International Journal of Community Medicine and Public Health
Doddaiah SK et al. Int J Community Med Public Health. 2021 Oct;8(10):4806-4811
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20213775

Original Research Article

Medical technology intervention in improving the quality of life among the type 2 diabetes mellitus patients

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Received: 27 April 2021
Revised: 25 August 2021
Accepted: 26 August 2021

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ABSTRACT

Background: Diabetes is a chronic disease characterized by high blood glucose with a disruption of fat and protein metabolism. Severe restrictions in diet, daily medications and other complications of diabetes can adversely affect an individual's health related quality of life. The present study was conducted to assess the effect of educational intervention on quality of life (QOL) among the type 2 diabetes mellitus (T2DM) patients in Mysuru city.
Methods: A quasi-experimental study was conducted from 1 November 2019 to 31 May 2020 among 138 diabetes patients at an urban health centre, Mysuru. Information regarding socio-demographic characteristics was collected using a pre-tested semi structured questionnaire. Assessment of QOL was done using the WHOQOL-BREF questionnaire. Data was analysed using SPSS version 23 (licensed to JSS AHER).
Results: The overall mean score of pre-test QOL of the study participants was 81.72±8.57 and post-test mean score was 86.43±6.322. It was observed that 68 (49.27%) participants had good total QOL score and 70 (50.72%) had poor total QOL score. Among all the 3 groups, group A showed improvement in QOL when compared to other 2 groups with 52.2% in post-test.
Conclusions: Improved QOL was seen in educational intervention using smartphone app when compared to other two groups (handouts and control group). QOL is one of the important factors among T2DM patients and it is important to take effective measures to improve it along with focusing on behavioural changes and health education.

Keywords: Diabetes mellitus, Educational intervention, Smartphone application, Handouts, QOL

INTRODUCTION

T2DM is a chronic disease characterized by high blood glucose levels, caused by a combination of genetic and lifestyle factors such as obesity and physical inactivity, which contributes to insulin resistance or decreased insulin output over time.[1] Diabetes impairs people's functional capacities and quality of life, resulting in significant morbidity and premature death. These trends have been blamed on increased consumption of unhealthy diets and sedentary lifestyles, which result in elevated body mass index (BMI) and fasting plasma glucose.[2]

According to the International diabetes federation 2019, there are around 463 million people worldwide living with diabetes and this number is expected to reach 700 million by 2045.[3] India is referred to as the diabetic capital of the world. It was discovered in 2017 that India had the second-largest diabetic population, after China, with 73 million diabetic patients and by 2045, this figure is expected to be doubled to 134 million.[4] Diabetes is a

psychologically difficult medical condition for both patients and caregivers. Living successfully with diabetes necessitates lifelong discipline and commitment, which can be very stressful and depressing.[5]

Patient education increases diabetic patients' QOL and metabolic regulation while also lower the rate of acute complications.6 Several studies have shown that behaviour change is more effective than basic disease education in enhancing diabetes regulation. Still the patients must have a basic understanding of the pathophysiology, complications and treatment of their disease, for controlling the metabolic parameters of diabetes mellitus. Usually, blood glucose levels has been used as an indicator of physiological control for assessing the impact of teaching programs. But recently other indicators like QOL or patient satisfaction have been proposed by educators.[7]

The WHO defined QOL as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standard and concerns.[8] When comparing chronically ill people to healthy adults or childbearing women, it was apparent that chronically ill people have lower mean QOL domain ratings.9 There were mixed findings when it came to the connection between QOL and glycaemic regulation and while some studies had clearly shown such a link, others had not.[10] Recent advancements in the fields of patient outcome analysis and health technology assessment have fueled an explosion in the use of QOL evaluation as a clinical research technique. More emphasis is now being placed on assessing the quality of health care and the economic value of new interventions.[11]

The role of mobile health technologies in improving self-efficacy in the management of chronic diseases is gaining popularity. In the coming years, the integration of mHealth into public health practice as a strategy for chronic disease surveillance will be critical as health costs rise due to an aging population and rising prevalence of chronic disease and co-morbidity.[12] Developers have created effective and user-friendly apps, which an increasing number of smartphone users have downloaded and used to aid in the management of chronic diseases.[1]

With the above background the present study was conducted to assess the effect of educational intervention on QOL among the T2DM patients attending the urban health centre, Bannimantap, Mysuru.

METHODS

Study design and population source

A quasi-experimental study was conducted in urban primary health centre, Bannimantap, Mysuru over a period of 6 months (November 2019 to May 2020) among T2DM patients who were regularly attending the non-communicable diseases unit at urban primary health centre. T2DM patients aged 18-65 years having more than 1 year of history of disease were selected for the study. Subjects who owned an android smartphone and received education up to 7th standard and above were included in the study. Patients with severe complications like gangrene, nephropathy, retinopathy, pregnant ladies, patients who were not capable of using smartphone application and illiterates were excluded from the study. The study was approved by the institutional ethics committee and oral informed consent was obtained from the participants after explaining the purpose and procedure of the study.

Sample size

Assuming a mean change of 4 mmol/l and 6 mmol/l in blood sugar of group A and group B and an alpha error of 5% with a power of 80%, at least 46 subjects needed to be studied in each group.[13,14]

Table 1: Distribution of study participant's based on the groups formed.

Group A	Group B	Group C
Technology based educational intervention using smart phone app	Educational intervention with handouts regarding diet and physical exercise	Control group

Sampling technique

T2DM patients who came for treatment at the urban health centre were noted and random number generation was done online. Using simple random sampling technique, the number of T2DM patients were allotted to each group for the study. After the participants were allotted into groups, group A was educational intervention using smartphone application, group B was given intervention with handouts regarding diet and physical exercise and group C was the control group. The patients were assessed for QOL before and 3 months after educational intervention.

Study tool

The study tools used in this study were QOL questionnaire of WHO (WHO-QOL-BREF) and the pre-tested semi-structured questionnaire to assess socio demographic characteristics. WHO-QOL-BREF questionnaire includes total 26 questions, out of 26 questions, 24 questions covered the domains which were classified into 4 domains such as physical health domain, psychological health domain, social functions domain and environmental domain and two questions pertaining to base on the satisfaction of overall health of that person. Each answer to the question was measured through Likert scale from 1-5 score, later each domain score was calculated which had got a set of domain score and was

converted to a scale ranging from 0-20, with minimum possible score of 20 and then this score was multiplied with 5 final score which ranged from 0-100 and it was calculated for each domain and the mean domain score of all domains together gave the QOL score in the range of 0-100. Higher the scores, better the QOL.

Statistical analysis

The data collected was entered in Microsoft excel 2019 spreadsheet followed by analysis using SPSS version 23 (licensed to JSS AHER). Qualitative variables like gender, religion, place of residence were represented using proportions. Quantitative data such as scores showing non-parametric distribution were expressed as median and interquartile range. The comparison between the educational interventional and control group was done using Chi-square test and McNemer test. P value <0.05 was considered statistically significant.

RESULTS

In the present study, out of the 138 study participants, around 50 (36.2%) participants belonged to the age group 51-60 years while 48 (34.8%) of them belonged to the age group 41-50 years. Majority of the study participants were females (77.5%) and 31 (22.5%) were males. Around 34 (24.6%) participants were illiterates while another 34 (24.6%) participants had primary school education. Majority of the study participants were homemakers (69.5%). 63% of the subjects belonged to lower middle class of modified Kuppuswamy scale. Around 101 (73.2%) participants belonged to joint family (73.2%) and more than half (57.2%) of the study participants had family history of T2DM. Around 50% of the patients had duration of diseases between 6-10 years and 39.1% between 0-5 years. Around 95 (68.8%) of the participants were on mixed diet and 105 (76.1%) of them were on oral hypoglycaemic drugs (Table 2).

Table 2: Distribution of study participant's based on the association of QOL with socio-demographic characteristics.

Variables	Frequency (%)	Chi square	P value
Age group (in years)			
31-40	21 (15.2)	8.556	0.381
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)	1.784	0.410
Male	31 (22.5)		
Education			
Illiterate	34 (24.6)	5.947	0.820
Primary school	34 (24.6)		
Middle school	16 (11.6)		
High school	31 (22.5)		
PUC	15 (10.9)		
Graduate	8 (5.8)		
Socioeconomic status			
Upper class	0	3.864	0.695
Upper middle class	15 (10.9)		
Lower middle class	87 (63.0)		
Upper lower class	25 (18.1)		
Lower class	11 (8.0)		
Type 2 diabetes family history			
Present	79 (57.2)	1.557	0.816
Absent	59 (42.8)		
Duration of type 2 diabetes (in years)			
0-5	54 (39.1)	8.830	0.016*
6-10	69 (50.0)		
11-15	15 (10.9)		
Post glycaemic status (HbA1c)			
4.1-7.0	77 (55.79)	3.769	0.041*
7.1-11.0	46 (33.34)		
11.1-15.0	15 (10.87)		

*significant p value.

Table 3: Comparison of study participants of group A, B and C before and after the educational intervention based on QOL.

Groups	Domains	Pre		Post		P value
		QOL		Good	Poor	
Group A (app)	Physical	Pre	Good	50	17	0.01
			Poor	25	42	
	Psychological	Pre	Good	46	21	0.03
			Poor	25	46	
	Social relationships	Pre	Good	62	18	0.05
			Poor	12	30	
	Environment	Pre	Good	43	24	0.02
			Poor	25	49	
Group B (handouts)	Physical	Pre	Good	40	25	0.12
			Poor	27	52	
	Psychological	Pre	Good	44	23	0.06
			Poor	25	48	
	Social relationships	Pre	Good	62	18	0.2
			Poor	12	30	
	Environment	Pre	Good	40	25	0.07
			Poor	27	52	
Group C (control group)	Physical	Pre	Good	41	26	0.16
			Poor	25	51	
	Psychological	Pre	Good	44	24	0.13
			Poor	24	48	
	Social relationships	Pre	Good	58	22	0.8
			Poor	12	34	
	Environment	Pre	Good	42	25	0.4
			Poor	25	50	

McNemer test.

Table 2 shows that duration of T2DM and glycaemic status of the patients were found to be statistically significant with a p value of less than 0.05.

On assessing the QOL score across all the four domains, the overall mean score of QOL improved from 81.72±8.572 to 86.43±6.322. After educational intervention, the mean score of physical health (domain 1) increased from 89.77±6.227 to 93.68±5.611, psychological health (domain 2) from 79.94±7.956 to 83.83±7.866, social relationship (domain 3) from 42.93±5.949 to 48.64±5.805 and that of environmental (domain 4) score from 114.35±15.104 to 117.48±13.91.

The QOL scores converted into categorical variable after getting the mean score and dividing the group into above the mean and below the mean score. Then they labelled as good and poor QOL. It was observed that after educational intervention, the total quality of life score was good for around 68 (49.27%) participants while 70 (50.72%) participants had poor QOL score. The physical QOL score was good for 29 (63.1%) out of the 46 group A participants when compared group B and C which had 21 (45.7%) and 20 (43.5%) participants with good QOL. The psychological and social QOL score after educational intervention score was also seen higher in group A, 25 (54.4%) and 28 (60.8%) when compared to group B and C. Majority of the participants in all the three groups had poor environmental QOL score. Group B and C had 25 each participants with poor QOL score while 24 participants in group A had poor environmental QOL score.

In the current study, the association of QOL of study subjects with that of educational intervention was compared using McNemers test and it was found that educational intervention using smartphone app (group A) was significant when compared to group B and group C with a statistical significance of p value <0.05 (Table 3).

DISCUSSION

The present study showed that educational intervention using smartphone application showed more effective results in the management of diabetes mellitus and overall quality of life when compared to handouts and control groups. This was found to be similar to a study conducted by Kumar et al in Mysuru, Karnataka which showed that an intervention using a mobile application had better effect in managing the outcome of T2DM patients.[15] Similar conclusion was also seen in a study conducted in Cairo university of Egypt showed that the educational

intervention was an effective tool and had a positive impact on the health of the diabetic patients.[16] Systematic review and meta-analysis study conducted in Beijing, China showed that smartphone apps offered moderate benefits for T2DM self-management which was similar to our study.[13] Another study conducted in China on mobile based intervention in the management of diabetes (systematic review of randomized control trial) also showed that the use of mobile based intervention yielded a clinically significant HbA1c reduction among adult outpatients with DM.[17]

The present study showed improvement in QOL after educational intervention which was similar to another study done by Kumar et al in Mysore, Karnataka which also showed an improvement in QOL after using an android mobile application.[12] Aghamolaei et al in Iran also showed significant improvement in HbA1c and QOL when compared to the control group.[18] Similar study using mobile application was conducted on type 1 diabetes patients by Berndt et al which showed an increase in the QOL of the subjects.[19]

However, many studies did not show any significant improvement in QOL as a result of the intervention. Mccarrol et al did a web based interventional study which showed no change in QOL of the subjects.[20] Klee et al three-month randomized double-crossover analysis also found that the mobile intervention had no impact on QOL.[21]

According to the findings of our research, educational intervention had a direct effect on the physical and mental health of T2DM patients. The educational intervention aided in the self-care management of diabetic patients so as to handle any complications that arose as a result of T2DM.[14] The boon of easy accessibility and affordability of cell phones in modern life had aided in the success of educational interventions using smart phone applications (group A). In the case of handouts (group B), these benefits were lost. In addition, older diabetic patients with vision problems may be unable to read the instructions on the handouts. As a result, the efficacy of educational intervention in group A was statistically significant with a $p<0.05$ when compared to the other two groups, group B and C.

CONCLUSION

Educational intervention using smartphone app for the management of T2DM showed a better improvement in quality of life when compared to other two groups, handouts and control group. All the four domains, physical, psychological, social and environmental scores showed improvements after the intervention. Educational interventions, especially technological approaches can be critical in the management of non-communicable diseases so as to improve the overall health and QOL of the patients.

ACKNOWLEDGEMENTS

The authors take this opportunity to thank the study participants for their cooperation. We also thank the medical officer and lab technicians of the urban primary health centre, Bannimantap. We also thank the JSS medical college, Mysuru for allowing us to conduct this study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Doddaiah SK, Shwetha G, Gopi A, Murthy MRN, Bilimale AS, Anil D. Medical technology intervention in improving the quality of life among the type 2 diabetes mellitus patients. Int J Community Med Public Health 2021;8:4806-11.