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Outcome of Text messaging on glycemic control in children with type 1 diabetes mellitus: A Single Group Pre and Post intervention Study.

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ABSTRACT… Objectives: The objective of this study is to find the outcome of text messaging on glycemic control in children with type1 DM. **Study Design:** Prospective Single Group Pre- and Post-intervention study. **Setting:** Diabetic Clinic of Department of Pediatric Endocrinology at The Children hospital and the Institute of Child Health, (CH & ICH) Multan. **Period:** October 2019 to December 2019. **Material & Methods:** Forty nine children and adolescents of 10-15 years old with T1DM were included in this study after taking informed consent from patient or their caregivers. Text messages were sent 5 times per week to patients/parents in simple Urdu language about diabetes education and Interactive message was sent weekly about blood sugar monitoring and insulin dose modification. To make sure patients are receiving text messages, phone calls were made regularly. **Results:** Among diabetic children 24 (49%) were males. The age ranged from 10-15 years and mean age was 12.6 ± 1.8 years. Mean duration of diabetes was 4.7± 2.8 years. Before intervention fasting and post prandial blood glucose levels per month were 160.4 mg/dl and 190 mg/dl respectively. After 12 weeks of text messaging fasting and post prandial blood glucose levels significantly (p-value < 0.001) dropped to 135.2 mg/dl and 170 mg/dl respectively. Similarly, HbA1C level decreased from 10% to 9% after intervention with p value of <0.001. Similar significant improvement was seen in frequency of hypoglycemic/hyperglycemic episode, missed insulin doses and frequency of hospital admissions. **Conclusion:** Our study showed a significant improvement in glycemic control and diabetes case management by diabetic educational and interactive text messages.

Key words: Diabetes Mellitus Type 1, Glycemic Control, Text Messaging.

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INTRODUCTION

Diabetes mellitus type 1 (T1DM) is increasing worldwide and it is estimated that over 500000 children are suffering from this condition.[1] Optimum care involves behavior modification and continuous support from family and primary care physicians. Adolescents become increasingly independent in diabetic management and non adherence to therapy leads to poor glycemic control.[2,3] Teenagers may benefit from increased support and due to increased use of mobile phone and text messaging, they may benefit from this technology. Including caregiver at home may increase children involvement for better glycemic control.[4]

A number of behavioral and educational interventions have shown promising results in diabetes management, but they are time consuming and need resources.[5-7] Text messaging has been studied widely and is found to be promising. Novel intervention in children's (NICH) healthcare program showed decrease in emergency visits by using text message intervention.[8]

According to Pakistan telecommunication authority (PTA) there were 165 million subscribers of cell phone in Pakistan in December 2019. As SMS (short message service) is supported by all types of mobiles, it can reach to higher percentage of population and is a simple way of communication. On one hand results of text messing intervention are promising but on the

other hand its long term use leads to decrease attention among adolescents.[9]

The objective of this study is to evaluate the outcome of text messaging intervention on glycemic control in children with type 1 diabetes mellitus.

MATERIAL & METHODS

This was a prospective single group pre- and post-intervention study conducted in the diabetic clinic of department of pediatric endocrinology from October 2019 to December 2019 at The Children hospital and the Institute of Child Health, (CH & ICH) Multan. A sample size of 49 patients was calculated through STATA version 15.0 by using formula for paired mean t-test, where pre-trial $HbA1_c$ (%) is 10±2 and post-trial 9.5±1.8 as reported by Bin-Abbas et al[10], with 95% confidence level, 80 % power of the study and 0.8 correlation between the means. So, a total of forty nine children and adolescents of 10-15 years old with T1DM were included in this study after taking informed consent from patient or their caregivers. Among study participant's duration of diabetes was more than 1 year and HbA1c was >10 with possession of mobile phone and texting ability among patients or their parents.

Patients were recruited among routine visit at diabetic clinic. Detailed history was taken on pre designed Performa including name, age, sex, duration of diabetes and date of visit. T1DM was diagnosed according to American diabetic association (ADA)[11] criteria. Glycosylated hemoglobin (HbA1C) level was estimated by using high-performance liquid chromatography method. HbA1C was taken as a marker of glycemic control. HbA1C of 6-7.9, 8-9.9 and >10 as good, fair and poor control respectively.[12] HbA1C was measured at recruitment visit and then after 3 months to see improvement in glycemic control.

At first visit following parameters were recorded. HbA1C level, frequency of hypoglycemic episodes (blood sugar < 40 mg/dl), hyperglycemic episode (blood sugar >180 mg /dl), missed insulin doses and blood sugar monitoring. Mean fasting and post prandial blood sugars and frequency of hospital admissions were also noted. At the end of trial all these variables were again noted.

Text messages were sent to patients/parents in simple Urdu language. Text message were about diabetic education like symptoms and signs of diabetes, hypoglycemia, psychotherapy, adherence to treatment, injection sites, dietary modifications, blood glucose monitoring and importance of insulin. These messages were sent 5 times per week. Interactive message was sent weekly in which insulin dose was adjusted according to blood glucose levels provided by patient/parents. To make sure patients are receiving text messages, phone calls were made regularly.

The data was analyzed by Statistical Program for Social Science software (SPSS, Chicago, IL, USA), version 20.0 for windows. Quantitative variables are presented as mean and standard deviation (SD). Qualitative variables are represented as frequency and percentages. Paired t test was used to evaluate difference in HbA1C values and other variables like, frequency of hypoglycemic/ hyperglycemic episode, missed insulin doses and frequency of hospital admissions. P value ≤ 0.05 is taken as statistically significant. Institutional Ethical committee of CH & ICH, Multan had approved this study.

RESULTS

Demographic data of T1DM is shown in Table-I. Forty nine patients with T1DM were included in this study with 24 (49%) males and 25 (51%) females. The age ranged from 10-15 years and mean age was 12.6 ± 1.8 years. Mean duration of diabetes was 4.7± 2.8 years.

During the study 2500 diabetic education message (5 messages/patient/week) were sent to patients. Similarly, 500 interactive texts were sent and hundred phone calls were made to make sure patients are receiving text messages. Insulin dose was adjusted in 80 of the phone calls according to blood glucose levels.

Prior to sending text messages mean fasting and post prandial blood glucose levels/month

were 160.4 mg/dl and 190 mg/dl respectively. After 12 weeks of trial they were 135.2 mg/dl and 170 mg/dl with p value of <0.001. Similarly, HbA1C level decreased from 10% to 9% with p value of <0.001 which is significant improvement in glycemic control. There was improvement in other parameters as shown in Table-II.

Age (mean±SD) Age Range	12.6 ± 1.8 years 10-15 years
Male	24 (49%)
Female	25 (51%)
Mean duration of diabetes	4.7± 2.8 years

Table-I. Demographic data of patients with TIDM (N=49)

	Pre Intervention		Post Intervention		P-Value
	Mean	SD	Mean	SD	
Fasting blood glucose (mg/dl)	160 ±	57	135 ±	57	<0.001
Post prandial blood sugar (mg/dl)	190 ±	67	170 ±	59	<0.001
Hypoglycemic episodes per week	0.7 ±	1.1	0.6 ±	0.7	<0.001
HbA1C %	10 ±	2.0	9.0 ±	1.5	<0.001
Missing insulin injections per week	0.4 ±	0.5	0 ±	0	<0.001
Blood glucose monitoring per day	1.7 ±	1.1	3.4 ±	1.0	<0.001
Hospital admissions per month	0.5 ±	0.6	0 ±	0	<0.001

Table-II. Outcome in various parameters before and after intervention in children with T1DM (N=41)

DISCUSSION

To achieve better glycemic control T1DM patients must adopt healthy life style, stick to a diabetic diet plan, regular physical activity and insulin injections. In addition to these measures patients need to check their blood sugar levels, maintain diabetic diary, be aware of hypoglycemic and hyperglycemic episodes, insulin dose adjustment according to blood sugar level, when to see a doctor and importance of regular follow up visits. This study showed improvement in glycemic control in children with T1DM after text message reminders. Arambepola et al[13] and Herbert et al[14] showed similar benefits in their studies.

Communication technologies have profound impact on management of chronic diseases. Adolescents and teenagers use mobile text messaging worldwide for engagement with their peer's and for social communication.[15] A recent Meta analysis showed profound improvement in glycemic control via use of telemedicine including text messaging.[16] Although there were some concerns among primary care physicians of increase burden beside their office visits, but over time they got used to texting after reviewing blood sugar reports of patients.

In our study population there were positive behavioral changes with improvement of glycemic control. Frequency of missing insulin doses and hospital admissions were zero with profound decrease in hypoglycemic attacks. These findings are in consistent with other studies like Burner et al[17] who showed similar results of medicine adherence and blood sugar monitoring.

Improved glycemic control was noted in our study by drop in HbA1C level from 10 to 9 % in 3 months duration. In Iran, Mulvaney et al[18] showed SMS was as effective as telephone calls for diabetic patients' education and guidance. There was almost equal drop in HbA1C levels with both modalities; despite telephone calls were more time consuming and expensive. Similar findings were reported from South Korea by Kim et al.[19] After 3 months of intervention HbA1c level dropped by 1.15%, while it increased for control patients by 0.07%.

Effects of interactive SMS on glycemic control were studied in Bahrain. Participants send their queries about varies aspects of diabetes management and received immediate text message from a doctor. There was a significant drop in their HbA1C levels among diabetes and control group (−2.76% and −1.6% respectively) compared to baseline.[20] Similarly CareSmarts

study[21] also studied effect of interactive SMS on glycemic control. Participants achieved drop in HbA1C from 7.0 to 7.2%.

To summarize, in this study text messing proved to be a tool for better diabetes self management and improvement in glycemic control. As mobile phone and text messing are widely used by adolescents, it can enhance better communication between patients and their providers between regular clinic visits.

One of the limitations in our study was short duration. We think 6 month would be optimum time to look in glycemic improvement, but it was not possible due to budget constraints. For generalizability large RCT trial would be needed. Other limitation of study was illiteracy among study population. Patients/parents who were unable to read or respond to text message were not included in study.

CONCLUSION

Our study showed significant improvement in glycemic control and diabetes case management by diabetic educational and interactive text messages. In future larger and longer RCTs are needed for greater acceptance of this modality.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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2	Asim Khurshid	Data acquisition, Critical review, Final approval.	
3	Sidra Anjum	Data acquisition, Critical review, Final approval.	Sidra.