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Original Research Article

Assessment of the impact of medPlan®, a medication reminder mobile application, in glaucoma patients in Benin City, Nigeria

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Abstract

Purpose: *To assess the impact of medPlan®, a medication reminder mobile application in glaucoma patients in Benin City, Nigeria.*
Methods: *In a randomized control trial with 2 months follow-up period, 200 patients receiving drug therapy for glaucoma were randomized into either into a control or study group. The study group comprised participants who made use of a medication reminder mobile application, medPlan®, while the control group consisted of those patients who did not use the application. Adherence to medication was measured for all the patients in both groups. Data was collected using a carefully designed questionnaire and statistically analyzed.*
Results: *This study recorded 100 % response rate from the participants. In the study group, 56 % were very adherent while 18 % were moderately adherent, and 26 % were non-adherent respondents as against 45 % very adherent, 13 % moderately adherent and 42 % non-adherent respondents from the control group. In addition, 78 % of those in the study group agreed that there was improvement in their medication adherence since they started using the medication reminder application. This showed a significant positive impact of the medication reminder application (p = 0.0110) on adherence to medication.*
Conclusion: *Medication adherence was improved in glaucoma patients who used medPlan®, a smartphone medication reminder application. This study lays a foundation for further research on medication reminder mobile applications.*

Keywords: *Glaucoma, Smartphone, Medication adherence, Impact, Medication reminder, medPlan®*

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INTRODUCTION

Glaucoma is a disease condition of the eye which damages the optic nerve and may lead to irreversible vision loss [1,2]. According to the World Health Organization (WHO), it is the second leading cause of blindness globally after cataracts [3]. Despite the abundance of effective therapeutic regimens, non-adherence to glaucoma medications still poses an impediment to the proper management of the condition [4]. Two major challenges experienced by patients managing ocular hypertension and glaucoma are suboptimal adherence and a lack of persistence

to prescribed therapy, both of which have been linked to an increased risk for visual loss [5].

The aspect of patient's compliance to their medications has seen a number of methods geared towards the improvement of adherence such as short message service (SMS) reminders and electronic reminder devices (ERD) [6,7]. With the advent of groundbreaking mobile phone technologies in recent years, smartphone medication reminder applications now reflect a neoteric approach to medication adherence improvement as they can be designed to aid patients and clinicians in enhancing medication-taking behavior [8].

However, limited data exists on the impact of smartphone adherence applications on medication adherence. This study is therefore vital as the result would serve as a foundation for further research evaluating the impact of smartphone reminder applications on medication adherence.

The following research questions therefore arise: Do smartphone medication reminder applications have any significant impact on medication adherence and medication taking behavior? What barriers may impede the effective use of these applications by patients?

The main objective of this study is to assess the impact of medPlan®, a medication reminder mobile application on medication adherence in glaucoma patients.

METHODS

Setting

The study was carried out from September to December 2019 at the out-patient Ophthalmic Pharmacy of University of Benin Teaching Hospital, Benin City, Nigeria among glaucoma patients.

Study design

A randomized control trial was conducted with follow up at 2 months to evaluate the impact of medPlan® a medication reminder mobile application on medication adherence in glaucoma patients.

Inclusion criteria included patients having a smartphone with a medical diagnosis of glaucoma and receiving treatment in the study site.

Sampling procedure

A total of 200 patients with glaucoma were selected and randomized into one of two groups (a control and study group) each comprising 100 participants. The study group comprised patients who made use of the medication reminder mobile application while the control group comprised participants who did not use the smartphone medication reminder application. A self-administered validated questionnaire was administered to the participants. The study group were given the questionnaire after 2 months follow-up period to evaluate their responses whereas the control group were administered the questionnaire at the beginning of the study.

Survey instrument

A 31-item survey questionnaire was designed for this study with 5 categories which comprised participants' demographic data, a medication adherence scale, a segment to assess participants' barriers to medication adherence, barriers to the use of smartphone adherence applications and the participants' perception of the use of the smartphone reminder application. The segment which assessed the participants medication adherence comprised of 5 questions with response options such as never, rarely, frequently, always, yes/no. The participants' responses to specific questions were scored as +1, +1/2, 0 or –1/2, -1 and summed up over 5. Patients that scored between 0 - 2.0 were categorized as poorly adherent, 2.5 - 3.5 were moderately adherent and 4.0 - 5.0 were categorized as adherent.

The medication reminder mobile application used for the study was medPlan® which at the time of the study was only available on Google playstore to android users.

Validation and reliability of the instrument

The questionnaire was initially tested on a sample of 25 random glaucoma patients who the aim of the study was explained to. The pilot study did not result in any changes to the questionnaire, hence the results from the pilot test was added to the result for the control group in the final study.

Analysis of data

The data collected were manually sorted out and coded. It was thereafter imputed into the computer using Microsoft Excel and exported to SPSS version 22 (Statistical Package for Social Science) for descriptive analysis of the data

which include frequency cross tabulation, percentages and measures of central tendency.

RESULTS

The response rate was 100 %. The study group comprised 44 % males and 56 % females whereas the control group comprised 43 % males and 57 % females. Socio-demographic characteristics of the participants are shown in Table 1. A total of 45 % and 56 % very adherent respondents were recorded from the control and study group, respectively. Level of medication adherence of the participants are shown in Table 2 and Figure 1.

Table 1: Socio-demographic characteristics of the participants

Variable	Control group	Study group
	(%)	(%)
Gender		
Male	43	44
Female	57	56
Age		
20-29	15	20
30-39	13	22
40-59	28	39
≥60	44	19
Level of education		
Nil	6	0
Primary	18	3
Secondary	23	14
Tertiary	38	27
Post graduate	15	56

Table 2: Respondents level of medication adherence

Variable		Control group	Study group
	Score	***(%)***	***(%)***
Very Adherent	4.0 - 5.0	45	56
Moderately Adherent	2.5 - 3.5	13	18
Non-adherent	0.0 - 2.0	42	26
Mean adherence score		3.24	3.44
Standard deviation of mean medication adherence score		1.6460	1.5247

The most cited barriers by the control group was an inability to afford nor operate a smartphone whereas the study group reported lack of steady electric power supply to power their phones. Figure 3 shows the barriers to the use of smartphone reminder applications by the participants.

Adherence scores of respondents revealed a higher medication adherence in the study group when compared to the control group with a statistically significant difference (p = 0.0110).

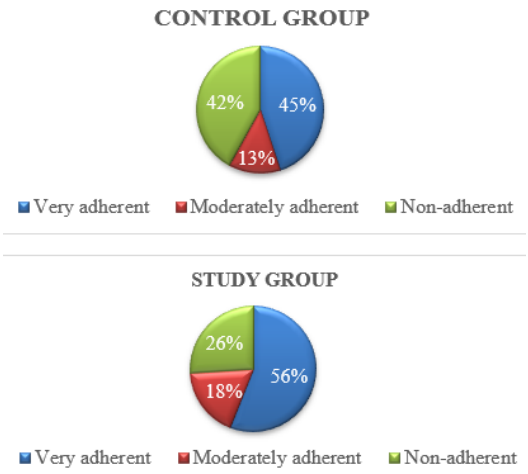

Figure 1: Respondents level of medication adherence

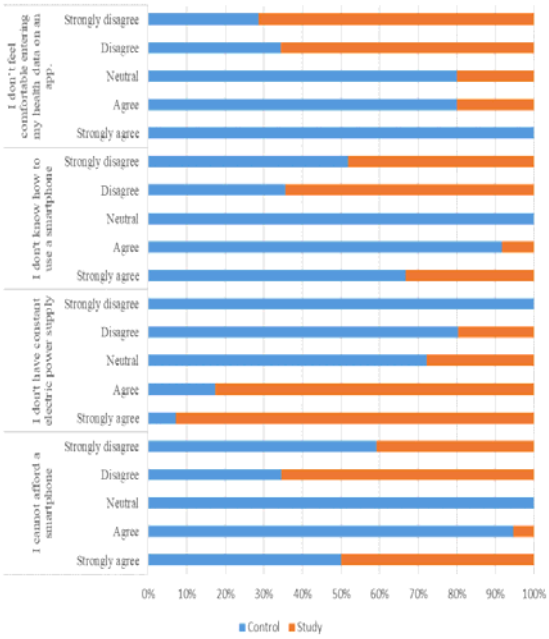

Figure 3: Barriers to the use of smartphone reminder applications by the participants

DISCUSSION

Glaucoma eyedrops are often preferred over surgery in controlling Intra Ocular Pressure (IOP) [9], however non-adherence to these medications impedes the proper management of the condition [4]. In recent years, digital health technologies of various forms have been incorporated into the healthcare delivery system to improve healthcare outcomes [10, 11]. Notable amongst these is mobile health which involves the use of mobile devices to support the practice of healthcare [12]. There has been a steady rise in the number of smartphone applications designed to combat medication non-adherence [13]. However, a

silent problem which de-escalates all efforts to enhance medication adherence through the adoption of the afore-mentioned tools has reared its ugly head, as a negligible number of documented studies exists which brings to light their impact on medication adherence.

In this study, glaucoma patients who used the smartphone medication reminder application showed a greater percentage of very adherent and moderately adherent patients i.e. 56 % and 18 % respectively as opposed to the control group which revealed 45 % and 13 %, respectively. The difference in medication adherence between the two study groups shows a significant impact of the smartphone reminder application (p = 0.0110). A possible reason for this could be the disparity in educational qualifications between the two groups as a higher proportion of the study group possessed higher educational qualifications which could have impacted their ability to use the reminder application. This 11 % improvement in medication adherence may appear negligible and inconsequential but with less forgiving medications and conditions which require > 95 % adherence, the medication reminder applications might just make all the difference.

The result obtained is similar to that obtained from a study carried out by Christensen *et al* [14] which assessed the impact of an electronic monitoring and reminder device on patient compliance with antihypertensive therapy. Of 398 patient's data analyzed, 91 % compliance was obtained from patients who used the device as opposed to 85 % compliance obtained from the control group [14].

Similar results were obtained from a study conducted by Boland *et al* [15] which assessed automated telecommunication-based reminders and adherence with once-daily glaucoma medication dosing. An increase in adherence rate from 54 % to 73 % ($p < 0.05$) was obtained in the intervention group whereas participants in the control group showed no statistical change in adherence rate [15].

Howsoever, according to Skalicky *et al* [5] adherence behavior is complicated with multifarious interrelated determinants such as provider factors, environmental factors, patient factors, etc. affecting an individual's level of adherence [5]. Therefore, interventions such as the use of medication reminder applications, counselling, pill counts and patient education would produce better therapeutic outcomes when two or more methods are used in unison. Other technological forms which have been used as medication reminders include iPhone reminders using Siri 7, basic cellular phone alarm, text messaging and desktop computer reminders [16]. In assessing the barriers to medication adherence experienced by the patients, it was observed that 20 % of the control group did not know the names of all of their medications nor were able to read and understand their medicine labels. An additional 45 % of the control group neither agreed nor disagreed to knowing the names of their medications. Whereas 74 % of the study group agreed to knowing the names of their medicines and indicated an ability to read their medicine labels. A possible reason for this disparity in the two groups is their level of education and health literacy. Studies have shown that poor communication of medicine information and an inability of the patients to read medicine labels may cause medication errors and increase medication non-compliance [17].

The causes of low health literacy are multifactorial [18]. Studies have revealed low health literacy to be prevalent among the elderly, patients with lower educational levels, immigrants and ethnic minorities [19,20]. According to Hayden Bosworth [21], health literacy- "the ability to understand and act on health information" is an integral determinant of medication comprehension and a vital predictor of medication non-adherence [22]. However, it must be noted that a higher educational qualification may not always equate a higher health literacy.

The most cited barriers among the control group was an inability to afford a smartphone (19 %) nor ability to operate a smartphone (13 %). This could be because majority of the respondents in the control group were older participants of age 60 and above (44 %), who could experience difficulty in operating a smartphone. However, among the intervention group, the most cited barrier was lack of steady electric power supply to power their phones.

The barriers cited in this study are major challenges impeding the use of digital health technologies in Africa. A study conducted by Olu *et al* [23] assessed the contribution of digital health technologies to sustainable attainment of Universal Health Coverage in Africa. Factors such as weak health systems, little to no awareness or knowledge about digital health, poor infrastructure such as unstable power supply, poor internet connectivity and lack of interoperability of the numerous digital health systems were listed as challenges impeding the deployment of digital health in Africa [23].

Of the 100 participants in the study group, 78 % acknowledged an improvement in their medication use habit since they began using the application and agreed to recommend it to family and friends. Howbeit, some patients still experienced difficultly adhering to their dosing interval despite use of the medication reminder application. A possible reason for this, could have been participants not responding promptly to the reminders as at when due. According to Nair *et al* (2011) "medication adherence appears to be a patterned behavior established through the creation of a routine and a reminder system for taking the medication" [24]. If the patient therefore does not comply with the established reminder system, the desired outcome would not be achieved.

Limitations of the study

Randomization technique: There was considerable difference in demographics of the participants in the study. Firstly, the age range of participants in the control group were not comparable to that of the study group. The control group had 44% of its participants above 60 years whereas the study group had 19% of its participants above 60 years of age. Secondly, just 15% of the control group obtained a postgraduate degree as opposed to 56% in the study group. These disparities could have significantly affected the research results as studies have revealed low health literacy to be prevalent among the elderly and patients with lower educational levels [19,20]. According to Hayden Bosworth (2012), health literacy is an integral determinant of medication comprehend-sion and a vital predictor of medication non-adherence [22]. For future studies, more attention should be placed on the randomization technique to ensure comparable demographic characteristics of participants.

Methodology: No baseline medication adherence level was obtained from both groups. A better method would have involved assessment of participants medication adherence level, to have a baseline medication adherence status of both groups, such that results can easily be compared with the baseline. This will give no room for speculations that the higher medication adherence level obtained in the study group could be due to chance and not the medication adherence application.

CONCLUSION

Medication adherence is improved in glaucoma patients who use medPlan®, a smartphone medication reminder application. Despite possible limitations that can easily be overcome, this study has laid a foundation for further research around the topic, which could significantly impact medication adherence and medication-taking behaviour. Healthcare professionals may wish to recommend the use of smartphone medication reminder applications especially in conditions requiring > 95 % adherence to therapeutic regimens.

DECLARATIONS

Acknowledgement

The authors are grateful to the medPlan® team for granting them the necessary permission required to use their proprietary smartphone medication reminder application for the study.

Conflict of interest

No conflict of interest is associated with this work

Contribution of authors

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. All authors read and approved the manuscript for publication. Lisa Mote conceived the study and wrote the manuscript. Ntaji Veronica collected and analyzed the data. Penaere Osahon designed the study and revised the manuscript.

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