IMPACT OF PHYSICAL ACTIVITY (45 MINUTES DAILY AND 15 MINUTES THREE TIMES A DAY AFTER MEALS) ON TYPE 2 DIABETES MELLITUS FEMALE PATIENTS

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ABSTRACT

Background and Objective: Type 2 Diabetes Mellitus is a chronic progressive metabolic disorder wherein physical activity creatively put in as a part of lifestyle intervention may aid in its prevention and management. Objective of the cross-over study was to compare impact of physical activity (walk) 45 minutes daily to 15 minutes physical activity (walk) three times a day after each meal on type 2 diabetic females.

Method: Female respondents (N=175) were prospectively enrolled from Endocrinology OPD of Post Graduate Institute of Medical Research (PGIMER), Chandigarh, India. Respondents were made to walk regularly for 45 minutes followed by 15 minutes post meal walk for 6 weeks each. Self designed questionnaire and WHO validated Global Physical Activity Questionnaire (version 2) were used for data collection. Data analysis was done using SPSS software (version 20).

Results: Out of 175 female respondents, 78.9% had family history of diabetes. It was seen that 95.4% respondents were diabetic for more than 6 months. Mean BMI was 28.14±3.63kg/m^2, 27.93±4.05kg/m^2 and 27.79±4.07kg/m^2 at initiation, 45 minutes walk and 15 minutes walk after each meal respectively. Mean Fasting plasma glucose (FPG) was 140.99±57.13mg/dL, 133.01±41.10mg/dL and 115.26±27.46mg/dL at initiation, 45 minutes walk and 15 minutes walk after each meal respectively. Mean Postprandial plasma glucose (PPPG) was 183.55±57.42mg/dL, 177.58±50.98 mg/dL and 158.59±38.7mg/dL at initiation, 45 minutes walk and 15 minutes walk after each meal respectively. Mean HbA1C was 8.31±1.96, 8.09±1.93 and 7.64±1.64 at initiation, 45 minutes walk and 15 minutes walk after each meal respectively. Highly significant difference ($p < 0.001$) in BMI, FPG, PPPG and HbA1C was found between initial, 45 minutes and 15 minutes post meal walk.

Conclusions: Post meal walk practice for wellness of patients was seen to be significantly effective among diabetics for achieving maximum health benefits as compared to one time physical activity a day.

Key Words: type 2 diabetes, physical activity, BMI, FPG, PPPG, HbA1C, wellness

INTRODUCTION

According to World Health Organisation (WHO), diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces.(1) WHO has observed an apparent epidemic of diabetes that is strongly related to lifestyle and economic change and thus, all are at risk of

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the development of complications.(2) The cause for Type 2 diabetes is a combination of insulin resistance, which develops from obesity and physical inactivity, and defective secretion of insulin by beta cells of the pancreas. Insulin Resistance precedes the onset of type 2 diabetes and is accompanied by some cardiovascular risk factors like dyslipidemia, hypertension etc. (3,4)

The number of people with diabetes has risen from 108 million in 1980 to 415 million in 2015. The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014. According to the Diabetes Atlas, 7th edition, the year 2015 had 415 million diabetics worldwide which may rise to 642 million in 2016. The number of people with diabetes in India is 65.1 million against 50.8 million in 2010. The prevalence of diabetes in India has fallen from rank one. The latest data shows Japan at rank one with its prevalence being 10.1%. Diabetes prevalence in India is 7.8% (5) The weighted prevalence of diabetes (both known and newly diagnosed) was 10.4% in Tamil Nadu, 8.4% in Maharashtra, 5.3% in Jharkhand, and 13.6% in Chandigarh. The prevalence of prediabetes (impaired fasting glucose and/or impaired glucose tolerance) were 8.3%, 12.8%, 8.1% and 14.6% respectively, wherein Chandigarh topped the list. (6)

Overweight and obesity, the main drivers of type 2 diabetes, have long been regarded as health risks associated with affluence. Over the last decade, profound changes in the quality, quantity and source of food consumed in many developing countries; combined with a decrease in levels of physical activity among the population, have led to an increase in the prevalence of diabetes and its complications. (7)

Studies conducted in Haryana, Punjab and Delhi, in 2012 reported that Indians are now seen frequently with problems of overweight and obesity. Indians exhibit unique features of obesity: excess body fat, abdominal adiposity, increased subcutaneous and intra-abdominal fat, and deposition of fat in ectopic sites (such as liver, muscle, and others). Obesity is a major driver for the widely prevalent metabolic syndrome and type-2 diabetes mellitus (T2DM). (8)

According to the National Family Health Survey (NFHS) , the percentage of women aged between 15-49 years who were overweight or obese increased from 11% in NFHS- 2 to 15% in NFHS-3. Under nutrition was more prevalent in rural areas, whereas overweight and obesity were more than three times higher in urban areas. This could be due to lesser physical activity in the urban areas. Furthermore, under nutrition and overweight/obesity were both higher in women than men. The percentage of women who were overweight or obese was highest in Punjab i.e. 30%, followed by Kerala- 28% and Delhi - 26%. (9)

Scott RA in 2013 et.al reported that family history of type 2 diabetes as a strong risk factor for the disease. Adjustment for established risk factors including BMI and waist circumference only modestly attenuated this association; the genetic score alone explained only 2% of the family history-associated risk of type 2 diabetes. The greatest risk of type 2 diabetes was observed in those with a bi-parental history of type 2 diabetes and those whose parents had been diagnosed with diabetes at a younger age (<50 years), an effect largely confined to a maternal family history. (10)

Obesity and body fat are measured by body mass index (BMI) — a number that expresses weight in relationship to height and is a reliable indicator of overall body fat. People with a BMI of 25 to 29.9kg/m^2 are considered overweight; those with a BMI of 30kg/m^2 or over are obese. The National Health and Nutrition Examination Survey (NIDDK) reports that 67% of people with type 2 diabetes have a BMI 27kg/m^2 or higher and 46 percent have a BMI 30kg/m^2 or higher. BMI between 18.5 kg/m^2 to 24.9 kg/m^2, is considered normal. A BMI-for-age at the 95th percentile or higher is considered overweight, while the 85th to 94th percentile is “at risk” for being overweight. The National Institutes of Health recommends that waist circumference be used as a screening tool for evaluating the risk of heart disease and type 2 diabetes (11) . In South Asia, a study was conducted in 2013 wherein researchers found that a BMI above 24.9 kg/m^2 among East Asians is a strong risk factor, just as it is in Western populations. (12)

In a study done by Feller, Boieng and Pischoon, a statistically significant interaction was found between BMI and waist circumference with respect to the risk of type 2 diabetes mellitus. The positive association between waist circumference and diabetes risk was stronger

in persons with lower BMI. The relative risk of developing type 2diabetes mellitus among persons of low or normal weight (BMI < 25) who had a large waist circumference was at least as high as that among overweight persons with a small waist circumference: for the first case, the relative risk was 3.62 in men and 2.74 in women; for the second case, the relative risk was 2.26 in men and 1.40 in women. These relative risks were calculated in comparison to the risk among persons of low or normal weight (BMI < 25) with a small waist circumference. (13)

According to American Heart Association physical inactivity is another modifiable major risk factor for insulin resistance and cardiovascular disease. Exercising and losing weight can prevent or delay the onset of type 2 diabetes, reduce blood pressure and help reduce the risk for heart attack and stroke. It is likely that any type of moderate and/or vigorous intensity, aerobic physical activity—whether sports, household work, gardening or work-related physical activity—is similarly beneficial. (14)

HbA1C is a good method of assessing glycemic control. The higher the percentage of circulating HbA1C in the diabetic , the poorer the mean diabetic control. Higher the fasting plasma glucose the higher is the glycated hemoglobin . (15)

The American Diabetes Association (ADA) recommended that people with diabetes strive for an A1C goal of less than 7%. An A1C for a person without diabetes is approximately 4-6% . ADA is introducing a new term into diabetes management, called “Estimated Average Glucose ″ (EAG). The EAG is the number of the A1C test (also known as glycated haemoglobin or HbA1c) converted into your average blood glucose levels like seen on glucose meter. (15) The American Diabetes Association (ADA) is recommending that health professionals begin using this new term with patients in diabetes management education because it allows patient to convert A1C results into the same unit (mg/dl) as their blood glucose meter. This in turn will hopefully help patient better monitor their long-term management (16)

Exercise intensity is typically measured in kilocalories burned per minute of activity or in a unit called the metabolic equivalent (MET) is defined as the ratio of the metabolic rate during

exercise to the metabolic rate at rest. Moderate-intensity activities, such brisk walking, are those that burn 3.5–7 kcal/ minute, or equivalently, those that expend 3–6 METs. Vigorous activities, such as running, are those that burn 7 kcal/minute or expend 6 METs. The traditional belief that physical activity must be vigorous to be salutary has been challenged in the last decade by epidemiological studies showing otherwise. Earlier guidelines advocating vigorous exercise for at least 20 min three times per week have been supplemented by a 1995 recommendation by the Centers for Disease Control and the American College of Sports Medicine that adults engage in 30 min of moderate-intensity physical activity on most, and preferably all, days of the week (17), a standard also endorsed by the US Surgeon General since 1996 (20). In 2002, the Institute of Medicine (IOM) doubled the daily moderate-intensity activity goal to 60 min, stating that 0.5 hour was not sufficient to maintain a healthy weight or to achieve maximal health benefits. (18)

According to The American Diabetic Association, walking 15 minutes three times a day was better for blood sugar levels than one 45-minute walk, individuals accumulate 30 min of moderate physical activity on most days of the week. In the context of diabetes, it was becoming increasingly clear that the epidemic of type 2 diabetes sweeping the globe was associated with decreasing levels of activity and an increasing prevalence of obesity. Thus, the importance of promoting physical activity as a vital component of the prevention as well as management of type 2 diabetes must be viewed as a high priority. It must also be recognized that the benefit of physical activity in improving the metabolic abnormalities of type 2 diabetes was probably greatest when it was used early in its progression from insulin resistance to impaired glucose tolerance to overt hyperglycemia requiring treatment with oral glucose-lowering agents and finally to insulin (19)

Thus, the present cross over study was conducted with the objective of understanding the impact of physical activity (walk) 45 minutes daily to 15 minutes physical activity (walk) three times a day after each meal on type 2 diabetic females.

METHODS

Locale of the Study :

The study was prospectively conducted on type 2 diabetes mellitus patients. The patients were selected from the OPD (Endocrinology) of Post Graduate Institute of Medical Education and Research Sector-12, Chandigarh. The OPD's are scheduled on Wednesday & Thursday.

Study Design

Cross over study was conducted.

Sampling Technique

Purposive sampling was done to proceed the study.

Sample Selection

The study subjects/respondents were taken from the OPD(Endocrinology) of Post Graduate Institute of Medical Education and Research, Sector-12, Chandigarh for conducting present study.

Inclusion Criteria :

- Age-limit 40-70 years
- Follow up of 6 weeks.
- The patients were taken keeping in view of the location as decided.
- Present study was designed to be conducted on 175 female patients which were followed by 6 weeks criteria of calling or either meeting them.
- The patients were taken from the Tricity : Chandigarh , Mohali and Panchkula .

Exclusion Criteria

- No complications with respect to physical health: diabetes retinopathy, diabetes foot, nephropathy, neuropathy.
- No Cardio vascular problems.
- No Renal problems.
- Patients who did not follow the criteria of 45 minutes and 15 minutes exercise.

TOOLS FOR DATA COLLECTION:

Self-Designed Questionnaire

A self designed structured questionnaire was designed considering the objectives of the study. The questionnaire was designed to gather information regarding the following parameters .

- General information
- Anthropometric data
- Patients and family history
- Biochemical analysis

The questions were kept open ended and close ended assuming the responses from the subjects. Considering the consistency of time the questions were kept simple and easy to comprehend and answerable by the people.

GENERAL INFORMATION:

The demographic information of every sample was written down carefully. The name, age, sex, address and the contact numbers of every sample were noted.

Patients and Family History :

Family health history is an important risk factor for developing type 2 diabetes. Family history is relatively easy to obtain and conveniently conveys information on genes and environment shared by close relatives. Every respondent was asked if any of their family relation was suffering from diabetes. These relatives included their parents, grandparents, siblings, maternal and paternal uncles and aunts. If any member or members out of these relations was diabetic, it was noted. The samples were asked as to at what age did diabetes set in them and that for how long had they been diabetic.

Questions were asked like if any of first generation or second generation has diabetes?.

ANTHROPOMETRIC DATA:

Anthropometry involves the external measurement of morphological traits of human being. Anthropometric measurements may also be stated as the set of non-invasive quantitative techniques for determining an individual's body fat composition by measuring recording and

analyzing specific dimensions of the body such as height ,weight and body circumference. Use of anthropometry at different ages is for assessing health, nutrition & social well-being. In order to assess the health & social-well being of the patients and to draw out different results, their height, weight & BMI was calculated and was taken on the day of enrolment of the study i.e. on the day of initiating 45 minutes of physical activity .The second height , weight, and BMI measurement was calculated after 6 weeks i.e when the subjects were asked to pursue 15 minutes of physical activity after each meal.

Height

Height was measured by a stadiometer, the height rule was taped vertically to the hard flat wall surface with the base at floor level. The participants stood barefoot with heels together, arms at the side, legs straight, shoulders relaxed and head in the Frankfort horizontal plane with heels, buttocks and scapulae lying against a vertical wall. All subjects wore light indoor clothes and no shoes. The head piece of the stadiometer or the sliding part of the measuring rod was lowered so that the hair (if present) was pressed flat. Height was recorded to the resolution of the height rule (i.e. nearest 1mm/0.5cm) (20)

Weight

The total body weight was measured with firm digital, portable scale. The digital portable scale was placed on a hard-floor surface. All subjects were wearing light indoor clothes and no shoes. The participant were asked to stand in the center of the platform, weight distributed evenly to both feet. The weight is recorded to the resolution of the scale (the nearest 0.1 kg or 0.2 kg). (20)

BMI

According to standards recommended by WHO- 2008, BMI was calculated as weight (kg)/ height (m^2). The cutoff value for normal BMI is 24.9kg/m^2.

The International Classification of adult underweight, overweight and obesity according to BMI

Standard Cut Offs for BMIcut-off points		
Underweight	**<18.50**	**<18.50**
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	**18.50 - 24.99**	**18.50 - 22.99**
		23.00 - 24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	**≥30.00**	**≥30.00**
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

(WHO.Mean Body Mass Index.Global Health Observatory. 2008) (20)

BIOCHEMICAL ANALYSIS:

Every samples' biochemical information was assessed. The reports of their fasting plasma glucose, post prandial plasma glucose and HbA1C levels were noted.

HbA1c

Assessment of therapeutic efficacy in the treatment of the hyperglycemia in type 2 diabetes is accomplished by routine measurement of the circulating levels of glycosylated hemoglobin, designated as the level of HbA1C, often designated as just A1C. HbA1C is the major form of adult hemoglobin in the blood and the "c" refers to the glycosylated form of the protein . Since hemoglobin is present in red blood cells and these cells have a limited life span of 120 days in the circulation, measurement of HbA_{1c} levels is a relatively accurate measure of the amount of glucose in the blood and the length of time the level has been elevated. The American Diabetes Association (ADA) recommended that people with diabetes strive for an A1C goal of less than 7% . (16)

FASTING GLUCOSE AND PLASMA GLUCOSE LEVELS

Glucose levels fluctuate from minute to minute, hour to hour, and day to day. In diabetes , glucose tend to rise more than usual, dropping with exercise, rising after food, rising a lot more after sweet food therefore test are done everyday . Therefore fasting and post-prandial glucose were noted in the OPD .

Values for fasting and post-prandial were recorded on the day of enrolment, secondly after 45 minutes of physical activity and then after 15 minutes of exercise after every meal .

According to World Health Organisation and IDF, the following criteria are recommended for the diagnosis of diabetes mellitus: fasting plasma glucose ≥ 7.0mmol/l (126mg/dl) or 2-h plasma glucose (venous plasma glucose 2 hours after ingestion of 75g oral glucose load) ≥ 11.1mmol/l (200mg/dl).

GPAQ

The second version of Global Physical Activity Questionnaire (GPAQ)was employed in the survey (WHO, 2008). The questionnaire which has been developed by WHO , comprises of 16 question about physical activity in a typical week . The questions assess physical activity in three domains namely, work , transportation and recreational activities . It also determines the intensity of activity (i.e vigorous or moderate) in each domain as well as the time spent on sedentary behaviors such as watching T.V .

Standardized Operational definitions were used in the present study . Some of the Standardised Operational definitions are :

Sedentary behavior was defined as activities such as sitting at a desk ,travelling in a car / bus / train ,reading ,working with computer and watching television.

Metabolic Equivalence (MET) is the ratio of a person's working metabolic rate relative to the metabolic resting rate.

One MET is defined as the energy cost of sitting quietly, and is equivalent to a calorie consumption of 1 kcal/kg/h.

In order to measure energy expenditure the concept of Metabolic Equivalence (MET) was used.

Calculations of MET's:

It was estimated that a person's calorie consumption is four times as high as when being operatively active, and eight times as high when being vigorously active therefore when calculating a person's overall energy expenditure using GPAQ data, four METs are assigned to the time spent on moderate activities, and eight METs to the time spent on vigorous activities.

The total physical activity score (TPA) was calculated as the sum of all MET x Minutes for moderate or vigorous intensity physical activity performed in work, commuting and recreation. Patients were classified into three categories of High , Moderate and Low .

A).High : a person reaching any of the following criteria is classified in this category :
Vigorous intensity activity on at least 3 days a week achieving a minimum of at least 1500 MET minutes per week,
OR
even or more days of any combination of walking and moderate or vigorous intensity activities achieving a minimum of at least 3000 MET minutes per week.
B). Moderate: a person not meeting the criteria for the "high" category, but meeting any of the following criteria is classified in this category.
Three or more days of vigorous activity of at least 20 minutes per day,
OR
Five or more days of moderate intensity activity or walking for at least 30 min per day,
OR
Five or more days of any combination of walking and moderate or vigorous intensity activities achieving a minimum of at least 600 MET minutes per week.
C). LOW: a person not meeting any of the above mentioned criteria falls in this category.
For classifying the study subjects in high , moderate and low category the patients were asked the different questions such as do you do any physical activity? Which type of physical activity do you prefer? .

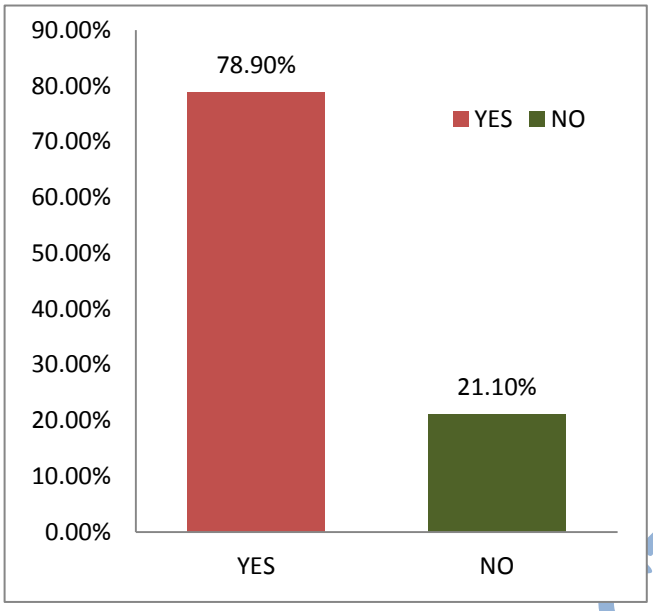
STATISTICAL ANALYSIS

The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 17.0 for Windows). All quantitative variables were estimated using measures of central location (mean, median) and measures of dispersion (standard deviation and standard error). Means were compared using one-way ANOVA (analysis of variance) for more than two groups. For two groups t-test was applied. Qualitative or categorical variables

were described as frequencies and proportions. Proportions were compared using Chi square or Fisher's exact test whichever was applicable. All statistical tests were two-sided and performed at a significance level of α=.05

RESULTS

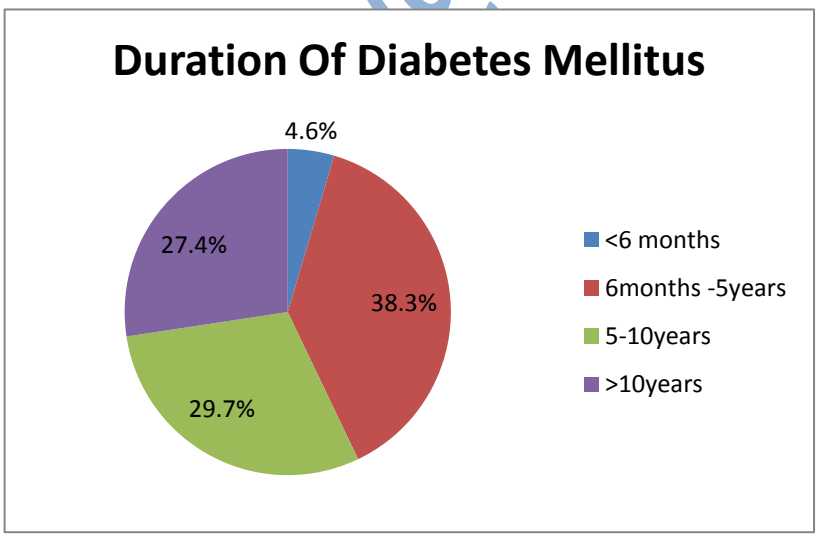
DISTRIBUTION ON THE BASIS OF FAMILY HISTORY



In the present study, family history was seen in 78.9% respondents. Scott RA in 2013 et.al reported family history of type 2 diabetes as a strong risk factor for the disease. The greatest risk of type 2 diabetes was observed in those with a biparental history of type 2 diabetes and in those whose parents had been diagnosed with diabetes at a younger age (<50 years), an effect largely confined to a maternal family history. (10)

Figure 1: Distribution on the basis of family history

DISTRIBUTION ON THE BASIS OF DURATION OF DIABETES



According to the figure, 95.4% respondents were diabetic for more than 6 months out of which 38.3% were diabetic since 6months-5years followed by 29.7% who were since 5-10years.Only 4.6 % were seen to be newly detected with diabetes.

Figure 2: Distribution on the basis of duration of diabetes

TABLE 1: DISTRIBUTION AND COMPARISON ON THE BASIS OF BMI AT INITIAL , AFTER 45 MINUTES WALK AND 15 MINUTES WALK THREE TIMES A DAY AFTER EACH MEAL

	Mean± Standard deviation	P-Value
BMI (initial)	28.14±3.63	<.001**(HS)
BMI(45 min walk) (for 45 days)	27.93±4.05	
BMI (initial)	28.14±3.63	<.001**(HS)
BMI (15 min walk) (for 90 days)	27.79±4.07	
BMI(45 min walk)	27.93±4.05	<.001**(HS)
BMI (15 min walk)	27.79±4.07	

HS-Highly significant

Mean BMI was 28.14±3.63kg/m^2, 27.93±4.05kg/m^2 and 27.79±4.07kg/m^2 at initiation, 45 minutes walk and 15 minutes walk after each meal respectively. The difference between initiation and 45 minutes walk was 0.75%. Physical activity in terms of walks were seen to bring down the BMI levels, further progressing towards a better health status. The difference between 45 minutes walk and 15 minutes walk was 0.5%. The result was highly significant.

TABLE 2: DISTRIBUTION AND COMPARISON OF HBA1C AT INITIAL, AFTER 45 MINUTES WALK AND 15 MINUTES WALK THREE TIMES A DAY AFTER EACH MEAL

	Mean±Standard deviation	P-Value
HbA1C (initial)	8.31±1.96	0.223
HbA1C- 45 min walk (for 45 days)	8.09±1.93	
HbA1C (initial)	8.31±1.96	<.001**(HS)
HbA1C- 15 min walk (for 90 days)	7.64±1.64	
HbA1C- 45 min walk	8.09±1.93	<.001**(HS)
HbA1C- 15 min walk	7.64±1.64	

HS-Highly significant

Mean HbA1C was 8.31±1.96, 8.09±1.93 and 7.64±1.64 at initiation, 45 minutes walk and 15 minutes walk after each meal respectively. The difference between initiation and 45 minutes walk was 2.64%. It was seen that through lifestyle intervention, HbA1C may fall in range as per the requisite biochemical parameters. The difference between 45 minutes walk and 15 minutes walk was 5.56%. The results were seen to be highly significant.

TABLE 3: DISTRIBUTION AND COMPARISON ON THE BASIS OF FASTING PLASMA GLUCOSE AT INITIAL, AFTER 45 MINUTES WALK AND AFTER 15 MINUTES WALK THREE TIMES A DAY AFTER EACH MEAL

	Mean±Standard deviation	P-Value
FPG (initial)	140.99±57.13	0.006**(HS)
FPG- 45 MIN WALK (for 45 days)	133.01±41.10	
FPG (initial)	140.99±57.13	<.001**(HS)
FPG- 15 MIN WALK (for 90 days)	115.26±27.46	
FPG- 45 MIN WALK	133.01±41.10	<.001**(HS)
FPG- 15 MIN WALK	115.26±27.46	

HS-Highly significant

Mean Fasting plasma glucose (FPG) was 140.99±57.13mg/dL, 133.01±41.10mg/dL and 115.26±27.46mg/dL at initiation, 45 minutes walk and 15 minutes walk after each meal respectively. The difference between initiation and 45 minutes walk was 5.66%. The difference between 45 minutes walk and 15 minutes walk was 13.34%. Post meal walks have been seen to bring down the FPG levels towards normal range which not only brings about better health, but also a better quality of life among diabetics. The result was found to be highly significant. It was seen that the FPG values fell within range as per biochemical parameters.

TABLE 4: DISTRIBUTION AND COMPARISON ON THE BASIS OF POSTPRANDIAL PLASMA GLUCOSE AT INITIAL, AFTER 45 MINUTES WALK AND AFTER 15 MINUTES WALK THREE TIMES A DAY AFTER EACH MEAL

	Mean±Standard deviation	P-Value

PPPG (initial)	183.55±57.42	0.006**(HS)
PPPG- 45 MIN WALK (for 45 days)	177.58±50.98	
PPPG (initial)	183.55±57.42	<.001**(HS)
PPPG- 15 MIN WALK (for 90 days)	158.59±38.73	
PPPG- 45 MIN WALK	177.58±50.98	<.001**(HS)
PPPG- 15 MIN WALK	158.59±38.73	

HS-Highly significant

Mean Postprandial plasma glucose (PPPG)was 183.55±57.42mg/dL, 177.58±50.98 mg/dL and 158.59±38.73mg/dL at initiation, 45 minutes walk and 15 minutes walk after each meal respectively. The difference between initiation and 45 minutes walk was 3.25%. The difference between 45 minutes walk and 15 minutes walk was 10.69%. The result was found to be highly significant.

CONCLUSION

It can be concluded that regular physical activity by type 2 diabetic respondents showed a beneficial and positive effect. Regular physical activity improves insulin action; BMI, Hba1c, FPG as well as PPPG levels among diabetics. Family history of type 2 diabetics is associated with higher incidence of the disease. The study showed that both 45 minutes of daily walk as well as 15 minutes walk three times a day after each meal proved beneficial in lowering the BMI levels, Hba1c levels as well as fasting plasma glucose levels. Both 45 minutes walk and 15 minutes walk post each meal showed a decline in BMI levels and HbA1c. Fasting plasma glucose levels were further seen to fall with the requisite biochemical range through lifestyle intervention of physical activity. However, on comparison between 45 minute daily walk and 15 minutes walk three times a day, post meal walk was seen to be significantly effective among diabetics for achieving maximum health benefits as compared to one time physical activity a day. It was seen that physical activity in daily routine is a necessity. Creatively splitting a 45 minutes walk to 15 minutes walk after every meal (3 times a day) as a part of lifestyle intervention helped the diabetics in improving their biochemical parameters; further

promoting wellness. Thus, inculcation of 15 minutes walk post meal may be beneficial for diabetics as well as non diabetics for better health status.

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