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Efficacy of behavior change communication using mobile calls on glycemic control among Type 2 diabetic patients in an urban area of Pondicherry, South India: A randomized controlled trial

B. Jayasree, P. Stalin

Department of Community Medicine, Pondicherry Institute of Medical Sciences, Puducherry, India

Address for correspondence:
Dr. P. Stalin, Department of Community Medicine, Pondicherry Institute of Medical Sciences, Kalapet, Puducherry - 605 014, India.
E-mail: stalinmedico@gmail.com

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Abstract:

CONTEXT: Lifestyle modifications play a major role in controlling blood glucose levels among diabetes mellitus for the prevention of its complications. Mobile phones can be used as an efficient tool for improving the healthy lifestyle through health education.

AIMS: The aim of the study is to measure the efficacy of behavior change communication using mobile calls in controlling blood sugar levels, increasing medication adherence, healthy diet, and physical activity among diabetic patients.

SETTINGS AND DESIGN: A randomized controlled trial was conducted in an urban area of Pondicherry between 50 (25 per arm) type 2 diabetes patients.

SUBJECTS AND METHODS: All participants were interviewed using a structured questionnaire. Fasting blood glucose (FBG) was measured. Single-time health education was given to both groups. The intervention group received a mobile phone calls reminders thrice weekly for 2 months. Changes in FBG, diet, physical activities, and adherence to medications were assessed after 2 months.

STATISTICAL ANALYSIS USED: Means and proportions were calculated. Chi-square test and paired *t*-test were used to calculate the *P* value.

RESULTS: FBG increased significantly in the control group by 25.6 mg/dl ($P = 0.03$), whereas it was only 6.5 mg/dl in the intervention group ($P = 0.56$). Adherence to medications was increased significantly in both interventions (+21%) and control (+19%) groups. Number of fruits intake days per week (+1, $P = 0.01$) and fruits serving per day (+0.5, $P = 0.00$) have increased significantly in the intervention group. Recreational physical activity was increased in the intervention group but not statistically significant.

CONCLUSION: Our study findings suggest that mobile phone calls might help to improve glycemic control. It also suggests that it could improve the adherence to medications and intake of fruits. In the future, studies with large sample size and longer intervention need to be conducted.

Keywords:

Cell phone, diabetes prevention and control, health promotion, risk reduction behavior

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Introduction

Diabetes is a chronic noncommunicable disease with increased blood sugar levels. The estimated number of adults with diabetes has increased four times from 108 million in 1980 to 422 million in 2014, worldwide. In terms of prevalence, diabetes among adults has nearly doubled from 4.7% to 8.5% over the same period.[1] Diabetes affects more than 72 million Indians, which is more than 7.1% of the adult population. The average age of onset is about 40 years. Nearly 1 million Indians die due to diabetes every year.[2] The symptoms of diabetes should not be neglected and should be treated as soon as they manifest.

Diabetes can be easily controlled by maintaining a healthy lifestyle and successfully following the medical regime prescribed by the physician. Healthy outcomes could be achieved in diabetes provided the patients follow the key self-preservation behaviors such as eating well, being physically active, monitoring blood sugar regularly, compliance and adherence to the medications prescribed, regular monitoring of blood sugar levels, good problem-solving skills, healthy coping skills, and risk-reduction behaviors.[3] All these behaviors have proven to show a positive correlation with good glycemic control, reduction of complications, and improvement in the quality of life. Individuals with diabetes have been shown to make a drastic impact on the advancement and development of their disease by partaking in their own care. Improper medication adherence can cause problems with other body functions, such as the kidneys, nerves, feet, and eyes.[4]

Despite this fact, adherence to these activities is incredibly low. A study conducted by Stalin *et al.* in an urban area of Puducherry stated that only 50% of diabetic patients were adhering to medications.[5] Factors contributing to poor medication adherence are myriad and include those that are related to patients, physicians, and health-care systems.[6]

A new era of information technology has begun. And that era is most definitely ruled by mobile phones. Everyone has at least one mobile phone. Mobile phones can be used in health-care delivery for many purposes which include health education, monitoring, and follow-up. Therefore, the aim of this study was to assess the efficacy of mobile phones as a tool for providing health education to improve the adherence to medications and lifestyle modifications among diabetic patients and thereby improving the glycemic control of the diabetic patients.

Subjects and Methods

A randomized controlled trial was conducted among type 2 diabetes patients residing in the field practice area of Urban Health Center which is under the Department of Community Medicine of a medical college in 2017. Type 2 diabetes patients who were taking oral hypoglycemic drugs and/or insulin and own a mobile phone were eligible to participate in this study. Calculated sample size per arm was 25 as per the formula for comparison of means in two samples $n = 2K\sigma^2/\Delta^2$. Here, K is a constant based on alpha value of 0.05 and powers of 80%. The values of standard deviation ($\sigma = 54$ mg/dl) and the difference ($\Delta = 9$ mg/dl) between the means of the change in fasting blood glucose (FBG) after the intervention were taken from a meta-analysis done by Bin Abbas *et al*.[7] Nonresponse rate/loss to follow-up of 20% was also taken into consideration. Fifty eligible study participants were identified from the study area by door-to-door survey. All the selected study participants were numbered from 1 to 50. Then, they were randomly allocated to the intervention and control arm using research randomizer online software, which is available at https://www.randomizer.org/.

A baseline survey was conducted among the study participants (both intervention and control group) using the structured questionnaire which consists of variables such as sociodemographic, adherence to medications, diet intake, physical activity, and anthropometry. The Morisky 4-Item Self-Report MEASURE of Medication-taking Behavior (MMAS-4) was used to measure the adherence to medications which includes four questions: (1) Do you ever forget to take your diabetes medicine? (2) Do you ever have problems remembering to take your diabetes medication? (3) When you feel better, do you sometimes stop taking your diabetes medicine? and (4) Sometimes if you feel worse when you take your diabetes medicine, do you stop taking it? If the participant answers YES to any one or more of these four questions, then there is no adherence. Height and weight were measured using the stadiometer and a bathroom weighing scale, respectively. After the interview, all the study participants were counseled by the principal investigator and given a referral slip for testing FBG level by GOD-POD method at Urban Health Center on the next day. The participants belonging to the intervention group received mobile calls (twice a week) for 2 months. During the calls, the first author reiterated the study participants with key messages on diet, physical activity, and adherence to medications. No such intervention was done for the control group. After 2 months, follow-up survey was done and FBG levels were tested again for both the groups to determine if there was any better glycemic control and to assess if there was any change in dietary pattern and physical activity and adherence to medications.

Data were entered in MS Excel and were analyzed in IBM SPSS Statistics for windows, Version 21.0 (IBM Corp, Armonk, Newyork). Means and proportions were calculated. Chi-square test and paired *t*-test were used to calculate the *P* value. $P < 0.05$ was considered to be statistically significant. Ethical clearance was obtained from the PIMS Institutional Ethics Committee. The participant information sheet was given to the participants, and written informed consent was obtained. The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000. Privacy and confidentiality of the study participants were maintained. The study participants identified with abnormal findings were advised and referred to the nearest health facility for further management.

Results

Sociodemographic characteristics and health-seeking behavior of the study participants are shown in Table 1. The mean age of the study participants in the intervention group was 61 years, which was almost similar to control group (60 years). The distribution of sex was uniform in both groups. The proportions of the study participants with education above middle school were higher in the control group (64.7%) than the intervention group (35.3%), but the difference was statistically not significant. About 80% of the study participants were receiving health care from private providers, and they were equally distributed in both interventions (50%) and control (50%) groups. The majority of the study participants were visiting their health-care providers once in 3 months, who were also distributed equally between the groups. All the study participants followed pharmacotherapy only and almost all received drugs from private pharmacies on payment.

Table 2 shows the comparison of dietary pattern before and after the intervention among the study participants in the intervention and control groups. The number of days of fruit intake per week was 1.1 and 1.5 at baseline in the intervention and control group, respectively, which increased to 2.1 and 3.3 after the intervention and the differences are statistically significant. In the intervention group, the number of servings of fruits per day had also increased from 0.4 to 0.9 ($P = 0.00$). There was a minimal increase in the number of vegetable servings/day from 1.1 to 1.3 in the intervention group but statistically not significant.

Comparison of physical activities (work, travel, and recreational) before and after the intervention among the study participants in the intervention and control groups is shown in Table 3. In the intervention group, the proportions of study participants who involved in moderate-intensity physical activity at the workplace were 20% and 20% at baseline and endline, respectively. The study participants who traveled by walking/cycling increased from 32% to 44% in the intervention group but statistically not significant. The duration of traveling by walking/cycling had also increased from 70.4 min/week ($P = 0.43$) in the intervention group. Proportions of participants involving moderate-intensity physical activity during recreation increased by 1.5 and 2.6 times in intervention and control groups, respectively, but statistically not significant.

Table 1: Sociodemography and health-seeking behavior of the study participants (*n*=49)

Variables	Intervention, *n* (%)	Control, *n* (%)	*P*
Age, mean (SD)	61 (10.2)	60 (10.0)	0.76
Sex			
Female	16 (51.6)	15 (48.4)	0.91
Male	9 (50.0)	9 (50.0)	
Education			
Above middle school	6 (35.3)	11 (64.7)	0.25
Up to middle school	15 (57.7)	11 (42.3)	
Illiterate	4 (66.7)	2 (33.3)	
Occupation			
Profession	2 (40.0)	3 (60.0)	0.97
Laborer	8 (53.3)	7 (46.7)	
Others	2 (40.0)	3 (60.0)	
Homemaker	13 (54.2)	11 (45.8)	
Health-care provider			
Government	4 (57.1)	3 (42.9)	0.33
Private	21 (50.0)	21 (50.0)	
Frequency of visits			
Monthly	4 (44.4)	5 (55.6)	0.25
Once in 3 months	15 (51.7)	14 (48.3)	
More than 3 months	6 (54.5)	5 (45.5)	
Mode of treatment			
Lifestyle changes	0	0	0.30
Pharmacotherapy	25 (51.0)	24 (49.0)	
Source of drugs			
Government	3 (75.0)	1 (25.0)	0.11
Private pharmacy	22 (48.8)	23 (51.2)	
Cost of drugs			
Free	4 (40.0)	6 (60.0)	0.43
On payment	21 (53.8)	18 (46.2)	
Frequency of buying/receiving drugs			
Weekly	3 (42.9)	4 (57.1)	0.78
Fortnightly	5 (45.5)	6 (45.2)	
Monthly and above	17 (54.8)	14 (45.2)	
Total	25 (51.0)	24 (49.0)	

SD=Standard deviation

The adherence to medications increased by 1.5 times in both intervention and control groups, but statistically significant only in the intervention group as shown in Table 4. The increase in FBG levels in control group (+25.6 mg/dl, $P = 0.02$) was much higher than the intervention group (+6.5 mg/dl, $P = 0.59$).

Discussion

This study was done to measure the efficacy of behavioral change communication using mobile calls

Table 2: Comparison of dietary pattern before and after the intervention among the study participants in the intervention and control groups (*n*=49)

Dietary intake	Intervention (*n*=25)			Control (*n*=24)		
	Before Mean (SD)	After Mean (SD)	*P*	Before Mean (SD)	After Mean (SD)	*P*
Fruits intake (days/week)	1.1 (2.0)	2.1 (2.1)	0.01	1.5 (2.3)	3.3 (2.9)	0.02
Fruits servings/day	0.4 (0.6)	0.9 (0.7)	0.00	0.7 (1.0)	0.8 (0.6)	0.52
Vegetables intake (days/week)	6.4 (1.7)	6.3 (1.6)	0.66	6.6 (1.2)	6.6 (1.5)	0.75
Vegetable servings/day	1.1 (0.4)	1.3 (0.6)	0.05	1.1 (0.3)	1 (0.3)	0.32
Outside meals (days/week)	0.1 (0.4)	0.1 (0.3)	1	0.5 (0.8)	0.5 (1.4)	0.78
Junk foods (days/week)	0.0 (0.0)	0.0 (0.2)	0.32	0.1 (0.4)	0.4 (1.4)	0.43
Junk foods (times/day)	0.0 (0.0)	0.1 (0.4)	0.32	0.0 (0.4)	0.1 (0.3)	0.32

SD=Standard deviation

Table 3: Comparison of physical activities (work, travel, and recreational) before and after the intervention among the study participants in the intervention and control groups (*n*=49)

Physical Activity	Intervention (*n*=25)			Control (*n*=24)		
	Before Mean (SD)	After Mean (SD)	*P*	Before Mean (SD)	After Mean (SD)	*P*
Workplace-moderate intensity						
Proportion, *n* (%)	5 (20.0)	5 (20.0)	0.00	6 (25.0)	6 (25.0)	0.01
Days/week	1.2 (2.6)	1.2 (2.6)	1	1.8 (3.1)	1.8 (3.1)	1
Minutes/week	120 (432.9)	120 (432.9)	1	183.8 (522.9)	183.8 (522.9)	1
Travel_walk_cycle						
Proportion, *n* (%)	8 (32.0)	11 (44.0)	0.44	10 (41.6)	8 (33.3)	0.21
Days/week	2.2 (3.3)	2.6 (3.2)	0.58	2.4 (3.2)	1.6 (2.8)	0.28
Minutes/week	194.4 (368.5)	264.8 (573.2)	0.43	226.3 (413.3)	103 (198.4)	0.10
Recreational-moderate intensity						
Proportion, *n* (%)	7 (28.0)	11 (44.0)	0.34	5 (20.8)	13 (54.2)	0.26
Days/week	1.8 (3.0)	2.6 (3.3)	0.30	1.5 (2.9)	3.2 (3.2)	0.03
Minutes/week	162 (315.6)	229 (379.5)	0.45	93.3 (213.2)	197.5 (241.6)	0.09
Sedentary behavior						
Minutes/day	536.4 (219.1)	492 (234.9)	0.38	542.5 (170.8)	447.5 (203.3)	0.15

SD=Standard deviation

Table 4: Comparison of adherence to medications and fasting blood glucose levels before and after the intervention among the study participants (*n*=49)

Outcome variables	Intervention (*n*=25)			Control (*n*=24)		
	Before	After	*P*	Before	After	*P*
Adherence (%)	39.5	60.5	0.02	40.5	59.5	0.05
Fasting blood glucose (mg/dl), mean (SD)	151.6	158.1	0.59	151.6	177.2	0.02

SD=Standard deviation

on glycemic control among type 2 diabetic patients. It showed an increase in adherence to medications in both the intervention and control groups, but statistically significant only in the intervention group. In dietary habits, there was statistically significant increase in the number of days of fruits intake among study participants in both the groups. Fruit servings per day had also increased in the intervention group and statistically significant also. Increase in physical activity was also noted where there was increase in proportion of participants who traveled by walking and cycling and recreational moderate-intensity activity in the intervention group but not statistically significant. Sedentary behavior was found to be decreased in both intervention and control group. The fasting blood sugar levels had increased in both the groups with clinically and statistically significant increase in the control group.

In the present study, there is an increase in adherence to medications in both the intervention and control groups. Similarly, in a study conducted by Sanjay Arora, medication adherence was improved from 4.5 to 5.4 in the TExT-MED group compared with a net decrease of –0.1 in the controls (Δ1.1 [95% CI: 0.1–2.1]).[8] However, in a study conducted in Korea comparing the mobile phone communication and online monitoring, there was no significant difference in adherence (77% and 83%, $P = 0.99$).[9]

There was a statistically significant increase in the number of days of fruits intake and servings among study participants in the intervention group in our study. A similar study using mobile phones was conducted in Pakistan, which showed improvement ($P < 0.001$) in following a diet plan from 17.3% at baseline to 43.6% at endline in the intervention group; however, the control group showed an insignificant increase ($P = 0.522$) from 13.6% at baseline to 15.9% at endline.[10]

Increase in physical activity was also noted where there was increase in the proportion of participants who traveled in the intervention group but not statistically significant, and similar results were seen in a study conducted by Krishnamohan *et al*. where physical activity during travel was found to be increased in both groups but not statistically significant which might be due to smaller sample sizes.[11]

Our study showed that the fasting blood sugar levels had increased in both the groups, but there was less increase in the intervention group than in the control group and it was not statistically significant. However, in a study conducted by Hussein *et al*., the reduction in glycemic level was significant in intervention than control group by receiving short text messages through phone.[12] Another study conducted in Bangladesh by Shariful Islam *et al*. showed a significant improvement in glycemic control through short text messages.[13] These differences may be due to the shorter duration of intervention in our study as compared to other studies.

Small sample size and shorter duration of intervention were some of the limitations of our study. We have also not done HbA1C to assess the glycemic control compared to other studies.

Conclusion

Our study findings suggest that mobile phone calls might help to improve glycemic control. It also suggests that it could improve the adherence to medications and intake of fruits. Even though there was improvement in other parameters related to diet and physical activity, they were not statistically significant. We recommend conducting similar studies in the future with large sample size and longer duration of intervention.

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Conflicts of interest
There are no conflicts of interest.

References

1. World Health Organization. Global Report on Diabetes, 2016. Geneva: World Health Organization; 2016.
2. Deaths due to Diabetes in India. South East Asia Regional Fact Sheet. Available from: http://www.diabetesatlas.org. [Last accessed on 2016 Dec 23].
3. Haas L, Maryniuk M, Beck J, Cox CE, Duker P, Edwards L, *et al.* National standards for diabetes self-management education and support. Diabetes Care 2014;37 Suppl 1:S144-53.
4. Diabetes Complications. U.S. National Library of Medicine. Rockville Pike, Bethesda, MD: U.S. Department of Health and Human Services National Institutes of Health; 2016. Available from: https://www.medlineplus.gov/diabetescomplications.html. [Last accessed on 2016 Dec 19].
5. Stalin P, Singh Z, Purty AJ, Sharma Y, Abraham SB. Study on prevalence and factors influencing patient's adherence to anti-diabetic medications in urban Puducherry. Int J Diabetes Dev Ctries 2015;35:128-31.
6. Brown MT, Bussell JK. Medication adherence: WHO cares? Mayo Clin Proc 2011;86:304-14.
7. Bin Abbas B, Al Fares A, Jabbari M, El Dali A, Al Orifi F. Effect of mobile phone short text messages on glycemic control in type 2 diabetes. Int J Endocrinol Metab 2015;13:e18791.
8. Arora S, Peters AL, Burner E, Lam CN, Menchine M. Trial to examine text message-based mHealth in emergency department patients with diabetes (TExT-MED): A randomized controlled trial. Ann Emerg Med 2014;63:745-54.
9. Cho JH, Lee HC, Lim DJ, Kwon HS, Yoon KH. Mobile communication using a mobile phone with a glucometer for glucose control in type 2 patients with diabetes: As effective as an internet-based glucose monitoring system. J Telemed Telecare 2009;15:77-82.
10. Shahid M, Mahar SA, Shaikh S, Shaikh ZU. Mobile phone intervention to improve diabetes care in rural areas of Pakistan: A randomized controlled trial. J Coll Physicians Surg Pak 2015;25:166-71.
11. Krishnamohan S, Stalin P, Singh Z, Sridhar M. Efficacy of health education using facebook to promote healthy lifestyle among medical students in Puducherry, India: A non-randomized controlled trial. J Clin Diagn Res 2017;11:LC07-10.
12. Hussein WI, Hasan K, Jaradat AA. Effectiveness of mobile phone short message service on diabetes mellitus management; the SMS-DM study. Diabetes Res Clin Pract 2011;94:e24-6.
13. Shariful Islam SM, Niessen LW, Ferrari U, Ali L, Seissler J, Lechner A, *et al.* Effects of mobile phone SMS to improve glycemic control among patients with type 2 diabetes in bangladesh: A prospective, parallel-group, randomized controlled trial. Diabetes Care 2015;38:e112-3.