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Pregnant mother's intention to use mobile phone-based messaging interventions for improving maternal and newborn health practices in Jimma Zone, Ethiopia

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Abstract

Background Mobile phone-based messaging for maternal education has shown promising outcomes in promoting maternal and child healthcare in low- and middle-income countries, where there is poor utilization of healthcare services. However, the success of a mobile phone messaging-based intervention depends on identifying and addressing the underlying factors that determine its utilization before implementation.

Objective To assess pregnant mothers' intention to use a mobile phone-based messaging intervention to improve maternal and newborn health in Jimma Zone, Ethiopia.

Method This study employed a cross-sectional study design among randomly selected pregnant mothers residing in six primary health care units that were selected from three districts of Jimma Zone, Ethiopia. Data were collected using an interviewer-administered structured questionnaire. Descriptive statistics such as frequencies, percentages, mean, and standard deviation were calculated and presented using tables. Multivariable linear regression analysis was used to identify predictors of intention. Standardized regression coefficients were used to understand the effect of the independent variables and outcome variable. A 95% confidence interval and a *p*-value of < 0.05 were considered significant.

Result Two hundred seventy-nine pregnant mothers participated in this study, resulting in a 98.9% response rate. Almost all (98.9%) respondents preferred the Afan Oromo language, 41.9% of respondents preferred the afternoon and 48.4% preferred receiving health information as text messages once daily. Having family members who can share SMS information ($\beta = 0.098$, 95% CI: (0.279—1.867), perceived usefulness ($\beta = 0.283$, 95% CI: (0.143—0.341), perceived easiness ($\beta = 0.209$, 95% CI: (0.054—0.392), perceived acceptability ($\beta = 0.158$, 95% CI: (0.007—0.178) and perceived feasibility ($\beta = 0.186$, 95% CI: (0.057—0.284) were found to have a positive significant association with the intention to use mobile phone-based messaging for maternal and newborn health.

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Conclusion The majority of respondents preferred receiving mobile phone-based messaging on MNH in the Afan Oromo language, during the afternoon, and once daily. Having family members who share text message information, perceived usefulness, perceived easiness, perceived acceptability, and feasibility were significantly associated with intention. These findings highlight the importance of considering user preferences and determinants of intention when designing mobile phone-based messaging.

Keywords mHealth, Mobile phone messaging, SMS, Intention, Maternal & newborn health, Ethiopia

Background

Globally, maternal and newborn remains an urgent priority due to the high death toll among these population groups [1]. Maternal and newborn deaths primarily occur due to complications during pregnancy, labor, childbirth, and the postpartum period [2]. The majority of these deaths takes place in low- and middle-income countries (LMICs), where access to and utilization of healthcare services are limited [3, 4]. Although the government of Ethiopia has implemented several initiatives and strategies to improve maternal and newborn health outcomes [5, 6], the country still has the highest maternal and neonatal mortality ratios, with a maternal mortality ratio of 267 per 100,000 live births [7] and a neonatal mortality rate of 33 per 1,000 live births [8].

Utilization of essential maternal health care services such as antenatal care (ANC), skilled delivery, postnatal care (PNC), and newborn care practices plays a significant role in promoting maternal and newborn health [9]. However, these services are underutilized in LMICs due to various factors [10, 11]. In addition to health system-related factors like infrastructure, finance, and human resources, individual factors such as low health literacy [12], knowledge [13], attitude [14], and other behavioral factors [15] also contribute to inadequate utilization of maternal and newborn care services in LMICs. Evidence indicates that educational interventions targeting mothers have a positive impact on the utilization of maternal health care services and newborn care practices, including colostrum administration and early initiation of breastfeeding in LMICs [16].

The global growth of mobile connectivity has created an opportunity for the emergence of a subset of eHealth known as mHealth [17]. mHealth is defined as the use of mobile wireless technologies for health [18]. It covers using mobile phones and tablets for voice calls, texting, audio, images, video, voice short message service (SMS), multimedia messaging, and internet access [19]. According to the International Telecommunication Union, in 2022, mobile phone coverage reached 97.4% of the world's population, with 72.7% owning mobile phones [20]. This high coverage and penetration of mobile phones have provided an opportunity to utilize mHealth for monitoring health services, facilitating interaction among healthcare providers, managing human resources, providing educational information, and enhancing behavior change [21, 22]. Mobile phone messaging, particularly through SMS, is a commonly used component of mHealth, employed for improving self-management of conditions such as diabetes, weight loss, physical activity, quitting smoking, medication adherence in antiretroviral therapy, and promoting the utilization of maternal and newborn health care services [23–26].

However, the success of mobile phone messaging-based interventions depends on the identification and addressing of underlying factors prior to implementation [27]. Factors such as acceptance, end-users' preferences regarding the receipt of text messages, experience with using mobile phones and text messages, perception, and intention to use text messages affect the implementation of mobile phone messaging-based intervention [28, 29]. Additionally, factors such as culture, accessibility, and acceptance in the local context play a significant role in determining the design and success of an mHealth intervention [30, 31]. Therefore, it is crucial to identify these factors when developing mobile phone messaging-based interventions to ensure their alignment with the local context and to avoid implementing interventions that fail due to low user adoption.

This study is part of the formative phase of an intervention aimed at evaluating the effectiveness of mobile phone messaging-based message framing to improve maternal and newborn care practices among mothers in Jimma Zone, Ethiopia. The current study aims to assess the intention, perceptions, and preferences of pregnant mothers regarding the use of mobile phone-based messaging for maternal and newborn health information (MNHI) in the Jimma Zone, Ethiopia.

Method

Study design and setting

A Cross-sectional study was conducted from October 3 to 28, 2022, in the Manna, Shebe Sombo, and Dedo districts of the Jimma Zone, Oromia, Ethiopia. Jimma Zone is characterized by poor health infrastructure, including a high health worker-to-population ratio (1:329) and a limited number of health facilities providing comprehensive emergency obstetric and newborn care. The zone

also has a high maternal mortality ratio (412 per 100,000 live births). The three districts were selected from a total of 21 districts in Jimma Zone, based on the confirmation that each of them had no ongoing initiatives focused on digital health aimed at improving maternal and newborn health. This study was reported in accordance with the STROBE checklist for cross sectional studies (Additional file 1).

Study participants

Pregnant mothers living in the catchment area of the selected primary health care unit (PHCU) were selected to participate in the study. The study included pregnant mothers who had a follow-up for ANC service, owned a mobile phone or had a family member who owned one, and provided written informed consent to participate in the study.

Sample size calculation and sampling procedure

The sample size for this study was calculated using the single population proportion formula. The following assumptions were used: a proportion of mother who have the intention to use SMS reminders, which is 78.9% from previous study [31], a 95% confidence interval, and a 5% margin of error. Based on these, the initial sample size was calculated to be 256. Considering a 10% non-response, the final sample size was determined to be 282. The study participants were recruited using a simple random sampling method. First, two PHCUs were randomly selected from each of the three districts. The calculated sample was then proportionally allocated to each of the PHCU based on client flow. All pregnant mothers who met the enrollment criteria in the selected PHCU were registered, and this list served as sampling frame. The list was then entered into Microsoft Excel, and a random number generator was run to select participants. With the assistance of local volunteers, data collectors identified and visited the homes of randomly selected pregnant mothers. They personally informed the mothers about the study, provided a clear explanation of its objectives, and invited them to participate in the study.

Data collection tool and procedure

Data were collected using an interviewer-administered structured questionnaire, employing a face-to-face interview technique. According to the technology acceptance model, intention is determined by perceived easiness and perceived usefulness [32], and the questionnaire included these variables. The items for the intention to use text messages for MNH were adapted from the literature [33, 34], as were the perceived usefulness and easiness of using text messages for MNH [32–34]. The theoretical framework of acceptability suggests the possibility of assessing acceptability before exposure to the intervention, and the items used to measure perceived acceptability were adapted from this model [35] and another study that validated implementation outcomes [36]. The questionnaire also included socio-demographic characteristics, text message usage experience, and preference (language, timing, and frequency), self-efficacy—adapted from the literature [34, 37], and perceived feasibility—adapted from the literature [36] of mobile phone-based messaging interventions for MNH. The questionnaire was translated into Afan Oromo from English and the back-translated into English to ensure consistency. The additional file shows the questionnaire in more detail (see Additional file 2).

As this is a pre-implementation study, a detailed description of the planned intervention was presented to each participant. The description included a definition of the planned mobile phone messaging-based intervention, how it is delivered, and its aims to encourage participants to utilize maternal health services and practice the recommended newborn care. Following this, an explanation was provided on what a mobile phone messaging-based intervention entails, namely sending text messages to mothers' mobile phone, the topic areas of the messages, the duration of the intervention, and ensuring participants receive key messages that are specific to their gestational age, infant age and reminders for their appointment.

Six data collectors and three supervisors were recruited for data collection. The data collectors and supervisors were trained for two days on the objectives of the study, data collection tools and procedures, providing informed consent, maintaining confidentiality, and respecting respondents' rights. Continuous follow-up was conducted by the supervisors throughout the data collection period to ensure that the data were collected according to the plan.

Measurements

Intention

Intention is defined as an individual's readiness to engage in a given behavior [38]. For this study, a scale consisting of seven 5-point Likert scale items was adapted from the literature [33, 34] to measure of pregnant mothers' readiness to receive mobile phone-based messages on MNH. Item scores were summed after reverse coding negatively worded items and higher composite scores indicate a higher intention.

Perceived usefulness

Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance [32]. Nine items

designed on a 5-point Likert scale, adapted from the literature [32–34], were used to measure the extent to which pregnant mothers believe that using mobile phone-based messaging for MNH would enhance their maternal and newborn health practices. Item scores were summed after reverse coding negatively worded items, and higher composite scores indicate a higher perceived usefulness.

Perceived easiness

Perceived easiness is defined as the degree to which a person believes that using a particular system would be free of effort [32]. In this study, seven items designed on a 5-point Likert scale, adapted from previous studies [32–34], were used to measure mothers' belief that using mobile phone-based messaging for MNH would be effortless. Item scores were summed after reverse coding negatively worded items, and higher composite scores indicate a higher perceived easiness.

Self-efficacy

Self-efficacy was defined as the extent to which a pregnant mother believes that she can use mobile phone-based messaging for MNH [39]. Seven items designed on a 5-point Likert scale, adapted from the literature [34, 37], were used to measure this belief. Item scores were summed after reverse coding negatively worded items, and higher composite scores indicate a higher self-efficacy.

Perceived acceptability

Perceived acceptability is defined as the belief that a given innovation is agreeable, appropriate, suitable, convenient, effective and satisfactory [35, 40]. In this study, ten 5-point Likert scale items, adapted from the literature [36, 41], were used to measure pregnant mothers' belief about appropriateness, suitability, convenience, and effectiveness of mobile phone-based messaging for improving MNH. Items score was summed after reverse coding negatively worded items, and higher composite scores indicate a higher perceived acceptability.

Perceive feasibility

Perceived feasibility is defined as an individual's belief in the extent to which an innovation can be successfully used or carried out within a given setting [40]. For this study, it was used to measure the degree to which pregnant mothers believe that mobile phone-based messaging can be successfully used for MNH. This was assessed using seven 5-point Likert scale items adapted from the literature [36]. Item scores were summed after reverse coding negatively worded items, and higher composite scores indicate a higher perceived feasibility.

Household wealth level

Household wealth level was calculated using principal component analysis by considering 15 household asset properties. it was then categorized into wealth quantiles; lowest, second, middle, fourth, and highest [42].

Quality assurance

The face and content validity of the data collection instrument were ensured by adapting the tool from previous related studies. Before the actual data collection, the tool was pretested on 5% of the sample size. Modifications were made to the questionnaire content based on the findings. The internal consistency of the key constructs was checked using Cronbach's alpha, and all the constructs showed acceptable values of Cronbach alpha coefficient.

Data analysis plan

The collected data were entered into Epi-data V.3.1 and exported to SPSS V.25 software for analysis after ensuring completeness. Descriptive statistics, such as frequencies, means, standard deviations and percentages were computed, and presented using tables. Pearson's correlation analysis was done to identify associations between continuous variables and the intention to use mobile phone-based messaging for MNH. An independent sample t-test was performed to see association between dichotomous variables and intention. Multivariable linear regression analysis was employed to identify predictors of the intention to use mobile phone-based messaging for MNH. Variables that showed significant associations with the outcome variable in the bivariable analysis were included in the multivariable linear regression analysis to control for potential confounding effects. Standardized regression coefficients, along with their 95% CI, were used to understand the effect of the independent variables on outcome variable. A p-value < 0.05 was considered statistically significant.

Patient and public involvement

The technical committee for the project included maternal and child health experts from zonal and district health office, information technology experts, and academicians. This group evaluated the content of the questions and the overall research method. Three maternal and child health experts at the district level assisted with the data collector selection for this study. Six volunteers living in the catchment area of the selected primary health care unit contributed to the study by helping us review the Afan Oromo language version of the questions. We refined the questionnaire based on the feedback we received from the volunteers. The pregnant

mothers provided their opinions, experiences, preferences, and perceptions about the mobile phone messaging-based intervention after receiving a brief description of the proposed intervention.

Result

Sociodemographic characteristics

A total of 279 mothers participated in this study, resulting in a response rate of 98.9%. One hundred twenty (43%) of the study participants were in the age group of 25–29 years. One-third (66.7%) of the respondents lived in rural areas. A large number of the respondents were married (95%), identified as Oromo in ethnicity (96.1%), and were Muslim (94.3%). The majority of the participants (59.9%) and their husband (62.6%) had completed primary school. Regarding occupation, a large number (72.8%) of the respondents were housewives, followed by farmers (18.3%). The majority (63.1%) of the study participants had a family size of four and fewer. All of the study participants had family members who can read and write, and two-third (66.7%) of them had two family members who can read and write Table 1.

Table 1 Sociodemographic characteristics of pregnant mother in Jimma Zone, Ethiopia ($n=279$)

Variables	Frequency	Percent
Age of mothers		
< = 24	75	26.9
25—29	120	43
30—34	62	22.2
> = 35	22	7.9
Residence		
Rural	186	66.7
Urban	93	33.3
Marital status		
Married	265	95
Not married	14	5
Ethnicity		
Oromoo	268	96.1
Others	11	3.9
Religion		
Muslim	263	94.3
Others	16	3.7
Education status		
No formal education	55	19.7
Can read and write	9	3.2
Primary school	167	59.9
Secondary school	36	12.9
College and above	12	4.3
Husband educational status ($n=265$)		
No formal education	25	9.4
Can read and write	12	4.5
Primary school	166	62.6
Secondary school	42	15.9
College and above	20	7.6
Occupation		
Housewife	203	72.8
Farmer	51	18.3
Others	25	9
Wealth index		
Lowest	53	19
Second	68	24.4
Middle	47	16.8
Fourth	55	19.7
Highest	56	20.1
Family size		
< = 4	176	63.1
> 4	103	36.9
Number of family member who can read and write		
One	42	15
Two	186	66.7
Three and above	51	18.3

Mobile phone use and preference to receive message for maternal and newborn health

The majority (69.5%) of respondents had been using a mobile phone for 1 to 4 years. A Large number (91.8%) of respondents were using the standard mobile type. The majority of the participants can read (79.9%), and around half (54.1%) of them were able to send mobile phone text messages. Only 16.8% of the respondents had ever received health information from a healthcare provider through their mobile phone. More than three-fourths (77.4%) of the respondents stated that a family member shares information they receive through their phone. For almost all (98.9%) of respondents, Afan Oromo was the preferred language to receive health information as text messages. Regarding the preferred time of day to receive health information as text messages, 41.9% of respondents preferred the afternoon, and 35.8% preferred the evening. Around half (48.4%) of respondents preferred receiving one health information text message per day (Table 2).

Descriptive statistics of items and internal consistency measure of constructs

Table 3 presents the descriptive statistics for individual items and the internal consistency of key constructs. Among the items related to intention, using SMS in the future for information about pregnancy and newborn care had the highest mean score ($\mu=4.15$), followed by the willing to receive SMS about service provided at health facilities for mother and newborns ($\mu=4$).

Table 2 Pregnant mothers mobile phone use and preferences to receive message for maternal and newborn health in Jimma Zone, Ethiopia ($n=279$)

Variables	Frequency	Percent
Duration of mobile use		
Less than 1 year	26	9.3
1—4 years	194	69.5
Above 4 years	59	21.1
Type of current mobile phone		
Standard	256	91.8
Smart	23	8.2
Can read mobile phone text message		
Yes	223	79.9
No	56	20.1
Can send mobile phone text message		
Yes	151	54.1
No	128	45.9
Ever used mobile phone to get health information from healthcare providers		
Yes	47	16.8
No	232	83.2
Family members share SMS information		
Yes	216	77.4
No	63	22.6
Preference language for receiving MNHI as phone text message		
Afan Oromo	276	98.9
Amharic	3	1.1
Preferred time of a day for receiving MNHI as phone text message		
Morning (12:01—6:00)	20	7.2
Afternoon (6:00—12:00)	117	41.9
Evening (12:01—6:00)	100	35.8
Any time	42	15.1
Preferred number of text message to receive per day		
One	135	48.4
Two	79	28.3
Above two	65	23.3

The reversely coded item, which was about unwillingness to be contacted by one's own or a family member's mobile phone for important health message, had a lower mean score ($\mu=3.18$) within this construct. Items of perceived usefulness related to respondents' beliefs about convenience of SMS for maternal and newborn health information and its capability to improving their communication with healthcare providers had similar mean score ($\mu=4.10$). The item concerning the role of SMS-based interventions in reducing the time pregnant mother spend receiving routine education at health facilities had a lower mean score ($\mu=3.75$) compared to other items in perceived usefulness construct.

All five items used to measure perceived easiness had relatively similar mean score, ranging from 3.86 to 3.99, indicating that a large number of the respondents agreed on easy to use of SMS-based intervention. All items of self-efficacy also had nearly similar mean score within the 3.8 – 3.93 range. The item concerning the capability to differentiate health information from other SMS messages received on their phone scored the highest mean ($\mu=3.93$), while items on participants' confidence in their ability to read SMS and belief in their capability to manipulate their own mobile phone to read health information had a mean score of 3.8. Most items of perceived acceptability showed relatively higher mean scores. The item stating that using texts is a good way to teach about maternal and newborn health scored the higher mean ($\mu=4.09$). Items related to respondent's belief in other mothers' interest in receiving maternal and newborn

Table 3 Descriptive statistics of items and internal consistency measure of constructs

Items	Mean	Std. Dev	α
Intention			**0.72**
I will use SMS in the future to have information about my pregnancy and newborn	3.99	0.93	
I believe I will use SMS in the future to have information about my pregnancy and newborn	4.15	0.99	
I think I would like to receive maternal and newborn health information through SMS frequently	3.82	0.99	
I am not willing to be contacted by my/my family mobile phone to get important health message	3.18	1.55	
I am willing to receive SMS about the service my baby and I can get from health facility	4	1.08	
I am not willing to receive reminder SMS about service that my baby and I can get from health facility	3.27	1.45	
Perceived Usefulness			**0.86**
Text messaging is a better way of getting important pregnancy and newborn related health messages	3.90	1.05	
I believe texting is convenient way of receiving maternal and newborn related health information for mothers	4.10	0.99	
I believe SMS based intervention can improve communication between pregnant mothers & health workers	4.10	0.94	
SMS based intervention will reduce the time pregnant mother spend to get routine education at health facility	3.75	1.13	
Using SMS based would improve the care I will give to my new-born	3.85	1.13	
I believe SMS based service reminder will help me not to miss service appointment date	4.07	0.96	
Using SMS based would make it easier to receive important health message about newborn and maternal health	3.92	1.08	
Perceived easiness			**0.87**
I would find it easy to read health messaged sent over SMS	3.87	1.11	
SMS based health messages are easy to use	3.99	1.03	
Learning to operate my/family phone to read message would be easy for me	3.98	1.02	
I would find SMS based intervention to be flexible to interact with	3.86	1.07	
I am comfortable using a mobile phone	3.89	1.10	
Self-efficacy			**0.93**
I am confident about my ability to read SMS sent to me	3.8	1.12	
I believe I can differentiate health information from other SMS that I receive though my phone	3.93	1.03	
I believe I can read and understand information if there is no one around to tell me what to do	3.85	1.09	
I feel very confident of reading health messages I receive through SMS	3.82	1.09	
I am confident that I can understand health messages I receive through SMS	3.85	1.05	
I believe I can manipulate my mobile to read health information even if I never have such experience before	3.8	1.06	
Perceived acceptability			**0.91**
I believe most mothers are interested in receiving maternal and newborn related education by text message	3.87	1.09	
I think I would like to use SMS as means of communication about maternal and newborn frequently	4.00	1.04	
Allowing text message communication between mothers & health worker is too complex and not worth the time	3.92	1.08	
I think most pregnant mothers would be interested in communicating by text about maternal and newborn health	3.90	1.15	
The current SMS based education approach can improve maternal and newborn health	4.00	1.03	
I believe SMS-based maternal education approach can effectively meets my need	3.95	0.97	
I believe SMS-based maternal education approach fits the target issue and settings	3.95	1.07	
I believe SMS-based maternal education is appropriate to address existing maternal & newborn health problem	3.98	1.05	
I would recommend using SMS based maternal education if it is to be implemented in the future	4.06	0.97	
Using texts is a good way to teach about maternal and newborn health	4.09	0.98	
Perceived feasibility			**0.9**
SMS based education and service reminder intervention seems practical in this setting	3.99	1.02	
I believe I will use SMS based maternal and newborn related education in the future	3.95	1.04	
SMS based education and service reminder intervention seems easy to implement in this community	3.99	1.03	
SMS based education and service reminder seems realistic	3.96	1.01	
SMS based education and service reminder intervention components seems implementable	3.97	0.99	
SMS based education and service reminder intervention seems possible	3.97	1.01	

related education by text message (μ=3.87) and belief that the SMS-based maternal education approach can effectively meet need and fit the target issue and setting (μ=3.95) had relatively lower score compared with other items in this construct. All items of the perceived feasibility had similar mean score between 3.95 and 3.99.

The Cronbach's alpha coefficient was used to check the internal consistency of key constructs, and all constructs showed acceptable alpha coefficient. The alpha score of intention was (α = 0.72) after deleting one item due to a lower item-total correlation. The alpha score for perceived usefulness and perceived easiness was 0.86 and 0.87, respectively, after deleting two items from each dimension for lower item-total correlation. The alpha score for self-efficacy and perceived acceptability was 0.93 and 0.91 respectively. Perceived feasibility scored an alpha of 0.9 after removing one item (Table 3).

Descriptive statistics and correlations of key constructs

The Mean score of intention was 22.4 (SD = 4.59, range = 6—30). The mean score of perceived usefulness and perceived easiness was 27.69 (SD = 5.37, range = 7 – 35) and 19.59 (SD = 4.31, range = 5 – 25) respectively. Self-efficacy was found to have a mean score of 23.04 (SD = 5.5, range = 6 – 30). The perceived acceptability and feasibility had mean score of 39.72 (SD = 7.2, range = 10 – 50) and 23.82 (SD = 5.01, range = 6 – 30) respectively.

Correlations between Intention, perceived usefulness, perceived easy to use, self-efficacy, perceived acceptability, and perceived feasibility were moderate to strongly positive with r values between 0.54 and 0.84, ($p < 0.01$). The highest positive significant correlation was observed between self-efficacy and perceived easy to use ($r = 84$, $p < 0.01$). All the perceptions and the self-efficacy constructs have shown positive correlation with intention with r value in the 0.64 – 0.72 range, $p < 0.01$) (Table 4).

Factors associated with intention to use mobile phone-based messaging for MNH

Bivariable and multivariable linear regression analyses were conducted to identify factors associated with the intention to use mobile phone-based messaging for MNH. Variables that were significant during the bivariable analysis were included in the multivariable linear regression analysis**.** Accordingly, age, education, husband education, the number of literate family members, ability to read a text message, having a family member who can share SMS information, perceived usefulness, perceived easiness, self-efficacy, perceived acceptability, and perceived feasibility of mobile phone-based messaging for MNH, were included in the multivariable regression. However, only having family members who can share SMS information, perceived usefulness, perceived easiness, perceived acceptability, and perceived feasibility showed a statistically significant association with pregnant mothers' intention to use mobile phone-based messaging for MNH with ($p < 0.05$).

As shown in Table 5, having family members who can share SMS information (standardized β = 0.098, 95% CI: (0.279—1.867), perceived usefulness (standardized β = 0.283, 95% CI: (0.143—0.341), perceived easiness (standardized β = 0.209, 95% CI: (0.054—0.392), perceived acceptability (standardized β = 0.158, 95% CI: (0.007—0.178) and perceived feasibility (standardized β = 0.186, 95% CI: (0.057—0.284) had a positive significant association with the intention to use mobile phone-based messaging for MNH. Although it showed moderately strong positive correlation with intention during bivariable analysis, self-efficacy was the only psychometric variable not predicted with the intention to

Table 4 Correlations of intention to use and perceptions of mobile phone-based messaging for MNHI among pregnant mothers in Jimma Zone, Ethiopia, ($n = 279$)

SN	Variables	1	2	3	4	5	6
1	Intention	1					
2	Perceived usefulness	0.716[a]	1				
3	Perceived easiness	0.720[a]	0.767[a]	1			
4	Self-efficacy	0.634[a]	0.646[a]	0.839[a]	1		
5	Perceived acceptability	0.718[a]	0.684[a]	0.722[a]	.677[a]	1	
6	Perceived feasibility	0.666[a]	0.597[a]	0.587[a]	0.536[a]	0.818[a]	1
	Number of items	6	7	5	6	10	6
	Scale range	6–30	7–35	5–25	6–30	10–50	6–30
	Means	22.4	27.69	19.59	23.04	39.72	23.82
	Standard deviations	4.59	5.37	4.31	5.5	7.2	5.01

[a] Correlation is significant at the 0.01 level (2-tailed)

Table 5 Factors associated with intention to use mobile phone-based messaging intervention for MNHI Among pregnant mothers in Jimma Zone, Ethiopia, ($n=279$)

Variables	Unstandardized β	Standardized β	95.0% CI for β	*P* value
Age in years	-0.053	-0.050	(-0.132, 0.026)	0.187
Educational status	-0.462	-0.106	(-1.163, 0.238)	0.195
Husband educational status	-0.011	-0.002	(-0.452, 0.430)	0.961
Family member who can read and write	0.604	0.076	(-0.055, 1.262)	0.072
Can read mobile text message	-0.046	-0.004	(-1.042, 0.950)	0.927
Have family who share SMS information	1.073	0.098	(0.279, 1.867)	0.008
Perceived usefulness	0.242	0.283	(0.143, 0.341)	0.000
Perceived easiness	0.223	0.209	(0.054, 0.392)	0.010
Self-efficacy	0.025	0.030	(-0.085, 0.135)	0.654
Perceived acceptability	0.093	0.158	(0.007, 0.178)	0.034
Perceived feasibility	0.171	0.186	(0.057, 0.284)	0.003

use mobile phone-based messaging for MNH. Hence, the intention to use mobile phone-based messaging for MNH was mainly explained by having family members who can share SMS information, perceived easiness, perceived usefulness, perceived acceptability, and perceived feasibility (Table 5).

Discussion

The purpose of the current study was to assess pregnant mothers' intention and perceptions regarding the use mobile phone-based messaging for MNH. The study also assessed respondents' mobile phone usage and preference for receiving mobile phone-based messages about MNH. The findings showed that having family members who can share SMS information, perceived easiness, perceived usefulness, perceived acceptability, and perceived feasibility were positively associated with the intention to use mobile phone-based messaging for MNH.

This study also showed that 79.9% of the respondents can read mobile text messages, while only 54.1% of them can send them. This finding is comparable with a study conducted in India, where only 52.5% the participants could type and send text messages [43]. However, it is lower than the finding of study conducted in northern Ethiopia, where 91% and 87.3% of participants could read and send mobile text messages, respectively [31]. The difference might be due to variations in educational status of study participants. Although only about half of the participants in our study were able to send a text message, four out of five could read them, which would make a mobile phone-based messaging intervention feasible. Focusing on designing a one-way messaging intervention would likely maximize the provision of information on MNH to respondents in this study setting.

In this study, almost all participants preferred to receive maternal and newborn-related text messages in the Afan Oromo language. This high preference for the Afan Oromo could be because it is not only the official language but also the mother tongue for nearly all of the community members in the study setting. The preference for receiving message in the common language of their locality was also reported by the majority of participants in other studies [31, 43]. The afternoon was the preferred time for 41.9% of participants, followed by the evening, preferred by 35.8%. A study conducted in northern Ethiopia also revealed a comparable percent of mothers who preferred to receive text message reminders in the afternoon, although fewer preferred the evening [31]. Around half (48.4%) of the participants preferred receiving a text message on MNH once a day. To be successful, any mobile phone-based messaging intervention in this setting should fully consider the language, timing, and frequency preferences of mothers during the development process before implementing the intervention [29].

Having a family member who shares text message information was significantly associated with the intention to use mobile phone-based messaging for MNH. The presence of text message information sharing within a family might have created awareness and increased the perceived importance of text messages, leading to the intention to receive the messages. Moreover, all participants have a family member who can read and write, and these family members might play more supportive role, and could influence pregnant mothers' intention to use mobile phone-based messaging [44]. Therefore, the implementation of mobile phone-based messaging intervention could consider family members who can read and write to serve as facilitators and help in reading and explaining MNH information that

mothers with lower literacy levels receive through their own or a family member's phone.

Perceived usefulness was positively associated with the intention to use mobile phone-based messaging for MNH. This finding aligns with other studies where perceived usefulness positively predicted the intention to use mHealth-based services [31, 45–47]. These findings imply the importance of providing the end users with clear and concise information about the purpose, how it works, and benefits of mobile phone-based messaging before its implementation. Additionally, this study found a significant positive association between perceived easiness and intention to use mobile phone-based messaging for MNH. Similar findings have been reported in other studies, where perceived easiness was a predictor of intention [31, 46] and willingness to use mHealth services [48]. Therefore, involving mothers in the design and development process of mobile phone-based messaging intervention- through interviews, message content testing, pilot testing, and feedback ensures its easiness.

In this study, perceived acceptability and perceived feasibility were also significantly associated with intention to use mobile phone-based messaging for MNH. It implies perceived acceptability and feasibility can be used as facilitators, increasing the belief in the mobile phone-based messaging service and thereby increasing the intention to use it. Making the intervention convenient, accessible, personalized, easiness and providing clear information about its benefits could enhance the perceived acceptability and feasibility of mobile phone-based messaging for MNH [49, 50]. This, in turn, could increase the intention to use and eventually lead to its adoption.

Limitation of the study

This study has some limitations, and its findings should be interpreted with consideration of these limitations. Since the study included only pregnant mothers who visited a health facility for ANC service, its findings may not be generalizable to all pregnant mothers, particularly those who do not have ANC follow-up. Focusing on pregnant mothers who own a mobile phone is a drawback of this study, as it has the potential to marginalize those who do not have a mobile phone.

Failing to publish the protocol of the study may limit its transparency, which could result in publication bias. This study addressed only individual level factors and did not assess systemic factors that affect the implementation of technology. Furthermore, social desirability bias might exist since the data was collected using interviewer-administered technique.

Conclusion

Most respondents preferred to receive mobile phone-based messaging on MNH in the Afan Oromo language, during the afternoon and once a day. A Pregnant mother's intention to use mobile phone-based messaging for MNH is determined by having family members who share text message information, perceived usefulness and perceived easiness, perceived acceptability and feasibility of mobile phone-based messaging for MNH.

In addition to these predictors of intention, engaging mothers through interview and message content testing, as well as involving stakeholders in the design process, is crucial. Considering the identified pregnant mothers' preferences and tailoring messages to gestational and newborn age are very important when designing mobile phone-based messaging intervention for MNH. Providing a clear description of the intervention is also important during its implementation to maximize its utilization.

Abbreviation

SPSS	Statistical packages for the social sciences
AOR	Adjusted odds ratio
CI	Confidence interval
SMS	Short Message services
LMIC	Low- and middle-income countries
ANC	Antenatal care
PNC	Postnatal care
MNH	Maternal and newborn health
PHCU	Primary health care unit

Supplementary Information

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Additional file 1. STROBE- cross sectional studies checklist.

Additional file 2. Study questionnaire.

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Authors' contributions

H.G conceived the study. G.B, F.A, M.G, Y.K, J.N, D.A, and Z.B guided the design and conduct of the study. All the authors were involved in data analysis and manuscript writing. All authors read and approved the final manuscript.

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Availability of data and materials

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participants

Ethical clearance was obtained from the institutional review board of Jimma University. Permission was obtained from the Jimma Zone health department and project implementation districts. Oral informed consent was obtained from all participants which is approved by the institutional review board of

Jimma University and all methods were performed in accordance with the Declaration of Helsinki. Participants were informed about the benefits of the study and confidentiality assurance. The data collection procedure was anonymous, and their privacy was maintained.

Consent to publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Keenan L. Global progress in tackling maternal and newborn deaths stalls since 2015: UN. Who. 2023.
2. Mahmood MA, Mufidah I, Scroggs S, Siddiqui AR, Raheel H, Wibdarminto K, et al. Root-Cause Analysis of Persistently High Maternal Mortality in a Rural District of Indonesia : Role of Clinical Care Quality and Health Services Organizational Factors. 2018;2018.
3. United Nations Population Fund (UNFPA). Transformative Result: Ending Preventable Maternal Deaths. United Nations Popul Fund. 2020;1.
4. World Health Organization. Recommendations on newborn health: approved by the WHO Guidelines Review Committee. World Health Organization; 2017 p. 1–28.
5. Mullan Z. Transforming health care in Ethiopia. Lancet Glob Heal. 2016;4(1): e1.
6. Federal ministry of health FHD. National Strategy for Child Survival in Ethiopia 2015/16-2019/20 Maternal. Magzine Artic. 2015;2016:1–74.
7. UNFPA Ethiopia. Maternal Health [Internet]. [cited 2024 Feb 22]. Available from: https://ethiopia.unfpa.org/en/topics/maternal-health-17.
8. Federal ministry of health. Health Sector Transformation Plan II. 020/21–2024/25. Vol. 25. 2021.
9. Yaya S, Ghose B. Global Inequality in Maternal Health Care Service Utilization: Implications for Sustainable Development Goals. Heal Equity. 2019;3(1):145–54.
10. Wirth M, Sacks E, Delamonica E, Storeygard- A, Minujin A, Balk D. "Delivering" on the MDGs?: equity and maternal health in Ghana, Ethiopia and Kenya. East Afr J Public Health. 2008;5(3):133–41.
11. Zewdie A, Mose A, Yimer A, Melis T, Muhamed AN, Jemal AK. Essential maternal health service disruptions in Ethiopia during COVID 19 pandemic: a systematic review. BMC Womens Health. 2022;22(1):1–8.
12. Thomas SD, Mobley SC, Hudgins JL, Sutherland DE, Inglett SB, Ange BL. Conditions and dynamics that impact maternal health literacy among high risk prenatal-interconceptional women. Int J Environ Res Public Health. 2018;15(7):1–16.
13. Girmaye E, Mamo K, Ejara B, Wondimu F, Mossisa M. Assessment of Knowledge, Attitude, and Practice of Skilled Assistance Seeking Maternal Healthcare Services and Associated Factors among Women in West Shoa Zone, Oromia Region. Ethiopia Nurs Res Pract. 2021;2021:1–11.
14. Agonafir M, Shimbre MS, Hussen S, Temesgen G, Boday B, Tunje A, et al. Community Based Essential Newborn Care Practices and Associated Factors among Women Who Gave Birth at Home in Last 12 Months in Amaro Woreda, Southern Ethiopia, 2019. Glob Pediatr Heal. 2021;8:1–8.
15. Yanagisawa S, Oum S, Wakai S. Determinants of skilled birth attendance in rural Cambodia. Trop Med Int Heal. 2006;11(2):238–51.
16. Lassi ZS, Kedzior SGE, Bhutta ZA. Community-based maternal and newborn educational care packages for improving neonatal health and survival in low- and middle-income countries. Cochrane Database Syst Rev. 2019;2019(11).
17. Hampshire K, Mwase-Vuma T, Alemu K, Abane A, Munthali A, Awoke T, et al. Informal mhealth at scale in Africa: Opportunities and challenges. World Dev. 2021;140: 105257.
18. World Health Organization. WHO Guideline: Recommendationson digital strengthening for health system interventions. 2019;91.
19. Lee SH, Nurmatov UB, Nwaru BI, Mukherjee M, Grant L, Pagliari C. Effectiveness of mHealth interventions for maternal, newborn and child health in low–and middle–income countries: Systematic review and meta–analysis. J Glob Health. 2016;6(1):1–17.
20. International Telecommunication Union. World Telecommunication/ICT Indicators Database 2023. Public Underst Sci. 2023;22(1):2–15.
21. Felicie S, Sondaal V, Browne JL, Amoakoh-coleman M, Borgstein A, Miltenburg AS, et al. Assessing the Effect of mHealth Interventions in Improving Maternal and Neonatal Care in Low- and Middle-Income Countries : A Systematic Review. PLoS Med. 2016;11(5):1–26.
22. Agarwal S, Labrique A. Newborn health on the line: The potential mHealth applications. JAMA Netw. 2014;312(5):229–30.
23. Hall AK, Cole-Lewis H, Bernhardt JM. Mobile text messaging for health: A systematic review of reviews. Annu Rev Public Health. 2015;36:393–415.
24. Cole-Lewis H, Kershaw T. Text messaging as a tool for behavior change in disease prevention and management. Epidemiol Rev. 2010;32(1):56–69.
25. Li M, Zhang Y, Chen X, Wang D, Ji M, Jiang Y, et al. Effectiveness of community-based folate-oriented tertiary interventions on incidence of fetus and birth defects: A protocol for a single-blind cluster randomized controlled trial. BMC Pregnancy Childbirth. 2020;20(1):475.
26. Tobe RG, Haque SE, Ikegami K, Mori R. Mobile-health tool to improve maternal and neonatal health care in Bangladesh: A cluster randomized controlled trial. BMC Pregnancy Childbirth. 2018;18(1):1–7.
27. Gilbert M, Hottes TS, Kerr T, Taylor D, Fairley CK, Lester R, et al. Factors associated with intention to use internet-based testing for sexually transmitted infections among men who have sex with men. J Med Internet Res. 2013;15(11):1–11.
28. Maar MA, Yeates K, Toth Z, Barron M, Boesch L (hons), Hua-Stewart D, et al. Unpacking the black box: A formative research approach to the development of theory-driven, evidence-based, and culturally safe text messages in mobile health interventions. JMIR mHealth uHealth. 2016;4(1).
29. Endehabtu B, Weldeab A, Were M, Lester R, Worku A, Tilahun B. Mobile Phone Access and Willingness Among Mothers to Receive a Text-Based mHealth Intervention to Improve Prenatal Care in Northwest Ethiopia : Cross-Sectional Study. JMIR Pediatr Parent. 2018;1(2):1–13.
30. Aranda-Jan CB, Mohutsiwa-Dibe N, Loukanova S. Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa. BMC Public Health. 2014;14(1):1–15.
31. Mekonnen ZA, Gelaye KA, Were MC, Tilahun B. Mothers intention and preference to use mobile phone text message reminders for child vaccination in Northwest Ethiopia. BMJ Heal Care Informatics. 2021;28(1):1–9.
32. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q Manag Inf Syst. 1989;13(3):319–39.
33. Amoroso DL, Hunsinger S. Measuring the Acceptance of Internet Technology by Consumers. Int J E-Adoption. 2009;1(3):48–81.
34. Venkatesh V, Bala H. Technology Acceptance Model 3 and a Research Agenda on Interventions. J Decis Sci Inst. 2008;39(2):273–315.
35. Sekhon M, Cartwright M, Francis JJ. Acceptability of healthcare interventions: An overview of reviews and development of a theoretical framework. BMC Health Serv Res. 2017;17(1):1–13.
36. Weiner BJ, Lewis CC, Stanick C, Powell BJ, Dorsey CN, Clary AS, et al. Psychometric assessment of three newly developed implementation outcome measures. Implement Sci. 2017;12(1):1–12.
37. El-Wajeeh M, H. Galal-Edeen PG, Mokhtar DH. Technology Acceptance Model for Mobile Health Systems. IOSR J Mob Comput Appl. 2014;1(1):21–33.
38. Ajzen ICEK. The Theory of Planned Behavior. Organ Behav Hum Decis Process Process. 1991;50:179–211.
39. Compeau DR, Higgins CA. Computer Self-Efficacy: Development Of A Measure And Initial Test. MIS Q. 1995;19(2):189–211.
40. Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, et al. Outcomes for implementation research: Conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Heal Ment Heal Serv Res. 2011;38(2):65–76.

41. Sekhon M, Cartwright M, Francis JJ. Development of a theory-informed questionnaire to assess the acceptability of healthcare interventions. BMC Health Serv Res. 2022;22(1):1–12.
42. Lisa Hjelm, Astrid Mathiassen, Darryl Miller AW. WFP, Creation of a Wealth Index; VAM-Guidance paper. Wfp. 2017. p. 1–26.
43. Datta SS, Ranganathan P, Sivakumar KS. A study to assess the feasibility of text messaging service in delivering maternal and child healthcare messages in a rural area of Tamil nadu. India Australas Med J. 2014;7(4):175–80.
44. Peek STM, Wouters EJM, van Hoof J, Luijkx KG, Boeije HR, Vrijhoef HJM. Factors influencing acceptance of technology for aging in place: A systematic review. Int J Med Inform. 2014;83(4):235–48.
45. Deng Z, Hong Z, Ren C, Zhang W, Xiang F. What predicts patients' adoption intention toward mhealth services in China: Empirical study. JMIR mHealth uHealth. 2018;6(8):1–14.
46. Palos-sanchez PR, Saura JR, Miguel Á, Martin R. Toward a Better Understanding of the Intention to Use mHealth Apps : Exploratory Study. JMIR Mhealth Uhealth. 2021;9(9):1–19.
47. Wang X, Lee CF, Jiang J, Zhu X. Factors Influencing the Aged in the Use of Mobile Healthcare Applications: An Empirical Study in China. Healthc. 2023;11(3).
48. Walle AD, Ferede TA, Shibabaw AA, Wubante SM, Demsash AW. Willingness of diabetes mellitus patients to use mHealth applications and its care associated factors for self-care management in a low-income country: an input for digital health implementation. BMJ Heal Care Informatics. 2023;1–9.
49. Materia FT, Smyth JM. Acceptability of intervention design factors in mhealth intervention research: Experimental factorial study. JMIR mHealth uHealth. 2021;9(7):1–13.
50. Degroote L, Dyck D Van, Bourdeaudhuij I De, Paepe A De, Crombez G. Acceptability and feasibility of the mHealth intervention ' MyDayPlan ' to increase physical activity in a general adult population. BMC Public Health. 2020;1–12.

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