Original Research Article

Correlation Between Level of Physical Activity Using GPAQ and Exercise Capacity Using 6 Min Walk Test in Non-Insulin Dependent Type 2 Diabetes Mellitus

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Abstract

Background: This study was designed to find the Correlation Between the Level of Physical Activity and Exercise Capacity in Non-Insulin Dependent Type 2 Diabetes Mellitus.

Purpose: To find the Correlation between the Level of Physical Activity and Exercise Capacity in Non-Insulin Dependent Type 2 Diabetes Mellitus.

Materials and Methods: Materials required for this study were Countdown timer(or stopwatch),Two small cones, Chair, Worksheet on a clipboard, Sphygmomanometer. It was a correlational study design. The sampling method used was Convenient type of sampling. Sixty subjects with non-insulin dependent type 2 were included in this study. The written informed consent was taken. Informed consent document was signed, retained by the principal investigator and a copy was given to the participant. Global Physical Activity Questionnaire and 6 Minutes walk test was used to study the Physical Activity and Exercise Capacity respectively. All the data obtained was statistically analysed using proper tests.

Results: The results showed positive significant (p value< 0.0001) correlation between the level of physical activity and exercise capacity, Physical activity level correlates statistically with distance walked in percentage.

Conclusion: Our study concluded that Physical activity level correlate statistically with distance walked in type 2 diabetic patients.

Key Word: Physical Activity (PA), Global Physical Activity Questionnaire (GPAQ), Diabetes Mellitus (DM), Type 2 Diabetes Mellitus(T2DM), 6 Minute Walk Test(6MWT).

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Introduction

Diabetes mellitus (DM) is an aggregation of all metabolic diseases with hyperglycaemia due to increased glucose level in the blood. It is a characterized by hyperglycaemia due to insufficient secretion and impaired utilization of insulin. Although not a direct cause of death, DM yields serious damages by causing blindness, kidney failure, non-traumatic limb amputation, and complications such as coronary artery disease and stroke. Therefore, DM can be called as a chronic disease whose symptoms can be controlled but cannot be cured.[1]

Type 2 Diabetes Mellitus (T2DM) mostly results from the interaction among genetic, environmental and other risk factors. Furthermore, loss of first-phase of insulin release, abnormal pulsatility of basal insulin secretion, and increased glucagon secretion also accelerate the development of T2DM. Although T2DM patients are generally independent of exogenous insulin, they may need it when blood glucose levels are not well controlled with diet alone or with oral hypoglycaemic drugs. In addition, people with T2DM are often accompanied by complications, such as cardiovascular diseases, diabetic neuropathy, nephropathy, and retinopathy. Diabetes and its associated complications lower the quality of people's lives and generate enormous economic and social burden.[2]

Physical activity level and exercise capacity are important determinants of health status and mortality.

Physical activity (PA) is any bodily movement produced by skeletal muscle that result in energy expenditure beyond resting energy expenditure.[3]

During any type of PA, glucose uptake into active skeletal muscles increases via insulin-independent pathways. Blood glucose levels are maintained by glucoregulatory hormone- derived increases in hepatic glucose production and mobilization of free fatty acids, which may be impaired by insulin resistance or diabetes. Improvements in systemic and possibly hepatic, insulin sensitivity after any PA can last from 2 to 72 h, with reductions in blood glucose closely associated with PA duration and intensity. In addition, regular PA enhances B-cell function insulin sensitivity, vascular function, and gut microbiota, all of which may lead to better diabetes and health management as well as disease risk reduction.[4]

PA level of patients can be assessed using a WHO validated Global Physical Activity Questionnaire (GPAQ).[5]

The GPAQ uses a standardized protocol as surveillance of PA engagement at the population level with self-report and interview-administrated modes. The GPAQ has questions revolving around three domains: Occupational, transport-related, and leisure-time PA. For each domain, there is a pre-set PA list to help participants recall PA, which ensures the reliability and validity of the questionnaire. Moreover, the GPAQ can also standardize data collected, focusing on the moderate-to- vigorous PA (MVPA) for work and recreation, minutes of walking and bicycling for transport only.[6]

For validity, GPAQ demonstrated fair-to-moderate correlations for moderate-to- vigorous physical activity (MVPA) for interviewer-administration (rs-046) Reliability for MVPA revealed moderate correlations (-0.63) for interviewer-administration.

Walking has emerged as one of the most popular activities to improve fitness over the last few decades. It is popular because it is simple and can be performed by individuals of all ages and abilities owing to its low risk of injury. Walking exercise is easy to use, as it requires simple preparation and has many desirable effects such as improving aerobic capacity and reducing body fat, risks of depression and anxiety, and blood cholesterol levels. In particular, the 6-minute walk test (6-MWT) is also a widely used method for evaluating cardio-pulmonary performance. The correlation between the 6-MWT travel distance and the maximum oxygen uptake was shown to be high ($r = 0.73$). Therefore, walking is an attractive aerobic exercise that is easily selected for exercise testing.

The 6-MWT can be performed in accordance with the guidelines of the American Thoracic Society. 6MWT is a practical simple test that requires 100-ft hallway. Walking is an activity performed daily by all but the most severely impaired patients. This test measures the distance that patient can quickly walk on a flat hard surface in a period of 6 minutes.

It evaluates the global and integrated response of all the systems involved during exercise. The self -paced 6MWT assesses the submaximal level of functional capacity. Most patients do not achieve maximal exercise capacity during the 6MWT; instead, they choose their own intensity of exercise and are allow to stop and rest during the test. However, because most activity of daily living are performed at submaximal levels of exertion, the 6MWD may better reflect the functional exercise level for daily PA.[7]

AIM

To study the correlation between level of physical activity and exercise capacity in non-insulin dependent type 2 diabetes mellitus patients.

Material and Method

Materials required for this study were Countdown timer, two small cones to mark the turnaround points, A chair that can be easily moved along the walking course, Worksheets on a clipboard, Sphygmomanometer. It was a correlational study conducted on 60 subjects with T2DM, age between 40-60 years, was taken from Outpatients department tertiary hospital and care centre. The method used in this study for sampling was Convenient sampling.

Inclusion criteria:

- Age: 40-60 years
- Patients diagnosed with type 2 diabetes not less than 6 months and not more than 24 months before baseline examination.
- Management by lifestyle with pharmacotherapy without insulin.

Exclusion criteria:

- Type 1 diabetes
- Uncooperative patients
- Recent lower limb and spine
- Recent surgeries
- Complication such as diabetic neuropathy, diabetic nephropathy, diabetic retinopathy.

Outcome measures:

1. **Global Physical Activity Questionnaire (GPAQ)**

   PA was assessed using the GPAQ. It comprises 16 questions (P1-P16) and collects information on PA in three different situations: at work, when moving from one place to another, and during leisure time. To analyse the questionnaire data, the metabolic equivalent (MET), which expresses the ratio between metabolic rate during PA and metabolic rate at rest, was used. It is estimated that the caloric expenditure of a moderately active person is four times higher than that of a person at rest. While that of a very active person is eight times higher than the caloric expenditure of a person at rest. So, energy expenditure of 4 METs was attributed to time spent in moderately intense PA, and 8 METs to time spent in intense PA. Thus, the total PA score was calculated as the sum of all METs per week in work, commuting and leisure respectively. Finally, PA levels were classified into 3 classes: intense (MET / min / week ≥ 3000), moderate (600 ≤ MET / min / week ≤ 2999) and low (MET / min / week <600 .

2. **The 6-minute walk test:**

   The 6-MWT was performed in accordance with the guidelines of the American Thoracic Society. The subject was instructed to walk for 6 minutes at a given time along a 30-m line at an interval of 1.5 m in an outdoor corridor, and the distance walked was recorded in meters. The walk test was conducted in hallways or outdoor corridors, and the patients were encouraged to continue walking as fast as possible.

Procedure

Ethical approval was taken from the ethical Committee. Subjects were screened according to inclusion and exclusion criteria and only those eligible were included in the study (n=60). and age group of 40-60 years were selected. The written informed consent was taken. After filling the consent form, the participants demographic data was taken. PA of the individual was measured by using GPAQ Scale and the score was noted down. The exercise capacity of the individual was measured by using 6MWT. In the 6MWT, the patient was asked to walk as far as possible. Before and after the test parameters were taken. The subjects were instructed to walk

for 6 minutes at a given time along a 30-m line at an interval of 1.5 m in an outdoor, and the subjects were encouraged to continue walking as fast as possible. The data was analyzed using Graphpad Prism version 10.2.1 and Microsoft Excel 2007.

Fig 1: Pre parameters were taken

Fig 3-post parameters were taken

Data Analysis

Table 1: Age Wise Distribution

AGE	PARTICIPANTS	PERCENTAGE
40-45	5	9%
46-50	3	5%
51-55	2	3%
56-60	50	83%

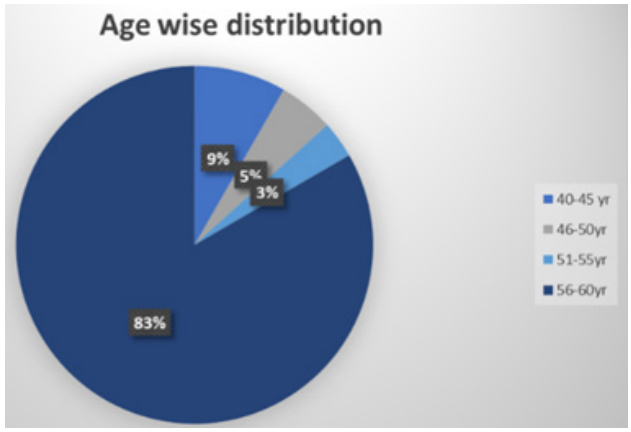

Figure No. 1

INTERPRETATION: The fig shows that participants between the age group of 40-45 years were 5 participants which is 9% and participants between the age group of 46-50 years were 3 participants which is 5%. Participants between the age group between the group of 51-55 years were 2 participants which is 3%.and participants between the age group of 56-60 years were 50 participant which is 83%.

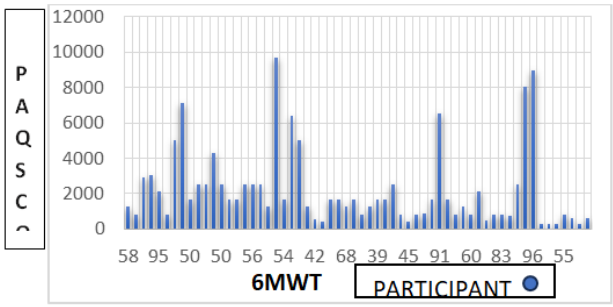

Figure No. 2

INTERPRETATION: Figure shows that there is positive significant correlation between physical activity and exercise capacity

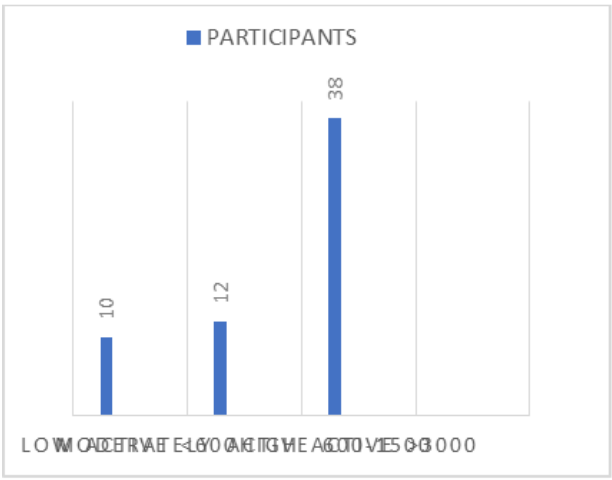

Figure No. 3

INTERPRETATION: Figure 3 shows that 10 participants were low active <600.12 participants were moderately active 600-1500.and 38 participants were high active >3000.

Result

Statistical analysis was performed using GraphPad Prism version 10.2.1 and Microsoft Excel 2007.

Normality test was applied to see the normality of the data.

Table 2: Correlation of GPAQ score and 6MWT in non-insulin dependent type 2 diabetes mellitus

GPAQ score and 6 Min Walk Test	
SPEARMAN r	0.4838
p – value	<0.0001

Non-parametric test Spearman's correlation coefficient was used for data which was not normally distributed.

Based on the statistical analysis:

Figure 1 shows that out of 60 subjects 9% were between 40-45 years, 5% were between 46-50 years, 3% were between 51- 55 years and 83% were between 56-60 years.

Figure 2 shows that that there is positive significant correlation between physical activity and exercise capacity.

Table 3: Distribution of GPAQ with low, moderate and high active

	LOW ACTIVE <600	MODERATELY ACTIVE 600-1500	HIGH ACTIVE >3000
PARTICIPANTS	10	12	38

Figure 3 shows that 10 participants were low active <600, 12 participants were moderately active 600-1500,and 38 participants were high active >3000.

Discussion

A correlation study was carried out in 60 Type 2 diabetic patients to find out relation between physical activity level and submaximal exercise capacity.

Functional exercise capacity was assessed by the 6MWT and PA was assessed by the GPAQ scale and found that there is discrepancy between functional exercise capacity and daily PA in patients with T2DM.

The average distance walked by the participants was 484 meter, 64% of their predicted distance which is less than normal individual

The PA score averaged to 2197 which is low according to GPAQ.

The results showed that PA level correlates statistically with distance walked in percentage.

Moderate PA level is more common among T2DM patients which could be due to the information dissemination of health care providers about the health benefits of doing regular PA. It is necessary that health care workers know about the socio-cultural habits and expected barriers in giving

advice to patients with T2DM to enhance adherence to lifestyle modification by developing a diversified and appropriate health education programmes for these high risk group.

Poor glycemic control was associated with low PA level. A study among diabetic patients showed that moderate and vigorous PA provides good glycemic control by reducing the value of HbA1c.

PA helps in glycemic control by improving insulin sensitivity thus improving glycemic control. In a meta-analysis of 14 clinical controlled trials of PA intervention among middle-aged diabetic individuals lasting for about 8 weeks or more demonstrated that regular exercise resulted to a decrease in HbA1c levels.[9] Findings of the available clinical research in knowing the physiologic relationship between diabetes and PAstill remains insufficient. Aside from searching for complete data of the applicable physiology, we should also give priority towards identifying the strategies on how to encourage our patients to have a sustained exercise that will offer health improvement.

A Significantly higher percentage of those aged 60 years had lower PA than those with younger age group. Older age group prefers to do low intensity PA because of their perception that diabetes 'weakened' and 'aged' the body causing them to have some demotivational effect in involving or maintaining a regular exercise regimen and more intense PA.

Indeed, these recommendations suggest that patients engage in moderate activity every day of the week. The effect of PA on insulin resistance lasts between 24 and 72 hours. In addition, in the areas of PA studied, the efforts made during travel and leisure activities were significantly more intense with diabetics than in non-diabetics. On the other hand, efforts made at work were comparable in both groups. This result identifies areas where PA should be more pronounced in non-diabetic subjects as part of primary prevention.[8]

In the study of Determinants of Exercise Capacity in Patients with T2DM The study demonstrates that in addition to the expected associations with aging, female gender, and obesity, impaired exercise capacity in T2DM is also associated with control poor diabetes.[9]

The association of poor glycaemic control with poorer exercise is seen with studies of asymptomatic T2DM. Studies have also shown that HBA1C is inversely correlated with maximal oxygen consumption, exercise duration. It is important to note that chronic maintenance of near normal blood glucose levels is associated with improved cardiopulmonary function and increased exercise capacity.

Glycosylation may impair the function of some proteins, and vascular or endothelial dysfunction may be a plausible link between decreased exercise capacity and disorders metabolism associated with poor diabetes control, including abnormalities in glucose transport and utilization increased free fatty acids.[9]

Diabetes belongs to a group of disorders that reduce regular PA, the poor exercise capacity in patients with diabetes based on the results of the 6MWT might be because of the link between diabetes and adverse cardiac effects. Impaired exercise capacity is a powerful and independent predictor of an increased risk of cardiac events in DM patients.

In this situation, poor glycemic control has been associated with increased stiffness of vessels in the vascular bed in several organs, including the lungs. Compliance plays a significant role in modulating coronary artery blood flow, which has important consequences for myocardial work capacity and, therefore, leads to reduced exercise capacity. A reduction in the distance walked in the walking test was also observed in patients with diabetes.[10]

From the observation it clearly demonstrates that there is positive correlation between PA and exercise capacity in T2DM. The factors contributing could be age, medical condition, occupation etc.

Conclusion

Our study concluded that Physical activity level correlate statistically with distance walked in type 2 diabetic patients.

Limitations

The limitation of this study is that physical activity was assessed by using a questionnaire which provides a crude measurement of PA and is subjected

to recall bias. Participation to PA itself might be under-reported because most of the patients were not able to recall exactly the type and duration of the activity done.

Ethical Approval: Institutional Ethics Committee of LSFPEF'S College of Physiotherapy, Pune[Ref. LSFPEF/PT/IEC/15/2023 dated 16/03/2023]

Conflict of Interest: Nil

Source of Funding: Self

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