A Study On The Use Of Smartphones To Improve Adherence To Anti-Diabetic Treatment In A Tertiary Hospital in Accra, Ghana

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Abstract

Introduction: Diabetes Mellitus is a disease caused by the body's inability to control blood glucose levels, with Type 1 and Type 2 being the two main types. It can lead to serious medical issues such as kidney, eye, and cardiovascular problems, and is the 7th most significant cause of death globally. Patients and their families are financially burdened by diabetes, with hospital inpatient treatment, medical supplies, and physician appointments making up the majority of the direct costs. The use of smartphones has made it easier to provide patient-centred healthcare, fostering a collaborative relationship between patients and medical personnel at a lower price and faster pace.

Aim: The main objective of this study is to examine the use of Information and Communication Technology tools (smartphones) in treatment adherence in patients with diabetes mellitus at the Greater Accra Regional Hospital (GARH).

Methods: This exploratory cross-sectional study employed a questionnaire administered to patients at the GARH Diabetes Clinic. The extracted data was analysed using WPS Spreadsheet and Statistical Package for the Social Sciences, Version 27. Data was analysed using descriptive statistics (Frequency and percentages).

Results: The study included 120 participants (61 females and 59 males), predominantly aged over 45 years, residing in Accra. Type 2 Diabetes was prevalent in 68.3% of participants, with 31.7% having Type 1 Diabetes, all diagnosed six months ago. Most patients managed their condition well, attending clinics consistently. The study found that 74.1% of participants owned smartphones, with a majority having owned them for over a year. Additionally, 30.3% were aware of diabetes apps, and 58.1% of those who were aware and used them. "My-Therapy" was the top medication tracker, and "Diabetes diary-Glucose tracker" was for glucose monitoring. Users found the apps to be beneficial (88.9%), which correlated with a decrease in hospitalisations. Limited awareness, unavailability, and compatibility concerns deterred usage; however, participants expressed willingness to embrace such apps.

Conclusion: This study examined participants' socio-demographics, diabetes-related information, smartphone usage, and awareness of diabetes apps. Findings showed positive perceptions of the benefits of apps but highlighted low awareness among non-users. Targeted efforts are needed to promote app adoption for better diabetes management.

Keywords: Adherence, anti-diabetic treatment, diabetic-related apps, smartphones, diabetes mellitus.

Introduction

Diabetes mellitus is a condition caused by the body's inability to regulate blood glucose levels. The two main types are Type 1 and Type 2 diabetes. Type 1 diabetes develops when the body cannot produce enough insulin; it is insulin-dependent. Type 2 diabetes develops when the body produces enough insulin but is unable to use it properly, thus called non- insulin-dependent diabetes mellitus (NIDDM).[1,2] The disease can cause severe harm to the body's essential organs, such as the kidneys, eyes and others, which can result in impairments and occasionally even death.[1] According to the International Diabetes Federation (IDF), the disease affected 463 million people worldwide in 2019 and was the 7th leading cause of death globally.[2] Patients and their families are severely financially burdened by diabetes. Hospital inpatient treatment, medical supplies, and physician appointments account for the majority of direct costs. The indirect costs are associated with higher absenteeism, worse productivity at work, and less capacity for production due to a disability related to diabetes mellitus.[2]

Information and Communication Technology (ICT) use has made it easier to provide patient-centred healthcare, which fosters a collaborative relationship between patients and medical personnel at a lower cost and faster pace. Additionally, it has enhanced the standard of care and the communication between patients and medical staff. As a result, it is becoming a vital tool for improving the delivery of healthcare services worldwide.[3] Due to population increase, age, urbanisation, rising obesity rates, and physical inactivity, there is an increasing number of persons with diabetes mellitus.[4] Recently, health technology has been rapidly developed and used to process, access, and retrieve data and information effectively and efficiently. Currently, most European nations use ICT in healthcare. The usage of computers in the healthcare industry is virtually universal. E-health plans and initiatives, including electronic medical reports and e-prescriptions, are also in place in many European Union countries.[5]

ICT has become a necessary tool for health professionals, notably nurses, in addition to playing a crucial role in clinical practice and research. They are leading the charge in organising and delivering healthcare services. They must immediately adapt their services to the present technological transition, which includes communication and decision- making.[6] Adherence to drug therapy refers to how closely a person follows advice from medical professionals regarding using drugs or making lifestyle adjustments.[7] Non-adherence occurs when a patient fails to comply with a prescription or stops using a medication.[8] Non-adherence frequently raises the risk of relapse, sub-therapeutic results, and avoidable deaths.[8] This can happen due to either intentional or unintentional reasons.[9] When patients do not take their medications as prescribed, there is increased hospital admissions, readmissions, emergency room visits, and fatalities.[10,11] A growing body of literature on patient adherence to anti-diabetic treatment regimen has shown that a significant proportion of patients are non-adherent, ranging from as low as 6.3% to as high as 87%.[12] Medication non-adherence is a significant problem in low-and middle-income countries, such as Ghana. Diabetes also accounted for 6.8% of all adult admissions and 7.8% of all adult deaths at the Korle-Bu Teaching Hospital.[13]

With previous studies showing a meagre prevalence rate of less than 0.02% of the adult population and more current statistics ranging from 6.2% to 13.9%, Ghana's trends in the prevalence of diabetes do not materially differ from those reported in other sub- Saharan African countries.[14] In Ghana, like in many other Low and Middle Income Countries (LMICs), there are few national level data on medication adherence, particularly among patients with diabetes and hypertension. However, a study conducted by Bruce et al., discovered a 38.5% adherence rate among diabetic patients.[15] These numbers fall below the suggested 90% threshold.[16]

A study conducted at the Ho Municipal Hospital in the Volta region of Ghana reported that patients living with diabetes mellitus had high levels of uncontrolled glycaemia and blood pressure

secondary to medication non-adherence.[12] This study aims to examine the use of ICT tools (Smartphone Apps) in treatment adherence among patients with diabetes mellitus at the Greater Accra Regional Hospital.

Methods

This cross-sectional study was conducted at the Greater Accra Regional Hospital (GARH), located in North Ridge, within the Osu-Klottey Sub-Metro of the Accra Metropolitan Area, Greater Accra Region, Ghana. It covers a land area of approximately 15.7 acres with an estimated population of over 4,671,363 based on 2016 projections from the 2010 Ghana Statistical Service census. The immediate catchment area includes suburbs such as Ridge, Nima, Maamobi, Kanda, Accra New Town, Kotobabi, Osu, La, Adabraka, Achimota, Airport Residential Area, and Central Accra.

The study population consisted of individuals aged 18 years or older who were diagnosed with diabetes mellitus and presented at the special Out-Patient Department (OPD) clinic at GARH, and who provided consent to participate in the study. The inclusion criteria required participants to have been on medication for at least six months and to have provided informed consent.

A convenient sampling method was employed to select participants. A total of 120 participants were included in the study. Data collection took place over one month, from February to March 2023, following the pretesting of the research questionnaire. The data were primarily quantitative, collected through a structured questionnaire tailored to the respondents' understanding and comprehension. The response categories for various questions were mostly pre- coded. Approval for the study was obtained from the Ethical and Protocol Review Committee of the Department of Community Health, Family Health Medical School (FHUC- EPRC-037/2023). Ethical considerations were observed in the design of clear and concise questions, the avoidance of emotionally triggering queries, and the obtaining of informed consent from participants. Descriptive statistics were performed using Excel Spreadsheet software and SPSS version 23 to code and analyse the data, which was expressed in frequencies and percentages. Results were presented in tables and charts.

Results

The study involved 120 participants with a reasonably balanced gender distribution: 61 females (50.8%) and 59 males (49.2%). Most participants were above 45 years old (54.2%) and only 1.7% below 25 years of age (Table 1). Regarding education, more than 95% had at least high school education. Employment types varied, with 35.8% self-employed, 32.5% employed, 22.5% unemployed, and 4.2% students. Majority (48.3%) were married and lifestyle habits indicated that 71.7% were non-drinkers and non-smokers and 4.2% engaged in both cigarette smoking and alcohol consumption (Table 1).

Eighty–two participants (68.3%) were diagnosed with type 2 diabetes, whereas 38 participants (31.7%) had type 1 diabetes, and all were diagnosed over six months before the study. Clinic attendance varied, with 58 participants (48.3%) performing very well, 52 participants (43.3%) performing well to some degree, and 10 participants (8.3%) not performing well to some degree. Regarding optimal blood sugar maintenance, 63 participants (52.5%) were doing very well, 24 participants (20%) were doing somewhat well, and 33 participants (27.5%) were not doing well. In self-blood sugar testing, 80 participants (66.7%) performed very well, 21 participants (17.5%) performed well to some degree, 16 participants (13.3%) did not perform well, and 3 participants (2.5%) never completed the test.

When experiencing symptoms like tremor, pallor, and headache, 74 participants (61.7%) frequently did a self-sugar test very well, 32 participants (26.7%) did well to some degree, 11(10%) did not do well, and 3 participants (2.5%) never did the test. Medication compliance showed that 56 participants (46.7%) performed very well, 36 (30%) performed well to some degree 22 (18.3%) did not

perform well, and 6 (5%) never performed well. In terms of diabetes information-seeking behaviours, 37 participants (30.8%) were very enthusiastic, 23 (19.2%) showed moderate interest, 43 (35.8%) reported some disinterest, and 17 participants (14.2%) never actively pursued information through educational programs.

Table 1 Socio-demography of study participant

Category	Frequency	Percentage
Sex		
Female	61	50.8
Male	59	49.1
Age (years)		
18-25	2	1.7
26-35	8	6.7
36-45	45	37.5
Above 45	65	54.2
Level of Education		
Less than High School	6	5.0
High School	30	25.0
College	12	10.0
Bachelor's Degree	26	1.7
Graduate	32	26.7
Higher Education	14	11.67
Employment Status		
Student	5	4.2
Employed	39	32.5
Unemployed	27	22.5
Self-employed	43	35.8
Part-time Employed	6	5.0
Marital Status		
Single	24	20.0
Divorced	23	19.2
Married	58	48.3
Widowed	15	12.5
Lifestyle		
Smoking cigarette	2	1.7
Alcohol	27	22.5
Both Smoking & Alcohol	5	4.2

Enquiry about reasons for not using applications showed the 91 (75.8%) participants had never heard of such smartphone apps, 11 (9.2%) answered that the apps were incompatible with their mobile devices, 10 (8.3%) stated they had no reason, and 5 (4.2%) responded that they were challenging to use. The remaining 3 each stated that the apps were not available on Apple shop, expensive to buy or needed help for the use. With exception of 3 participants, all others (117, 97.5%) are willing to explore and use apps.

Table 2 summarizes key findings on smartphone ownership, duration of usage, frequency of use, awareness, and utilisation of diabetes-related apps, as well as their impact on health management among 120 participants. A majority (74.1%) owned a smartphone, with most using it for over a year. However, only 30.3% were aware of diabetes-related applications (apps) and among them 59.3% actively used such apps for medication tracking and glucose monitoring. The results also show reduction in hospital admissions after app usage, with 85% of app users reporting fewer than two hospital visits per year, compared to higher admission rates before app adoption.

Table 2 Smartphone Ownership, Usage, and Impact on Health Management Among Participants

Category	Subcategory	Frequency	Percentage
Ownership of smartphones (120)	Owns a smartphone	89	74.2
	Does not own a smartphone	31	25.8
Smartphone Use (89)			
Duration of Smartphone Usage	Over a year	78	87.6
	About a year	6	6.7
	A few months	5	5.6
Frequency of Smartphone Usage	Very frequently	48	53.9
	More frequently	17	19.1
	Constantly	14	15.7
	Not often	10	11.2
Knowledge of Smart-phone Apps	Aware of diabetes-related apps	27	30.3
	Not aware of diabetes-related apps	62	69.7
Usage of Diabetic Related Apps (27)			
	Uses the apps actively	16	59.3
	Uses the apps less actively	4	14.8
	Does not use the apps	7	25.9
Common Apps Used for Tracking Medications (20)			
	MyTherapy	6	30.0
	Pill Reminder and Tracker	5	25.0
	MedicaReminder	4	20.0
	Uses MedicaReminder & MyTherapy	1	5.0
	Uses all three apps	1	5.0
	Uses MedicaReminder & Pill Reminder, and Tracker	1	5.0
Common Apps Used for Glucose Monitoring (5)			
	Diabetes Dairy-Glucose Tracker & Blood Sugar Buddy	2	40.0
	Diabetes Diary - Glucose Tracker	1	20.0
	MySugar	1	20.0
	Blood Sugar Buddy	1	20.0
Benefits of Using Apps (20)			
	Very helpful	18	90.0
	Moderately helpful	2	10.0
Hospital Admissions Before App Usage (20)			
	2-5 times per year	9	45.0
	5-10 times per year	7	25.0
	Less than twice per year	4	20.0
Hospital Admissions After App Usage (20)			
	Less than twice per year	17	85.0
	2-5 times per year	3	15.0

Discussion

This study examined the use of ICT tools (Smartphone Apps) in treatment adherence in patients with diabetes mellitus at the Greater Accra Regional Hospital. The results showed that 74.1% participants own a smartphone, and 87.6% of the owners have used these devices for over a year. Additionally, 88.8% of the owners regularly use their smartphones, suggesting that they are well-experienced in smartphone use.

These findings are consistent with a study conducted in South-West Nigeria by Olamoyegun et al., that the majority (97.3%) of patients with diabetes owned mobile phones.[17]

This finding could be attributed to the fact that most participants were in an urban setting where communication is essential, as well as the relatively low cost of owning a phone. Less than half of the study participants, 46.7% were compliant (always adhering to the medication regimen very well). These findings are similar to Ghanaian studies that reported a compliance percentage of 38.5% and 47.6% among diabetic patients.[15,18]

It was also observed that most participants 69.2% were not particularly interested in or concerned with obtaining modern updates on diabetes control from various information sources, which may have influenced the findings of this study regarding their compliance with anti-diabetic treatment. An example is the use of smartphone applications for tracking medication intake and blood glucose monitoring. It revealed that the majority of participants (84.2%) performed a self-blood sugar test. It is unexpected because if the majority are poorly compliant with medications, they will probably not be bothered to do a self-blood sugar test. However, it is observed that even a greater percentage of participants do a self-blood sugar test only when they experience symptoms. A similar study by Osei-Yeboah et al., in Ho Municipality in Ghana showed that the optimal medication adherence was 60.7% and glycemic control were achieved in 33.3% of cases with prevalence of glycosuria and proteinuria being 10.7% and 3.3% respectively.[12] Percentage glycemic control was found to be higher among the medication adherent group, while glycosuria and proteinuria were the highest among participants presenting with low medication adherence. The present findings are also in consonance with a study by Potakey on non-adherence to medication among people living with Type 2 diabetes at Shai Osudoku District Hospital, which reported that medication adherence to anti-diabetic medications was very poor.[19]

Mobile phone Apps are important features of smartphones, giving them the ability to perform various functions that make life easier. There is a wide range of mobile apps on the market that serve multiple purposes, so it is worthwhile to do some research to explore these various apps that can help make life easier. Although 74.2% in this study had smartphones, only 30.3% of these owners were aware of these apps and 22.5% could use them. This is lower than a similar study by Kebede & Pischke, which was web-based, and reported that more than half (52.2%) and one third (33.3%) of respondents with Type 1 and 2 Diabetes respectively, reported using diabetes apps for self-management.[20] This means that many of the participants were aware of these diabetic apps. The lack of awareness in the participants of the present study can be attributed to their limited interest in exploring methods of managing diabetes through educational programs, forums, or the internet. Specifically, 69.2% expressed a lack of interest in diabetes control programs probably due to being in the older generation group (45 years and older). It was evident that most participants were unaware of the existence of these apps due to limited knowledge of digital apps used to improve medication adherence.

Participants who used these applications primarily used both Diabetes Diary and Blood Sugar Buddy for glucose monitoring (40%) and MyTherapy for tracking medications (35%). This is in contrast to the survey by Kebede et al., found that "mySugar" was the most popular diabetes app among both groups of respondents with type 1 and type 2 diabetes mellitus.[20] The same study also referred to other apps for glucose monitoring, but they are not commonly used in Ghana, except for mySugar.[20]

All participants who used these apps benefited from them, with 88.9% having fewer hospital admissions

and symptoms while using these apps compared to before they started using the apps (44.4%). This aligns with previous reports
that continuous usage of the diabetes management app is associated with better glycemic control in the real world clinical practice.[20,21]

Conclusion

The study reveals high smartphone ownership among participants, with a reduction in hospital admissions for those using diabetes-related apps. Despite limited awareness, the significant health benefits for informed users highlight the potential of these apps. Enhancing awareness and utilisation can further improve health outcomes and decrease healthcare costs. Integrating mobile technology into health management is crucial for better management of chronic conditions. The findings emphasise the importance of leveraging smartphone applications to enhance quality of life.

Conflict of Interests

Authors declare no competing interests.

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