Original Research Article

A novel approach to assess the effectiveness of medical technological intervention in the management of diabetes mellitus

Sunil Kumar Doddaiiah*, G. Shwetha, Arun Gopi, M. R. Narayana Murthy, Anil S. Bilimale

Department of Community Medicine, JSS Medical College, JSS Academy of Higher Education and Research, Mysuru, Karnataka, India

Received: 24 August 2021

Accepted: 17 September 2021

*Correspondence:

Dr. Sunil Kumar Doddaiiah,

E-mail: sunilclass@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Diabetes mellitus is one of the leading diseases in the current scenario due to lifestyle changes it causes premature illness and death across the world. Hence, the current study aimed at studying the effectiveness of medical technological education intervention in the management of diabetes mellitus.

Methods: A quasi-experimental study of 138 diabetes mellitus patients at an urban health Centre, Mysuru was conducted from 1st November 2019 to 31st May 2020, information regarding socio-demographic characteristics was collected in a pre-tested proforma by interview technique and HbA_{1c} levels was collected after taking consent from the study participants. The assessment of the effectiveness of medical technological education intervention was done by considering the improvement in mean HbA_{1c} levels.

Results: The comparison of HbA_{1c} of group A, B and C before and after the educational intervention showed a reduction of mean HbA_{1c} from 7.60% to 6.84% in group A which was significant statistically and in group B it has reduced from 7.30% to 7.14%, however in group C it has increased from 7.71% to 8.50%.

Conclusions: The medical technological education intervention using the smartphone application is effective when compared to traditional methods. It plays an important role in the management of diabetes mellitus.

Keywords: Diabetes mellitus, Educational intervention, Smartphone application, Traditional methods

INTRODUCTION

Diabetes mellitus is one of the leading diseases in the current scenario due to lifestyle change; it causes premature illness and death all over the world. Diabetes prevalence is increasing day by day in the world. Diabetes is a metabolic disease which mainly characterized by the rise in the blood sugar level. The main cause for diabetes is due to lack of insulin (type 1 diabetes) or either the body cells fail to respond to the insulin produced (type 2 diabetes). Type 2 diabetes and its complications are the most important concern at this point of time and it is one of the important impacting factors on the quality of life of diabetic patient.¹

Diabetes is a chronic disease, which needs regular medication along with regular to follow up with the

physician. With this, the patient should follow a healthy diet and regular physical activity. By maintaining the blood glucose levels, blood pressure, and cholesterol at or close to normal can help delay or prevent diabetes complications. Therefore people with diabetes need regular monitoring.²

In the management of type 2 diabetes, one should maintain the proper healthy daily habits with a consistency like sticking to a healthy diet and following regular physical exercise. Along with this, the person should also need to take regular medications in a prescribed manner with regular follow up. Through these measures, the person with diabetes can prevent and control further complications which may occur due to diabetes.^{3,4} As type 2 diabetes is a multisystem disorder which is associated with several complications, so it is

important to create awareness about prevention and control measures in the management of diabetes among diabetic patients is very important.^{5,6}

Hence, the current study aimed at studying the effectiveness of medical technological education intervention in the management of diabetes mellitus among the patients attending the Urban Health Centre, Bannimantap, Mysuru.

METHODS

The study was conducted in the urban primary health centre of the Mysuru district, Karnataka, India. Around a hundred and fifty diabetes mellitus patients were registered in the non-communicable disease (NCD) clinic of the health centre, who turned for the regular follow up. The study design selected was quasi-experimental study which was conducted for the period from 1st November 2019 to 31st May 2020. Type-II diabetes mellitus patients who are regularly attending the NCD unit at an urban primary health centre were selected for the study.

Inclusion criteria

The patients aged 18-65 years, type-II diabetes mellitus patients with a history of more than one year, patients with random blood sugar >200 mg/dl or fasting blood sugar >110 mg/dl or HbA_{1c}>7.5% were included in the study. The patients receiving treatment with oral hypoglycemic drugs, who own an android smartphone and patients who have studied 7th standard and above were included in the study.

Exclusion criteria

Patients with severe complications, pregnant ladies, patients who were not capable of using smartphone application and illiterates were excluded from the study.

Assuming at least a mean change of 4 mmol/l and 6 mmol/l in blood sugar levels of group A (smartphone application) and group B (diet and physical exercise) respectively at an alpha level 5% with a power of 80%, at least 45 subjects has to be taken in each group. Assuming the 'lost to follow up as 10%, a sample size of 50 subjects' were required (total 150).^{10,11}

The line listing of the number of type-II diabetes mellitus patients who came for treatment at the urban health centre was done, the random number generation has done online and the diabetes mellitus patients were selected randomly for carrying out the study. Simple random sampling technique was applied based on the number of type-II diabetes mellitus patients available for the study.

The quasi-experimental study of 150 type-II diabetes mellitus patients was conducted, the information regarding socio-demographic characteristics like age, gender, education, the occupation was collected in a

pretested proforma by interview technique. The glycemic status of type-II diabetes mellitus patients was assessed based on the HbA_{1c} levels and the comparison of the effectiveness of medical technological education intervention in the management of diabetes mellitus was done.

Permission from the concerned authorities was taken and the written informed consent was taken from the selected study participants before collecting HbA_{1c} sample and other socio-demographic data. The study has been approved by the Institutional Ethical Committee of the institution.

Statistical analysis

The data entry and statistical analysis were done using Microsoft excel 2010 and Statistical Package for the Social Sciences (SPSS) version 22 (licensed to JSSAHER). The demographic characteristics such as age, gender, place, and the socio-economic status of the participants were represented using the arithmetic mean, standard deviation, percentages. The comparison of HbA_{1c}, before and after the intervention was done using a paired sample t-test. P value <0.05 has been considered as statistically significant.

RESULTS

In the present study, majority of them 50 (36.2%) and 48 (34.8%) belonged to age group 51-60 and 41-50 years, 107 (77.5%) were females and 31 (22.5%) were males, about 34 (24.6%) were illiterate, 34 (24.6%) were studied primary school, majority of them 87 (63.0%) belonged to lower middle class, majority of the study participants belonged to joint family 101 (73.2%), 79 (57.2%) have the family history of type-II diabetes mellitus, 105 (76.1%) of study participants were under oral drugs and 4 (2.9%) under both oral drugs along with insulin (Table 1).

Before the intervention it was observed that out of 46 study participants who belong to group-A, 24 (17.4%) comes in HbA_{1c} range of <7% and 22 (16%) in more than >7% HbA_{1c} range with the mean value of 1.54 and standard deviation 0.622, in group-B, about 28 (20%) under <7% HbA_{1c} range and 18 (12.9%) above >7% HbA_{1c} range with the mean value 1.54 and standard deviation 0.751 and in group-C, 25 (18.1%) under <7% HbA_{1c} and 21 (15.2%) more than >7% with the mean value 1.57 and standard deviation 0.688. (Table 2). After the intervention, it was observed that out of 46 study participants who belong to group-A, 30 (22%) comes in HbA_{1c} range of < 7% and 16 (11.6%) in more than >7% HbA_{1c} range with the mean value of 1.34 and standard deviation 0.481, in group-B, 29 (20.9%) under normal and 17 (12.2%) more than normal, with the mean value 1.434 and standard deviation 0.62 and in group-C (control), 13 (9.4%) under normal and 33 (23.7%) more than normal, With the mean value 1.431 and standard deviation 0.620 (Figure 1).

Table 1: Distribution of study participant's based on the socio-demographic characteristics.

Variables	Frequency (%)
Age group (years)	
31-40	21 (15.2)
41-50	48 (34.8)
51-60	50 (36.2)
61-70	12 (8.7)
71-80	7 (5.1)
Gender	
Female	107 (77.5)
Male	31 (22.5)
Education	
Illiterate	34 (24.6)
Primary school	34 (24.6)
Middle school	16 (11.6)
High school	31 (22.5)
PUC	15 (10.9)
Graduate	8 (5.8)
Occupation	
Housewife	96 (69.5)
Retired	5 (3.6)
Skilled	21 (15.2)
Semiskilled	15 (10.9)
Unskilled	1 (0.7)
Professional	0
Socioeconomic status	
Upper class	0
Upper middle class	15 (10.9)
Lower middle class	87 (63.0)
Upper lower class	25 (18.1)
Lower class	11 (8.0)
Type of family	
Nuclear family	28 (20.3)
Joint family	101 (73.2)
Three generation family	9 (6.5)
Type-II diabetes family history	
Present	79 (57.2)
Absent	59 (42.8)
Duration of type-2 diabetes (years)	
0-5	54 (39.1)
6-10	69 (50.0)
11-15	15 (10.9)
Type of medication	
Oral drugs	105 (76.1)
Insulin	29(21.0)
Both	4 (2.9)

The comparison of HbA_{1c} of group A, B and C before and after the educational intervention showed a reduction of mean HbA_{1c} from 7.60% to 6.84% in group A which was significant statistically and in GROUP B it has reduced from 7.30% to 7.14%, however in GROUP C it has increased from 7.71% to 8.50% (Table 2).

Figure 1: Distribution of study participant's based on HbA1C levels.**Table 2: Comparison of HbA1C of group A, B and C before and after the educational intervention.**

Group	HbA _{1c} value	N	Mean score	SD	Df	T	P value
Group A (app)	Pre	46	7.60	2.286	45	4.128	<0.0001
	Post	46	6.84	1.329			
Group B (handouts)	Pre	46	7.30	2.643	45	1.044	0.302
	Post	46	7.14	1.977			
Group C (control group)	Pre	46	7.71	2.522	45	2.662	0.061
	Post	46	8.50	1.872			

*SD-Std. Deviation, Df – Degrees of freedom

DISCUSSION

Summary findings

In the present study, majority of them 50 (36.2%) and 48 (34.8%) belonged to age group 51-60 and 41-50 years, least of them 7 (5.1%) belonged to 71-80 years, 107 (77.5%) were females and 31 (22.5%) were males, about 34 (24.6%) were illiterate, 34 (24.6%) were only studied primary school and least of them 8 (5.8%) were graduates, majority of them 87 (63.0%) belonged to lower middle class, about 11 (8.0%) belonged to lower class and no one belonged to upper class, most of the study participants belonged to joint family 101 (73.2%) and least of them belonged to three generation family 9 (6.5%), about 79 (57.2%) have the family history of type 2 diabetes, about 69 (50.0%) have diabetes history of 6 to 10 years and 15 (10.9%) present with the history of 11 to 15 years, about 105 (76.1%) of study participants were under oral drugs and 4 (2.9%) under both oral drugs along with insulin.

The result confirms that the effectiveness of educational intervention using smartphone app (group A) was more effective with the p value<0.0001 compared to handouts (group B) with respect to control group (group C).

Evaluation of technology and handouts based educational intervention in type-2 diabetes mellitus management

The education intervention by using smartphone application (group A) helped in type 2 diabetes management when compared to other two groups with the post intervention results of 30 (22%) which comes under normal range of HbA_{1c} when compare to pre-test result of 24 (17.4%). Followed by users of handouts (group B), pre-test HbA_{1c} 28 (20%) were under normal range but in post-test HbA_{1c} 29 (20.9%) which comes under normal range. In control group (group C) during pre-test 25 (18%) were under normal range, but in post-test 13 (9.4%) comes under normal range.

The effectiveness of educational intervention using smartphone application (group A) was more effective with the p-value < 0.0001 compared to handouts (group B) with respect to control group (group C).

Mobile health intervention by using smart phone app is considered to be the promising tools in improving diabetes care and self-management. In a systematic review and meta-analysis showed the patients with borderline blood sugar level, lower than 8% will be more benefited by this m-Health apps when compared to those having high blood sugar level.¹²⁻¹⁴

Educating the type 2 diabetic patients to manage their diabetes through the educational intervention has been considered as important part of the clinical management since 1930. The aim of diabetic self-management education is to make the metabolic control of the body and to improve the quality of life in order to prevent and control the further complications through the acceptable costs.^{4,15,16}

In our study we got the results that educational intervention directly impacts on the physical and mental health of the type 2 diabetic patients. The educational intervention helps in the management of diabetes i.e. self-care management of type 2 diabetes and the diabetic patient will be able to manage further complication which caused due to type 2 diabetes.¹¹ The effectiveness of educational intervention using smart phone application (group A) is because of the accessibility and availability of mobile phones in day today life.¹⁷ While in case of handouts (group B), it may be misplaced and due to vision problem the older diabetic patients may not be able to read the instruction in the handouts. Hence the effectiveness of educational intervention in group A compared to other two groups i.e. group B and C showed the statistical significance with p value of < 0.05.

CONCLUSION

The educational intervention using smartphone application is more effective when compare to handouts and control group. Educational intervention plays the

important role in the management of any non-communicable disease especially type 2 diabetes, as it is a typical chronic illness that can influence quality of life because of its complications like diabetic retinopathy, diabetic foot etc.

ACKNOWLEDGEMENTS

I would like to thank all my teachers for their constant support and all the study participants who cooperated in my study and the Medical Officer of the UPHC, Bannimantap along with the Lab technicians in UPHC and JSS Hospital. I would like to thank our university "JSS Academy of Higher Education and Research" for encouraging me through the Research grant to carry out this study effectively.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Alouki K, Delisle H, Bermúdez-Tamayo C, Johri M. Lifestyle interventions to prevent type 2 diabetes: a systematic review of economic evaluation studies. *J Diabetes Res*. 2016;2016.
2. WHO Factsheet. Diabetes. Available from: https://www.who.int/health-topics/diabetes#tab=tab_1. Accessed on 23 May 2020.
3. Merlotti C, Morabito A, Pontiroli AE. Prevention of type 2 diabetes; a systematic review and meta-analysis of different intervention strategies. *Diabetes Obes Metab*. 2014;16(8):719-27.
4. Asif M. The prevention and control the type-2 diabetes by changing lifestyle and dietary pattern. *J Educ Health Promot*. 2014;3.
5. Rashed OA. Effect of diabetes education program on type 2 diabetic patients in Tulkarm Directorate of Health. 2012.
6. Ramachandran A, Snehalatha C, Yamuna A, Mary S, Ping Z. Cost-effectiveness of the interventions in the primary prevention of diabetes among Asian Indians: within-trial results of the Indian Diabetes Prevention Programme (IDPP). *Diabetes Care*. 2007;30(10):2548-52.
7. Unick JL, Beavers D, Jakicic JM, Kitabchi AE, Knowler WC, Wadden TA, Wing RR, Look AHEAD Research Group. Effectiveness of lifestyle interventions for individuals with severe obesity and type 2 diabetes: results from the Look AHEAD trial. *Diabetes Care*. 2011;34(10):2152-7.
8. Ristau RA, Yang J, White JR. Evaluation and evolution of diabetes mobile applications: key factors for health care professionals seeking to guide patients. *Diabetes Spectr*. 2013;26(4):211-5.
9. Pramanik BK, Angelin JJ, Mathai VJ, Mathai S, Korula S, Simon A. Smartphone app as motivational

intervention to improve glycemic control in adolescents with type 1 diabetes. *Indian J Pediatr*. 2019;86(12):1118-23.

10. Cui M, Wu X, Mao J, Wang X, Nie M. T2DM self-management via smartphone applications: a systematic review and meta-analysis. *PloS One*. 2016;11(11):e0166718.
11. Chen L, Pei JH, Kuang J, Chen HM, Chen Z, Li ZW, et al. Effect of lifestyle intervention in patients with type 2 diabetes: a meta-analysis. *Metabolism*. 2015;64(2):338-47.
12. Target blood sugar level chart. Available at: https://www.diabetes.co.uk/diabetes_care/blood-sugar-level-ranges.html. Accessed on 20 May 2021.
13. Normal and Diabetic blood sugar level ranges- Diabetes UK. Available from: https://www.diabetes.co.uk/diabetes_care/blood-sugar-level-ranges.html. Accessed on 23 May 2020.
14. IDF Diabetes Atlas. 9th edn. 2019. Available from: <https://www.diabetesatlas.org/en/>. Accessed on 23 May 2020.

15. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia. WHO. Available from: <https://www.who.int/publications-detail/definition-and-diagnosis-of-diabetes-mellitus-and-intermediate-hyperglycaemia>. Accessed on 23 May 2020.
16. Diabetes complications. International Diabetes Federation. Available at: <https://www.idf.org/aboutdiabetes/complications>. Accessed on 23 May 2020.
17. Wu Y, Yao X, Vespasiani G, Nicolucci A, Dong Y, Kwong J, et al. Mobile app-based interventions to support diabetes self-management: a systematic review of randomized controlled trials to identify functions associated with glycemic efficacy. *JMIR mHealth uHealth*. 2017;5(3):e6522.

Cite this article as: Doddaiiah SK, Shwetha G, Gopi A, Murthy MRN, Bilimale AS. A novel approach to assess the effectiveness of medical technological intervention in the management of diabetes mellitus. *Int J Community Med Public Health* 2021;8:4812-6.