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Effectiveness of Short Message Service (SMS) based Glycaemic Control

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ABSTRACT

Objective: To find out the effectiveness of short message service (SMS) on glycaemic control among patients with diabetes at a tertiary care hospital in Rawalpindi.

***Study Design*:** Quasi-experimental study.

Place and Duration of Study: Department of Endocrinology, Pak Emirates Military Hospital, Rawalpindi Pakistan, from Jan to Jul 2020.

Methodology: A total of 218 patients with diabetes were included in the study. Patients were randomized into two groups by lottery method. Group-A received a tailored SMS package daily for six months along with printed dietary instructions, while Group-B was given only printed dietary instructions. After six months, HbA1c levels and other sociodemographic factors were compared among the two Groups A and B.

Results: In Group-A (SMS-Group) mean HbA1c levels reduced from 9.3±2.0 to 7.0±0.4 compared to Group-B (non-SMS-Group) with mean HbA1c levels from 9.7±1.8 to 8.8 ±1.4. Before SMS intervention, all variables, including HbA1c levels between the two groups, were insignificant. However, the use of structured SMS-based intervention in Group-A showed a statistically significant reduction in HbA1c levels compared to Group-B (p-value <0.05). The mean difference was 1.77(95% CI: -2.44 to -1.10).

Conclusion: This study showed Short Message Service (SMS) effectiveness by significantly reducing glycaemic levels (HbA1c) among people with diabetes compared to conventional methods of diabetic education for glycaemic control.

Keywords: Diabetes, Glycaemic control, HbA1c, Non-communicable diseases (NCD), Short message service (SMS).

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INTRODUCTION

Globally 463 million people had diabetes in 2019, and it is estimated to reach 693 million by 20451. Diabetes is the seventh leading cause of death. According to the international diabetes federation (IDF), diabetes caused 4.2 million deaths globally in 2019.[1,2]

Diabetes mellitus (D.M.) is a systemic disorder, a group of metabolic disorders characterized by persistent high blood sugar levels over a prolonged period resulting from defects in insulin secretion, insulin action or both.[3,4] It has two main categories type 1 and types 2 diabetes. Type 1, also known as insulin-dependent diabetes, occurs due to the failure of the pancreas to produce enough insulin. As a result, patients require life-long insulin injections, usually in childhood or adolescence.[5,6] Type 2, also known as non-insulin dependent diabetes, is a more common type of diabetes that develops due to insulin resistance in the body and is attributed to modifiable risk factors.[7] Other forms of diabetes include gestational diabetes6. Diabetes is associated with various modifiable and non-modifiable risk factors.[8] Modifiable factors include a sedentary lifestyle, unhealthy food intake, duration of disease, lack of knowledge and guidance, inaccessible and unaffordable health system, low socio-economic status, non-compliance to drugs, lack of physical activity, unbalanced diet, obesity, urbanization, smoking.[9,10]

Pakistan, a developing country, is also facing a rapid increase in the prevalence of diabetes. Since 1947, three national diabetes surveys (NDSP) have been conducted, latest (NDSP 2016-17) estimated that approximately 26.3% of the population above 19 years is diabetic. According to the international diabetes federation (IDF) prevalence of diabetes in Pakistan is 17.1%, which is 148% higher than previously reported.[6] However, fewer local studies focused on the intervention, especially SMS-based effective glycaemic control. Due to the different sociodynamics and pharmacogenetics of Pakistan, one cannot generalize the results of international studies on our local demographics.

METHODOLOGY

This quasi-experimental study was carried out at the Department of Endocrinology, Pak Emirates Military Hospital, Rawalpindi Pakistan, from January

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to July 2020. Hospital Ethical Review Board (A/28/EC/236/2021) was approached for ethical approval of this study. The sample size was calculated by using an open Epi sample size calculator with a diabetes prevalence of 17.1%,[2] which came out to be 218. Non-probability consecutive sampling technique was used to gather sample for the study.

Inclusion Criteria: Patients of both genders, with HBA1c >6.5% and age >18 years, were included in the study.

Exclusion Criteria: Patients with no HbA1c record available were not included in the study.

Written informed consent was taken from all the participants of the study. Various methods were used for data collection as OPD records, laboratory records or contact via phone/internet. Only hospital-entitled patients sharing contact information and follow-up after six months were included. Randomization was done via lottery method, so every patient had an equal chance of falling into any of two Groups A or B and both groups were given printed food and caloric charts with daily energy requirements. Group-A additionally received computer-based tailored SMS once daily as a reminder for medications, exercise and diet control and HbA1c levels were compared after six months.

SPSS (Statistical Package for social sciences) version 22 was used to analyse the data. For continuous variables, mean and standard deviation were reported, while for categorical variables, frequencies and percentages were reported. For inferential statistics, Independent Samples t-test was applied to look for the significant difference in the mean HbA1c scores among the two groups. The magnitude of difference between groups was found by using eta squared. Differences between groups were considered significant if the *p*-value was less than or equal to 0.05.

RESULTS

A total of 218 patients with diabetes were included in the study. Of 218 patients, 88(40%) were smokers, while 130(60%) were non-smokers and 166(72%) had a positive family history of diabetes mellitus (Table-I). 120(55) participants fell in the obese category of body mass index (BMI). 117(54%) patients had no history of hypertension, and 120(55%) participants were doing regular daily exercise for 30 minutes. Mean HbA1c levels before intervention for Group-A was 9.4±2.0mmol/mol, and for the Group-B was 9.6±1.8 mmol/mol, whereas mean HbA1c levels after intervention for Group-A was 7.0±0.5mmol/mol whereas for Group-B was 8.6±1.2mmol/mol (Table-II).

Table-I: Sociodemographic Characteristics of the Patients (n=218)

Characteristics		n (%)
Age	≤ 45yrs	82 (38%)
	≥ 46yrs	136 (62%)
Gender	Male	109 (50%)
	Female	109 (50%)
Smoking	Yes	88 (40%)
	No	130 (60%)
Monthly income	≤ 40,000	83 (38%)
	> 40,000	135 (62%)
Family history of Diabetes Mellitus	Yes	166 (76%)
	No	52 (24%)
Body Mass Index	≤ 24	98 (45%)
	> 24	120 (55%)
Hypertension history	Yes	101 (46%)
	No	117 (54%)
Working/Job	Yes	160 (73%)
	No	58 (27%)
Exercise daily for 30 minutes	Yes	120 (55%)
	No	98 (45%)
Medicine on time daily	Yes	103 (47%)
	No	115 (53%)
Controlled food intake	Yes	105 (48%)
	No	113 (52%)
Intervention	Group-A	109 (50%)
	Group-B	109 (50%)

Table-II: Comparison of HbA1c levels Before and After SMS Intervention (n=218)

		Mean±SD	*p*-value
HbA1c Before	Group-A	9.4±2.0 mmol/mol	0.32
	Group-B	9.6±1.8 mmol/mol	
HbA1c After	Group-A	7.0±0.5 mmol/mol	<0.05
	Group-B	8.6±1.2 mmol/mol	

There was a significant difference in HbA1c levels for Group-A (7.0±0.5mmol/mol) and Group-B (8.6±1.2 mmol/mol), $p<0.05$. Independent variables such as gender, smoking status, monthly income, family history of diabetes mellitus, history of hypertension, and daily on-time medications as advised by the respective doctor were insignificant in this study before or after intervention as *p*-value >0.05. Whereas non-modifiable factors like age and modifiable factors like body mass index, nature or status of the job, exercise daily for at least 30 minutes and controlled food intake came out to be statistically significant as *p*-value <0.05 in the Intervention-Group compared to Non-Intervention-Group were age, gender, exercise daily for 30 minutes and smoking came out to be statistically significant as *p*-value <0.05 (Table-III).

Table-III: Overall HbA1c levels Post SMS Intervention (n=218)

Variables		Mean HbA1c (mmol/mol) Before	Mean HbA1c (mmol/mol) After	*p*-value
Gender	Males	9.2±1.5	7.9±1.2	0.26
	Females	9.8±2.1	7.7±1.2	
Age	≤45yrs	8.9±1.6	7.5±1.1	<0.05
	≥46yrs	9.9±1.9	8.0±1.2	
Smoking	Yes	9.2±1.6	7.8±1.2	0.75
	No	9.7±2.0	7.8±1.2	
Monthly income	≤40,000	9.7±2.1	7.8±1.1	0.87
	>40,000	9.4±1.7	7.8±1.3	
Family history of Diabetes Mellitus	Yes	9.5±1.9	7.9±1.2	0.25
	No	9.4±1.8	7.6±1.2	
Body Mass Index	≤24	9.7±1.9	8.0±1.3	0.02
	>24	9.4±1.8	7.6±1.1	
Hypertension	Yes	9.6±2.0	7.7±1.0	0.21
	No	9.4±1.8	7.9±1.4	
Working/Job	Yes	9.5±1.7	7.9±1.3	<0.05
	No	9.6±2.4	7.5±0.7	
Exercise daily for 30 min	Yes	9.3±1.8	7.6±1.0	0.03
	No	9.8±1.9	8.0±1.4	
Medicines on time daily	Yes	9.7±2.0	7.9±1.2	0.24
	No	9.4±1.7	7.7±1.2	
Controlled food intake	Yes	9.3±1.9	7.5±1.0	<0.05
	No	9.7±1.8	8.1±1.3	
Intervention	Group-A	9.4±2.0	7.0±0.5	<0.05
	Group-B	9.6±1.8	8.6±1.2	

DISCUSSION

This study showed an overall decrease in mean HbA1c levels in both groups. Group-A mean HbA1c levels after intervention came out to be statistically significant. The results of this study were consistent with the previous research. However, other associated factors like age, weight, work status, exercise for at least 30 minutes, and controlled food intake were significant for glycaemic control. However, the literature review shows that other factors, which were not included in this study, have a significant effect on controlling glycaemic levels.[11,12]

Peters *et al.* did a similar study in 2017. Socio-economic like ours showed significant improvement in glycaemic levels along with better disease knowledge, healthier lifestyle, and medication adherence with the SMS service.[13] A study on the effectiveness of text message-based diabetes self-management found a significant glycaemic control *p*-value<0.05.[14] Randomized control trial by Abaza *et al.* using SMS education to promote self-management of diabetes, found significant improvement in sugar levels *p*-value<0.05.[15] A community implementation for improving glycaemic control with standardized text messages showed statistically significant improvement in glycaemic levels *p*-value<0.05.[16] Another study to find out the effect of SMS on glycaemic control in type 2 diabetes patients and also revealed a statistically significant improvement in HbA1c levels *p*-value <0.05.[17] A study done on the Hispanic population with type 2 diabetes for improving glycaemic control via SMS-based intervention showed a significant reduction in HbA1c levels *p*-value <0.05.[18]

LIMITATIONS OF STUDY

The study had a few limitations, including the availability and affordability of the HbA1c test, the ability to read SMS and the use of mobile phones. In addition, only entitled patients were included. Other tests for assessing diabetic health status were not considered due to limited time, resources and patients' unwillingness for these tests. However, the study had multiple strengths as this study showed telecom sector could augment our health system or conventional public health awareness programs to achieve health-related sustainable development goals. Furthermore, this study used an equal number of diabetics in both groups, and equal representation was given to males and females.

CONCLUSION

Results of this study showed a significant reduction in HbA1c levels of diabetic patients included in Group-A, who received daily SMS reminders, compared to patients in Group-B, who were given conational pamphlets and other disease-related materials. Therefore, the Diabetic Association of Pakistan, along with other health-related authorities involved in monitoring, evaluation, disease prevention and health promotion, should develop a mechanism for the centralization of data both from the public and private sectors so that the diabetic population can be approached via telecom sector for effective glycaemic control, thus reducing morbidity, mortality, improving life expectancy and overall health of individuals leading them to a healthier life.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

MT & SN: Conception, Study design, drafting the manuscript, approval of the final version to be published.

AA & AE: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

MSK & MZH: Critical review, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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