A study on improving care in diabetes by evaluating patient empowerment through eHealth Technology

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ABSTRACT

Diabetes Mellitus (DM) is a lifestyle illness affecting majority of the population worldwide. The effective management of Diabetes Mellitus is essential to prevent long term complications (American Diabetic Association, 2016). The advent of newer technologies has provided greater possibilities in diabetes self-management, smart-phone applications are one of these technical advancement. Also encouraging people with diabetes for diabetes self-control is powerful through empowering them through health education. The objectives of the study to examine the effectiveness of eHealth technology by using a freely available smart-phone application in diabetic self-care and also to study patient empowerment through health education in improving diabetic care. This study is divide into three parts, the part 1 is a cross sectional study, Part 2 was a pilot study and Part 3 is a cross sectional study. This included a convenient sampling and the study was carried out for a period of six months. The analysis of the study was done using SPSS software. Correlation was applied to part 1 of the study, which revealed that the smart-phone prevalence was more in the younger age people whose income is above Rs.1,00,000/- and whose educational level is above degree. Part 2 study was analyzed with the paired t test which depicted that there was a significant relationship between the glycated hemoglobin (HbA1c) level for intervention and control group. And lastly the part 3 study was analyzed using the paired t test which revealed a significant relationship between the pretest and post test scores for Diabetic Knowledge Questionnaire (DKQ) also the correlation test shows that the education level and duration of diabetics has a significant relationship. Part 1 of the study shows that the reach of smart phones was more in younger individuals with salary above 1,00,000/- and education level above degree. Part 2 of the study, shows that the intervention using smart-phone applications in diabetic self-care is effective. And part 3 of the study reveals that the patient empowerment in the form of health education will bring about positive behavioral changes in the individual which will aid in diabetes management. The study concludes that the eHealth applications and patient empowerment is effective in diabetes management. The present diabetic population lack sufficient knowledge on the usage of smart-phones but the future generation will be well versed with this and hence the implementation of eHealth strategies is promising for the future. Patient empowerment is very important aspect in health care this has to be considered as the patients can take part in the decision making process pertaining to their health with the health care team.

Keywords: Smart phone application, eHealth, Diabetes Mellitus, Diabetes Self-management, Patient empowerment

1. INTRODUCTION

Diabetes Mellitus is chronic and progressive disorder mainly due to type 1 and type 2 that is absolute or relative causes respectively and it affects every system of our body (American Diabetes Association 2009). Resulting from poor glycaemia control, diabetes is raising globally. Poor control of diabetes results in higher rates of complications also increases the health care expenditure. It was believed to be a disease occurring in developed countries until

recently, but findings revealed its raising number of new cases with an earlier onset and associated complications in developing countries as well . Globally, it is observed that, 422 million adults were living with diabetes in the year 2014 where compared to 108 million in 1980. It is increased from 4.7% to 8.5% in the adult population from 1980 onwards. Around 1.5 million of deaths occurred due to diabetes in the year 2012 and 3.7 million Deaths will occur before the age of 70 years for Forty- three percent of population (World Health organization 2016).

Diabetes self-management and support is the severe division of care for all the people with diabetes. (American Diabetic Association 2009). It facilities the knowledge, skill, and abilities for diabetes self-care as well as activities that will assist an individual for implementing and sustaining behavior changes to manage his or her health condition on an on-going basis. It is necessary to learn how to manage diabetes and prevent or delay complications. With the increasing use of smart-phones and Internet, there is an opportunity to use digital tools for training people with diabetes to self-manage their disease. There are many mobile applications, Internet portal, and websites are available to help patients to improve their diabetes care. (Laura F. Garabedian, et al 2015)

Diabetes self-administration and bolster is the extreme division of care for all the individuals with diabetes, it moreover incorporates self-monitoring of different wellbeing parameters like expanding physical movement keeping a low carbohydrate slim down and taking solutions (American Diabetic Association 2009). It encourages the information, aptitude, and capacities for diabetes self-care, as well as exercises that will help a person for actualizing and supporting behavior changes to oversee his or her wellbeing condition on an ongoing premise. It is fundamental to memorize how to oversee diabetes and avoid or delay complications. With the expanding utilize of smart phones and web, there is an opportunity to utilize computerized devices for preparing individuals with diabetes to self-manage their infection. There are numerous portable applications, internet entrance, and websites are accessible to assist patients to progress their diabetes care. (Laura F. Garabedian,et al 2015).

Progress in smart-phone innovation and remote systems have brought about in expanded selection and upgraded capability, driving to openings for progressed diabetes self-administration. Eirik Årsand et al, (2010) surveyed instruments for administration of diabetes that were detailed within the writing or freely accessible on the web. The ponder recorded the instruments, but not the point by point depiction. Chomutare T, et al , (2011) checked on the usefulness of diabetes applications. Though, Martin C et al, 2011 checked on the diabetes applications accessible on the Apple app store(AAS), with the specific accentuation on ease of use. The objective of engaging patients is to advance independent self-regulation in arrange to maximize the individual's potential for wellbeing and wellness. Arrangement of data and instruction is the primary step to engaging patients. Strengthening is something more than an association, system or methodology. It includes a potential to make strides the generally wellbeing and well-being of people and communities, and to alter the socio-environmental variables that cause destitute wellbeing conditions. (Azar Tol.et al 2015). The understanding strengthening development begun in 1970's at the same time when the patient's right constitution was drawn up. (Henderson D.J.et al,1997). The objective was to construct the capacity of patients together to be dynamic accomplishes in their possess care, to empower them to share in clinical choice making, and to contribute to a more extensive view point within the wellbeing care system,(Smith M. et al 2013).Expanding self-esteem and subsequently moving forward self-efficacy may well be of a incredible significance in engaging diabetic.

2. STATEMENT OF THE PROBLEM:

- To study the effectiveness of smart-phone applications and patient empowerment in improving diabetic care**.**

3. OBJECTIVES OF THE STUDY:

The major objectives of the study are:

- To examine the effectiveness of a freely available smart phone application in diabetic self-care.
- To study patient empowerment through health education in improving diabetic care

4. SCOPE OF THE STUDY:

This research focuses primarily on smartphone applications and empowering patients in improving diabetes treatment. The main purpose of this study is to help patients determine and develop their own ability to take responsibility for their lives, and to self-regulate to maximize the potential for individual health and well-being is to promote.

5. REVIEW OF LITERATURE:

1. Laurence L. Alpay,et al (2010) E-health applications and services for patient potential in the Netherlands aimed at developing e-health that promotes patient empowerment in their study conducted good practises guidance's for. The results of the study found that best practices promote patient empowerment through e-health. The study concluded that Despite extensive knowledge of patient empowerment and technical visibility of e-health, there is little evidence of good practices in general especially for patient empowerment.

2. Christian Meyer, et al (2008) and their research topic "Clinical research for patient empowerment" investigate whether theoretical is possible through motivational interviews in clinical studies of critically ill patients. It aims to develop quantitative approach to improving heart health in chronic disease. The results of the study showed a high level of patient satisfaction. The course is complete. Promoting empowerment in clinical research project is ethically essential and can actively improve self-care oriented, disease –specific skills in patients with severe chronic illness. Clinical research can open up new ways to further strengthen patient sovereignty in interdisplinary health sciences,

3. Eirik Arsand ,et al (2010) Mobile Phone-Based Self-Management Tools for Type 2 Diabetes: overview of included systems and its main purpose is the use of information and communication technologies (ICT) to support self-management of personal health both Type 1 and Type 2 diabetes identified in their study have diabetic challenges. People with diabetes are generally as mobile as others and need to be able to use mobility techniques to manage their condition. In this study we came to conclusion that it is possible and feasible to develop an application that integrates multiple sensor and feedback application into a single health. The few application reminds people with type 2 diabetics of this idea of how to improve their health. It gives them the ability to collect and analyse personal data related to their illness. Six months of user intervention have shown that the system has a motivational effect on users.

There are many scholarly research papers published on the eHealth technology concept, in health care industry and some of the important results on related work are listed in Table 1 with the research area, research focus and reference.

Table 1 Related research work on A study on improving care in diabetes through eHealth Technology by evaluating patient empowerment

R.No.	Research Area	Research Focus	References

4	Evaluating Patient Empowerment in Association With eHealth Technology: Scoping Review	Concept of patient empowerment in the context of eHealth	Tracie Risling, et al (2013)
5	Diabetes Self-Management Smart-phone Application for Adults With Type 1 Diabetes: Randomized Controlled Trials	According to SMS medical experts, diabetes-related smart-phone applications can significantly improve glycaemic control in adults with type 1 diabetes.	Morwenna Kirwan, et al, (2013)
6	Mobile Applications for Self-Management for diabetics: Status and Potential	coupled with the proliferation of data connections smart phone technology has led to increased interest and use of mobile technology for self-management for diabetes	Omar El Gayar, et al, (2013)
7	"Diabetes Mobile Applications Evaluation and development: A Key Factors for Health Care Professionals wanting to advise Patients"	Effectiveness of using mobile applications in self-management of diabetics.	Ryan A Ristau**,** et al, (2013)
8	Effectiveness of Smart-phone applications to improve Healthy lifestyles, Randomized clinical tail(Evidence II): Research protocol.	New technologies contribute to a healthier lifestyle, and their benefits are beneficial for arterial aging and improved population health.	Jose Recio-Rodriguez, et al **(**2014)
9	Survey on the potential Reach of Smart-phones in diabetes	Identify the use of smart-phones by individuals and investigate social demographic profiles.	Katherine S Blandon, et al (2014)
10	Assessment of diabetes empowerment in Indian patients	To assess the psychological aspects of diabetics and their empowerment	K.V.S Hari Kumar, et al (2014)
11	Evaluation of a simple Diabetes Knowledge tool for the elderly and Minority Adults	assess and identify possible changes to improve his ability to document his knowledge of diabetes.	Sara A Quandt, et al (2014)
12	Mobile Phone and Smart-phone Technology for	Mobile and smart-phone (m-Health) technology	Laura F. Garabedian, et al (2015)

	Diabetes treatment and Self-Management.		
13	Conceptualization of patient empowerment: mixed method research	patient empowerment components such as health literacy, self-management, and shared decision-making	Paulina Bravo, et al (2015)
14	Self-Management of type 2 diabetes with smart-phone applications: Systematic Review and Meta-Analysis	Mobile health intervention (health) based on smart-phone applications (apps)	Cui M, et al (2016)
15	Self-care mobile Health app: Qualitative study of user experience	consumer experience and expectations to promote sustainability of self-monitoring	Kevin Anderson, et al (2016)
16	How to use and believe in mobile app for self-management of diabetics	Use of app for DM self-management, and whether HP recommends the app to patients.	Leah Boyle, et al (2017)
17	Patient Involvement and participation in Research	Patient / caregiver empowerment process as a priority in rare disease situations	Lilisbeth Perestelo-Pérez , et al (2017)
18	Adhere to self-care practices and em diabetes power diabetes: randomized clinical trials	Peoples self-care and glycation control and empowerment in group formation	Misa Mara Lopes Macedo, et al (2017)
19	Tools for assessing the adoption of mobile technology in self-management of diabetes: Validation and reliability studies	Use of cellular technology, and determination of sociodemographic characteristics and quality of life factors	Mirela Frandes et al (2017)
20	Content Analysis for diabetic Mobile Health Applications	Comparison of mobile app content and features for self-management of diabetes	Syarafina Izahar, et al (2017)
21	Diabetes management in the digital age	use of new technologies and digital health in self-management diabetes with a focus on future directions and potential challenges	Viral N Shah, et al (2015)

22	Willingness of diabetes to use an ICT-based self-management tools: Cross-sectional study	patients willingness to use personal computers, smart-phones, and mobile phones	Shibuta Tomomi, et al (2017)
23	Training and support for self-management of Diabetes with mobile health interventions (m-health) for adults with type 2 diabetes.	Benefits of training and support for diabetes self-management through mobile health interventions in adults with type 2 diabetes	Anne Meike Boels et al (2017)
24	Rapid Evidence Review of Mobile Applications for Diabetes Self-management	Diabetics self-management app features, clinical benefits, and ease of use.	Stephanie Veazie, et al (2018)
25	Use and interest in mobile health for diabetic self-care in vulnerable populations	Assess the use of patient interest in Text Messaging and mHealth applications for diabetes self-care	Gitte Reventlov Husted, et al (2018)

6. HYPOTHESIS OF THE STUDY:

Ho1: Organization implementing e-Health technology does not have any impact towards problems encountered while implementing eHealth concept.

Ho2: Age don't have any relation after eHealth technology implementation

7. RESEARCH METHODOLOGY:

A theoretical study based on a pilot study of a randomized comparative pathway using qualitative and quantitative data to investigate the effectiveness of smart phone use to improve diabetes self-management and patient empowerment. This study is basically divided into three parts to investigate the effectiveness of smart-phone and patient empowerment.

PART 1:

A cross sectional study was conducted to collect subjects based on random samples to analyse the range of diabetic smartphones compared to non-diabetic patients.

Sample size: 100

Study duration: Two months

Inclusion criteria:

- Adults age >30 years
- Using smart-phone health applications.

Exclusion criteria:

- Individuals not using smart-phones.
- Age of individuals <30 years

Sources of the data:

Patients with diabetes visiting the hospital outpatient department for regular follow up consultation. Few questions were asked regarding usage of smart-phone, utilizing any health related applications, whether they track online health related information, and usage of emails for communication. Based on the above responses the data was collected and analysed.

PART 2:

A pilot study based on randomized control trail to evaluate the effectiveness of a smart-phone app "GLUCOSE BUDDY". Efforts *are needed* to find out if diabetes are using smart-phone technology to help them manage their diabetes focuses on how the need for supportive technologies evolves over times as both disease and its management change over times.

Sample size: 30

- Control group: 15
- Intervention group: 15

Study period: Six months

Inclusion criteria:

- Type 2 diabetes mellitus
- Using smart phone application

Exclusion criteria:

- Type 1 diabetes
- Gestational diabetes

Important parameter to assess the effectiveness of the app was the testing of HbA1c before and after the trail

GLUCOSE BUDDY:

No. 1 in diabetes management applications for over 9 years. Glucose Buddy is the most comprehensive diabetes management app.

1 Diabetes iPhone Application by Manny Hernandez, Founder of TuDiabetes.com. As seen in the American Diabetes Association's Forecast Magazine, NYTimes, Wired Magazine, DiabetesMine.com, MedGadget.com, Mendosa.com, Diabetes Health Magazine, JDRF Newsletters and Mobi HealthNews.

FEATURES in the app:

- Easily record your blood glucose, medication, and diet in one entry

- Track trends such as blood glucose, insulin, weight, blood pressure, and Glycated haemoglobin (A1C), - Add a note to the entry for later reference

- Watch your blood sugar and carbohydrate change every hour

- Track your diet with our extensive food database

- Supports milligrams per decilitre (mg/dL) and millimolar per litre (mmol/L)

Fig 1 : Logo of Glucose Buddy application.

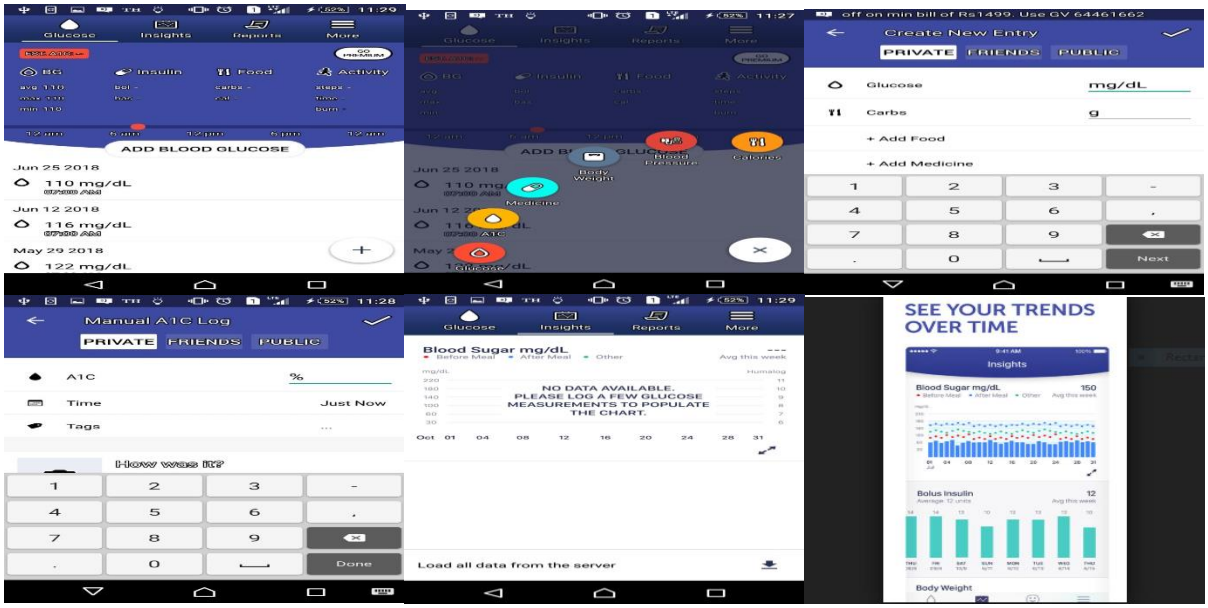


Fig 2: The screenshots of the Glucose Buddy application

Table 2: The applications export data to the care providers mail will appears as follows.

type	Date	Time	glucose	Note	Tags
glucose	25-06-2019	07:00:56	110		
glucose	12-06-2019	07:00:26	116		
glucose	29-05-2019	07:00:59	122		
glucose	13-05-2019	07:00:26	132		
glucose	26-04-2019	07:00:53	134		
glucose	10-04-2019	07:00:24	154		
glucose	22-03-2019	18:34:50	150		
glucose	11-03-2019	20:25:20	102		
glucose	11-03-2019	07:24:19	178		
glucose	13-02-2019	17:04:37	180		Out Of Bed
glucose	08-02-2019	15:16:15	200		After Lunch
glucose	08-02-2019	10:05:06	150		Out Of Bed
glucose	31-01-2019	06:33:44	156		Out Of Bed
glucose	29-01-2019	16:49:47	150		Before Snack
glucose	12-12-2018	07:00:25	156		
glucose	05-08-2018	11:21:27	100		Out Of Bed

Intervention group:

- Participants were informed about the use of the glucose buddy app and its features.
- Participants were instructed to record their blood sugar levels along with the date and time during a blood test at home or in the laboratory.
- HbA1c was measured twice during the trail, once at the beginning and end of the test period.

Control group:

- Monitoring of patients in this group was done in a traditional manner.
- The consultant monitored these patients under normal circumstances.
- These patients received follow up care advice on the management of diabetes based on their health condition.

Sources of the data:

Type 2 DM Patients visiting for consultation in endocrinology the outpatient department were considered for control group. And for intervention group individuals diagnosed with type 2 DM well known to the researcher who were willing to use the app were included.

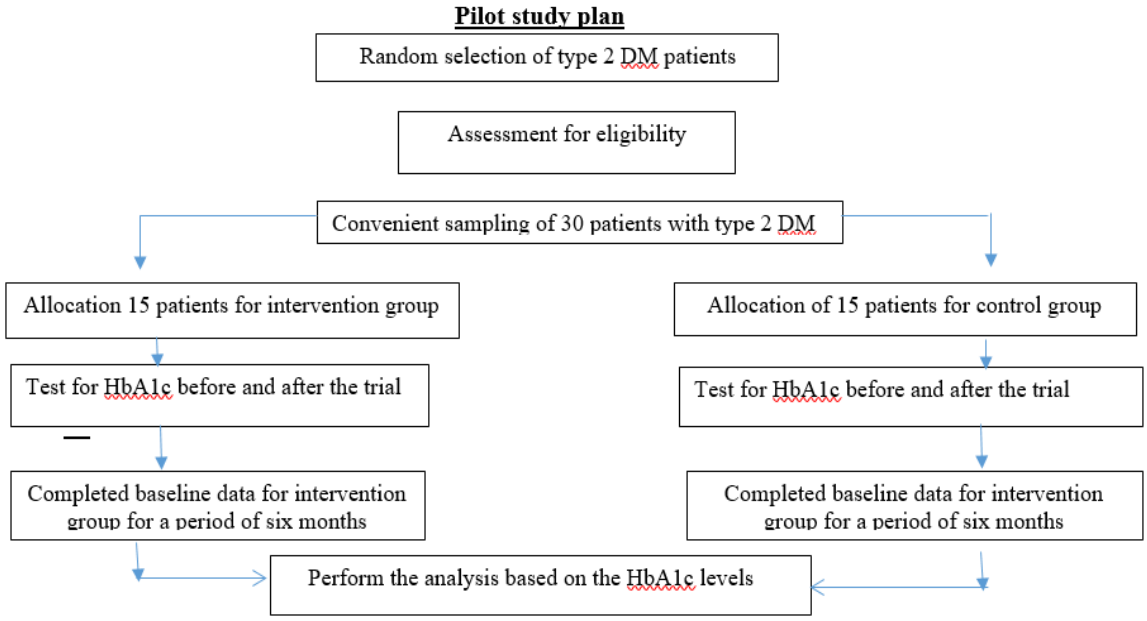


Fig 3: Pilot Study plan

Statistical tools used: Descriptive statistics, Likert scale, Flow chart, Tables

8. **ANALYSIS AND INTERPRETATION**:

Part 1: Reach of smart phones in diabetics compared to non-diabetics.

Smartphones show that self-management of diabetes can be improved. With the rapid spread of smartphones and the proliferation of diabetes, a variety of support applications designed to improve self-management of diabetes in a day today in daily operations and decision making have been developed. These will help to learn about diabetes and its management, as well as graphical health parameters. Data for tracking sharing options and enabling calendar of daily tasks or annual review procedures (Katherine S Blandon, et al (2014). The scope and understanding is very high in India because the concept is ambiguous. The characteristics of the smart-phone for diabetics are important for the population. This contributes to user friendly development and design of the application.

Cross-sectional studies use interview records. Participants have a practical sampling method selected. A sample size of 100 diabetic patients visiting outpatient department for consultation was interviewed and the responses were gathered. The data obtained was analyzed using SPSS software. Correlation was used as a statistical tool to find relationships between variables such as the age, Diabetic or not, gender, income, education.

The analysis shows that age($p=0.000428$), education ($p=0.0098$) and income($p=0.000005$) and diabetic usage ($p=0.0009$) were found to be statistically significant in relation to smart-phone usage.

Table 3: Showing Smart-phone User * Education of the participant

Smart-phone User

Education of the participant	N	Mean	Std. Deviation
<SSLC	5	.00	.000
>SSLC	8	1.00	.000
DEGREE	37	.92	.277
Total	50	.84	.370

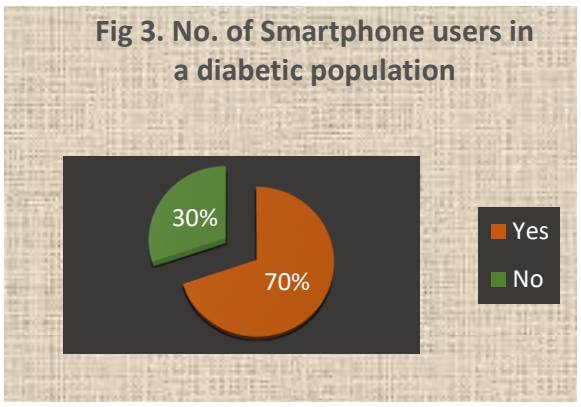
Table 4: Showing Correlations between variables and smart-phone usage.

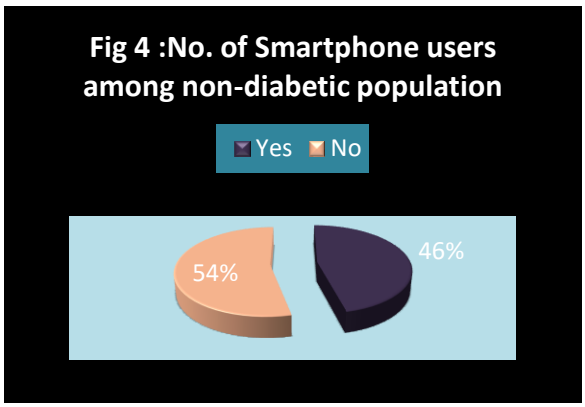
		Age of the respondent	DIABETIC OR NOT	Education of the participant	Income of the respondent	Gender	Smart-phone User
Age of the respondant	Pearson Correlation	1	.357**	-.318**	-.520**	-.010	-.346**
	Sig. (2-tailed)		.000	.001	.000	.922	.000
	N	100	100	100	100	100	100
DIABETIC OR NOT	Pearson Correlation	.357**	1	-.269**	-.125	-.104	-.257**
	Sig. (2-tailed)	.000		.007	.215	.305	.010
	N	100	100	100	100	100	100
Education of the participant	Pearson Correlation	-.318**	-.269**	1	.611**	-.202*	.597**
	Sig. (2-tailed)	.001	.007		.000	.043	.000
	N	100	100	100	100	100	100
Income of the respondat	Pearson Correlation	-.520**	-.125	.611**	1	-.429**	.440**
	Sig. (2-tailed)	.000	.215	.000		.000	.000
	N	100	100	100	100	100	100
Gender	Pearson Correlation	-.010	-.104	-.202*	-.429**	1	-.193
	Sig. (2-tailed)	.922	.305	.043	.000		.054
	N	100	100	100	100	100	100
Smart-phone User	Pearson Correlation	-.346**	-.257**	.597**	.440**	-.193	1
	Sig. (2-tailed)	.000	.010	.000	.000	.054	
	N	100	100	100	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Secondary analysis was done based on the data available to obtain the percentage of smart-phone users to non-smart-phone users using a pie chart.





From the above fig 3 and fig 4 we can interpret that the smart-phones users are more prevalent in both groups, hence smart-phones can be used as a means to achieve improvement in diabetes self-management.

The above Analysis to understand the reach of smart-phones in diabetic population compared to non-diabetic population. Data collection was done and the data was processed using correlation of the independent variable such as the age, gender, diabetic or not , Income , education with the dependent variable smart phone usage.

Primary analysis results showed that the education (p=0.000), income (p=0.000005), age (p=0000428) with negative correlation of r = -0.346 and diabetic or not (p=0.009846) are statistically significant. This means that, in people with education level above a degree smart phone usage was found more. And with income more than Rs.1, 00,000 the usage of smart phone was found more. Age had a negative correlation which shows that the usage of smart phones will decrease as the age advances i.e it is more prevalent among the younger people. Other variable like gender(p=0.054) did not show any significant relationship with smart-phone usage. From this we can assume that the people are more attracted to use smart-phones if they are more educated and having good income. Thus using this data, the application developers can make an effort in designing an application which is more user friendly i.e easily understandable and also to be cost effective so that it can be within the reach of majority of the target population.

The secondary analysis is done by comparing the smart-phone usage among the diabetic and non-diabetic group, with the help of a pie chart since the above analysis has also revealed a very slight correlation between these two aspects and with the pie charts which shows good number of usages in both the groups (diabetic=70%), (non-diabetic=54%) we can interpret that the smart-phones can be a means to improve the diabetic self-care management.

Part 2: To study the effectiveness of smart-phone app in managing diabetes.

A pilot study based on randomized control trail with the sample size of 30 participants, which includes 15 control and 15 interventional group to study the effectiveness of mobile application in managing diabetes self-care was analyzed. The baseline data of the study is given below.

Table No 5 : Baseline data on implementation of smart-phone application

	Cell								
	Intervention group			Control group			Total		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation
HbA1c before intervention	15	7.100	2.3848	15	8.767	2.4471	30	7.933	2.5209
HbA1c after intervention	15	6.520	2.2243	15	9.027	2.4324	30	7.773	2.6210
Age of the participant	15	63.53	9.156	15	60.07	10.152	30	61.80	9.661
Duration of diabetes	15	10.93	7.035	15	10.93	7.035	30	10.93	6.913

The primary out-come of the study was the measure of HbA1c level. The data was collected before and after the intervention. The results were statistically analysed using paired t-tests and correlation analysis. The P value & it; 0.05 was considered statistically significant. From the initial data, it can be estimated that the mean of the intervention group range from 7.1±2.3 before the intervention to 6.5±2.2 after the intervention, compared to the mean of the control group, 8.7±2.4. Before the intervention, it is increased to 9.02±2.4 after the intervention, and the intervention decreased.

We performed a paired sample t- test to find statistical differences in pre-intervention and post intervention HbA1c levels. The result showed that there was a statistically significant association between HbA1c results before and after the intervention with p<0.000. This is less than p=0.001.

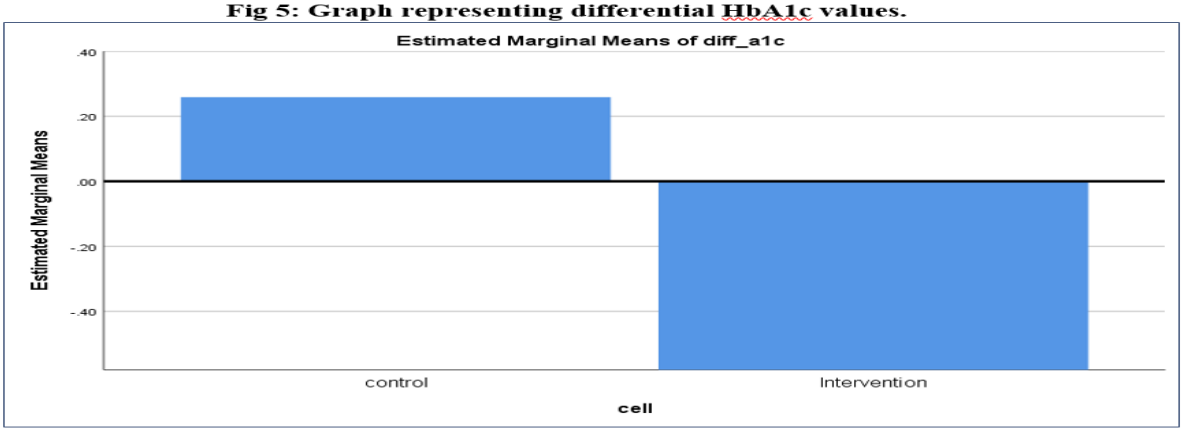
Table no 6: Paired Sample t- Test for before and after intervention

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	HbA1c before intervention - HbA1c after intervention	.5800	.3256	.0841	.3997	.7603	6.900	14	.000

the decrease in the HbA1c values in the intervention group.

The following graph shows the difference in HbA1c values. A positive control group indicates an increase in HbA1c value, while a negative value indicates a decrease in HbA1c value in the intervention group.

Fig 5: Graph representing differential HbA1c values.



The correlation analysis with age (p=0.365) and duration of diabetes (p=0.64) are not statistically significant.

Table 7: Showing correlations of variable with the smart-phone intervention

		Age of the participant	Duration of diabetes	diff_a1c
Age of the participant	Pearson Correlation	1	.300	-.171
	Sig. (2-tailed)		.108	.365
	N	30	30	30
Duration of diabetes	Pearson Correlation	.300	1	-.088
	Sig. (2-tailed)	.108		.643
	N	30	30	30
diff_a1c	Pearson Correlation	-.171	-.088	1
	Sig. (2-tailed)	.365	.643	
	N	30	30	30

Therefore, the variables age and duration of diabetes does not have any impact on the effectiveness of smart-phone intervention.

It is based on data collected from pilot studies using outcome indicators for HbA1c levels, including intervention and control groups. A comparison of the two aspects before and after the intervention was analysed in SPSS using the paired t –test and correlation analysis.

The paired t-test showed a statistically significant relationship with the intervention (p=0.000) and the initial data showed the mean HbA1c value of the intervention group dropped sharply from 7.1±2.3 to 6.5±2.2 as a control. Mean HbA1c value from 8.7±2.4 to 9.02±2.4 in the group. Both values indicate that smart-phone use is effective in self-care for diabetes.

Correlation analysis, on the other hand, showed that the variables age (p=0.365) and the duration of diabetes (p=0.64) were not statistically significant. This means that it does not affect smart-phone intervention.

Part 3: Effectiveness of patient empowerment through health education.

Empowerment based on patient education makes people aware of their responsibilities for their own health condition, helps them in sharing responsibilities with health care professionals and having actions in health care management. They will be empowered in making their own decisions which will in turn make them responsible for their own diabetes management. In this particular part of the study, sample sizes for 100 patients were selected based on appropriate sampling method. DKQ was conducted as a means of evaluating knowledge before and after the test, and responses were recorded accordingly.

The answer from the questionnaire were evaluated using SPSS software. Statistical tools such as correlation and pair sample t-tests were used to assess the level of knowledge about diabetes before and after the test.

The Paired sample t –test showed significant differences in results of before and after the test with p=0.000. This is less than p=0.05, therefore health education has a positive impact on patient empowerment.

Table 8: Paired Samples Test for patient empowerment

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	Df	Sig. (2-tailed)
Pair 1	Pretest scores - Posttest scores	-5.600	2.420	.242	-6.080	-5.120	-23.136	99	.000

The effects of variables with the differential scores using correlation revealed that the education level has a significant difference on patient empowerment with p=0.001 which is less than p=0.01, and duration of diabetes are statistically significant with p=0.034 which is less than p=0.05 whereas other variables such as the age, and gender did not show any significant difference.

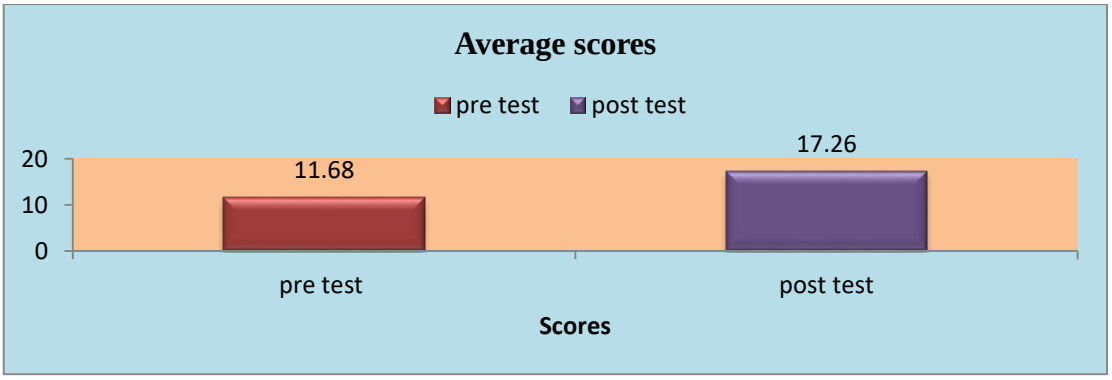
Table 9: Correlation of variable with differential scores

		Diff_scores	Age of the participant	Edu status	Duration of diabetes	Gender of the participant
Diff_scores	Pearson Correlation	1	.042	-.338**	-.213*	-.079
	Sig. (2-tailed)		.675	.001	.034	.436
	N	100	100	100	100	100
Age of the participant	Pearson Correlation	.042	1	-.288**	.150	-.071
	Sig. (2-tailed)	.675		.004	.135	.480
	N	100	100	100	100	100
Edu status	Pearson Correlation	-.338**	-.288**	1	.137	.355**
	Sig. (2-tailed)	.001	.004		.174	.000
	N	100	100	100	100	100
Duration of diabetes	Pearson Correlation	-.213*	.150	.137	1	.151
	Sig. (2-tailed)	.034	.135	.174		.134
	N	100	100	100	100	100
Gender of the participant	Pearson Correlation	-.079	-.071	.355**	.151	1
	Sig. (2-tailed)	.436	.480	.000	.134	
	N	100	100	100	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Fig 6: Graph representing average pre and post test scores



The graph above shows the average results before and after the test. You can see that the introduction of health education has improved the average score after the test.

We collect data using a reliable DKQ survey tool to investigate the effectiveness of patient empowerment through health education. Answer were analysed using statistical tools such as SPSS software pair sample tests and correlation analysis.

Health education is an effective measure of patient empowerment, as the pair sample test was statistically significant for pre-test and post-test results at p=0.000.

With correlation analysis the effects of variables with the differential scores revealed that the education level has a significant difference on patient empowerment with p=0.001 which is less than p=0.01, and duration of diabetes are statistically significant with p=0.034 which is less than p=0.05 whereas other variables such as the age, and gender did not show any significant difference. From this it can be inferred that in educated and long term diabetics have more knowledge of their condition.

Secondary analysis using graph of pre-test and post –test results, suggesting a positive impact on health education as one of the major factors in patient empowerment.

9. FINDINGS:

The basic purpose of this study was to understand the effectiveness of mobile devices and patient empowerment in improving diabetes management. The study was divided into three parts to analyze the data effectively. The analysis has yielded results which helps in concluding the followings findings. They are

Part 1: In this part we will explore the range of diabetes smart phones compared to non-diabetics.

- The reach of smart-phones is affected by the age i.e. comparatively the younger age people used smart-phones more than the older generation.
- The individuals who had income above Rs.1,00,000 possessed smart-phones compared to those with income below Rs.1,00,000.
- The individuals with education above a degree used smart-phones more compared to those with education less than a degree.
- The prevalence of smart-phone was almost the same with 54% in non-diabetic and 70% in diabetic population. Hence the diabetes status had no effect in possessing a smart phone.
- Gender did not have any significance in the reach of smart-phones.

The above findings are useful for an application developer in designing a user friendly and cost effective smart phone application in managing diabetes.

Part 2: This part studies the effectiveness of a smart-phone application in diabetes self-care.

- The baseline data shows the downfall in the average mean scores if HbA1c values in intervention group, and a rise in the HbA1c values in its average mean score in control group.
- Pair t-test shows that there is a significant relationship between the value before and after the intervention.
- The correlation test does no depict any relationship between variable age and diabetes duration on the application effectiveness.

The above findings underlines that the smart-phone application is effective in managing diabetes care management. Hence one can rely on the usefulness of the smart phone application.

Part 3: Effectiveness of patient empowerment through health education.

Patient empowerment in healthcare makes the patient aware of their responsibilities towards their health condition. In this part of the study the effectiveness of patient empowerment through health education is studied. A DKQ questionnaire tool was administered to record the responses. The analysis was done using SPSS software using statistical tools correlation and paired t –test.

- The paired t test shows that there is a statistical significance with (P=0.000), which interprets that there is a positive impact of health education on patient empowerment.
- Correlation tests, on the other hand show that the level of education (P=0.001) and duration of diabetes (P=0.034) were significant.
- This shows that the knowledge about the disease was found more as duration of diabetes increased and also that the individuals who are more educated had more interest in learning about their disease condition.
- Thus implying that the improvement in knowledge can bring about a behaviour change in the patients in empowering them for managing their health. The analysis also revealed that the age and gender did not have much significance with the implementation.

10. SUGGESTIONS:

The data analysis from the study and understanding of different aspects of the study enables us with the following suggestions they are:

In the first and the second part of the study we understand that the development of an application for diabetes self-care is definitely effective, thus application developers can develop a user friendly and cost effective application keeping in mind the features which needs to be incorporated. Our next generation of diabetes group will be techno savvy, who will be more interested in using such applications hence it will be more helpful. Alotiabi Mohammed M et al ,(2016) (SAED) Hospital medical; their study with components such as intelligent mobile diabetes management , wireless technology, sensors, global positioning system. Technology and features for providing services. The development of such a system in the hospital has the potential to be successful because it can effectively monitor patients inside and outside the hospital. The system helps to remotely monitor patients, record and maintain a medical history database, and improve their knowledge of their illness.

11. CONCLUSION:

In this part of the study, efforts were made to understand the effectiveness of mobile health applications and patient empowerment in self-management of diabetes. You need to understand the concepts of these digital tools, create a perception that the public is aware of them, and know how they can affect your health.

Diabetes self-management is very critical in controlling late complications associated with the diabetes. A proper measure in this direction needs to be implemented. The usage of m- health applications and health education is found effective in this present study. Thus the health care management along with the techno savvy individuals have to take up actions to effectively implement these aspects in healthcare. Also creating awareness about the disease, its measures and outcomes through health education should be a part and parcel of health care delivery in all its levels, as this will empower the patients and their family in managing the disease effectively.

Countries like India are coming up with the idea of digitalizing the varied concepts in economy, industry, healthcare, etc. Hence more in-depth studies in this regard will prove to be very beneficial in upholding the quality of care to the approaching clients. Health care is one sector where an individual will mainly focus on the effective outcomes with the interventions on health rather than the cost factor. Hence implementing such effective ideologies can definitely be successful.

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