1 and 3 postpartum, respectively (Tseng et al., 2020). Additionally, a scoping review of related literature found that phone-based breastfeeding education enhanced BSE and EBF practices (Putri & Anggraeni, 2023). Comparable findings were reported in the RCT-based Iranian study (Seddighi et al., 2022). Consistency of our findings with those of previous literature indicates that tailor-made provisions of mobile-based interventions can enhance mothers' BSE in various settings (Ghafourian Abadi et al., 2024; Tseng et al., 2020). Interventions based on social media, such as WhatsApp combined with face-to-face delivery, were utilised by other studies and found the improvement in BSE and breastfeeding knowledge amongst mothers (Mohamad Pilus et al., 2022). On the other hand, smartphone-assisted intervention couldn't bring a significant difference in increasing BSE, according to a study conducted in the USA (de Mello Sa et al., 2025). This scenario suggests that using smartphones and social media to increase BSE produced mixed effects compared with direct short message services. The difference in SMS and app-based effects could be attributed to participants' need for extra motivation and internet connections to open smartphone applications and utilise resources, in contrast to mobile direct messages.

In general, this study indicates that targeted breastfeeding education can improve mothers' understanding of and confidence in adhering to recommended practices and promoting EBF. Consequently, healthcare planners might consider increasing mothers' confidence to enhance recommended breastfeeding practices.

8.3.4 Receiving support for exclusive breastfeeding

The perception of receiving EBF support among mothers was also examined in this study. Mothers in the intervention group have perceived receiving higher overall EBF support from their partners

compared with those who received routine care only. The overall support for EBF includes instrumental, emotional and informational support. Since fathers were also the beneficiaries of the intervention programme in terms of guidance and support provision on PNC utilisation and EBF, the mHealth intervention might have helped the mothers to receive greater support from their spouses. This positive effect implies that the mHealth educational intervention strengthened partner support by providing information, practical assistance and emotional support. This finding is consistent with those of previous studies. For example, evidence from an integrative review has shown that partners' responsive support behaviours, which include respecting women's decisions and sensitivity to women's needs, have improved breastfeeding outcomes (Davidson & Ollerton, 2020). Moreover, mothers also value their partners' encouragement and understanding to continue with the breastfeeding practice (Nickerson et al., 2012). Another RCT-based study in Canada revealed that mothers who received educational intervention along with their husbands via telephone calls and watched videos reported receiving significantly greater support from their husbands at six weeks postpartum than did the control group (Abbass-Dick et al., 2015). These results are consistent with earlier study findings, which demonstrated that interventions focusing on couples are more likely to improve the women's perception of receiving breastfeeding support and EBF practices than interventions solely focused on women.

Furthermore, a study assessing mothers' views on the breastfeeding support received from their partners following a mobile app-based intervention revealed that most of them believed the programme was beneficial to their partners, and they reported receiving adequate breastfeeding assistance from their partners (White et al., 2023). In addition, couple-based mobile app educational programmes have successfully increased parental self-efficacy, social support and parenting satisfaction (Shorey et al., 2017). A telephone-based peer support in an Australian study

showed that women perceived a high level of satisfaction and support from their peers, which suggests women may also consider receiving support from their social circle in addition to support from their partners (McLardie-Hore et al., 2020).

Amongst the EBF support components, mothers in the intervention group reported receiving significantly more instrumental support than did those in the control group at six and twelve weeks postpartum. This support includes physical assistance in household chores, laundry, meal preparation and other activities typically performed by mothers. Although no significant difference was observed, parents who received mobile educational messages reported better emotional and informational support. These breastfeeding support components have the potential to increase women's commitment to EBF practices (Fadjriah et al., 2021).

In general, the present study indicated that mobile-based educational interventions amongst new first-time parents enhanced mothers' perceptions of receiving EBF support from their husbands. This support includes instrumental, emotional and informational assistance. Therefore, fathers must be involved in efforts to increase EBF in low-income nations, including Ethiopia, where breast milk is the only cost-effective and essential intervention in preventing child complications associated with mixed feeding or non-exclusivity in the first six months.

8.3.5 Providing support for breastfeeding

Fathers in the intervention group have provided significantly higher overall breastfeeding support at six weeks and three months compared with those fathers in the control group in the present study. Given that the mobile educational intervention has incorporated the benefits of EBF for newborns and recommends that fathers provide support to mothers during breastfeeding, it may have improved the provision of perceived support for breastfeeding amongst fathers. According to

an Indonesian study, EBF was greater amongst fathers who provided breastfeeding support to their partners. The study further showed that fathers were more supportive when they were provided with breastfeeding information and their expected role (Izzatul Arifah & Dina Rahayuning P., 2014). Our findings are also consistent with a quasi-experimental study carried out in China that examined the role of fathers in breastfeeding success (Su & Ouyang, 2016). According to this literature, partners in the intervention group helped their partners by caring for the baby, cleaning and offering emotional support, as evidenced by a higher EBF rate amongst the intervention group than amongst the control group (Su & Ouyang, 2016). This effectiveness showed that involving fathers in breastfeeding education might increase the rate of EBF and that the duration of breastfeeding could be extended.

A qualitative study conducted in Australia also found that fathers were eager to obtain breastfeeding information and motivated to learn about the support they could offer to their partners during lactation and the postpartum period so that breastfeeding difficulties could be effectively managed (Tohotoa et al., 2009). According to another study done in the USA, fathers' awareness of their expected participation in breastfeeding is also very important. In line with the support components evaluated in this study, fathers described their role in breastfeeding as offering various breastfeeding activities, including assisting mothers, feeding the infant expressed breastmilk, helping the mother breastfeed at night, and seeking information on breastfeeding (Rios et al., 2025).

Moreover, in this study, the mHealth intervention specifically improved fathers' support in the breastfeeding savvy and breastfeeding helping domains. Support related to breastfeeding savvy refers to fathers' readiness to learn and share breastfeeding information with their partners such as

discussing on how long to breastfeed and suggesting solution for any breastfeeding related challenges (Lynn A. Rempel et al., 2017). In addition, it includes fathers' roles in helping their partners with household tasks and caring for the baby during and after breastfeeding. In this study, the perception of mothers receiving support and fathers' perception of providing support on breastfeeding were consistent, demonstrating the effectiveness of the intervention.

8.3.6 Maternal and newborn complications

Besides the primary and secondary outcomes, maternal and neonatal death and stillbirth were also assessed during the study period. There were three stillbirths in the control group, one maternal death and one stillbirth in the intervention group. The incidence of maternal and newborn mortality did not differ significantly between the intervention and control groups. The absence of a significant difference may be due to the nature of pregnancy, as every pregnancy is not without risk and the requirement of a large sample size to obtain generalisable findings for this outcome. The multifaceted determinants of maternal or neonatal death (Tesfay, Legesse, et al., 2022) attributed to institutional factors such as delay in receiving care, health facility readiness in managing emergency complications in addition to individual-level factors could also buffer the effect of mHealth interventions mortality related outcomes. Although the direct effects of mHealth interventions on maternal and neonatal mortality have been poorly explored in previous studies, some studies have shown that mHealth interventions do not significantly improve perinatal mortality, suggesting further exploration (Lund et al., 2016; Lund et al., 2014). Furthermore, an extensive cohort study in Guatemala revealed that telehealth significantly improved maternal and child health, as assessed after two years of follow-up, suggesting that the impact of telehealth on these outcomes may be unnoticeable within a short period (Martinez-Fernandez et al., 2015). Therefore, further exploration of the impact of mobile-based educational interventions is

recommended by employing a large cohort of mothers followed for a longer follow-up period to ascertain the impact on reducing maternal and neonatal mortality.

8.4 Implications of the study

8.4.1 Implications for research

This study revealed that phone-based, theoretically guided educational interventions for first-time parents can increase health service utilisation amongst mothers for care during childbirth and postpartum and may contribute to the reduction in maternal and neonatal complications that can occur during this period. The higher level of satisfaction with the intervention indicates that these programmes are well received and can be extended to other subgroups of parents to address other postpartum healthcare challenges of women and children, such as postpartum family planning, immunisations and infant and young child complementary feeding. Whilst the sample size in this study may be inadequate to determine the direct impact of mHealth educational interventions on maternal and neonatal mortality, future researchers can use these findings as a basis to examine the direct effects with a larger sample size and extended follow-up. A study has indicated that employing a large sample size with longer follow-up is required to get a significant impact on these outcomes using mHealth interventions (Martinez-Fernandez et al., 2015).

The present study has included multiple health facilities to increase the generalizability of the findings. Future researchers are recommended to consider the inclusion of more health institutions with a cluster-randomised trial to reduce contamination of information during intervention delivery and enhance representativeness. Moreover, participants who cannot read and write the target language should be considered by addressing them via phone counselling or interactive voice messages. With the growing number of mobile phone users, future researchers can incorporate

video-based educational messages and use of mobile health applications. Moreover, web-based data collection techniques can be considered by future researchers as a means to save time and resources on the basis of their applicability to the target population.

The conceptual framework and developed intervention messages in the current study may guide future researchers in their efforts to study mobile-based investigations of maternal and child health. Future researchers can also integrate other postpartum components, such as postpartum family planning and child immunisations, into interventions to increase the health of mothers and newborns. In this study, three scales (BSES-SF, EBFSS and PBIS) were validated for the first time in the local language of Ethiopia. These validated instruments could assist researchers and practitioners in further studies and in clinical practice.

8.4.2 Implications for policy and practice

In this study, mHealth interventions were found to significantly improve the mothers' understanding of ODSs, which is often experienced during pregnancy, childbirth and the postpartum period. This could help the parents to seek appropriate and timely management if any of the danger signs occur. Parents may get health information from various sources, such as social or mainstream media. However, navigating and implementing bulky information from these sources can be challenging. Therefore, theory-based, partner-supported, educational messages from pregnancy through the postpartum period can increase parents' knowledge, self-efficacy and motivation to use PNC services. Furthermore, such intervention has the potential to enhance parental communication and engagement in practising EBF recommendations. Therefore, these findings have important implications for clinical practitioners and policymakers who want to

formulate customised educational messages to increase parents' use of healthcare services for the overall health of the family.

The findings of the present study can also be integrated into routine PNC services, provided that healthcare facilities establish technology-based health information with trained experts to ensure sustainability. Integrating mHealth into the existing health services may speed up the communication between healthcare personnel and parents for timely management of maternal or newborn complications that arise during the perinatal period. These results could also provide input for the national healthcare system to plan for integrating mHealth technologies and the human resources required for implementation in health facilities. In addition, the findings of this study can serve as a key input for relevant stakeholders such as Ministry of Health and other non-governmental organisations working to enhance PNC uptake and EBF practices by establishing policies and standards for mHealth-assisted services.

8.5 Strengths and Limitations of the Study

8.5.1 Strength of the study

This study has some strengths. The present study has used four hospitals for participant enrolment. The multicentre nature of this study could enhance its representativeness. In addition, a large sample size involving first-time parents was employed, which could improve the validity of the results. The study also utilised a validated outcome measurement tools in Ethiopia, which was implemented in the target language for the first time. All the validated instruments demonstrated excellent reliability and validity. Furthermore, the development of the intervention was on the basis of a systematic review and meta-analysis of evidence regarding the effectiveness of mHealth interventions in resource-limited settings, which was gradually used for RCT studies. Besides, a

conceptual framework adapted from two behavioural theories (HBM and SCT) was used in this study to guide intervention development. The intervention has also focused on fathers to reinforce the support mothers needed, which previous studies largely ignored. The intervention timing was also tailored according to the mother's GA during pregnancy and the child's age after childbirth, which allowed parents to receive appropriate interventions at the appropriate time. Moreover, the study objectives were achieved with employed study design signifying the original contribution of the study to the body of knowledge on the value of mobile-based healthcare interventions among child-bearing couples in low-income settings.

8.5.2 Limitations of the study

Despite commencing the intervention delivery during pregnancy, most outcomes, such as PNC, EBF and support behaviours, were assessed after childbirth; therefore, no baseline measurement was considered, although knowledge related to ODSs, BSE and sociodemographic characteristics was assessed. Nonetheless, the differences in outcomes across groups and time and the interaction of group and time were evaluated after childbirth. Although various strategies were employed, including informing the intervention participants and starting the intervention weeks after baseline collection to minimise information contamination, it was unlikely to be completely avoided. Thus, implementing a cluster randomised trial in future studies could prevent information contamination between the intervention and control groups. The educational intervention was also considered successful, as nearly 90% of parents in the intervention group received all the messages. However, a loss to follow-up in the study occurred during subsequent assessments because participants' engagement in their daily activities may have affected their willingness and availability to respond. In addition, social desirability bias might not be ruled out, although participants were informed that they would respond to the questionnaire as best as possible.

The present study generally targeted literate participants who could at least read and write the target language and own a mobile phone. This situation may limit the generalizability of the findings to all parents. Thus, future studies should consider including those unable to read and write and design appropriate mHealth interventions, such as phone calls or interactive voice responses (IVRs), along with other strategies to involve them. The satisfaction of parents with the intervention programme was assessed quantitatively, but the qualitative aspect of the participants' responses, particularly from the intervention group, was not evaluated because of limited resources and is recommended for consideration by future researchers. Additionally, the convenience sampling used for scale validation may limit generalisation.

8.6 Chapter summary

The current study investigated the effectiveness of mHealth interventions in improving PNC service uptake, EBF practices and related outcomes. Accordingly, the study revealed that mHealth interventions were effective, producing positive effects and implying successful delivery and benefits. Additionally, the findings were mostly comparable with those of previous studies and supported the hypothesis of the present study. Additionally, the strengths and limitations of this study are briefly described for readers' consideration.

CHAPTER NINE: CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

This PhD project has evaluated the effectiveness of a mobile-based educational message intervention in improving the uptake of PNC services, the practice of EBF and related outcomes amongst new parents. The current study involved 236 first-time parents assigned to a mobile message intervention and routine care, who were recruited during late second trimester and early third trimester of pregnancy at four public hospitals. Tailor-made educational messages developed via the HBM and SCT were delivered to first-time parents in the intervention group. Prior to the development of the intervention, a systematic review and meta-analysis were conducted on the effects of mHealth on institutional childbirth and PNC service utilisation, which guided the development of the intervention used in this study. The scales used to measure the effectiveness of the intervention related to breastfeeding were then adapted to the target language before testing the effectiveness of the mHealth intervention.

The mobile-based educational message intervention improved the primary and secondary outcomes with small to medium effect sizes. The intervention produced significant differences in the third PNC visit, overall knowledge of ODSs and each component of danger signs, EBF practice at three months, improvement in BSE over time and breastfeeding support behaviours. Although not statistically significant, the intervention still improved the outcomes at the remaining assessment time points, highlighting the benefits of mobile technology for health promotion during the critical periods of pregnancy, childbirth and the postpartum period. The present study provides empirical evidence that mHealth interventions improved postnatal service utilisation and EBF

practices amongst first-time parents. The findings of the present study are therefore key to improving maternal and child health amongst first-time parents in Ethiopia.

9.2 Recommendations

The health system may integrate mHealth messages from pregnancy to postpartum via SMS or application-based systems, which can assist parents with key information to enhance health service uptake and promote EBF practices. Short message services are considered a cost-effective way of delivering information and can reach a broader population, which makes it ideal for delivering healthcare and related information. The current study has focused on short educational message intervention, which has good implications for low-income countries where rural communities face challenges in accessing nearby healthcare facilities and delays in obtaining healthcare. Therefore, stakeholders should work on translation of this evidence to clinical practice with collaboration of researchers, healthcare leaders and professional associations. working on maternal and child health may consider mHealth technologies as a means of reaching the target population to provide health promotion and disease prevention measures.

The findings of the present study can also serve as baseline evidence to enhance healthcare service provision through modern communication technologies, extending beyond health promotion and disease prevention; they can also provide baseline evidence for telemedicine-based treatment modalities.

Although mHealth interventions improved major outcomes assessed in this study, the factors contributing to low PNC, EBF and related outcomes in Ethiopia are multifaceted and may still require interventions at various levels. This approach may include strengthening and establishing healthcare service delivery points at the community level and creating strong referral links to

nearby equipped health facilities. In addition, whilst the findings of the present study revealed greater PNC utilisation immediately after birth, subsequent visits gradually decreased. This decline implies that stakeholders are required to make extra efforts to strengthen the existing health extension programme by providing home visits and care to mothers who cannot adhere to the recommended PNC visits and build strong links with nearby hospitals. In addition, cost-effective analysis of mHealth interventions is recommended to assist implementation of the intervention in clinical and public health practice.

APPENDICES

Appendix I

Ethical approval letter



To	Ngai Fei Wan (School of Nursing)		
From	Pang Marco Yiu Chung, Chair, PolyU Institutional Review Board		
Email	marco.pang@	Date	07-Nov-2023

Application for Ethical Review for Teaching/Research Involving Human Subjects

I write to inform you that approval has been given to your application for human subjects ethics review of the following project for a period from 01-Oct-2023 to 01-Aug-2025:

Project title:	The effectiveness of phone-based educational message intervention targeting women and their husbands on improving postnatal care services uptake in Western Ethiopia: a randomized controlled trial
Department:	School of Nursing
Principal Investigator:	Ngai Fei Wan
Project Start Date:	01-Oct-2023
Project type:	Human subjects (clinical)
Review type:	Expedited Review
Reference Number:	HSEARS20230828006

You will be held responsible for the ethical approval granted for the project and the ethical conduct of the personnel involved in the project. In case the Co-PI, if any, has also obtained ethical approval for the project, the Co-PI will also assume the responsibility in respect of the ethical approval (in relation to the areas of expertise of respective Co-PI in accordance with the stipulations given by the approving authority).

You are responsible for informing the PolyU Institutional Review Board in advance of any changes in the proposal or procedures which may affect the validity of this ethical approval.

Pang Marco Yiu Chung
Chair
PolyU Institutional Review Board

Appendix II

Wollega University Institute of Health Sciences Support Letter

ወላጌ ዩኒቨርሲቲ
Wollega University
የጤና ሳይንስ ኢንስቲትዩት ምርምር፣ ቴክኖሎጂ ሽግግር እና ድህረ ምረቃ ተባባሪ ዲን
Institute of Health Sciences Research, Postgraduate and Technology Transfer Associate Dean

Lakk: HISRP/TAO/10/01/2016
Guyyaa: 48/5/2016

Hospitaala Riferaalaa Yun/ Wallaggaaf
Hospitaala Ispeshaalayizdii Naqamteef
Hospitaala Arjoof
Hospitaala Sibuu Sireef
Bul/Mag/Naqamtee Ganda 03f
Bul/Mag/Naqamtee Ganda 07f

Y/W

Dhimmi isaa:- Deeggarsa gaafachuu ta'a.

Akkuma armaan olitti ibsamuuf yaalametti, Yuunivarsiitiin keenya Qorannoo fi tajaajila hawwaasaa kallattii garaagaraan kennaa jiraachuun isaa ni beekama. Haaluma kanaan, mata-duree qorannoo *"The effectiveness of phone-based educational message interventions targeting women and their husbands on improving postnatal care services uptake in Western Ethiopia: a randomized controlled trial"* jedhu hojjetaan inistiitiyuutii keenyaa B/saa Rattaa Tsaggaayee Gayeessaa qorannoo digrii 3ffaa isaaniif, haadholii fi abbootii irratti dhimma hordoffii dahumsa boodaa fi harma hoosisuu irratti hospitaalotaa fi gandoota filataman irratti ni hojjetu. Qorannoon isaanii koree dhimma naamuusaa qorannoo nama irratti adeemsifamu irraa eeyyama kan argatan (Ref. No: HSEARS20230828006) yoo ta'u, qorannoo kana akka hojjetaniif gama keessaniin deeggarsa barbaachisaa ta'e akka gootaniif kabajaan isin gaafanna.

Nagaa Wajjin




Bizuneh Wakuma Efa (Ass't Professor)
ኮሚቴ ምረቃ እና ምርምር (ሪፕረፕረንቲቲቭ)
የጤና ሳይንስ ኢንስቲትዩት ምርምር
ክሊኒክ ሽግግር እና ድህረ ምረቃ
ምረቃ ትምህርት አስተባባሪ
Institute of Health Sciences, Research
Coordinator & Post Graduate
Study Coordinator

P.O.Box- 395 Nekemte
Tel.No. 057 861 9026
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ፖ.ሣ.ቁ 395 ነቂምቲ
ስልክ 057 861 9026
ፋክስ 057 661 7980
E-mail: WU@

Appendix III

Intervention Messages - English version

	Messages during pregnancy	Theoretical constructs addressed	Preferred time of message delivery	Remarks
1.	Be aware of danger signs! Severe abdominal cramps, bleeding, sudden and severe swelling of hands, feet, and face with malaise, headaches, or blurred vision during pregnancy are danger signs. Come to the hospital if any of these happen.	Perceived threat (severity + susceptibility)	31 weeks	ODS
2.	Tell your family to be aware of any danger signs. If you experience reduced fetal movement, water breaks without labor, or high fever, you should go to a clinic immediately.	Perceived threat (severity + susceptibility) + family support	31 weeks	ODS
3.	Having a skilled birth attendant present during childbirth is crucial. They possess the necessary skills and expertise to deliver the placenta and control severe postpartum bleeding. Planning to deliver at a health facility is critical to ensure you receive this vital care.	Perceived benefits	32 weeks	PNC
4.	Remember that postnatal visits are as crucial as antenatal care follow-up. They allow your baby's health and development and ensure that it grows and develops normally	Perceived benefits	32 weeks	PNC
5.	To prevent complications following delivery due to bleeding and infections and receive family planning services, attending post-natal care visits according to schedule is very important.	Perceived threat	33 weeks	PNC
6.	During a later stage of pregnancy, you may feel heaviness, frequent urination, interrupted sleep, swollen legs, and tiredness, which is normal. You must stay strong and positive.	Perceived threat	33 weeks	ODS
7.	Plan to breastfeed as soon as possible after giving birth to help establish a good milk supply. It is a great way to provide nutrition and faster recovery of your abdomen	Breastfeeding Self-efficacy	34 weeks	BF
8.	Post-natal appointments allow you to visit a healthcare provider who will examine your physical and emotional well-being, assess your baby's health, and monitor your recovery. They also provide essential advice on breastfeeding and infant care	Perceived benefits	34 weeks	PNC

9.	Whether you will have a natural delivery or a surgical delivery, give your infant a colostrum as soon as possible. Keep relaxed; you'll make more milk.	Perceived benefits	35 weeks	BF
10.	The support of your husband during pregnancy or after birth is essential. Plan and discuss in advance so that you receive support for your post-natal care visits.	BF Self-efficacy	35 weeks	BF
11.	Mixed feeding increases the risk of allergies and digestive problems, whereas exclusive breastfeeding helps to protect your baby from these issues. Plan to breastfeed exclusively for the first 6 months	Perceived threat + Perceived benefits	36 weeks	BF
12.	When labor starts, please come to the hospital immediately. Signs of labor include painful, regular contractions, a break in the water, and the presence of a show. You will receive the first PNC during birth	Perceived benefits	36 weeks	PNC
Messages after childbirth				
13.	Congratulations on the birth of your baby. You might experience a week or so of intense bleeding followed by up to six weeks of light bleeding. Rest as much as possible and follow up with your subsequent postnatal appointments.	Perceived benefits	1 st week	PNC
14.	Bring your baby to the breast, not breast to the baby. A good position and attachment are essential for good milk flow. Remember to attend your postnatal care after 3 days of childbirth	Self-efficacy on BF + perceived benefits	1 st week	BF +PNC
15.	If you get increased or foul-smelling bleeding, headache, blurry vision, or fever, come to the hospital as soon as possible. Remember to attend your postnatal care at 14 th days of childbirth	Perceived threat (severity +susceptibility)	2 nd week	ODS
16.	When breastfeeding, please put as much nipple in the baby's mouth as possible. Point the nipple towards the back of the baby's palate. You will see the baby's jaw move as it sucks	Self-efficacy on BF + perceived benefits	2 nd week	BF
17.	Postnatal care visits can help you monitor your and your baby's health. Attend all appointments even if you are feeling healthy.	Perceived benefits	3 rd week	PNC
18.	If your baby pees 6-8 times a day, it indicates that he is getting enough breast milk. If not, breastfeed it frequently. It is recommended to breastfeed a baby 8-12 times a day	Perceived threat Perceived benefits	3 rd week	BF

19.	Look for signs of danger in your baby. If breathing and feeding difficulties, reduced activity, fever, or pale or yellow skin, go to the clinic immediately.	Perceived threat (severity +susceptibility)	4 th week	ODS
20.	Your husband can be a great source of emotional and physical support during this time. Don't hesitate to ask for help and tell him to accompany you for postnatal visits	Social support	4 th week	Husband Support
21.	Infants should only be given breast milk during the first six months of life to lessen the danger of infections and other health issues.	Perceived benefits Perceived threats	5 th week	BF
22.	Missing postpartum checkups could make you miss the investigation and treatment of postpartum health issues. Come for your last visit in 6 th week, and don't allow postpartum complications to put your health at risk	Perceived threat (severity +susceptibility)	5 th week	PNC
23.	Remember that breastfeeding requires collaboration. Never be afraid to seek assistance from your partner, family, or healthcare provider	Social support	6 th week	BF husband Support
24.	Providing your newborn with any additional food or liquids is unnecessary before 6 months; breast milk is sufficient. When provided in addition to breast milk, the supply of breast milk will be diminished	Perceived threat (severity +susceptibility)	6 th week	BF

BF: Breastfeeding; ODS: obstetric danger signs; PNC: Postnatal care

Appendix IV

Intervention Messages- Afaan Oromo version

	Ergaa gabaabaa yeroo ulfaa ergamu (Haadha manaa fi abbaa manaaf kan ergamu)	Yeroo ergaan gabaabaa kun itti ergamu	Xiyyeeffannoo ergaa gabaabaa
1.	Mallattoolee balaafamoo yeroo ulfaa qalbeeffadhaa! Garaa dhukkubbii cimaa, dhaqna gubaa fi bishaan gubbee dhangala'uu fi sochiin daa'ima hir'isuu yoo si mudate hatattaamaan mana yaalaa deemaa	Torban 31ffaa	Beekumsa mallattoolee balaafamoo
2.	Mallattoolee balaafamoo yeroo ulfaa maatiikeetti himi. Mallattooleen akka dhiiguu, fi garmalee dhiita'uu harkaa ykn miilaa fi fuulaa, mataa bowwuu fi ija dura maruu yoo isin mudate mana yaalaa hatattamaan deemaa	Torban 31ffaa	Beekumsa mallattoolee balaafamoo
3.	Ogeessonni fayyaa yeroo da'umsaa fi isa booda haadhaa fi mucaa hordofuu fi rakkoo yoo jiraate ammo dafanii to'achuuf ogummaa waan qabaniif buufata fayyaatti ogeessa yaalaatiin dahuun akkaan barbaachisaadha	Torban 32ffaa	Fayyadama hordoffii dahumsa boodaa
4.	Hordoffiin dahumsa boodaa akkuma hordoffii yeroo ulfaa baay'ee murteessaadha. Fayyaa fi guddina daa'ima keessanii qixa sirriin hordofuuf carraa guddaa isinii kenna	Torban 32ffaa	Fayyadama hordoffii dahumsa boodaa
5.	Beellama daumsa boodaa sirriitti hordofuun haadholeen rakkoo fayyaa da'umsa booda mudatan irraa akka eegamanii fi tajaajila qusannaa maatii yeerodhaan akka argatan waan isaan gargaaruuf haalaan barbaachisaadha	Torban 33ffaa	Mallattoolee balaafamoo fi hordoffii dahumsa boodaa
6.	Yeroo ulfaatti wantootni akka aaruu, ofitti ulfaachuu, amma amma finceessisuu, hirriba keessaa dammaquu, milli dhiitahuu fi dadhabuun waanuma jiru. Kanaaf of jajjabeessuu qabda	Torban 33ffaa	Mallattoolee balaafamoo
7.	Daa'imni dhalatee yeroo sa'aatii 1 hin caalle keessatti harma hoosisuu jalqabsiisi. Kunis guddina daa'imaaf nyaata barbaachisaa ta'e akka argatuu fi gadameessi haadhaas dafee akka iddootti deebi'uuf gargaara	Torban 34ffaa	Harma haadhaa qofa hoosisuu
8.	Yeroo beellama dahumsa boodaa deemu, talaalliin daa'imakeef ni kennama. Akkasumas qorannoon fayyaa fi gorsi barbaachisaan harma hoosisuu fi kunuunsaa daa'ima irratti siif kennama	Torban 34ffaa	Hordoffii dahumsa boodaa
9.	Da'umsa karaa uumamaanis ta'e karaa baqaqsanii hodhuun (oppereeshiniin) yoo deesse, daa'imaaf aannan jalqabaa (silga) kennuun fayyaa daa'imaaf barbaachisaadha. Akkasumas, silga hoosisuun aannan harmaa itti fufinsaan akka bahuuf gargaara	Torban 35ffaa	Harma haadhaa qofa hoosisuu
10.	Beellama yeroo ulfaas ta'e kan da'umsa boodaa sirriitti hordofuuf gargaarsi abbaa manaakee murteessaa waan	Torban 35ffaa	Gargaarsa abbaa manaa

	ta'eef dursitanii waliin mari'achuun gargaarsa gahaa akka argattuuf si fayyada		
11.	Aannan harma haadhaa fi nyaata dabalataa wal keessa nyachisuun rakkoo bullaa'insa nyaataa fi alerjiif saaxiluu danda'a. Daa'ima kee rakkoowwan kana irraa eeguuf Ji'oota jahan jalqabaaf harma kee qofa hoosisi	Torban 36ffaa	Harma haadhaa qofa hoosisuu
12.	Yeroo miixuun eegalu dhaabbata fayyaa deemuu qabda. Mallattooleen miixuu; dhukkubbii dhufee badu, bishaan gubbee dhangala'uu fi dhangala'aan walharkisu bahuu fa'i. Hordoffiin dahumsa boodaa jalqabaas siif ni kennama	Torban 36ffaa	Mallattoolee balaafamoo fi hordoffii dahumsa boodaa
	Da'umsa booda (after childbirth)		
13.	Mucaa kee бага nagaan deesse! Da'umsa booda torban tokkoof dhiigni hamma marsaa laguu ta'u yaa'uu ni danda'a; dhiigni salphaan haga torban jahaatti ni jiraata. Beellama kee da'umsa boodaa sirnaan hordofi	Torban 1ffaa	Mallattoolee balaafamoo
14.	Harma gara daa'imaatti otoo hin taane daa'ima gara harma keetti fiduun hoosisi. Harma yeroo hoosiftu isa tokko keessaa hanga fixutti isa biraatti hin dabarsiin. Beellama da'umsa boodaa kan guyyaa 3ffaa irratti argamuus hin dagatiin	Torban 1ffaa	Harma hoosisuu fi hordoffii dahumsa boodaa
15.	Karaa gadameessaa dhiigni bahu dabaluu fi foolii qabaachuu, mataa bowwuu cimaa, ija dura maruu ykn dhaqna gubaan yoo si mudate hatattamaan mana yaalaa deemaa. Beellama da'umsa booda kan guyyaa 14ffaatti godhamu irratti argamaa.	Torban 2ffaa	Mallattoolee balaafamoo
16.	Yeroo harma hoosiftu hanga danda'ametti fiixee harmaa sirriitti afaan daa'imaa keessa kaa'uun hoosisi. Yeroo mucaan hodhu mangaagaan isaa akka socho'u qalbeeffadhu	Torban 2ffaa	Harma hoosisuu
17.	Beellamni da'umsa boodaa fayyaa kee fi kan daa'imakee hordofuuf barbaachisaadha. Fayyaa guutuun yoo sitti dhagahamellee, beellama keessan hanga dhumaatti hordofaa	Torban 3ffaa	Hordoffii dahumsa boodaa
18.	Daa'imni kee guyyaatti yeroo 6-8 kan fincaa'u yoo ta'e aannan gahaa argachaa jiraachuu agarsiisa. Yoo kana hin ta'iin, yeroo baay'ee hoosisi. Sa'aa 24 keessatti si'a 8-12 hoosisuun barbaachisaadha	Torban 3ffaa	Harma hoosisuu
19.	Mallattoolee balaafamoo daa'imman irratti mul'achuu danda'an hubadhu. Yoo rakkoon hargansuu, harma hodhuu diduu, ofdadhahuu, dhaqna gubaa, gogaan bifa keelloo fakkaachuu fi garaa kaasaan jiraate mana yaalaatti geessaa	Torban 4ffaa	Mallattoolee balaafamoo kan daa'ima
20.	Dahumsa booda abbaan manaakee madda gargaarsa miiraa fi qaamaa sii ta'uu danda'a. Gargaarsa gaafachuu	Torban 4ffaa	Gargaarsa abbaa manaa

	irraa duubatti hin jedhiin, hordoffii dahumsa boodaaf akka si waliin deemus itti himi.		
21.	Aannan harma haadhaa daa'ima ni jabeessa. Carraa dhukkubaan qabamuus ni hir'isa. Ji'oota ja'an jalqabaa keessatti aannan harmaa malee waan biraa hin kenniiniif	Torban 5ffaa	Harma haadhaa qofa hoosisuu
22.	Hordoffii da'umsa boodaa irraa hafuun sakatta'insi fi yaaliin isinii godhamu akka harkifatu waan taasisuuf beellama keessan eeguudhaan hordofaa	Torban 5ffaa	Hordoffii dahumsa boodaa
23.	Harma hoosisuun gargaarsa akka barbaadu yaadadhu. Abbaa manaakee irraa ykn maatii kee ykn ogeessa fayyaa irraa gargaarsa gaafachuu gonkumaa hin sodaatiin	Torban 6ffaa	Harma hoosisuu fi gargaarsa abbaa manaa
24.	Daa'imnikee ji'a 6 otoo hin guutiin nyaata ykn dhangala'aa dabalataa hin kenniin; aannan harmaa qofti gahaadha. Yoo hin ta'iin aannan harmaa daa'imaaf bahu akka xiqqaatu godha.	Torban 6ffaa	Harma haadhaa qofaa hoosisuu

Appendix V

Expert feedback request form for intervention validation

Feedback from the expert committee

Dear experts,

You are invited to serve as a member of an expert panel to provide your expert judgment on the content of the intervention SMS messages aimed at improving postnatal service uptake, exclusive breastfeeding, and knowledge of obstetric danger signs. The purpose of this work is to validate the relevance of these messages in improving postnatal care service utilisation, promoting exclusive breastfeeding, and enhancing knowledge of obstetric danger signs among first-time mothers and their partners before applying them to our study. The main aim of the intervention is to deliver tailor-made information and recommendations on the benefits of Postnatal care utilisation, exclusive breastfeeding, and the dangers of obstetric complications. This protocol contains 24 messages to be delivered during late pregnancy and after childbirth. We require your expert judgment on the degree of relevance each message holds in achieving the stated aim. We request your feedback on whether the content of this protocol aligns with the best available evidence, is **appropriate**, and is culturally acceptable before we proceed with its use. Please feel free to modify or replace any messages or provide feedback using the 'track changes' feature.

Please take your time to carefully evaluate and comment on whether it is appropriate to use the protocol as is, with modifications, or not. You may encircle (bold) what you feel applies in the table below. Furthermore, please suggest any changes if you think they are needed. Thank you!

Sample Messages for expert validation

List of messages (Sample format)	Timeliness of message delivery	The target area of the message	Relevance of the messages			
			Not relevant	Somewhat relevant	Quite relevant	Highly relevant
Messages during pregnancy						
M1	31 st week		1	2	3	4
M2	31 st week		1	2	3	4
M3	32 nd week		1	2	3	4

M4...	32 nd week		1	2	3	4
...M12	36 th week		1	2	3	4
Messages after childbirth						
M13	1 st week		1	2	3	4
M14	1 st week		1	2	3	4
M15	2 nd week		1	2	3	4
M16	2 nd week		1	2	3	4
...M24	6 th week		1	2	3	4

M: Messages; BF: Breastfeeding; ODS: Obstetric Danger signs; PNC: Postnatal care

Feedback _____

Appendix VI

Sample Logbook to mark receiving intervention messages- given to dyads

Please indicate whether you have received each message by placing “✓” in the box when a message is received. The form will be returned to the data collector.

Weeks	Received	Not received
Message 1		
Message 2		
Message 3		
Message 4		
Message 5		
Message 6		
Message 7...		
Message 24		

Appendix VII

Subject Information Sheet-English Version

Title of the study: The effectiveness of phone-based educational message interventions targeting women and their husbands on improving postnatal care services uptake in Western Ethiopia: a randomized controlled trial.

Dear Sir/Madam, You are cordially invited to take part in the research study mentioned above, which is being carried out by Mr. Reta Tsegaye Gayesa under the guidance of Dr. Vivian NGAI and Dr. Grace XIE, faculty members at the School of Nursing of The Hong Kong Polytechnic University. The project has been approved by the PolyU Institutional Review Board (PolyU IRB) (or its Delegate) (Reference Number: HSEARS20230828006); Pregnant women and their partners are eligible for the study if the dyads who are aged above 18 years and own a cell phone, and can read Afaan Oromo language, and gestational age of a woman is between 24-30 weeks with primiparous singleton pregnancy.

Aim of the study: This study aims to assess the effectiveness of a phone-based educational messages intervention targeting both mothers and husbands in improving the uptake of postnatal care services and other outcomes, such as knowledge of obstetric danger signs and exclusive breastfeeding practices.

Overview of the procedure: we will group participants into two groups by random allocation. These groups are intervention and control groups. If you are assigned to the intervention group, you will receive short educational SMS messages on postnatal care services, maternal obstetric danger signs during childbirth, and postpartum and exclusive breastfeeding recommendations twice a week for 12 weeks... If you are assigned to the control group, you will continue to receive the usual care at this hospital.

Expectations from participants: If you are assigned to the intervention group, you are required to receive and use the messages. If you are assigned to the control group, you will continue to receive the usual services from this health institution as usual. Data related to postnatal care uptake, knowledge of obstetric danger signs, and exclusive breastfeeding will be collected at baseline, immediately after the end of the SMS intervention, and six weeks after completion of the SMS

intervention. Data related to the frequency of PNC visits may be additionally collected from your medical records. At one time point, the collection of data may take 40 minutes.

Benefits and risks: You will be provided airtime vouchers worth 50 Ethiopian Birr to acknowledge your participation and completion of the study. The study will not cause any harm because of your participation.

Confidentiality of your information: The information you provide as part of the project is the research data. Any research data from which you can be identified is known as personal data. Personal data does not include data where the identity has been removed (anonymous data). We will minimize our use of personal data in the study as much as possible. The researcher and his team, and supervisor will have access to personal data and research data for the purposes of the study. Responsible members of The Hong Kong Polytechnic University may be given access for monitoring and/or audit of the research.

All information related to you will remain confidential and will be identifiable by codes only known to the researchers. The information collected will be kept for 5 years after project completion or publication. The overall duration of the project is 1 year. The results will be reported in aggregate format in publication. The Hong Kong Polytechnic University takes reasonable precautions to prevent the loss, misappropriation, unauthorized access or destruction of the information you provide.

Participants' rights: You have full right to withdraw from the study at any time without any penalty

If you have any questions, you may ask our helpers now or later, even after the study has started.

You may contact Mr. Reta Tsegaye Gayesa (Tel: +2519/ email:) or Dr. Vivian Ngai (Tel:) of PolyU under the following situations:

- a. if you have any other questions in relation to the study.
- b. if, under very rare conditions, you become injured because of your participation in the study; or

c. If you want to get access to/or change your personal data before (the expiry date).

In the event you have any complaints about the conduct of this research study, you may contact the Secretary of PolyU Institutional Review Board in writing (institutional.review.board@polyu.edu.hk) stating clearly the responsible person and department of this study as well as the Reference Number.

In case of a serious adverse event (SAE)¹, please report to the Principal Investigator/Chief investigator immediately and the Principal Investigator/Chief Investigator will be required to report it to the PolyU IRB within 48 hours upon the receipt of your report.

Thank you for your interest in participating in this study.

Dr. Vivian NGAI

The Hong Kong Polytechnic University, School of Nursing

Principal investigator

Dr. Grace Xie

The Hong Kong Polytechnic University, School of Nursing

Co-investigator

¹ 1SAE any adverse event that:

- Results in death
- Is life threatening, or places the participant at immediate risk of death from the event as it occurred
- Requires or prolongs hospitalization
- Causes persistent or significant disability or incapacity
- Results in congenital anomalies or birth defects
- Is another condition which investigators judge to represent significant hazards (Reference: NIA Adverse Event and Serious Adverse Event Guidelines. <https://www.nia.nih.gov/sites/default/files/2018-09/nia-ae-and-sae-guidelines-2018.pdf>)

Appendix VIII

Consent form for participation in the study -English version

I, _____, hereby consent to participate in the captioned research titled ‘The effectiveness of phone-based educational message interventions targeting women and their husbands on improving postnatal care services uptake in Western Ethiopia: a randomized controlled trial’ supervised by Dr. Vivian NGAI and Dr. Grace XIE and conducted by Reta Tsegaye Gayesa.

I understand that information obtained from this research may be used in future research and published. However, my right to privacy will be retained, i.e., my personal details will not be revealed. The procedure, as set out in the attached information sheet, has been fully explained. I understand the benefits and risks involved. My participation in the project is voluntary. I acknowledge that I have the right to question any part of the procedure and can withdraw at any time without penalty of any kind.

I am aware that information collected from this study might be published and used in future studies. Since, my privacy will be respected, details of my personal information will not be revealed. The information document that is included contains a detailed explanation of the method. I am aware of both the potential advantages and risks. I voluntarily agreed to take part in the project. I recognize that I have the right to inquire any part of the process and may withdraw at any time without incurring any penalties

Name of the participant: _____

Signature of the participant: _____ date _____

Name of researcher: _____

Signature of the researcher: _____ Date _____

Appendix IX

English Version questionnaire for RCT study- to be collected from women

Section 1. Interview questionnaire for Postnatal care service utilisation

Instruction: Please respond to the following questions related to your postnatal appointments

	Items	1. Yes	2. No	Remarks
1.	Did you give birth to your baby in a health facility?			
2.	Did you receive the PNC within 24 hours of your stay during birth?			
3.	Did you receive the PNC between 24 hours and 48 hours?			
4.	Did you go to the hospital for a PNC appointment within 48 to 72 hours after giving birth?			
5.	Did you go to the hospital for a PNC appointment between 7 and 14 days after giving birth?			
6.	Did you go to the hospital for a PNC appointment service at 6 weeks after giving birth?			

Section 2. PNC checklist (For extraction of data from patient card) (To be collected by data assessor)

Name of a patient _____	Patient card No _____
Date of delivery _____	Date of discharge _____
Newborn: alive _____ Stillbirth _____	

PNC service components		Over 24 hrs	24-48 hrs	48-72 hrs	7-14 days	42 days	Remark
1.	Mother assessment (vital signs, vaginal discharge (after 4 weeks), uterus contracted, etc.)						
2.	Newborn assessment (breathing, BF, Weight, immunization, etc.)						
3.	Counselling services (BF, ODS, etc.)						
4.	Actions taken						

Section 3. Knowledge of obstetric danger signs

Instruction: Please respond to the following questions appropriately

S.no	Questions	Responses	Remark
101	Are there any danger signs that can occur during pregnancy?	1. Yes 2. No 3. I don't know	
102	If you answer 'yes to Q101', what are these danger signs? (first, do not mention the options to identify whether they list spontaneously or not) more than one answer is possible)	1. Vaginal bleeding 2. Severe headache 3. Blurred vision 4. Convulsions 5. Swollen hands/face 6. High fever 7. Loss of consciousness 8. Difficulty breathing 9. Severe weakness 10. Severe abdominal pain	

		11. Accelerated/reduced foetal movement 12. Water breaks without labor 13. 13. Other (Specify)-----	
103	Are there any danger signs that can occur during labor or childbirth?	1. Yes 2. No 3. I don't know	
104	If 'yes' to Q103, what are these danger signs? (first, do not mention the options to identify whether they list spontaneously or not) more than one answer is possible)	1. Severe vaginal bleeding 2. Severe headache 3. Convulsions 4. High fever 5. Loss of consciousness 6. Labor lasting > 12 hours 7. Placenta not delivered 30 minutes after delivery 8. Other (Specify)	
105	Are there any signs of danger that can occur during the postpartum period?	1. Yes 2. No 3. I don't know	
106	If 'yes,' to Q105, what are the danger signs that can occur during the postpartum period? (first, do not mention the options to identify whether they list spontaneously or not) more than one answer is possible)	1. Severe vaginal bleeding 2. Severe headache 3. Blurred vision 4. Convulsions 5. Swollen hands/face 6. High fever 7. Loss of consciousness 8. Difficulty breathing 9. Severe weakness 10. Malodorous vaginal discharge 11. Others (specify)_____	

Section 3. The breastfeeding self-efficacy scale short form

Instruction: Please describe your level of confidence in carrying out the following tasks related to the breastfeeding activities

1= Not at all confident, 2= not confident, 3=somewhat confident, 4=confident, 5=always confident

	Questions	1	2	3	4	5
1.	I can always determine that my baby is getting enough milk	1	2	3	4	5
2.	I can always successfully cope with breastfeeding as I have with other challenging tasks	1	2	3	4	5
3.	I can always breastfeed my baby without using formula as a supplement	1	2	3	4	5
4.	I can always ensure that my baby is properly latched on for the whole feeding	1	2	3	4	5
5.	I can always manage the breastfeeding situation to my satisfaction	1	2	3	4	5
6.	I can always manage to breastfeed even if my baby is crying	1	2	3	4	5
7.	I can always keep wanting to breastfeed	1	2	3	4	5
8.	I can always comfortably breastfeed with my family members present	1	2	3	4	5
9.	I can always be satisfied with my breastfeeding experience	1	2	3	4	5
10	I can always deal with the fact that breastfeeding can be time-consuming	1	2	3	4	5
11	I can always finish feeding my baby on one breast before switching to the other breast	1	2	3	4	5
12	I can always continue to breastfeed my baby for every feeding	1	2	3	4	5
13	I can always manage to keep up with my baby's breastfeeding demands	1	2	3	4	5
14	I can always tell when my baby is finished Breastfeeding	1	2	3	4	5
Exclusive breastfeeding practice						
1	What is the current breastfeeding status of your child? (e.g Inquire what the baby has been feeding on since yesterday)	1. Not breast-feeding at all 2. Exclusively breast-feeding 3. Breastfeeding and consuming plain water only 4. Breast-feeding and consuming nonmilk liquids 5. Breast-feeding and consuming other milk				

		6. Breast-feeding and consuming complementary Foods
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Section 4. Please describe the amount of help you received from your husband in each of the following areas during the past month

	Items	No help at all or much less than you would like (1)	Less than you would like (2)	As much as you would like (3)
Instrumental support on EBF				
1.	Did tasks I would normally do so that I could exclusively breastfeed	1	2	3
2.	Prepared meals	1	2	3
3.	Did laundry	1	2	3
Emotional support on EBF				
4.	Approved of me exclusively breastfeeding my baby	1	2	3
5.	Told me I was doing well caring for my baby	1	2	3
6.	Made me feel confident even when I made mistakes	1	2	3
7.	Listened to me talk about the new baby	1	2	3
8.	Believed that I am a good mother	1	2	3
9.	Showed concern about my own physical condition and health	1	2	3
10	Showed concern when I felt sad or depressed	1	2	3
11	Praised me for my efforts to exclusively breastfeed	1	2	3
Informational support on EBF		1	2	3
12	Answered my questions about breastfeeding	1	2	3
13	Gave me advice and suggestions about how to exclusively breastfeed	1	2	3
14	Told me where I could get help if I had questions about breastfeeding or caring for my baby	1	2	3
15	Showed me how to breastfeed	1	2	3
16	Taught me how to take care of myself	1	2	3

Section 5: Mobile-based SMS Program Satisfaction Questionnaire (Collected from dyads)

Instructions: The following questions pertain to the mobile SMS educational program provided during antenatal, labour, and postnatal care. Please rate each of the described aspects of the program on a scale of 1 to 4, indicating how satisfied you were with each one.

1 = not at all satisfied

2 = not satisfied

3 = satisfied

4 = very satisfied

1. The dates of the messaging service	1	2	3	4
2. The time of the messaging service	1	2	3	4
3. The duration of the messaging program	1	2	3	4
4. The content of the SMS program	1	2	3	4
5. The educational methods of the program (e.g., by SMS message)	1	2	3	4
6. The knowledge provided as being personally what I needed	1	2	3	4
7. Your participation in the program	1	2	3	4
8. Overall, my general feeling for the program was	1	2	3	4

Appendix X

A breastfeeding support questionnaire collected from Husbands-English version

Section 1. Sociodemographic characteristics of a husband Instruction: Please respond appropriately to the following questions		
Age of husband in years		_____ years
1.	Religion	1. Protestant Christian 2. Orthodox Christian 3. Muslim 4. Catholic
2.	Ethnicity	1. Oromo 2. Amhara 3. Tigre 4. Others
3.	Your educational status	1. Unable to read and write 2. Read and write 3. Primary (Grade 1-8) 4. Secondary (grade 9-12) 5. College and above
4.	Your occupation	1. Farmer 2. Government employee 3. Private employee 4. Merchant 5. Others...(please specify)
5	What is your monthly income in Ethiopian Birr	1. <=1,300 2. 1,301-2,200 3. 2,201-3,600 4. 3,601-6,500 5. >=6,500

Section 2. Partner Breastfeeding Influence Scale (PBIS) (To be collected from husbands)-English version

Instruction: Please indicate how often you apply the following statements

1= Not at all; 2= rarely; 3= Sometimes; 4= often; 5= very often

Breastfeeding Savvy	1	2	3	4	5
----------------------------	---	---	---	---	---

1.	Discuss with your partner about how long to continue breastfeeding	1	2	3	4	5
2.	Discuss with your partner about how ideas for trying to solve breastfeeding problems or different ways to make breastfeeding to work better	1	2	3	4	5
3.	Tell your partner your opinion about how long you think that she should breastfeed	1	2	3	4	5
4.	Speak up in support of your partner or defend breastfeeding when someone makes a negative breastfeeding comment	1	2	3	4	5
5.	Help your partner get assistance from others for solving breastfeeding problems or improving breastfeeding	1	2	3	4	5
6.	Remind your partner of the benefits that the breastfeeding has for her or for your baby	1	2	3	4	5
7.	Show patience and willingness to wait for your opportunity to feed your baby	1	2	3	4	5
8.	Support your partner's attendance at a breastfeeding support group.	1	2	3	4	5
Helping		1	2	3	4	5
9.	Help out with or take care of other childcare tasks with the baby	1	2	3	4	5
10.	Give something up in order to make breastfeeding easier	1	2	3	4	5
11.	Help out with other household tasks and responsibilities to free up your partner's time and energy	1	2	3	4	5
12.	Help with breastfeeding at night	1	2	3	4	5
13.	Care for your baby during and after breastfeeding is done	1	2	3	4	5
14.	Try to improve your partner's health and nutrition	1	2	3	4	5
15.	Give your partner a break from a baby	1	2	3	4	5
Appreciation		1	2	3	4	5
16.	Encourage your partner to do her best when it comes to breastfeeding and let her know she is not less of a mother if she feels like quitting	1	2	3	4	5
17.	Praise your partner for breastfeeding and let her know that what she is doing is a beautiful, worthwhile thing	1	2	3	4	5
18.	Let your partner know that breastfeeding is natural and/or give her a message that she is breastfeeding because she wants the best for her baby	1	2	3	4	5
19.	Listen to and encourage your partner when she is feeling frustrated or discouraged about breastfeeding	1	2	3	4	5
20.	Show appreciation that your partner is breastfeeding	1	2	3	4	5
21.	Tell your partner that you value and support her mothering decisions and intuitions around breastfeeding	1	2	3	4	5
Breastfeeding presence		1	2	3	4	5

22.	Try to improve the breastfeeding experience by getting equipment or supplies ready for breastfeeding	1	2	3	4	5
23.	Act attentively toward your partner during breastfeeding	1	2	3	4	5
24.	Quietly share time and watch or hold your partner during breastfeeding	1	2	3	4	5
25.	Physically help with breastfeeding-related activities	1	2	3	4	5
26.	Help create a quiet, pleasant environment for breastfeeding	1	2	3	4	5
Responsiveness		1	2	3	4	5
27.	Show pleasure and satisfaction while your partner is breastfeeding	1	2	3	4	5
28.	Respond sensitively and positively to sexual issues	1	2	3	4	5
29.	Be patient and understanding of the time it takes to breastfeed and don't get upset if the other housework is not done	1	2	3	4	5
30.	Show your comfort with breastfeeding in public and help her feel comfortable too	1	2	3	4	5
31.	Pay attention to how much and how your partner wants to participate in breastfeeding	1	2	3	4	5

Section 3. Questionnaires collected from husbands on Maternal Mortality and Neonatal Mortality

Instruction: Please indicate the time of death of the mother or newborn for the death associated with pregnancy, childbirth, or postpartum (if death is reported in either of the periods)

Questions	Pregnancy	Childbirth	Postpartum (Within six weeks)
Time of death of the mother	Yes No	Yes No	Yes No
Time of death of the baby	Yes No	Yes No	Yes No

Appendix XI

Information Sheet for RCT Study- Afaan Oromo Version

Yuunivarsiitii Pooliiteekinikii Hoong Koongitti Mana Barnootaa Narsiingii

Unka Odeeffannoo

Mata duree: Bu'a qabeessummaa ergaa barnootaa bilbilaan dubartootaa fi abbootii warraa isaanii irratti xiyyeeffate fudhatama tajaajila kunuunsa dahumsa boodaa fooyyessuu irratti Lixa Itoophiyaa keessatti gaggeeffamu:

Qorannoo duraa. Kabajamoo, Isin qorannoo armaan olitti caqasame irratti akka hirmaattaniif kabajaan affeeramtaniittu. Qorannoon kunis kan adeemsifamu obbo Rattaa Tsaggaayee Gayeessaa (barataa digirii 3ffaa) fi to'annaa Dr. Viiviyaan Nagaayi, Dr. Grees Shaayi kanneen hojjetoota Yuunivarsiitii Pooliiteekinikii Hoong Koong dhaani. Qorannichi koree dhimma naamuusaa qorannoo nama irratti adeemsifamu kan Yuunivarsiitii Pooliiteekinikii Hoong Koong'tti argamu irraa eeyyama qorannaa kan argateedha (Lakkoofsa xalayaa ittiin eeyyamame: HSEARS20230828006)

Kaayyoo qorannichaa: Kaayyoon qorannoo kanaas bu'a qabeessummaa ergaa barnootaa karaa bilbilaan haadholii fi abbaa warraa irratti xiyyeeffatee taasifamuu fi fudhatama tajaajila kunuunsa dahumsa boodaa fooyyessuu fi bu'aawwan biroo Kan akka beekumsa mallattoolee balaa dahumsaa fi gochaalee harma haadhaa qofa hoosisuu madaaluuf Kan yaadamedha.

Haala adeemsa qorannichaa: Namoota fedhiidhaan qorannoo kana irratti hirmaachuuf filataman kun garee lamatti carraadhaan ni hiramtu. Garee yaalii akka duraatti itti fufan Yaalii duraan isinii kennamaa ture otoo addaan hin kutiin itti fuftu. Barumsi addaa isiniif dabalataan kennamu hin jiru. Yoo garee yaalii keessatti ramadamtan, barumsii karaa bilbilaatiin deeggarama ergaa gabaabaan torbanitti si'a lama torban kudha lamaaf isinii ni ergama. Ergaan gabaabaan kun waa'ee bu'aa fi barbaachisummaa tajaajila da'umsa boodaa, mallattoolee balaa da'umsaa fi bu'aalee harma haadhaa qofa hoosisuu irratti kan xiyyeeffatedha.

Hirmaattota irraa kan eeggamu: Yoo garee yaalii keessatti ramadamtan, ergaa gabaabaan karaa mobaayila keessanii isiniif ni ergama. Bu'aa barumsaa fi gargaarsa kanaa beekuuf yeroo ji'a sagal keessatti si'a sadii (ergaa gabaabaa dura, akkuma ergaawwan gabaabaa sinii ergamu xumurameenii fi torban jahaffaa xumura ergaawwan gabaabaa tti odeeffannoowwan tajaajila

dahumsa boodaa, harma haadhaa qofa hoosisuu fi beekumsa mallattoolee balaa dahumsaa waliin walqabatan ni gaafatamtu. Ragaan nuuf laattan kun yaali keessa keessatti akka odeeffannoo yaalii keessanii irra ooluuf ni gargaara. Hojiiwwan kana xumuruuf gara giddu-galeessaan daqiiqaa 40 fudhaachuu danda'a. Gaaffilee gaafatamtan kana keessatti kan isinitti hin tolle hin jiran jennee yaadna.

Bu'aa hirmaachuu

Qorannicha keessatti hirmaachuu keessaniif beekamtii kennuuf kaardiin yeroo qilleensaa Birrii Itiyoophiyaa 50 haga dhumaatti qorannoo kana yoo xumurtan siniif ni kennama. Miidhaan biraa isin irra gahu hin jiru.

Icciiitii eeguu

Odeeffannoon isin irraa argannu icciitiin eegama, koodiin gaggeessaan qorannichaa qofti beekuu isiniif ni laatama. Odeeffannoon nuuf laattan wagga shaniif ni tura. Argannoon qorannoo kanaas maxxanfamuu ni mala. Odeeffannoon kun akka hin badneef, dogoggoraan akka hin hiikamneef, qaamni isa ilaallatu akka hin arganneef, akkasumas akka hin dhabamsiifamneef Yuunivarsiitiin Pooliiteekinikii Hoong Koong of eegannoo barbaachisaa ni godha.

Mirga qorannoo addaan kutuu

Yoo hirmaannaa keessan addaan kutuu barbaaddan, adabbii tokko malee yeroo barbaaddanitti addaan kutuu ni dandeessu.

Gaaffii fi yaada

Gaaffii yoo qabaattan dursaa qorannoo kanaa kan ta'an obbo Rattaa Tsaggaayee Gayeessaa lakkoofsa bilbilaa +2519 / i-meelii yookiin Dr. Viiviyaan Nagaayi (Lakkoofsa Bilbilaa: gaafachuu ni dandeessu.

- a) Gaaffii qorannoon wal qabatan biroo yoo qabaattan
- b) Hirmaannaa qorannoo kanaan kan walqabate miidhamni yoo isin mudate
- c) Osoo guyyaan odeeffannoosaa hin darbin odeeffannoo waa'ee dhuunfaa keessanii argachuu ykn jijjiiruu yoo barbaaddan

Qorannoo kanaan wal-qabatee komii kamiyyuu yoo qabaattan, koree naamuusaa qorannoo nama irratti raawwatuuf kan Yuunivarsiitii Pooliiteekinikii Hoong Koongitiif (garagalcha

biiroo qorannoo yuunivarsiitichaaf) gochuudhaan waan komii uume kana sirriitti caqasuun eenyu akka itti gaafatamuu fi muummee qorannaa kana geggeessu akkasumas lakkoofsa xalayaa ittiin eeyyamame caqasuun eeruu ni dandeessu.

Yoo taatee hamaan isin mudate², maaloo hatattamaan dursaa qorannichaatti gabaasaa. Dursaan qorannichaas gabaasni isa qaqqabee sa'aa 48 heessatti, koree dhimma naamusaa yuunivarsiitii Hoonk Koongitti gabaasuu qaba.

Fedhii horattanii qorannoo kanarratti sababa hirmaattaniif guddaa galatoomaa!

Dr. Viiviyaan Nagaayi
Yuunivarsiitii Hoong Koong, Mana barnootaa Nursiingii
Dursaa qorannoo

Dr. Grees Shaayi
Yuunivarsiitii Hoong Koong, Mana barnootaa Nursiingii
Itti-aanaa dursaa qorannoo

² Taatee hamaa yeroo jedhamu:

Balaa du'aaf nama geessisuu danda'u

Lubbuu namaa balaaf kan saaxilu

Hir'ina qaamaaf kan nama saaxiluu danda'u

Bu'aan isaa mudaa dhalootaaf kan saaxilu

Haala biraa qorattoonni balaa guddaa ta;uu murteessan fa'i. (Wabii: NIA Adverse Event and Serious Adverse Event Guidelines. <https://www.nia.nih.gov/sites/default/files/2018-09/nia-ae-and-sae-guidelines-2018.pdf>)

Appendix XII

Consent form for RCT study- Afaan Oromo version

Unka walii galtee qorannoo keessatti hirmaachuu

Ani maqaan koo _____ qorannoo “Bu’aa qabeessummaa ergaa barnootaa bilbilaan dubartootaa fi abbootii warraa isaanii irratti xiyyeeffate fudhatama tajaajila kunuunsa dahumsa boodaa fooyyessuu irratti Lixa Itoophiyaa keessatti gaggeeffamu kan Dr. Viiviyaan Nagaayi, Dr. Grees Shaaye fi kan obbo Rattaa Tsaggaayee Gayeessaatiin gaggeefamu keessatti fedhii kootiin hirmaachuuf walii galeera. Odeeffannoon qorannoo kanaaf ani kennu gara fuulduraatti qorannoof akka ooluu fi akkasumas maxxanfamuu akka danda’u hubadheera. Akkaataan adeemsa qorannichaa unka odeeffannoo irratti sirriitti naaf kennameera. Bu’aalee fi miidhaa isaas hubadheera. Qorannicha keessatti hirmaannaan koo fedhiidhaani.

Akkan gaaffii fedhe haala adeemsa qorannichaa fi yeroon barbaadeti adabbii tokko malee addaan kutuu akkan danda’u adda baafadheera.

Maqaa hirmaataa/ttuu _____

Mallattoo _____

Guyyaa _____

Maqaa dursaa qorannoo: Dr. Viiviyaan Nagaayi

Mallattoo _____

Guyyaa _____

Appendix XIII

Afaan Oromo Version questionnaire for RCT study- Collected from women

Kutaa 1ffaa. Odeeffannoo hawaasummaa fi haala yeroo ulfaa fi hordoffii ulfaa wajjin wal qabatan

Qajeelfama: Gaaffilee armaan gadiif deebii sirriidha jettan nuu deebisaa

Lakk	Gaaffilee	Deebiiwwan
101.	Lakkoofsa kaardii (... <i>kaardii hirmaataa irraa kan guutamu</i>)	
102.	Umuriin kee meeqa?	Waggaa _____
103.	Amantaan ati hordoftu maali?	1. Kiristaana Prootestaantii 2. Kiristaana Ortodoksii 3. Musliima 4. Kaatoolikii 5. Kan biroo...ibsi
104.	Qomoon kee maali?	1. Oromoo 2. Amaara 3. Guraagee 4. Tigree 5. Kan biro...ibsi
105.	Haalli gaa'ela kee yeroo ammaa maal fakkaata?	1. Kan heerumte 2. Kan hin heerumne 3. Kan wal hiikan 4. Kan biraa...ibsi
106.	Sadarkaan barnootaa kee maali?	1. Kan hin baratne 2. Sadarkaa 1ffaa (1-8) 3. Sadarkaa 2ffaa (9-12) 4. Kolleejjii fi isaa ol
107.	Hojiin kee maali?	1. Haadha manaa 2. Hojjetaa mootummaa 3. Hojjetaa miti-mootummaa 4. Daldalaa 5. Kan biro...(ibsi)

108.	Galiin kee ji'aa qarshii meeqa ta'a?	1. $\leq 1,300$ 2. 1,301-2,200 3. 2,201-3,600 4. 3,601-6,500 5. $\geq 6,500$
109.	Ulfi ammaa kun kan itti yaadamee fi karoofamedhaa?	1. Eyyee 2. Lakki

Kutaa 2ffaa. Af-gaaffii Hordoffii dahumsa boodaa ilaalchisee godhamu (haadholii irraa kan funaanamu)

Qajeelfama: Gaaffileen armaan gadii dahumsa booda hagam hordoffii dahumsa boodaa akka hordoftan ilaallata. Mee hordoffii kana hagam akka hordoftan deebii keessan nuu kennaa

	Items	Eyyee	Lakki	Yaada
1.	Daa'imakee kan deesse buufata fayyaattidhaa?			
2.	Turtii sa'aa 24 buufata fayyaa keessatti tajaajila da'umsa boodaa argatteetaa?			
3.	Turtii sa'aa 24-48 buufata fayyaa keessatti tajaajila da'umsa boodaa argatteetaa?			
4.	Turtii sa'aa 48-72 buufata fayyaa keessatti tajaajila da'umsa boodaa argatteetaa?			
5.	Dahumsa booda guyyaa 7-14 gidduutti hospitaala deemuun tajaajila da'umsa boodaa argatteetaa?			
6.	Dahumsa booda torban 6ffaatti hospitaala deemuun tajaajila da'umsa boodaa argatteetaa?			

Kutaa 2ffaa: Beekumsa Waa'ee mallattoolee balaafamoo veroo ulfaa, dahumsaa fi dahumsa boodaa

Qajeelfama: Gaaffileen armaan gadii beekumsa ati mallattoolee balaafamoo yeroo ulfaa, da'umsaa fi isa booda mudachuu danda'an irratti qabdu madaaluuf oolanidha. Gaaffilee kanaaf deebii sirrii dha jettanii yaaddan nuuf ibsaa

S.no	Gaaffilee	Deebii filannoowwanii
201	Mallattoolee balaafamoon yeroo ulfaa mul'achuu danda'an ni jiruu?	1. Eeyyee 2. Lakki 3. Hin beeku
202	Yoo gaaffii 201 'eeyyee' ta'e, mallattooleen balaafamoon kun maal fa'i?	1. Gar-malee dhiiguu karaa gadameessaa 2. Mataa dhukkubbii garmalee 3. Ija dura nama maruu 4. Gaggabdoo/hurgufamuu qaamaa 5. Harki/fuulli dhidhiita'uu 6. Dhaqna gubaa garmalee 7. Of wallaalu 8. Hafuura baafachuuf rakkachuu 9. Dadhabbii cimaa 10. Dhukkubbii garaa cimaa 11. Sosochiin daa'imaa saffisiisuu/hir'isuu 12. Ciniinsuun dura bishaan gubbee dhangala'uu 13. Kan biro (ibsi)
203	Mallattoolee balaafamoon yeroo da'umsaa mul'achuu danda'an ni jiruu?	1. Eeyyee 2. Lakki 3. Hin beeku
204	Yoo gaaffii lakk 203 'eeyyee' ta'e, mallattooleen kun maal fa'i? (<i>deebii isaa ofumaan tarreessuu akka danda'an adda baafachuuf dursitee filannoowwan jiran hin kaasiin</i>) deebii tokkoo ol ni danda'ama)	1. karaa gadameessaa dhiigni baayinaan bahuu 2. Dhukkubbii mataa/bowoo mataa cimaa 3. Gaggabdoo/hurgufamuu qaamaa 4. Dhaqna gubaa garmalee 5. Of wallaalu 6. Ciniinsuu sa'aa 12 oliif turuu

		7. Dahumsa booda obbaatiin otoo hin bahiin daqiiqaa 30 ol turuu 8. Kan biroo---- (ibsi)
205	Mallattoolee balaafamoon yeroo da'umsa booda mul'achuu danda'an ni jiruu?	1. Eeyyee 2. Lakki 3. Hin beeku
206	Yoo gaaffii lakk 205 'eeyyee' ta'e, mallattooleen kun maal fa'i? (<i>deebii isaa ofumaan tarreessuu akka danda'an adda baafachuuf dursitee filannoowwan jiran hin kaasiin</i>) deebiin tokkoo ol ni danda'ama)	1. Karaa gadameessaa garmalee dhiiguu 2. Dhukkubbii mataa/bowoo mataa cimaa 3. Ija dura nama maruu 4. Gaggabdoo/suu 5. Harki/fuulli dhidhiita'uu 6. Dhaqna gubaa garmalee 7. Of wallaaluu 8. Hafuura baafachuu/galfachuuf rakkachuu 9. Dadhabbii cimaa 10. Dhangal'aan qaama keessaa ba'uu foolii godhachuu 11. Kan biroo... (ibsi)

Kutaa 1ffaa: Gaaffilee of-gahumsa harma hoosisuu haadholii safaruuf oolan

Qajeelfama: Gaaffileen armaan gadii **Sadarkaa of-gahumsa harma hoosisuu** haadholii madaaluu irratti kan xiyyeeffatudha. Mee gochoota harma hoosisuu keessaniin walqabatee gaaffilee armaan gadiif sadarkaa ofitti amanamummaan keessan nuuf ibsaa. Deebiin sadarkaalee ofitti amanamummaa keessanii

- 1= *Tasumaa ofitti amanamummaa hin qabu*
2= *Ofitti amanamummaankoo baay'ee xiqqoo dha*
3= *Hamma tokko ofitti amanamummaa nan qaba*
4= *Ofitti amanamummaa nan qaba*
5= *Yeroo hunda ofitti amanamummaa nan qaba*

	Gaaffilee	Deebii				
1.	Daa'imnikoo aannan harmaa gahaa argachaa akka jiru/jirtu yeroo hunda murteessuu nan danda'a	1	2	3	4	5

2.	Akkuma hojiiwwan qormaata natti ta'an biroo dandamadhutti, harma hoosisuus yeroo hunda milkaa'ainaan dandamachuu nan danda'a	1	2	3	4	5
3.	Daakuu aannaii (aannan xaasaa) akka dabalataatti osoo hin fayyadamiin, yeroo hunda daa'imakoo harma qofa hoosisuu nan danda'a	1	2	3	4	5
4.	Daa'imni koo harma sirriitti afaan kaawwatee/tee hodhaa akka jiru/jirtu, yeroo hunda mirkaneessuu nan danda'a	1	2	3	4	5
5.	Haala harma hoosisuu akka itti quufinsakootti yeroo hunda to'achuu nan danda'a	1	2	3	4	5
6.	Daa'imni koo yoo boo'ellee/boossellee, yeroo hunda harma akka hodhu/hootu gochuu nan danda'a	1	2	3	4	5
7.	Yeroo hundumaa fedhiin harma hoosisuu koo akka hin daangofne gochuu nan danda'a	1	2	3	4	5
8.	Bakka maatiinkoo jiranitti, daa'imakoo sodaa tokko malee yeroo hunda harma hoosisuuu nan danda'a	1	2	3	4	5
9.	Muuxannoo harma hoosisuu kootti yeroo hunda gammachuu natti dhagahama	1	2	3	4	5
10.	Harma hoosisuun yeroo fudhatuyyuu, yeroo hunda furmaata itti gochuu nan danda'a	1	2	3	4	5
11.	Daa'imakoo gara harma biraatti osoo hin jijjiiriin dura yeroo hunda harma isa jalqabaa keessaa hodhee akka xumuru/tu gochuu nan danda'a	1	2	3	4	5
12.	Daa'imakoo sa'aatii nyaataa kam irrattiyyuu yeroo hunda harma hoosisuu nan danda'a	1	2	3	4	5
13.	Yeroo hunda fedhii harma hodhuu daa'ima koo guutuu nan danda'a	1	2	3	4	5
14.	Daa'imni koo harma hodhee xumuruu isaa/ishee, yeroo hunda adda baasee himuu nan danda'a	1	2	3	4	5

Kutaa 2ffaa: Gaaffilee haadholiin harma hoosisan gargaarsa abbaa manaa isaanii irraa argatan ilaalchisee

Qajeelfama: Gaaffileen armaan gadii ji'a **darbe** keessatti, gargaarsa qabatamaa, haamilee, fi odeeffannoo abbaa manaa keessan irraa argattan irratti xiyyeeffata. Mee **ji'a darbe keessa**, tokkoon tokkoo gochaalee armaan gadii irratti gargaarsa abbaa manaa keessanii hagam akka argattan ibsaa.

1= Gargaarsa tasumaa hin arganne ykn kan ati barbaaddu caalaa baay'ee xiqqaa dha

2= Hamma gargaarsa ati barbaadduun gadi dha

3= Hamma gargaarsa ati barbaadduun kan wal gitu dha

	Gaaffilee	Deebii		
Harma qofa hoosisuu irratti gargaarsa qabatamaa ta’e argachuu				
1.	Harma qofa akkan hoosisuuf, hojiiwwan idilee ani hojjechuu qabu hojjeteera	1	2	3
2.	Nyaata qopheessuudhaan na gargaareera	1	2	3
3.	Uffata miicuudhaan na gargaareera	1	2	3
Harma qofa hoosisuu irratti deeggarsa miiraa/haamilee argachuu				
4.	Daa’ima koo harma qofa akkan hoosisu naaf eeyyameera	1	2	3
5.	Daa’ima koo haala gaariitiin kunuunsaa akkan jiru natti himeera	1	2	3
6.	Harma hoosisuu irratti yeroon dogoggora hojjjedhu illee, ofitti amanamummaa akkan qabaadhu na taasisseera	1	2	3
7.	Waa’ee daa’ima reefu dhalate kanaa yeroon haasa’u, na dhaggeeffateera	1	2	3
8.	Haadha gaarii akkan ta’e amantaa narraa qaba	1	2	3
9.	Haala qaamaa fi fayyaa kootiif akka naaf dhimmu natti agarsiiseera	1	2	3
10.	Gaddi ykn dhiphinni yeroo natti dhaga’amu akka naaf dhimmu natti agarsiiseera	1	2	3
11.	Harma qofa hoosisuuf carraaqqii ani godheef na jajateera	1	2	3
Harma haadhaa qofa hoosisuu irratti deeggarsa odeeffannoo argachuu				
12.	Gaaffilee ani waa’ee harma qofa hoosisuu irratti qabu naa deebiseera	1	2	3
13.	Akkaataa harma qofa hoosisuu irratti gorsaa fi yaada naaf kenneera	1	2	3
14.	Waa’ee harma hoosisuu ykn daa’ima koo kunuunsuu irratti gaaffii yoon qabaadhe, eessaa gargaarsa argachuu akkan danda’u natti himeera	1	2	3
15.	Akkaataa itti harma hoosisan natti agarsiiseera	1	2	3
16.	Akkamitti akkan of kunuunsuu qabu na barsiiseera	1	2	3

Kutaa 3ffaa

Qajeelfama: Gaaffiin armaan gadii shaakala harma hoosisuu wajjin walqabata. Mee sadarkaa harma hoosisuu keessan nuuf ibsaa.

(Shaakala Harma Haadhaa Qofa Hoosisuu ilaalchisee)	
Yeroo ammaa kana sadarkaan harma hodhuu daa'imakee maal fakkaata? (Fakkeenyaaf kaleessaa fi eda galgala maal akka sooratte gaafadhu)	1. Tasuma harma hodhaa hin jiru/jirtu 2. Harma qofa hodhaa jira/jirti 3. Harma hodhuu fi bishaan qulqulluu qofa soorachaa jira/jirti 4. Harma hodhuu fi dhangala'oo aannan hin ta'iin soorachaa jira/jirti. 5. Harma hodhuu fi aannan kan biroo soorachaa jira/jirti.

	6. Harma hodhuu fi nyaata dabalataa soorachaa jira/jirti
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Kutaa 4ffaa: Mobile-based SMS Program Satisfaction Questionnaire-Afaan Oromo version
(Abbaa manaa fi haadha manaa irraa kan funaanamu)

Qajeelfama: Gaaffileen armaan gadii itti quufinsa ergaawwan gabaabaa isinii ergaman irratti xiyyeeffata. Maaloo tokkoon tokkoo armaan gadiif hagam akka itti quufinsa qabdu iskeelii 1 haga 4 tiin nuu ibsaa.

1 = Tasuma itti quufinsa hin qabu

2 = Itti quufinsa hin qabu

3 = Itti quufinsa nan qaba

4 = Baay'ee itti quufinsa qaba

1. Guyyoota ergaan gabaabaa isiniif ergaman	1	2	3	4
2. Sa'aa ergawwan gabaabaa itti isiniif ergamn	1	2	3	4
3. Turtii ergaawwan gabaa isinii ergaman irratti	1	2	3	4
4. Qabiyyee ergaawwan gabaabaa isinii ergaman irratti	1	2	3	4
5. Ergaawwan barnootaa kun bilbilaan ta'uu isaa irratti	1	2	3	4
6. Ergaawwan kun waanuma ati beekuu barbaaddu ta'uu	1	2	3	4
7. Sagantaa kana irratti hirmaannaa keessan	1	2	3	4
8. Walumaa galatti miira sagantichaaf qabdu	1	2	3	4

Appendix XIV

The Breastfeeding support questionnaire collected from husbands-Afaan Oromo version

Kutaa 1ffaa. Odeeffannoo hawaasummaa abbaa manaa irraa kan funaanamu		
Qajeelfama: Gaaaffilee armaan gadiif deebii sirriidha jettan nuuf deebisaa		
Umuriin kee waggaa dhaan meeqa ta'a?		Waggaa _____
1.	Qomoon kee maali?	1. Oromoo 2. Amaaraa 3. Tigree 4. Kan biraa (ibsi)
2.	Amantaan ati hordoftu maali?	1. Protestaantii 2. Ortodoksii 3. Musliima 4. Kan biiraa (Ibsi)
3.	Sadarkaan barnootaa kee inni guddaan maali?	1. Kan hin baratne 2. Barreessuu fi dubbisuu kan danda'u 3. Sadarkaa 1ffaa (1-8) 4. Sadarkaa 2ffaa (9-12) 5. Yuuniversiitii fi isaa ol
4.	Hojiin kee yeroo ammaa maali?	1. Qotee bulaa 2. Hojjetaa mootummaa 3. Hojjetaa dhuunfaa 4. Daldalaa 5. Kan biraa--- (ibsi)
5.	Galiin kee ji'atti meeqa ta'a (Qarshiidhaan)	1. <=1,300 2. 1,301-2,200 3. 2,201-3,600 4. 3,601-6,500 5. >=6,500

Kutaa 2ffaa: Gaaffilee deeggarsa abbaan manaa haadha manaa isaaf harma hoosisuu irratti kennuu danda’u wajjin walqabatan (Abbaa manaa irraa kan funaanamu)

Qajeelfama: Gochootni armaan gadii waa’ee harma hoosisuu irratti deeggarsa abbaan manaa haadha manaa isaaf kennuu danda’u irratti xiyyeeffata. Mee gochoota armaan gadii **yeroo hammam haammamitti** akka hojiirra oolchitan nuu ibsaa.

1= Gonkumaa hojii irra hin oolchu

2=Yeroo baay’ee xiqqoo hojiirran oolcha

3= Altokko tokko hojiirran oolcha,

4= Yeroo baay’ee hojiirran oolcha,

5=Yeroo baay’ee irra deddeebiidhaan hojiirran oolcha

Waa’ee harma hoosisuu hubachiisuu						
1.	Haati manaakee yeroo hangamiif harma hoosisuu akka itti fuftu irratti waliin mari’achuu	1	2	3	4	5
2.	Haadha manaakee waliin rakkoolee harma hoosisuu furuu irratti ykn haalota harma hoosisuu fooyyessan irratti mari’achuu	1	2	3	4	5
3.	Haati manaakee yeroo hangamiif harma hoosisuu akka qabdu, yaadaakee itti himuu	1	2	3	4	5
4.	Yeroo namni yaada dogoggoraa harma hoosisuu irratti haadha manaakeef kennu yaadicha mormuun haadha manaakee deeggaruu	1	2	3	4	5
5.	Haati manaakee rakkoolee harma hoosisuu furuuf ykn harma hoosisuu fooyyessuuf namoota biroo irraa deeggarsa akka argattu gargaaruu	1	2	3	4	5
6.	Faayidaa harma hoosisuun haadhaaf ykn daa’imaaf qabu haadha manaakee yaadachiisuu	1	2	3	4	5
7.	Daa’ima kee nyaachisuuf obsaa fi fedhii qabaachuukee agarsiisuu	1	2	3	4	5
8.	Haati manaakee garee harma hoosisuu irratti deeggarsa kennan bira deemtee gargaarsa akka argattu deeggaruu	1	2	3	4	5
Gargaaruu						
9.	Hojiiwwan kunuunsa daa’imaa kanneen biroo tiin haadha manaa kee gargaaruu (qaama dhiquu ykn uffata jijjiiruu ta’uu danda’a)	1	2	3	4	5
10.	Haala harma hoosisuu haadha manaakeetiif salphisuuf waan ofii kee hojjechaa jirtu dhiisuun ishee deeggaruu	1	2	3	4	5
11.	Yeroo fi humna haadha manaakee qusachuuf, hojiiwwan mana keessaa fi itti gaafatamummaa biroo irratti ishee gargaaruu	1	2	3	4	5
12.	Haati manaakee halkan yeroo harma hoosisu gargaaruu	1	2	3	4	5
13.	Daa’imakeef yeroo harma hoosisuu fi hoosisuu booda, kunuunsa barbaachisaa ta’e gochuu	1	2	3	4	5
14.	Fayyaa fi soorata haadha manaakee fooyyessuuf tattaaffii gochuu	1	2	3	4	5
15.	Haati manaakee kunuunsa daa’imaa irraa boqonnaa akka fudhattu (aara akka galfattu) gochuu	1	2	3	4	5

Ajaa'ibsiifannaa						
16.	Haati manaakee harma akka hoosiftu jajjabeessuu fi yoo harmaa hoosisuu dhaabuu yaaddes, isheen haadha kamiyyuu gadi akka hin taane itti himuun	1	2	3	4	5
17.	Haati manaakee harma hoosisuu isheef jajachuu akkasumas harma hoosisuun ishee waan bareedaa fi gatii qabeessa ta'uu hubachiisuu	1	2	3	4	5
18.	Haati manaakee harma hoosisuun uumama ta'uu isaa akka beektuu fi sababa daa'ima isheef waan gaarii barbaadduuf harma hoosisaa akka jirtu hubachiisuu	1	2	3	4	5
19.	Haati manaakee harma hoosisuu irratti dadhabbii fi abdii kutannaan yeroo itti dhagahamu hubachuun jajjabeessuu	1	2	3	4	5
20.	Haati manaa kee harma hoosisuu isheef dinqisiifachuu	1	2	3	4	5
21.	Haati manaakee ejjennoo haadhummaa fi hubannoo harma hoosisuu isheen qabduuf iddoo guddaa akka itti kennituu fi akka deggertu itti himuu	1	2	3	4	5
Harma hoosisuu irratti wajjin ta'uu						
22.	Wantootaa (meeshaalee) harma hoosisuuf barbaachisan dhiheessuudhaan muuxannoo harma hoosisuu fooyyessuuf yaalii gochuu	1	2	3	4	5
23.	Haati manaa kee yeroo harma hoosiftu, xiyyeeffannoo itti kennuun hordofuu	1	2	3	4	5
24.	Haati manaakee yeroo harma hoosistu, ishee bira taa'uun ykn ofitti ishee qabuudhaan yeroo gahaa ishiif kennuu	1	2	3	4	5
25.	Hojiwwan harma hoosisuu wajjin walqabatan irratti qaamaan argamuun gargaaruu	1	2	3	4	5
26.	Harma hoosisuuf bakka tasgabbaa'aa fi namatti tolu filachuun gargaaruu	1	2	3	4	5
Deebii kennuu						
27.	Haati manaakee yeroo harma hoosistu gammachuuu qabaachuu kee fi sitti tolaa ta'uu kee itti agarsiisuu	1	2	3	4	5
28.	Dhimma saalqunnamtii irratti deebii qajeelaa fi miira hubannaa qabuun deebii kennuu	1	2	3	4	5
29.	Harma hoosisuun yeroo waan fudhatuuf obsaa fi hubannoo qabaachuu kee fi hojiin mana keessaa yoo hin hojjetamiin hafe illee aaruu dhiisuu	1	2	3	4	5
30.	Haati manaakee bakka namni walitti qabamee jirutti illee yoo harma hoosifte akka sitti toluu fi isheettis akka tolu gochuu	1	2	3	4	5
31.	Haati manaa kee harma hoosisuu irratti hammamii fi akkamitti hirmaachuu akka barbaaddu xiyyeeffannoon hordofuu	1	2	3	4	5

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