

Original research article

Observing Effects of Six Months Moderate Exercise Training in type II Diabetes Mellitus Patients at Tertiary Care Hospital.

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Abstract

Introduction: Diabetes mellitus (DM) is one of the biggest breaking ice berg of our planet leading billions of affected lives counting one-third (34.1 %) of adults. The summed total of prevalence for DM is 27.6% between women and 34.1% between men.

Hence to tackle this disease almost all the physicians ask their patients for a regular exercise. But as the quantification of the exercise is not calibrated the outcome of exercise prescribed often goes in vain. Evaluating levels of physical activity and fitness (ALPHA-FIT) test battery was applies and effects of exercise training were observed.

Material Methods: A prospective observational hospital-based study was performed at tertiary care centre in harmony with Physiotherapy instructor. For present study patients were selected who were testing on routine basis for the blood sugar level at central lab of Dept. of Pathology.

Study protocol was designed along with exercise protocol for patients. For present study a total of 79 patients were selected with 42 males and 37 females. Exercise protocol was designed. Also, patients were instructed to follow their medication on regular basis. Evaluating levels of physical activity and fitness (ALPHA-FIT) test was used.

Results: Amongst the selected study population demographic data in form of Age (in years), Duration of diabetes (in years), etc. was recorded and found to be non-significant in male and female patients. Considering the pre test and post test data all the parameters One-leg stand test (Sec.), Vertical jump test (cm.), Grip strength test, etc. were found to be significant after 6 months of training along with strict diabetic control over same anti diabetic régime.

Conclusion: The ALPHA-FIT test battery is easy and useful method for assessment of physical fitness for patients with diabetes type 2. The battery also helps to the detection of the individual needs of exercise type and pattern that contribute to better control of diabetic and improve the physical status. Hence larger scale studied to be implemented all over the country to evaluate the actual outcome over the Diabetic patients which may be implemented as national health program for Diabetic control.

Keywords: (ALPHA-FIT) test, type 2 Diabetes Mellitus , Moderate exercise

Introduction

Diabetes mellitus (DM) is one of the biggest breaking ice berg of our planet leading billions of affected lives counting one-third (34.1 %) of adults. The summed total of prevalence for DM is 27.6% between women and 34.1% between men.^{1, 2, 3.}

The International Diabetes Federation (IDF) preordained that there would be 334 million patients with diabetes by 2025.⁴ Also in Indian continents the disease is spreading very vastly due to sedentary life style and improper eating habits.

Never the less type 2 DM is popularly known for its multi systemic complications majority affecting cardiac and renal system; finally leading to premature death.⁵

Hence to tackle this disease almost all the physicians ask their patients for a regular exercise. But as the quantification of the exercise is not calibrated the outcome of exercise prescribed often goes in vain.

There are many provinces of test batteries on physical aptness which are indorsed that used to escalate the various physical fitness parameters. Evaluating levels of physical activity and fitness (ALPHA-FIT) test battery is one of them.⁶ The ALPHA-FIT test battery is consisting of simple and relatively cheap tests, which can be managed easily by observers.⁷

Hence the study was undertaken in diagnosed Type 2 DM patients who were having history of sedentary lifestyle and almost no physical exercise to see effects of 6 months of brisk physical exercise common to all the participants under consideration. Effects of these physical training were assessed after 6 months from the onset of the program using ALPHA FIT test to see any change in physical activity of these patients.

Materials and Methods

A prospective observational hospital-based study was performed at tertiary care centre in harmony with Physiotherapy instructor, Dept. Of Physiology and Dept. of Pathology. For present study patients were selected who were testing on routine basis for the blood sugar level at central lab of Dept. of Pathology.

After getting ethical clearance from the institutional ethics committee written and informed consent was taken from the patients.

Study protocol was designed along with exercise protocol for patients. For present study a total of 79 patients were selected with 42 males and 37 females. Exercise protocol was designed considering standard diabetic exercise guideline in such a way that it was very easy to follow having daily 6000 steps walk with a minimum of half hour brisk walking, stretching upper and lower extremity joints for five minutes to improve stretchability. Also, patients were instructed to follow their medication on regular basis.

At the first visit patients' demographic data, history and blood sample and urine sample was taken for evaluation. Then study protocol was explained in detail to the patients and aske to keep record of physical activity for a minimum of 5 days a week.

Follow up was taken on every 30th day from start of the physical activity in form of blood sugar level fasting and post meal, HbA1C and Urine routine to maintain the record of disease progress.^{8, 9}

Exclusion criteria: Patients who were on regular exercise/diet programs for the preceding 6 months. Patients with a history or clinical evidence of orthopaedic, neurological, or cardiopulmonary disorders.

Procedure and measures

The latest HbA1c was to be used to evaluate long term metabolic monitoring of the patients. The ALPHA-FIT Test Battery was be used to examine the body fitness of the subjects with type 2 diabetes, thorough seven measurements including body composition, motor balance,

musculoskeletal system fitness strength, and endurance and cardiopulmonary fitness. Table (1) shows the series of test items of the fitness for health the ALPHA-FIT test battery for adults.

Table 1: Shows the series of examination items for the ALPHA-FIT Test Battery for adults.

Fitness component	Fitness factor	Fitness test category
Body composition	Fat distribution	Waist Circumference (WC)
	Obesity	Body mass index (BMI)
Motor	Balance	One-leg stand
Musculoskeletal	Upper body muscle strength	Hand grip dynamometer Jump-and-reach test
	Lower body muscle strength	
	Muscular endurance Trunk	Modified push-up test
Cardiorespiratory	Submaximal aerobic capacity (VO ₂ max)	6 minutes' walk test, predicted (6MWT)

The body mass index (BMI) was examined through the participant's weights, and heights to detect the degree of obesity and body composition usually indicate peripheral obesity. Central obesity and fat distribution were explored by measuring the waist circumference (WC). The objective of the test was to check the percent of abdominal fat tissue. The procedure of the waist circumference test was done as follows. The participant was standing with feet apart by about 10 inches in front of the examiner. The tape measurement was put around the abdominal at umbilicus level, midway between the iliac crest bone and the number 12th rib bone. During the normal exhalation, the three times repeated measurements were taken. The result was calculated to the nearest 0.5cm, and the mean of the measurements was recorded.⁷

The one-leg stand test was being done to examine the postural control and balance by decreasing the body space of support. From a standing position, the participant moves to one-leg stand position of the dominant leg. The participant was moving the heel of the other leg on the medial side of the knee. The participant kept up his arms, hanged beside the body without closing eyes. The participant was trying to keep in the one-leg position for the longest time. The results were calculated by seconds until 60 seconds.¹⁰

To assess the upper and lower limbs musculoskeletal fitness, the handgrip test, and the test of the vertical jump (VR) were used. The hand dynamometer was applied to examine the strength of the upper limb muscle of the dominant hand from the neutral position of the shoulder with extension elbow position. The test was done two times, and a higher score was recorded. For measuring the strength of lower extremities muscles, the vertical jump test was suitable. The subject stands at eight-inch away from the wall and facing to it. The procedure was done by jumping as high as possible. Outcomes of maximum distance jumped was recorded. The upper-body and trunk muscular endurance were measured by modified push-up. From a prone position, the practitioner, try to doing as much as possible of push-ups. The total time of the test was 40 seconds. The total number of complete correctly performed push-up was recorded.¹¹

The six minutes' walk test (6MWT) was be used to determine the cardiopulmonary fitness. It was conducted on a 30-meter indoor track. Then we counted the distance that was being walked. Then through certain formula: $VO_{2max} = 4.948 + 0.023 * \text{Mean 6 MWD (m.)}$ was being used to determine VO_{2max} (ml. / kg. In.).^{12, 13}

Results

The data of the study was recorded by Microsoft office excel 21 and Statistical analysis was performed by graph pad prism 8. For statistically significant results paired t-test was applied for the data collected using ALPHA FIT battery test.

The demographic data of all subjects in each group shown in Table (2). The results appeared that no differences between the demographics of the participants in the diabetic male and females.

Table 2: Shows the demographic characteristics of the male and female diabetic patients.

	Males	Females	p value	Significance
Age (year)	43.4± 6.8	41.3± 4.88	0.229	NS
Duration (years)	6.63± 1.4	6.91±1.7	0.32	NS
HbA1c (%)	8.24± 0.81	8.6±0.4	0.19	NS
Weight (Kg.)	78.8± 6.83	77.5± 7.65	0.578	NS
Height (cm)	159± 9	153± 7.500	0.521	NS
BMI (kg./m ²)	26.12±2.01	25.98±1.94	0.414	NS
Waist circumference(cm)	82.5± 8.06	83.6±8.1	0.184	NS

As the demographic values amongst the male and female participants of the study are not statistically significant hence the data can be correlated.

As illustrated in Table (3), there were a significant reduction in mean values of total walked distant, VO₂ max, time of one-leg stand test, numbers of repetition of modified push up test, the height of vertical jump test and power of grip strength test between pre and post exercise effects showing significant p-value < 0.05.

Table 3: Shows the physical fitness results in 6 months duration of pre and post session.

Variable	Pre-Mean± SD	Post Mean± SD	p-value	Sig.
One-leg stand test (Sec.)	25.61± 3.9	35.01±4.36	0.001	*
Vertical jump test (cm.)	33.62± 5.6	43±3.91	.001	*
Grip strength test (Newton)	48.3± 9.33	59.81±13	0.005	*
Modified push up test (number of repetition)	8.9± 4.18	15.17±3.44	0.001	*
Total distance (m)	459± 31.8	536±36.2	0.005	*
VO ₂ max (ml./kg./min.)	13.7± 0.88	16.1±0.43	0.001	*

It can be clearly seen that after a training session of six months statistically significant results were observed in diabetic patients highly significant results were observed in one leg stand test, vertical jump test and modified push up tests. Which signifies strengthening of muscular fitness amongst the patients.

Discussion:

Physical fitness is generally decreased with diabetes mellitus, several studies evaluated the physical fitness of diabetic patients, but most of these studies do not focus on different battery of test, in addition quantification and tracing of effects of exercise. So, this study adds to the

knowledge about valuation of physical fitness by the new test the ALPHA-FIT test battery among diabetic population.

In this study, investigated the musculoskeletal and cardiorespiratory fitness of young male with type 2 diabetes using the standardized ALPHA-FIT test battery (Assessing levels of physical activity and fitness). The results of the study were compared on pre and post basis in diabetic group which were statistically comparable amongst the male and females' patients.

Olufemi et al., and Mehtap et al. evaluated the level of physical fitness in subjects with diabetes mellitus type II. They tested and gaging cardiorespiratory fitness in patients with diabetes and made comparison with the healthy control men. All outcomes' results showed lowering of cardiopulmonary fitness factors in diabetic patients. The findings of present study are similar where at the start of the study diabetic patients were having reduced fitness due to sedentary life style.^{14, 15}

The cause of why diabetes patients showed impaired musculoskeletal and cardiovascular on various tests is because of sedentary lifestyle and lack of physical activity. Britta W mentioned that the reduction of physical fitness in patients with diabetic might occur due to the decrease of physical activity and other physiological changes resulting from the pathogenesis of diabetes.¹⁶

It is noted that patients with diabetes have lower physical activity due to the apprehension of hypoglycemia incidence during the physical activity, in addition to the skills of patients with diabetes to carry out such examinations are lower than subjects without diabetes.^{17, 18}

Considering the balance work in pre and post sessions after 6 months of training more coordinated activity was observed in patients which was in agreement with work of Timar et al. they evaluate the balance in 89 male patients with type 2 diabetic having to mean age 61 years by single leg stand test (SLS). They found that SLS time is decreased with diabetic neuropathic patients than diabetic without overt neuropathy.^{10, 19}

The functional capacity was investigated by Olufemi et al., in thirty patients with diabetes type II and compared to thirty age matching control subjects. Patients with diabetes had lower values of the Jump-stretch and handgrip which found to improve after training in present study.¹⁴ This also supported by previous work whose study handgrip strength, which is important parameter of hand function, for 76 subjects with Diabetes type 2 Mellitus in a case control study.¹³

Vertical Jump can be used for the assessment of performance and musculoskeletal activities. Earlier studies reported the relationship between the vertical jump and the anthropometric factors. Coaches and researchers have used the vertical jump as a method for evaluating physical fitness of the lower extremities. The test is valid and reliable for male and female, and all ages. In this study, the results of the VR test outcomes were decreased in diabetic subjects in pre test session which were found to improve in post test session.^{20, 21}

Endurance is an essential component of physical fitness. Our patients with type 2 diabetes had lower test values than post training session for the modified push up test, suggesting that endurance is decreased in these patients also. Boshra et al., who found a similar results with decrease in endurance capabilities.²² The development of diabetes mellitus may combine some neuromuscular and vascular deterioration. However, Tekade A found that these changes can be improved after muscle endurance and performance training.²³

In the current study maximum aerobic capacity was evaluated by using the 6MWT, for estimation of maximum oxygen consumption VO₂max which is non-expensive and straight forward methods to determine the maximal aerobic power, especially when the gas analysis is impractical or unavailable. The results of Robert et al. support it., that concluded that the general equation could be used to accurately estimate VO₂max from mean 6MWT among a

group of patients. The more patient characteristics, the more ability for estimation of VO₂max and more of variability.¹²

Conclusion

This study found that cardiopulmonary fitness, strength, balance, endurance, motor, and musculoskeletal system fitness are lower in patients with diabetes type 2 at the start of the study in pre training session and found to be improved after 6 months of exercise. It is the known fact that Diabetic cannot be cured but by improvement of lifestyle and bit of exercise can improve the quality of life which can prevent or delay the complications caused by the disease. Effects of these physical training were assessed after 6 months from the onset of the program using ALPHA FIT test which has clearly demarcated the improvement in physical activity of the patients along with good glycemic control. The ALPHA-FIT test battery is easy and useful method for assessment of physical fitness for patients with diabetes type 2. The battery also helps to the detection of the individual needs of exercise type and pattern that contribute to better control of diabetic and improve the physical status. Hence larger scale studied to be implemented all over the country to evaluate the actual outcome over the Diabetic patients which may be implemented as national health program for Diabetic control.

References:

1. American Diabetes Association. Standards of medical care in diabetes. *Diab. Care.* 2017;40(Suppl.1):S1–S135.
2. William H, Thomas D, James D, et al. Standards of Medical Care in Diabetes. *Diab. Care.* 2016; 39(Sup- pl.1):S1-S112.
3. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. *Indian J Ophthalmol* 2021;69:2932-8.
4. Guariguata L, Whiting D, Weil C, et al. The International Diabetes Federation diabetes atlas methodology for estimating global and national prevalence of diabetes in adults. *Diabetes Res Clin Pract.* 2011;94:322–32.
5. Albache N, AlAli R, Rastam S, et al. Epidemiology of Type 2 diabetes mellitus in Aleppo, Syria. *J Diabetes.* 2010;2(2):85–91.
6. Vanhees L, Lefevre J, Philippaerts R, et al. How to assess physical activity? How to assess physical fitness? *Eur J Cardiovasc Prev Rehabil.* 2005; 12:102–114.
7. Fitness for Health: The ALPHA-FIT test battery for adults aged 18-69 Tester's Manual provisional hand- book. Published by European Union, DG SANCO, and the UKK Institute for health promotion research, tampere, FINLAND. Cited form: www.ukkinstituutti.fi. Cited on 11.01.2022
8. Albright A, Franz M, Hornsby G, et al. American College of Sports Medicine. Position Stand: exercise and type 2 diabetes. *Med Sci Sports Exerc* 2000;32(7):1345–60
9. American Diabetes Association. Physical activity/exercise and diabetes. *Diabetes Care* 2004;27(90001):S58–S62
10. Timar B, Timar R, Gaiță L, et al. The impact of diabetic neuropathy on balance and on the risk of falls in patients with type 2 diabetes mellitus: A cross-sectional study. *PLOS One Journal.* 2016;27(4):1-11.
11. Fogelhom M, Malmberg J, Santtila M, et al. Waist circumference and BMI are independently associated with the variation of cardio-respiratory and neuromuscular fitness in young men. *International journal of obesity.* 2006;30:962-969.
12. Robert R, Jayasimha M, Istvan W, et al. The six minute walk test accurately estimates mean peak oxygen uptake. *BMC Pulmonary Medicine.* 2010;10:31.

13. Ari M, Jaana S, Harri S, et al. Six-minute walk test: a tool for predicting maximal aerobic power (VO₂ max) in healthy adults. *Clin Physiol Funct Imaging*. 2018;1- 8. doi: 10.1111/cpf.12525.
14. Olufemi O, Olatunde O, Kolawole O, et al. Physical activity among type-2 diabetic adult Nigerians. *Annals of African Medicine*. 2014; 13(4):189-194.
15. Mehtap O, Sevinc B, Ayse O. Evaluation of physical fitness in patients with type 2 diabetes mellitus. *Diabetes Research and Clinical Practice*. 2003; 60:171- 176.
16. Britta W, Barbara E, Martin T, et al. Type 2 diabetes is associated with lower cardiorespiratory fitness independent of pulmonary function in severe obesity. *Exp Clin Endocrinol Diabetes*. 2017;125(5): 301-306.
17. Sheri C, Ronald S, Bo Fernhall, et al. Exercise and Type 2 Diabetes. *Diabetes Care*. 2010; 33(12): e147 - e167.
18. Sigal J, Kenny P, Wasserman H, et al. Physical activity/ exercise and type 2 diabetes: a consensus statement from the American Diabetes Association. *Diabetes Care*. 2006;29(6):1433–8.
19. Dixon J, Knight T, Binns E, et al. Clinical measures of balance in people with type two diabetes: A systematic literature review. *Gait Posture*. 2017;58:325-332.
20. M.K. Seyab. Outcomes of physical fitness for young males with type ii diabetes in KSA. *Int J Physiother*. 2019; 6(4): 106-111. DOI:10.15621/ijphy/2019/v6i4/185411
21. Cetinus E, Buyukbese A, Uzel M, et al. Hand grip strength in patients with type 2 diabetes mellitus. *Diabetes Res Clin Pract*. 2005;70(3):278-86.
22. Boshra H, Farid B, Mohammad T. The comparison of muscle strength and short-term endurance in the different periods of type 2 diabetes. *Journal of Diabetes & Metabolic Disorders*. 2014;13(22):1-10.
23. Tekade Avinash, Gupta Yogesh. Cross sectional analytical study of effects of resistance training on improvement of cardiovascular endurance, flexibility and muscular endurance in adults. *International Journal of Physiology*. Nov-2019; 7(4): 40-45. DOI:10.5958/2320-608X.2019.00134.3