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EFFECT OF TELEHEALTH ON GLYCEMIC CONTROL, PHYSICAL ACTIVITY AND QUALITY OF LIFE IN TYPE 2 DIABETES MELLITUS INDIVIDUALS

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ABSTRACT:

INTRODUCTION:

Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia. **It was first reported in Egyptian manuscript about 3000 years ago.** It has dreadful complications and can significantly compromise quality of life. Currently India is having second position in respect of most number of diabetes patients after China. By 2045 it was expected that India will have 134.3 million diabetes patients. The prevalence of diabetes in Tirupati was found to be 12.4%.

DM has well known risk factors like age, heredity, obesity, hypertension (HTN), lack of exercise, smoking, alcoholism, dyslipidemia and positive family history. Proper drug therapy, social support, health education, and psychological care in diabetes are essential but are usually deficient, especially in developing countries. Financial restrictions, distance from hospital, low levels of education, and less disease awareness among the patients are the limiting factors in the effective follow-up of diabetic patients under treatment.

Exercise is considered a crucial component of disease management for individuals with type 2 diabetes, and it is associated with extensive health and mental health benefits. Regular physical activity improves blood glucose control, may prevent or delay T2DM, and enables better and more effective glucose utilization by reducing insulin resistance. Furthermore, it affects blood lipids, blood pressure, cardiovascular risk factors, mortality, and quality of life in a positive way.

Although the benefits of exercise are well established, most people with diabetes do not engage in physical activity in a regular and sustained manner. To address this, it is important to develop interventions that are easily and broadly accessible and that address specific barriers that prevent individuals with diabetes from participating in physical activity. Hence the present study is done to find the effect of the easiest and cheapest means of communication i.e., telehealth in engaging the diabetes patients in physical activity and thus enhancing the quality of life with proper diabetes management.

AIM OF THE STUDY:

The aim of the study is to find out the effect of telehealth on glycemic control, physical activity and quality of life in type 2 DM individuals.

OBJECTIVES:

- To find out the effect of telehealth on glycemic control through FPG, HbA1c in type 2 DM individuals.
- To study the effect of telehealth on physical activity (PA) through, BP, BMI, International Physical Activity Questionnaire (IPAQ) (Telugu translation) in type 2 DM individuals.
- To study the effect of telehealth on quality of life (QOL) through Quality of Life Instrument for Indian Diabetes Patients Questionnaire (QOLID) (Telugu translation) in type 2 DM individuals.

Study design: This is a randomized controlled study.

Study Setup: Patients with type 2 DM attending to SVIMS Endocrinology OP.

Period of follow up: 3 months

Study sampling: Simple randomized sampling

Sample size calculation: Minimum of 128 subjects in both groups, hence 70 subjects in each group.

METHODOLOGY:

Baseline information of BP, BMI, THR, HbA1c, FPG, PA, and QOL are taken along with their contact number and with informed consent at the first time of visit to SVIMS Endocrinology OP. Advice about regular physical activity adherence, diet, lifestyle modification and diabetes management will be given orally and in the form of handouts for the subjects in both the groups along with weekly thrice phone calls and motivation and encouragement about regular physical activity participation is advised for the subjects in experimental group. Follow up is taken after three months about BP, BMI, HbA1c, FPG, PA and QOL.

RESULTS:

The pre and post experimental mean value, t-test and p values of all the outcomes that is BP, BMI, HbA1C, FPG, PA, QOL shows significance (0.05) in both the groups.

CONCLUSION:

Hence, the study concluded that telehealth showed a significant improvement in glycemic control, physical activity and quality of life at 0.05 level of significance.

KEYWORDS:

DIABETES MELLITUS, TELEHEALTH, GLYCEMIC CONTROL, QUALITY OF LIFE, PHYSICAL ACTIVITY.

INTRODUCTION

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced (WHO) [1]. It has dreadful complications and can significantly compromise quality of life. In 2017 according to International Diabetes Federation Atlas, 424.9 million people suffer from DM and the number is expected to rise further to 628.6 million by 2045.

Healthcare expenditures for people with diabetes are assumed to be an average two-fold higher than people without diabetes. Low and middle economic countries are having 79% of the global burden of DM in the 21st century as a result of population growth, ageing and sedentary lifestyles. Currently, India is having second position in respect of most number of diabetes patients after China. By 2045 it was expected that India will have 134.3 million diabetes patients [2].The total adult population in India is 829,491,000 with the prevalence of 8.8% and the total cases of diabetes in adults are 72,946,400.

The world health organisation (WHO) stated that the incidence of DM appears to increase by 6% every year [3]. In one of the study carried out in 108 centres of India the prevalence of diabetes seems to be 5.9% in urban population and 2.7% in rural population. The prevalence of diabetes in Tirupati was found to be 12.4% [4]. Approximately 4.0 million people aged between 20 and 79 years are estimated to die from diabetes in 2017, which is equivalent to one death every eight seconds. Coola survey, the rates for diabetes complications regarding CAD (16%), retinopathy (15%), cerebrovascular accidents (9%), neuropathy (9%), peripheral vascular disease (7%), and nephropathy (6%) [18]. Hence, effective measures are required to control the early onset of these co morbidities. Globally, diabetes accounted for 10.7% mortality among people between 20-79 years age group [2]. About, 46.1% of deaths due to diabetes are in people under the age of 60.

An increase in body fat is generally associated with increased risk of metabolic diseases such as type 2 diabetes mellitus, hypertension and dyslipidaemia. The SHIELD and NHANES surveys reported that patients with higher BMI are at higher risk for having diabetes mellitus, hypertension and dyslipidaemia. It also confirms the converse that the majority of patients with these metabolic diseases are either overweight or obese [17]. Hence to know the impact of physical activity, physiological parameters like blood pressure and body mass index are also measured along with glycemic parameters like HbA1C, FBG.

Exercise is considered a crucial component of disease management for individuals with type 2 diabetes, and it is associated with extensive health and mental health benefits [9]. Regular physical activity improves blood glucose control, may prevent or delay T2DM, and enables better and more effective glucose utilization by reducing insulin resistance. In this study, physical activity level was assessed by using the long version of the International Physical Activity Questionnaire (IPAQ). The IPAQ was developed to assess physical activity during the past week among adults. The IPAQ contains 7 items and assesses the frequency of activity (days) and duration (minutes and/or hours) in vigorous- and moderate-intensity activities, walking, and sitting activities. Physical activity scores are classified into three categories, namely "inactive," "moderately active," and "highly active". Metabolic equivalent (MET)-minute is computed by multiplying the MET score of activity duration (minute) [10,11] .

DM has well known risk factors like age, heredity, obesity, hypertension (HTN), lack of exercise, smoking, alcoholism, dyslipidemia and positive family history [13]. People with diabetes have an increased risk of developing a number of serious health problems. Consistently high blood glucose levels can lead to serious diseases affecting the heart and blood vessels, eyes, kidneys, nerves and teeth which affect the quality of life. In addition, people with diabetes also have a higher risk of developing infections. In almost, all high-income countries, diabetes is a leading cause of cardiovascular disease, blindness, kidney failure, and lower limb amputation [8].

Most of the existing quality of life questionnaires have been developed in western population, which are socially, culturally and economically different from Indian participants and work from India on the subject is scarce. One such diabetes specific instrument developed and validated in India recently restricts itself to the psychosocial aspect of quality of life. In the absence of comprehensive and validated diabetes specific quality of life instrument in India, led to the development of a reliable and valid structured questionnaire (QOLID). QOLID is a reliable, valid and sensitive tool with 8 domains and 34 items for assessment of quality of life of Indian patients with diabetes [16].

Although the benefits of exercise are well established, most people with diabetes do not engage in physical activity in a regular and sustained manner [9]. Proper drug therapy, social support, health education, and psychological care in diabetes are essential but are usually deficient, especially in developing countries [7]. Financial restrictions, distance from hospital, low levels of education, and less disease awareness among the patients are the limiting factors in the effective follow-up of diabetic patients under treatment [8]. Quality health care requires effective collaboration between clinicians and

patients. Finding novel ways to enhance communication and improve the health of those with chronic diseases is also a continuing part of providing effective care.

To address this, it is important to develop interventions that are easily and broadly accessible and that address specific barriers that prevent individuals with diabetes from participating in physical activity. Several investigations have examined the efficacy of using various forms of technology to deliver or enhance interventions designed to promote regular physical activity. The outcomes have been promising, providing support for continued exploration of telehealth interventions that promote physical activity in the diabetic population [9].

Telehealth delivers tailored health care that is acceptable to patients and it facilitates more responsive interventions from professionals, resulting in better disease control with fewer exacerbations and admissions [12]. **Telehealth** involves the distribution of health-related services and information via electronic information and telecommunication technologies. It allows long distance patient/clinician contact and care, advice, reminders, education, intervention, monitoring and remote admissions. Though there are concerns with technical challenges and the time commitment required to use messaging and monitoring devices, they are seen as useful tools for monitoring those patients who are interested in working on the management of their disease [13].

Because of the widespread usage and availability of telephones, these devices can be used to maximize efficiency in the health care system [14]. Few studies in which a telephone is used as a means to improve the management of diabetes have been done earlier in developing countries such as India. In this study the calls were done by the physiotherapist reinforcing dietary advice, participation in physical activity i.e., walking , which is one of the most economical and beneficial means of physical activity affordable for all communities. Hence the aim of the present study is to find out the effect of telehealth on glycemic control, physical activity and quality of life in type 2 DM individuals.

NEED OF THE STUDY:

Diabetes is one of the major health problems increasing the economic burden in developing countries. Physical inactivity and lack of exercise adherence is one of the major risk factor for diabetes. Lack of efficient measures for checking the follow up of patient care, effective means to encourage participation and increasing burden on the patient for diabetes management also cause hindrances in diabetes management.

Hence the need of the present study is to find the effect of the easiest and cheapest means of communication i.e., telehealth in engaging the diabetes patients in physical activity and thus enhancing the quality of life with proper diabetes management.

AIM OF THE STUDY:

The aim of the study is to find out the effect of telehealth on glycemic control, physical activity and quality of life in type 2 Diabetes Mellitus individuals.

OBJECTIVES:

1. To find out the effect of telehealth on glycemic control through FPG, HbA1c in type 2 DM individuals.
2. To study the effect of telehealth on physical activity (PA) through, BP, BMI, International Physical Activity Questionnaire (IPAQ) (Telugu translation) in type 2 DM individuals.
3. To study the effect of telehealth on quality of life (QOL) through Quality of Life Instrument for Indian Diabetes Patients Questionnaire (QOLID) (Telugu translation) in type 2 DM individuals.

STUDY DESIGN: Randomized Clinical Trial.

ETHICAL COMMITTEE APPROVAL: Ethical approval was obtained from the **INSTITUTIONAL ETHICS COMMITTEE OF SVIMS UNIVERSITY,** with **IEC NO:-845.**

STUDY CENTRE: The study was conducted in the departments of endocrinology and physiotherapy at SVIMS, Tirupati, A.P, India.

STUDY SUBJECTS: Employees, out patients of either sex with type 2 diabetes mellitus diagnosed by the endocrinologist and who met the inclusion criteria were taken for the study.

SAMPLING METHOD: Randomized sampling using lottery method.

Subjects were selected through simple random sampling technique using **Lottery method,** it is the procedure adopted to randomly select the subjects. 140 slips were written, with the numbers randomly as 1C/1E,2C/2E....70C/70E on small slips of paper. The paper slips were of the same size to ensure random selection of subjects. These slips were thoroughly mixed and the subjects were asked to pick a slip. The same procedure is repeated till subjects were selected randomly and equally into the groups. All the subjects who met the inclusive criteria were numbered from 1E to 70E. This is called as sampling frame.

All subjects were randomly divided into group-1 and group-2 by simple randomization method with 70 subjects in group-1(CG) while the group-2 (EG) consists of 70 subjects.

Sampling is done for 6 months.

STUDY DURATION: 3 months. (12weeks) From February 2019 to April 2019.

SAMPLE SIZE CALCULATION: Sample size calculation was done by using Cohen's D online software with (d= 0.5(moderate effect size)) which worked out with n=64 in each group.

SAMPLE SIZE: 140 subjects, 70 subjects were taken into group -1(CG) and 70 subjects were taken into group-2 (EG).

SUBJECTS CONSENT:

All the subjects were screened for inclusion and exclusion criteria. The subjects who met inclusion criteria had an initial consultation. At the initial consultation, the purpose of the study was explained to the subjects and a case history, relevant physical examination and regional examination of the type 2 diabetes mellitus performed by endocrinologist. Those who accepted to participate in the study were asked to read a patient information sheet and sign in informed consent form.

INCLUSION CRITERIA:

- Subjects who were clinically diagnosed as type 2 diabetes mellitus by endocrinologist.
- Age 40-50 years
- Both males and females, diabetic from 5 to 10 years.
- Only on stable and constant oral hypoglycaemic medication.

EXCLUSION CRITERIA:

- Type 1 DM individuals
- Any other co-morbidities of DM (Musculoskeletal complications, neurological disorders, etc)
- Gestational diabetes and pregnancy.

MATERIALS AND METHODOLOGY:

MATERIALS:

The following are the materials used for the study:-

- The individual subject parameter of height was calculated by using wall mounted stature meter height measure ruler.
- Weight was measured by using weighing machine.
- BMI was calculated by using an online app.
- The blood pressure was calculated by using stethoscope and sphygmomanometer.
- HbA1c (%), FPG (mg/dl) values were obtained from medical records, values are recorded for three months.
- Physical activity level of patients with T2DM were assessed using a WHO validated International Physical Activity Questionnaire (IPAQ) (Telugu translation).
- Quality of life (QOL) was assessed through Quality of Life Instrument for Indian Diabetes Patients Questionnaire (QOLID) (Telugu translation)in type 2 DM individuals.
- A pamphlet for exercise prescription.

METHODOLOGY

A.SCREENING WAS DONE:

160 subjects were referred with the diagnosis of type 2 diabetes mellitus. Subjects were screened and subjects who met the inclusion criteria were randomly placed in two groups with 85 subjects in CG and 75 subjects in EG initially; the subjects were explained clearly regarding the study procedure. Subjects were familiarized with the equipment and baseline characteristics. Basic demographic data (age, gender, weight, height, BP, BMI, etc.) along with their mobile number were recorded from the subjects. But by the end of the study there were 15 dropouts in CG and 5 dropouts in EG with remaining of 70 subjects in each group with a total of 140 subjects (n=140).

B.OUTCOME MEASURES:

- Physiological parameters- BP
- Physical parameters-Height, Weight- BMI.
- Glycemic variables- FPG, HbA1c.
- Physical activity level by International physical activity questionnaire (IPAQ) (Telugu translation).
- Quality of life (QOL) - Quality of Life Instrument for Indian Diabetes Patients Questionnaire (QOLID) (Telugu translation).

C. INTERVENTION:

a) **Control group**:

- Baseline information of BP, BMI, THR, HbA1c, FPG, PA, and QOL were taken along with their contact number at the first time of visit to SVIMS Endocrinology OP.
- Advice about regular physical activity adherence, diet, lifestyle modification and diabetes management were given orally and in the form of handouts.
- Follow up is taken after three months about BP, BMI, HbA1c, FPG, PA and QOL.

b) **Experimental group**:

- Baseline information of BP, THR, BMI, HbA1c, FPG, PA and QOL were taken along with their contact number at the first time of visit to SVIMS Endocrinology OP.
- Advice about regular physical activity adherence, diet, lifestyle modification and diabetes management were given orally and in the form of handouts.
- Weekly thrice phone calls were done and motivation and encouragement about regular physical activity participation is advised.
- Follow up is taken after three months about BP, BMI, HbA1c, FPG, PA a

RESULTS& STATISTICAL ANALYSIS:

The pre and post results were analysed for both groups, by using SPSS 16.0 version. The data was entered into MS excel sheet and tabulated for statistical analysis.

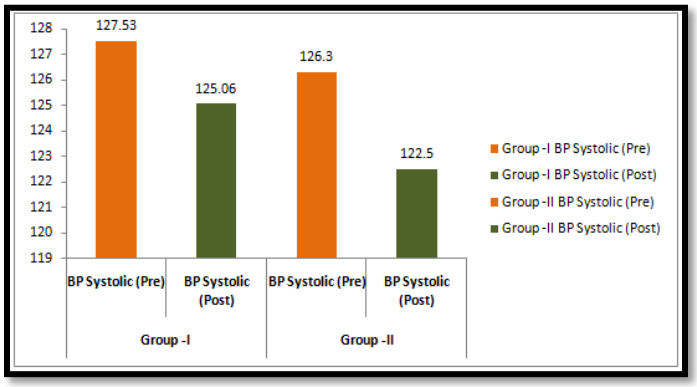
To compare the pre and post therapeutic effects within the groups, the simple t-test was performed. Then the paired t-test has been performed between the outcomes values of control and experimental groups

TABLE: 1 PRE AND POST MEAN VALUES OF SYSTOLIC BP IN GROUP-1 AND GROUP-2

Groups	Intervention	N	Mean ± SD	Df	t-value	P-value
Group -I	BP Systolic (Pre)	70	127.53±25.45	69	2.46	0.05
	BP Systolic (Post	70	125.06±25.02			
Group-II	BP Systolic (Pre)	70	126.30±25.26	69	5.17	0.01
	BP Systolic (Post	70	122.50±24.52			

Result: The results shows that the pre and post mean values of SYSTOLIC BP are more significant in group-2 than the group-1.

FIG 1: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUES SYSTOLIC BP IN GROUP-1 AND GROUP-2



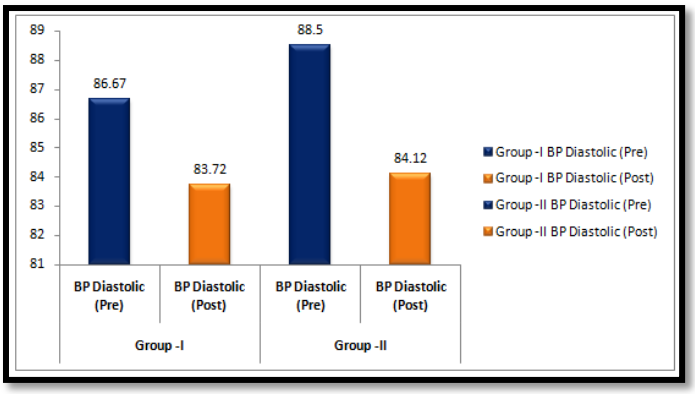
Result: The graphical representation shows that the pre and post mean values of SYSTOLIC BP which are more significant in group-2 than the group-1.

TABLE: 2 PRE AND POST MEAN VALUES OF DIASTOLIC BP, IN GROUP-1 AND GROUP-2

Groups	Intervention	N	Mean± SD	Df	t-value	P-value
Group -I	BP Diastolic (Pre)	70	86.67±17.43	69	4.68	0.01
	BP Diastolic (Post)	70	83.72±16.74			
Group-II	BP Diastolic (Pre)	70	88.50±17.57	69	6.24	0.01
	BP Diastolic (Post)	70	84.12±16.84			

Result: The results shows that the pre and post mean values of DIASTOLIC BP which are more significant in group-2 than the group-1.

FIG 2: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUES DIASTOLIC BP IN GROUP-1 AND GROUP-2



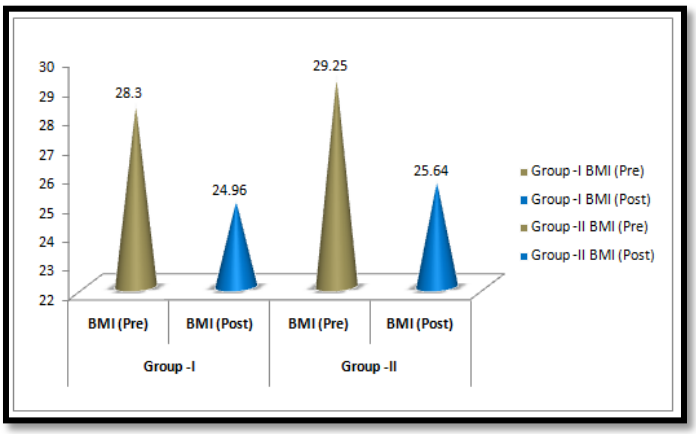
Result: The graphical representation shows that the pre and post mean values of DIASTOLIC BP which are more significant in group-2 than the group-1.

TABLE: 3 PRE AND POST MEAN VALUES OF BMI, IN GROUP-1 AND GROUP-2

Groups	Intervention	N	Mean± SD	Df	t-value	P-value
Group -I	BMI (Pre)	70	28.30±5.66	69	3.05	0.01
	BMI (Post)	70	24.96±4.92			
Group-II	BMI (Pre)	70	29.25±5.75	69	6.21	0.01
	BMI (Post)	70	25.64±5.13			

Result: The results shows that the pre and post mean values of BMI which are more significant in group-2 than the group-1.

FIG 3: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUES BMI IN GROUP-1 AND GROUP-2



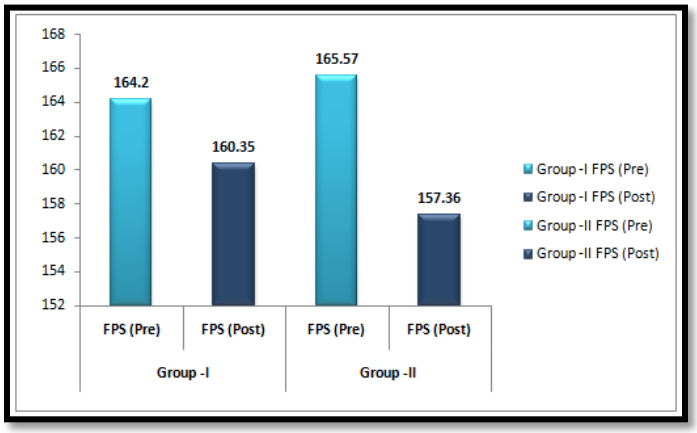
Result: The graphical representation shows that the pre and post mean values of BMI which are more significant in group-2 than the group-1.

TABLE: 4 PRE AND POST MEAN VALUES OF FPG, IN GROUP-1 AND GROUP-2

Groups	Intervention	N	Mean± SD	Df	t-value	P-value
Group -I	FPS (Pre)	70	164.20±32.86	69	3.18	0.01
	FPS (Post)	70	160.35±32.12			
Group-II	FPS (Pre)	70	165.57±33.14	69	4.26	0.01
	FPS (Post)	70	157.36±31.47			

Result: The results shows that the pre and post mean values of FPG which are more significant in group-2 than the group-1.

FIG 4: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUES FPG IN GROUP-1 AND GROUP-2



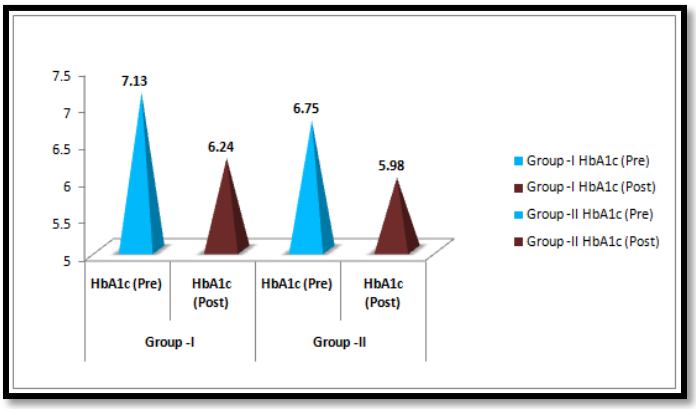
Result: The graphical representation shows that the pre and post mean values of FPG which are more significant in group-2 than the group-1.

TABLE: 5 PRE AND POST MEAN VALUES OF HBA1C, IN GROUP-1 AND GROUP-2

Groups	Intervention	N	Mean± SD	Df	t-value	P-value
Group -I	HbA1c (Pre)	70	7.13±1.42	69	2.14	0.05
	HbA1c (Post)	70	6.24±1.28			
Group-II	HbA1c (Pre)	70	6.75±1.35	69	5.22	0.01
	HbA1c (Post)	70	5.98±1.17			

Result: The results shows that the pre and post mean values of HbA1c are more significant in group-2 than the group-1.

FIG 5: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUES HBA1C IN GROUP-1 AND GROUP-2



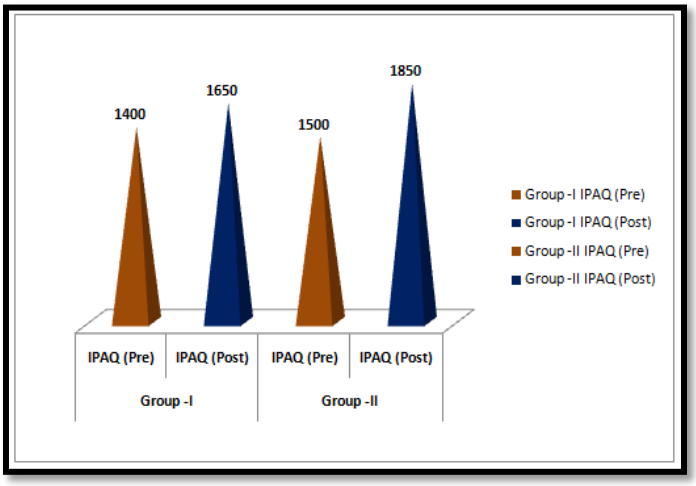
Result: The graphical representation shows that the pre and post mean values of HbA1c which are more significant in group-2 than the group-1.

TABLE: 6 PRE AND POST MEAN VALUES OF IPAQ, IN GROUP-1 AND GROUP-2

Groups	Intervention	N	Mean± SD	Df	t-value	P-value
Group -I	IPAQ (Pre)	70	1450±1.86	69	2.84	0.05
	IPAQ (Post)	70	1600±2.52			
Group-II	IPAQ (Pre)	70	1650±1.72	69	3.91	0.01
	IPAQ (Post)	70	1850±2.24			

Result: The results shows that the pre and post mean values of IPAQ are more significant in group-2 than the group-1.

FIG 6: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUES IPAQ IN GROUP-1 AND GROUP-2



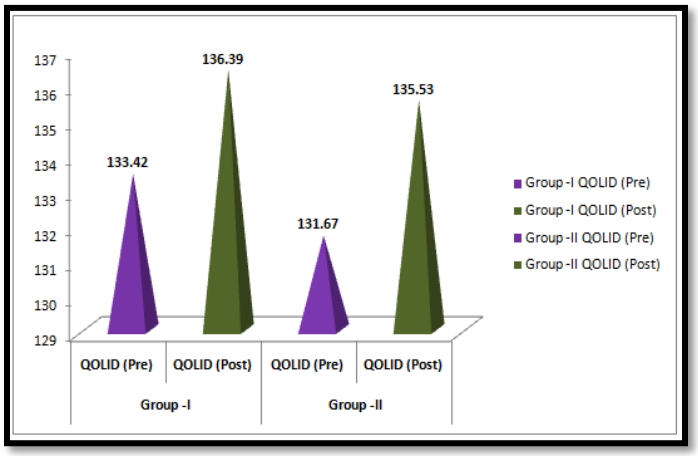
Result: The graphical representation shows that the pre and post mean values of IPAQ which are more significant in group-2 than the group-1.

TABLE: 7 PRE AND POST MEAN VALUES OF QOLID IN GROUP-1 AND GROUP-2

Groups	Intervention	N	Mean± SD	Df	t-value	P-value
Group -I	QOLID (Pre)	70	133.42±26.64	69	3.65	0.01
	QOLID (Post)	70	136.39±27.28			
Group-II	QOLID (Pre)	70	131.67±26.33	69	4.11	0.01
	QOLID (Post)	70	135.53±27.10			

Result: The results shows that the pre and post mean values of QOLID are more significant in group-2 than the group-1.

FIG 7: GRAPHICAL REPRESENTATION OF PRE AND POST MEAN VALUES QOLID IN GROUP-1 AND GROUP-2



Result: The graphical representation shows that the pre and post mean values of QOLID which are more significant in group-2 than the group-1.

DISCUSSION:

The aim of the present study is to find out the effect of telehealth on glycemic control, physical activity and quality of life in type 2 DM individuals. The study was conducted in the departments of endocrinology and physiotherapy at SVIMS, Tirupati, A.P., India.

Employees, out patients of either sex with type 2 diabetes mellitus diagnosed by the endocrinologist and who met the inclusion criteria were taken for the study. All subjects were randomly divided into group-1 and group-2 by simple randomization method with 85 subjects in group-1(CG) while group-2 (EG) consists of 75 subjects initially but by the end of the study, CG has 15 and EG has 5 dropouts respectively with a total of 70 subjects in each group.

The subjects who met inclusion criteria had an initial consultation. At the initial consultation, the purpose of the study was explained to the subjects and a case history, relevant physical examination and regional examination of the type 2 diabetes mellitus performed by endocrinologist. Those who accepted to participate in the study were asked to read a patient information sheet and sign in informed consent form.

Baseline information of BP, BMI, THR, HbA1c, FPG, PA, and QOL were taken along with their contact number at the first time of visit to SVIMS Endocrinology OP for both groups. Advice about regular physical activity adherence, diet, lifestyle modification and diabetes management were given orally and in the form of handouts for both the groups. Weekly thrice phone calls were done and motivation and encouragement about regular physical activity participation is advised for subjects of EG only. Follow up is taken after three months about BP, BMI, HbA1c, FPG, PA and QOL for all the subjects.

BLOOD PRESSSURE (BP)

Diabetes and hypertension share common pathways such as SNS—sympathetic nervous system; VSMC—vascular smooth muscle cell; RAAS- renin- angiotensin- aldosterone system; oxidative stress, adipokines, insulin resistance, and PPARs- Peroxisome proliferator-activated receptor. These pathways interact and influence each other and may even cause a vicious cycle. Hypertension and diabetes are both end results of the metabolic syndrome. They may, therefore, develop one after the other in the same individual [44].

In the present study, the pre and post mean values of **SYSTOLIC BP** of **CG** shows Mean ± SD of 127.53±25.45 (pre) and 125.06±25.02 (post) with a significance of p=0.05 respectively. The pre and post mean values of **SYSTOLIC BP** of **EG** shows Mean ± SD of 126.30±25.26 (pre) and 122.50±24.52 (post) with a significance of p=0.01 respectively.

In the present study, the pre and post mean values of **DIASTOLIC BP** of **CG** shows Mean ± SD of 86.67±17.43 (pre) and 83.72±16.74 (post) with a significance of p=0.01 respectively. The pre and post mean values of **DIASTOLIC BP** of **EG** shows Mean ± SD of 88.50±17.57 (pre) and 84.12±16.84 (post) with a significance of p=0.01 respectively.

Bernard M. Y. Cheung et al., 2012, in his study has stated that optimization of lifestyle remains the cornerstone in the prevention and treatment of diabetes and hypertension [20].

Medha Mathur et al., 2018, stated that health education, promotion of exercise, favourable life style, dietary modification, cessation of smoking, screening programmes for early detection of blood pressure, blood sugar, lipid profile can be effective prevention strategies [19].

In our study, the post results of BP were comparatively more significant in EG than CG supporting the above studies. Telehealth is effective, through which regular physical activity can be initiated in life that regulates blood pressure.

BODY MASS INDEX (BMI)

Body mass index has a strong relationship to diabetes and

insulin resistance. In an obese individual, the amount of NEFA, glycerol, hormones, cytokines, pro inflammatory substances, and other substances that are involved in the development of insulin resistance are increased. Gaining weight in early life is associated with the development of type 1 diabetes. NEFA is a cornerstone in the development of insulin resistance and in the impairment of β-cell function. Adiposopathy is a term used to describe pathogenic adipose tissue whose adverse clinical consequences may be promoted and exacerbated by adipocyte hypertrophy, visceral adipose tissue accumulation, and sedentary lifestyle in genetically and environmentally susceptible patients, and which represents an underlying, root physiological process leading to metabolic diseases such as type 2 diabetes mellitus, hypertension and dyslipidaemia[21].

In the present study, the pre and post mean values of **BMI** of **CG** shows Mean ± SD of 28.30±5.66 (pre) and 24.96±4.92 (post) with a significance of p=0.05 respectively. The pre and post mean values of **BMI** of **EG** shows Mean ± SD of 29.25±5.75 (pre) and 25.64±5.13 (post) with a significance of p=0.01 respectively.

Lydia C. Siegel et al., 2009 has concluded that active men with normal and overweight BMIs had lower diabetes hazards than their inactive counterparts, but no difference by weekly activity was seen in obese men. Elevated BMI is a key driver of diabetes risk, with relatively modest attenuation by activity

In our study, the post results of BMI were comparatively more significant in EG than CG supporting the above studies. Telehealth is effective, through which regular physical activity can be initiated in life that regulates body weight which directly impacts BMI.

FASTING PLASMA GLUCOSE (FPG) AND HbA1c:

The two main pathological defects in type 2 diabetes are impaired insulin secretion through a dysfunction of the pancreatic β-cell, and impaired insulin action through insulin resistance [5]. In situations where resistance to insulin predominates, the mass of β-cells undergoes a transformation capable of increasing the insulin supply and compensating for the excessive and anomalous demand. In absolute terms, the plasma insulin concentration (both fasting and meal stimulated) usually is increased, although "relative" to the severity of insulin resistance, the plasma insulin concentration is insufficient to maintain normal glucose homeostasis [22]. Insulin resistance and hyperinsulinemia eventually lead to impaired glucose tolerance [23].

INSULIN RESISTANCE

The primary events are believed to be an initial deficit in insulin secretion and in many patients relative insulin deficiency in association with peripheral insulin resistance [24]. Resistance to the action of insulin will result in impaired insulin mediated glucose uptake in the periphery (by muscle and fat), incomplete suppression of hepatic glucose output and impaired triglyceride uptake by fat. To overcome the insulin resistance, islet cells will increase the amount of insulin secreted. Endogenous glucose production is accelerated in patients with type 2 diabetes or impaired fasting glucose. Because this increase occurs in the presence of hyper insulinemia, at least in the early and intermediate disease stages, hepatic insulin resistance is the driving force of hyperglycemia of type 2 diabetes.

GLYCATED HAEMOGLOBIN

The life span of haemoglobin in vivo is 90 to120 days. During this time glycated haemoglobin A forms, being the ketoamine compound formed by combination of haemoglobin A and glucose. Several subfractions of glycated haemoglobin have been isolated. Of these, glycated haemoglobin A fraction, HbA1c is of most interest serving as a retrospective indicator of the average glucose Concentration. HbA1c is recommended as an essential indicator for the monitoring of blood glucose control. The blood HbA1c≥ 6.5% is considered as diabetes [25].

In the present study, the pre and post mean values of **FPG** of **CG** shows Mean ± SD of 164.20±32.86 (pre) and 160.35±32.12 (post) with a significance of p=0.01 respectively. The pre and post mean values of **FPG** of **EG** shows Mean ± SD of 165.57±33.14 (pre) and 157.36±31.47 (post) with a significance of p=0.01 respectively.

In the present study, the pre and post mean values of **HbA1c** of **CG** shows Mean ± SD of 7.13±1.42 (pre) and 6.24±1.28 (post) with a significance of p=0.5 respectively. The pre and post mean values of **HbA1c** of **EG** shows Mean ± SD of 6.75±1.35 (pre) and 5.98±1.17 (post) with a significance of p=0.01 respectively.

Sheri R. Colberg, et al., 2017, physical activity and exercise should be recommended and prescribed to all individuals with diabetes as part of management of glycemic control and overall health. Specific recommendations and precautions will vary by the type of diabetes, age, activity done, and presence of diabetes-related health complications. Recommendations should be tailored to meet the specific needs of each individual. In addition to engaging in regular physical activity, all adults should be encouraged to decrease the total amount of daily sedentary time and to break up sitting time with frequent bouts of activity. Finally, behaviour-change strategies can be used to promote the adoption and maintenance of lifetime physical activity [26].

In our study, the post results of **FPG, HbA1c** were comparatively more significant in EG than CG supporting the above studies. Telehealth is effective, through which regular physical activity can be initiated in life that helps in regulating the glycemic parameters in diabetics.

PHYSICAL ACTIVITY (PA):

Daily physical activity is defined as continuous bodily movements via the contraction of skeletal muscle that results in an increase in energy expenditure in daily life [27]. This includes various activities that are conducted in

both occupational and leisure time such as walking, working at a desk, washing, cooking, and sports.

In the present study, the pre and post mean values of **IPAQ** of **CG** shows Mean ± SD of 1450±1.86 (pre) and 1600±2.52 (post) with a significance of p=0.01 respectively. The pre and post mean values of **IPAQ** of **EG** shows Mean ± SD of 1650±1.72 (pre) and 1850±2.24 (post) with a significance of p=0.01 respectively.

Majorie Amoroto Palermo et al., 2016, subjects with poor glycemic control and older age group were associated with low physical activity. Hence we should promote regular physical activity among diabetic patients with sedentary lifestyle in order to achieve optimal glycemic control and prevent diabetic complications [28].

Tugba Kuru Colak et al., 2016, Physical activity and regular exercise are important elements that should be considered for delaying the onset of and treating T2DM, and for improving the quality of life and long-term life expectancy of T2DM patients [28-37]. Awareness on increasing physical activity and lifestyle modifications should be raised in patients in the early phase of diabetes mellitus and in individuals with risk of diabetes mellitus [38].

Sheri R. Colberg et al., 2010, has stated that exercise plays a major role in the prevention and control of insulin resistance, prediabetes, GDM, type 2 diabetes, and diabetes-related health complications. Both aerobic and resistance training improve insulin action, at least acutely, and can assist with the management of BG levels, lipids, BP, CV risk, mortality, and QOL, but exercise must be undertaken regularly to have continue benefits and likely include regular training of varying types. Most persons with type 2 diabetes can perform exercise safely as long as certain precautions are taken. The inclusion of an exercise program or other means of increasing overall PA is critical for optimal health in individuals with type 2 diabetes [39].

In our study, the post results of **IPAQ** were comparatively more significant in EG than CG supporting the above studies. Telehealth is effective, through which regular physical activity can be initiated in life and thus helps in maintaining diabetes.

QUALITY OF LIFE (QOL):

Diabetes affects major components of QoL although differences in terms of ethnicity, environment, gender socioeconomic status, culture, profession dietary and lifestyle habits do exist. More specifically: (1) the physical component especially with coexisting obesity complications as CAD, renal failure, diabetic neuropathy or retinopathy or co morbidities; (2) the psychological component especially type 1 in younger subjects and in coexistence with depression; (3) the social component by destroying family ties and friendships; and (4) the mental cognitive component particularly when dementia presents. In that scope numerous worldwide studies have been performed and have demonstrated little to moderate benefit in different components towards positive direction is the development of projects such as diabetes quality improvement project but there is a lot to be done in the future [40]

In the present study, the pre and post mean values of **QOLID** of **CG** shows Mean ± SD of 133.42±26.64 (pre) and 136.39±27.28 (post) with a significance of p=0.01 respectively. The pre and post mean values of **QOLID** of **EG** shows Mean ± SD of 131.67±26.33 (pre) and 135.53±27.10 (post) with a significance of p=0.01 respectively.

Mathew George et al., 2016, in the study, have used QOLID as an outcome measure and found out that diabetes is a non-curable disease but can be controlled if effective steps were taken at right time thus preventing its progression and hence improves the quality of life. It is essential to assess the impact of diabetes on quality of life for improving diabetic care. High quality of life represents the ultimate goal and an important outcome of all medical interventions in diabetic patients. The study concludes by giving emphasis on the fact that, quality of life assessment should be made into practice in clinics for improving diabetes care [41].

In our study, the post results of QOLID were comparatively more significant in EG than CG supporting the above studies. Telehealth is effective, through which regular physical activity can be initiated in life that helps in improving the QOL.

TELEHEALTH:

As the population grows and ages, and medical advances are made which prolong life, demands increase on the healthcare system. Healthcare providers are also being asked to do more, with no increase in funding, or are encouraged to move to new models of funding and care such as patient-centred or outcomes based, rather than fee-for-service. When rural settings, lack of transport, lack of mobility (i.e. In the elderly or disabled), decreased funding or lack of staffing restrict access to care, telehealth can bridge the gap [42].

Rupinderjeet Kaur et al., 2012, has found that, telephonic consultation can be a useful measure to improve the follow-up and management of patients with DM [43].

In our study, the post results of BP, BMI, FPG, HbA1c, IPAQ, QOLID were comparatively more significant in EG than CG supporting the above studies. Telehealth is effective, through which regular physical activity can be initiated in life which helps in maintenance of diabetes.

CONCLUSION:

This study accepts alternate hypothesis and rejects null hypothesis. Hence, the study concludes that telehealth has a significant effect on glycemic control, physical activity and quality of life in type 2 diabetes mellitus individuals.

Telehealth is effective in maintaining physical and physiological parameters like BMI and BP in diabetic individuals.

Telehealth is effective in regulating glycemic parameters like FPG and HbA1c in diabetic individuals.

Telehealth is effective in improving physical activity (IPAQ) and quality of life(QOLID) in diabetic individuals.

CLINICAL IMPLICATIONS:

The above study **accepts alternate hypothesis, rejects null hypothesis.** The above study can help to give advice to the diabetic population to adapt regular exercise which is effective on glycemic control, physical activity level, and physiological, functional parameters and quality of life. Telehealth, the use of electronic communication to remotely provide health care information and services, is gaining more and more attention as providers, patients, and payers all seek more effective and cost-efficient ways to deliver care. Physical therapy is no exception, and while those services have developed mostly in rural areas to accommodate the long distances between patients and providers, telehealth in physical therapy is being considered in other geographic and clinical settings.

LIMITATIONS:

Study duration is only 3 months.

RECOMMENDATIONS:

Longitudinal study required.

Diabetic patients can be suggested to maintain a regular dairy regarding their exercise, medication along with diet.

Further study is recommended by using group interventions.

Further study is recommended to study other protocols also.

Further study is recommended to use video calls, virtual imaging and other advanced technologies.

Telehealth is proved to be effective in controlling glycemic index, PA level, physiological, functional parameters and QOL.

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