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ORIGINAL RESEARCH

Willingness to Receive mHealth Messages Among Diabetic Patients at Mizan Tepi University Teaching Hospital: Implications for Digital Health

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Background: The growing access and use of mobile technology provide new tools for diabetic care and management. Mobile-based technology (mHealth) is considered as a useful tool to deliver healthcare services as a makeshift alternative for consultations and follow-up of diabetic patients. Therefore, this study aimed to scrutinize the willingness to receive mHealth messages and its associated factors among diabetic patients at Mizan Tepi University Teaching Hospital (MTUTH).

Methods: A cross-sectional study was conducted among two hundred thirty-three diabetic patients. Data were collected using a structured and pre-tested interviewer-administered questionnaire. Epidata manager and SPSS software were used to enter and analyze the data, respectively. Multivariable logistic regression analysis was carried out to identify the independent factors associated with patients' willingness to receive mHealth messages.

Results: Two hundred and thirty-three patients participated in this study with a 95% response rate. Majority of the patients (213, 91.4%) had a mobile phone. Among those who had mobile phones, 59.1%, (95% CI: 48–64) of patients were willing to receive mHealth messages from providers, if they were offered the opportunity. In the multivariable binary logistic regression analysis, monthly income >3000 ETB (AOR = 2.43; 95% CI (1.36–3.81)), owning smartphone (AOR = 3.85; 95% CI (1.67–4.89)), internet access in their mobile phone (AOR = 2.74; 95% CI (1.42–4.61)), perceived usefulness (AOR = 4.66; 95% CI (2.38–6.83)) and perceived ease to use (AOR = 3.87; 95% CI (1.57–5.46)) were identified as significant factors associated with diabetic patients' willingness to receive mHealth messages.

Conclusion: A high proportion of patients who had mobile phones were willing to receive mHealth messages. Monthly income, type of mobile phone, access to the internet on the mobile phone, perceived ease of use, and perceived usefulness were associated with willingness to receive mHealth messages. Therefore, focusing on these factors could provide insight for designing and implementing mHealth messages for diabetic patients.

Keywords: mHealth, diabetic patients, willingness

Introduction

The global pandemic of Diabetes Mellitus (DM) continues at an alarming rate and more than half a billion (537 million) adults are living with diabetes. This figure is estimated to reach 700 million in 2045.[1] DM has dramatically risen in Africa, where 24 million adults had diabetes in 2021.[1,2] Ethiopia is one of the top burdened country in sub-Saharan Africa (SSA).[2,3] A systematic review and meta-analysis reported a pooled prevalence of 6.5% with significant urban-rural disparities in Ethiopia.[3]

From the economic versus healthcare costs devastation, DM has been causing its treatment and care challenging.[4–7] The estimated cost of more than 760 US$ in 2019. Both direct and indirect costs of the disease ranges from 29 to 237 US

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$ per person per year mainly in lower-middle-income countries (LMICs).[8] Furthermore, adherence to diabetic medication and care remains a problem in these countries.[9,10] For instance, studies conducted in Ethiopia reported only 25% of patients adhered to their medication and recommended diet.[11,12] Until now, global efforts have been made to halt the surge of the diabetic pandemic through the use of a healthy diet and regular practice of physical exercise.[13]

mHealth is a mobile-based telehealth approach that allows health providers to exchange information with patients or offer services, such as direct care, education, or remote monitoring through text messaging, web browsing, email, and videos.[14] The advancement of the technology offered cost-effective and friendly services for patients with chronic diseases. It has shown the ability to deliver healthcare services, or serve as a makeshift alternative for consultations and follow-up on chronic diseases.[14–16] Therefore, with the rise of emerging communication technologies; diabetic care and management could benefit from achieving glycemic control and adherence to physical activity, a healthy diet, and diabetic medication/drugs.[14,17,18]

Globally, access to mobile phones and technology is rapidly growing with more than 5 billion people using a mobile phone and 40% of them have smartphones.[19–21] With the rise of mobile phone access and use, there is also a growing interest in receiving mHealth messages in sub-Saharan Africa (SSA).[22–25] For instance, in Nigeria 97% had a mobile phone but 72.6% were willing to receive mobile phone-based diabetes health services among diabetic patients.[26] In Ethiopia, the access and use of mobile phones also rising with 55 total telecommunication and more than 52 million mobile voice subscribers in 2021.[27] A study conducted in Gondar town of Ethiopia showed a 78% of diabetic patients had access to mobile phones. Of those who had access to a mobile phone 71% of them were willing to receive mobile phone-based health services.[28] On the other hand, 79% of mothers had the intention to use text message reminders for vaccination in Northern Ethiopia.[29] With this evidence, there is a huge window of opportunity to use mobile technology for diabetic care and self-management.[30]

Multiple shreds of evidence showed mHealth enhances glycemic control, healthy diet, physical activity, and dropout among DM in developing countries.[31,32] One of the systematic reviews conducted in sub-Saharan Africa indicated the feasibility of empowering diabetic patients and enhancing retention of the patient in chronic disease care.[33] Despite DM being an ideal candidate public health problem for mHealth intervention, it is not well implemented and explored in SSA including Ethiopia.[30]

To implement mHealth technologies for diabetic care and management, it is crucial to identify determinants of patient willingness to receive mHealth messages. However, multiple factors were identified including socio-economic (age, income, sex), educational status, residential area, access to the internet, perceived ease, and usefulness.[26,28,29,34–36] Despite the paramount importance of mHealth and determinants for diabetic care and management, there is a paucity of evidence on the willingness of patients to use mHealth technology in Ethiopia. Therefore, this study aimed to determine the willingness to receive mHealth messages and its associated factors among diabetic patients in Southwest Ethiopia.

Methods and Materials

Study Area, Design, and Setting

A hospital-based cross-sectional study was conducted from August to September 2021 at Mizan Tepi University Teaching Hospital (MTUTH). The hospital is found in the Bench Sheko Zone of Mizan-Aman town, which is located 561 km away from Ethiopian capital Addis Ababa. During the study period, 245 diabetic patients are on follow-up at the hospital's chronic disease follow-up clinic. The study was conducted from 02 September to 26 October, 2021.

Study Population, Sample Size, and Sampling Procedure

The study population involved diabetic patients under follow-ups in the hospital for more than 3 months. All diabetic patients who had follow-up visits at the chronic disease clinic were included in the study to enhance the robustness of the study. Patients were recruited consecutively until all patients in the follow-up clinic were interviewed within the study period. The patient card number was recorded after interviewing the patient to identify an interviewed patient in the next follow-up visit.

Measurement, Method, and Quality Control

Data were collected from structured and pre-tested interviewer-administered questionnaires adapted from previously published literature.[26,28,29,34] The questionnaire included socio-demographic, clinical and behavioral factors, the possession and utilization of mobile phones, perceived ease, and perceived usefulness. An English version of the questionnaire was prepared for data collection and translated into the Amharic version for simplicity of data collection. To verify the consistency of the meaning, the Amharic version was translated back to English. A pretest was done on 5% of the sample and necessary modifications were made accordingly. Data were collected by three trained data collectors and supervised by a qualified health officer. The collected data were checked for completeness, clarity, and consistency by the supervisor and investigators on a daily basis.

Study Variables and Measurements

Willingness to use was measured by a single yes/no question about whether they would be willing to receive a mobile phone-based message about diabetic care, either through a mobile phone voice call or messaging services.[28]

Perceived ease of use was defined as the extent to which a person believes that using a particular system (in this case receiving a mHealth message) would be free from effort and measured by five items on a five-point Likert scale ranging from 1 to 5 (1 = strongly agree to 5 = strongly disagree). The final scores of the above three (agree and strongly agree) were categorized as 'Yes', while those final scores of three or below (strongly disagree, disagree and neutral) were categorized as "No".[29,37,38]

Perceived usefulness was defined as the degree to which a person believes that using a particular system (in this case receiving a mHealth message) would enhance his or her task and assessed by four items on a five-point Likert scale ranging from 1 to 5 (1 = strongly agree to 5 = strongly disagree). The final scores of the above three (agree and strongly agree) were categorized as 'Yes', while those final scores of three or below (strongly disagree, disagree and neutral) were categorized as "No".[29,37,38] The other independent variables include sociodemographic variables (age, sex, educational status, monthly income, marital status, and employment status), ownership of television, radio, transportation mechanism, behavioral factors such as substance use, and the habit of sugar intake, physical activity behavior, and mobile use pattern.

Data Processing and Analysis

Epidata manager version 4.0.2 was used for data entry and SPSS version 25 was utilized for analysis. Data exploration was conducted to examine different characteristics of the study participants, and descriptive statistics were carried out.

Bivariable binary logistic regression was carried out to select a candidate for multivariable binary logistic regression analysis with a p-value <0.25 at a 95% confidence level (CI). Then, candidate variables were entered into a multivariable logistic regressions model using the backward method to identify the statistically significant factors for the outcome variable by controlling possible confounders. The degree of association between dependent and independent variables was assessed using an adjusted odds ratio (aOR) and statistical significance was declared at 95% of the CI with a p-value of less than 0.05.

Results

Socio-Demographic Characteristics of the Patient

Two hundred and thirty-three patients have participated in this study, which yields 95% response. More than half of the participants were 137(58.8%) male and 127(62%) urban residents. The mean age was 44 years (SD = 11.5) and the median income was 4500 ETB (IQR 2750–7000 ETB). The majority of the patient were married 166 (71.2%) and lives with their spouse 165 (70.8%) (Table 1).

Clinical and Behavioral Attributes of Patients

The majority of patients 149 (63.9%) were diagnosed three and above years ago with diabetes. Ninety-four (40.3%) and 77 (33%) of patients ever missed their appointments and medication for different reasons, respectively. Forty-nine (21%) patients had used substances and 105 (45%) do physical exercise per week (Table 2).

Table 1 Socio-Demographic Characteristics of Diabetic Patients in Mizan Tepi University Teaching Hospital, Southwestern Ethiopia, 2021 (n = 233)

Variables		Frequency	Percent (%)
Age (Years)	<30	25	10.
	30–45	119	51.1
	>45	89	38.2
Sex	Male	137	58.8
	Female	96	41.2
Place of residence	Urban	147	63.1
	Rural	86	36.9
Educational status	Illiterate	25	10.7
	Informal education[a]	74	31.8
	Primary school	52	22.3
	Secondary school	51	21.9
	Higher education	31	13.3
Marital status	Single	39	16.7
	Married	166	71.2
	Separated	10	4.3
	Widowed/Divorced	18	7.7
Income status (ETH Birr)	<1500	25	10.7
	1500–3000	50	21.5
	>3000	158	67.8
Occupational status	Gov't Employed	40	17.1
	Farmer	46	19.7
	Merchant	64	27.5
	Student	13	5.6
	Housewife	39	16.8
	Daily Labourer	18	7.7
	Others[b]	13	5.6
Religion	Orthodox	72	30.9
	Protestant	82	35.2
	Muslim	73	31.3
	Catholic	6	2.6
Whom do you live with	Alone	34	14.6
	With spouse	165	70.8
	With parents	19	8.2
	Unstable	15	6.4
Radio	Yes	160	68.7
	No	73	31.3
Television	Yes	152	65.2
	No	81	34.8
Time to reach the hospital	<1 hour	167	71.7
	≥ 1 hour	66	28.3

Notes: [a]Those who able to read and write but do not attend formal school, [b]Driver, Unemployed & Carpenter.

Table 2 Clinical and Behavioral Attributes of Diabetic Patients in Mizan Tepi University Teaching Hospital, Southwestern Ethiopia, 2021 (n = 233)

Variables		Frequency	Percent (%)
Time since diagnosis	< 1 year 1–3 years > 3 years	19 65 149	8.2 27.9 63.9
Diabetes follow-up time	< 1 year 1–3 years > 3 years	20 66 147	8.6 28.3 63.1
Obtained education during follow up	Yes No	227 6	97.4 2.6
Obtained medication at any time	Yes No	142 91	60.9 39.1
Have you ever missed your appointment	Yes No	94 139	40.3 59.7
Reasons for missing appointment	I forgot it Unable to come myself I did not get permission from the employer	69 18 7	73.4 19.1 7.5
Did you miss your medication	Yes No	77 156	33 67
How often did you miss your medication	Every day At least once a week More than once a week	33 28 16	42.8 36.4 20.8
Substance use	Yes No	49 184	21 79
Type of substance use	Alcohol Khat Cigarette	21 27 1	9 11.6 0.4
A habit of excessive sugar consumption (per week)	Yes No	66 167	28.3 71.7
A habit of physical exercise (per week)	Yes No	105 128	45 55
Frequency of physical exercise (per week)	Once Twice Three-time Every day	38 46 15 6	36.2 43.8 14.3 5.7

The Pattern of Mobile Phone Utilization

Two hundred thirteen (91.4%) of patients have a mobile phone and 120 (56.3%) were using a regular mobile phone. Twenty-eight (13.1%) of diabetic patients used their mobile phones as a medication reminder and 132 (62%) of them can read and send text messages on their phone. Twenty-three (10.8%) of the patients share their mobile phones with others in the house and 27 (12. 6) of the patients are faced with network problems (Table 3).

Willingness to Receive mHealth Services

In this study from those who had a mobile phone, 126 (59.1%), 95% CI: 48–64 of diabetic patients were willing to receive mHealth messages from providers, if they were offered the opportunity (Figure 1). Of those willing to receive

Table 3 Diabetic Patients' Mobile Usage Patterns in Mizan Tepi University Teaching Hospital, Southwestern Ethiopia, 2021 (n = 233)

Variables		Frequency	Percent (%)
Type of mobile phone	Regular (standard) Smart	120 93	56.3 46.7
Mobile phone use as a medication reminder	Yes No	28 185	13.1 86.9
Have another phone number	Yes No	93 120	43.7 56.3
Switch off the phone during the day	Yes No	41 172	19.1 80.8
Experienced mobile network challenges	Usually Sometimes Not at all	27 63 123	12.6 29.6 57.8
Face mobile phone charging problem	Yes No	78 135	36.6 63.4
Mobile phone lost, damaged, or stolen in the past	Yes No	34 179	16 84
Share mobile phone with others in the house	Yes No	23 190	10.8 89.2
Preferred way of communications	Verbal Text	202 11	94.8 5.2
Can read and send a mobile text message	Yes No	132 81	62 38
Preferred time of the day to receive mHealth message	Morning Afternoon Evening At any time	34 9 19 151	16 4.2 8.9 70.9
Preferred language for mHealth message	Amharic English Both Amharic & English	153 13 47	71.8 6.1 22.1
Use the internet on mobile phone	Yes No	108 105	50.7 49.3
Do not answer unknown calls	Yes No	68 145	31.9 68.1
Put mobile phone where others could access	Yes No	36 177	16.9 83.1
Likelihood of mHealth message seen by others	Very likely Somewhat likely Somewhat unlikely Very unlikely	30 53 38 92	14.1 24.9 17.8 43.2

mHealth messages 51 (40.5%) preferred mobile phone calls, 41 (32.5%) text messages, and 34 (27%) both mobile phone calls and text messages. More than half (57.7%) of the patients perceived receiving mHealth would improve their diabetic management and 123 patients perceived mHealth messages are easy/simple to use (Figure 1).

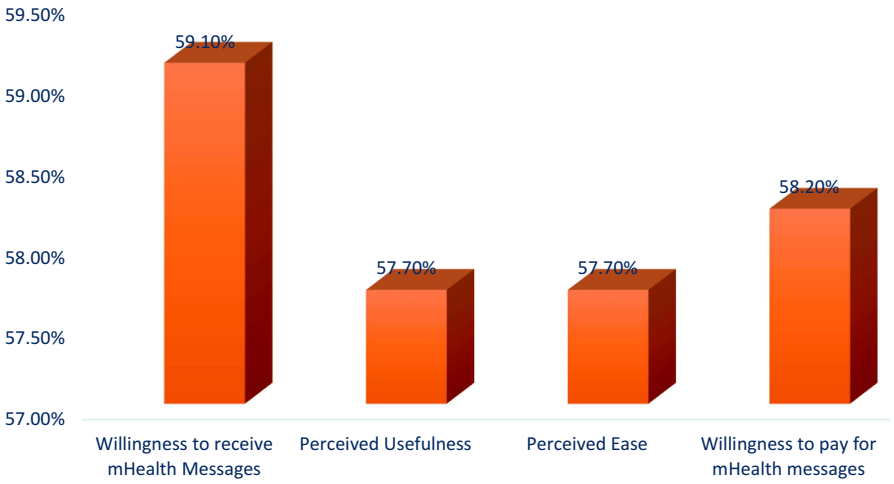

Figure 1 Intention to receive mHealth messages among diabetic patients in Mizan Tepi University Teaching Hospital, Southwestern Ethiopia, 2021 (n=213).

Factors Associated with Patients Willingness to Receive mHealth Messages

Bivariable binary logistic regression analysis was done to identify candidate variables for multivariable analysis. Accordingly, age, place of residence, monthly income, time to reach the hospital, type of mobile, using the internet on the mobile phone, perceived usefulness and perceived ease were candidate variables for the final model.

In the final multivariable binary logistic regression analysis monthly income, type of mobile, using the internet on the mobile phone, perceived usefulness, and perceived ease of use were significantly associated with diabetic patients' willingness to receive mHealth messages.

Patients with a monthly income of >3000 ETB were two times more likely willing to receive mHealth messages AOR = 2.43; 95% CI (1.36–3.81) in comparison with those patients with a monthly income of <1500 ETB. The likelihood of willingness to receive mHealth messages was 3.85 times higher AOR = 3.85; 95% CI (1.67–4.89) among patients who had smartphones than other types of phone users. Patients who used the internet on their mobile phones were nearly three times more likely (AOR = 2.74; 95% CI (1.42–4.61)) willing to receive mHealth messages as compared to their counterparts.

Moreover, perceived usefulness and perceived ease of use are also significantly associated with patients' willingness to receive mHealth. Patients who perceive receiving mHealth as useful were 4.66 times more likely AOR = 4.66; 95% CI (2.38–6.83) to receive mHealth for their diabetic care. Similarly, the odds of willingness to receive mHealth messages are around four times higher AOR = 3.87; 95% CI (1.57–5.46) among patients who perceive receiving mHealth messages as easy in comparison with their counterparts (Table 4).

Discussion

This study was conducted to investigate the willingness and its associated factors associated among diabetic patients to receive mHealth messages. More than half 59.1% (95% CI: 48–64) of diabetic patients have a willingness to receive mHealth messages. Monthly income, type of mobile, using the internet on the mobile phone, perceived usefulness, and perceived ease were significantly associated with receiving mHealth messages.

In the current study, as mentioned above, the majority 59.1% of patients are willing to receive mHealth messages for their diabetic care. Our finding is consistent with studies done among diabetic patients in Japan (50%),[39] the USA (56.7%),[40] and Ethiopian patients living with HIV/AIDS.[34] However, the proportion observed in this study is lower than studies conducted in Gondar, Ethiopia (70.5%),[28] and Nigeria (72.6%).[26] The discrepancy could be due to differences in socio-economic and digital technology awareness among study participants.

Table 4 Bivariable and Multivariable Binary Logistic Regression Analysis of Factors Associated with Willingness to Receive mHealth Messages Among Diabetic Patients in Mizan Tepi University Teaching Hospital Southwestern Ethiopia, 2021

Variables	Intention to Receive mHealth		COR at 95% CI	aOR at 95% CI	P-value
	Yes (%)	No (%)			
Age					
<30	11	13	1	1	
30–45	62	46	1.59 (0.89–5.64)	1.43 (0.68–4.76)	0.16
>45	53	28	2.24 (0.77–2.55)	1.78 (0.54–1.67)	0.23
Place of residence					
Rural	37	40	1	1	
Urban	89	47	0.48 (0.26–1.62)	0.36 (0.14–1.36)	0.37
Monthly Income					
<1500 ETB	8	16	1	1	
1500–3000 ETB	22	21	2.09 (1.54–9.58)	1.34 (0.31–7.43)	0.18
>3000 ETB	96	50	3.07 (1.92–5.65)	2.43 (1.36–3.81)	0.03*
Time taken to reach the hospital					
< 1 hour	90	63	0.95 (0.52–1.75)	0.67 (0.36–1.48)	0.18
≥ 1 hour	36	24	1	1	
Type of mobile phone					
Smart	72	21	4.20 (2.29–7.67)	3.85 (1.67–4.89)	<0.001*
Regular/standard	54	66	1	1	
Use the internet on mobile phone					
Yes	79	29	3.36 (1.89–5.96)	2.74 (1.42–4.61)	0.04*
No	47	58	1		
Perceived Usefulness					
Useful	68	55	7.32 (2.76–10.98)	4.66 (2.38–6.83)	<0.001*
Not useful	13	77	1	1	
Perceived Ease to Use					
Easy	54	69	5.09 (1.89–6.74)	3.87 (1.57–5.46)	<0.001*
Not easy	12	78	1	1	

Note: *Statistically significant at p-value <0.05.
Abbreviations: COR, Crude Odds Ratio; aOR, Adjusted Odds Ratio.

The monthly income of patients has shown a significant association with willingness to receive mHealth messages for diabetic care among diabetic patients. This is in agreement with previous studies.[36,41] Patients with lower income might perceive difficulty in accessing and adopting mHealth tools due to economic cost. Previous studies have also reported economic cost related to mHealth as a determinant of mHealth acceptance and use.[42,43] This finding calls for the design and implementation of cost-effective mHealth services for those already facing a catastrophic direct and indirect cost of treatment.[22]

In our study, patients with a smartphone are more likely to receive mHealth messages than those patients with standard or regular phones. This is in agreement with a study done among diabetic patients in Nigeria.[26] The possible reason could be smartphone users are more educated and able to access information on the internet by their phone about the care given for them.

Internet utilization has been associated with the willingness and acceptance of mHealth tools in the previous studies.[44,45] Our finding also shows patients who use the internet are more willing to receive mHealth messages for their diabetic care than their counterparts. Therefore, scaling up the internet access and infrastructure is needed for efficient delivery of mHealth messages.

Moreover, our study showed that perceived usefulness had a strong association with willingness to receive mHealth messages. Patients' perception of whether the offered system or services are useful or not is a very important factor for the adoption of any mHealth tools.[46] This finding is in agreement with studies conducted in Gondar, Ethiopia,[29] and China.[47] Hence, mHealth tools need to be implemented by providing adequate information and demonstration about actual benefits for end-users.

Perceived ease of use of the new technology was another significant factor in diabetic patients' willingness to receive mHealth messages for their care. Patients would hesitate to use new mHealth messages or tools regardless of how useful the system would be if they perceive the service is difficult to use. This is consistent with previous studies.[29,46] This implied the need to develop an easy and patient-friendly mHealth intervention for diabetic patients.

Limitations

This study should be interpreted considering some limitations. First, we assessed the intent of receiving mHealth messages and not the actual use of mHealth. We also assess the willingness among those who already have a mobile phone, so the generalizability is to restrict to only mobile phone owners. Variables like glycemic control could be correlated with willingness, which we missed to measure. Finally, the response might be subjected to bias since it is a self-report from the patient.

Conclusion

This study showed that a majority of patients had the intention to receive mHealth messages for their diabetic care. This implied motivation to receive mHealth messages is promising and could be used as a tool for diabetic patients. Monthly income, type of mobile, using the internet on the mobile phone, perceived usefulness, and perceived ease of use were significantly associated with receiving mHealth messages among diabetic patients. Therefore, designing and implementing mHealth messages for diabetic patients is recommended considering the identified factors for improving diabetic care and treatment.

Data Sharing Statement

Data will be available upon reasonable request from the corresponding author.

Ethical Approval

Before data collection, appropriate ethical clearance and a supportive letter were obtained from Mizan Tepi University, College of Medicine and Health Sciences with Ref.no: 027/2020. Informed consent was obtained from the patient. Moreover, the collected data were kept safe throughout the whole data collection and analysis time. We confirmed that the study was conducted in accordance with the Declaration of Helsinki.

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Disclosure

The authors declare that they have no conflicts of interest.

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