

Physical fitness in newly diagnosed type-2 Diabetics – A cross sectional study

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Abstract

Background : India leads the world with largest number of diabetic patients . India the “diabetes capital of the world “ is home to estimated 46 million people and predicted to be 79.4 million by the year 2030.

Aims & Objectives: The objective of the study was to compare the maximal aerobic capacity, muscle strength, body composition, body fat distribution in newly diagnosed type 2 diabetic patients with those of healthy controls.

Methods: 50 patients with newly diagnosed type 2 diabetes and 50 controls were included in the study. Maximal aerobic capacity, fasting and post meal blood sugar, glycated hemoglobin, body fat percentage, waist to hip ratio, hand grip strength was studied in both groups.

Result: Maximal aerobic capacity, muscle strength, lean body mass was significantly lower in newly diagnosed type – 2 diabetics than control and body fat and central obesity was significantly higher in newly diagnosed type-2 diabetics . The fasting blood sugar and glycated hemoglobin showed negative correlation with maximal aerobic capacity, muscle strength. While Body fat and waist hip ratio was positively correlated with fasting blood sugar and glycated hemoglobin

Keywords: Newly diagnosed type-2 diabetes, cardio respiratory fitness, muscle strength, body fat, lean body mass.

Introduction

Type-2 diabetes mellitus has reached epidemic proportion World Wide and is associated with obesity and metabolic and cardio vascular disease (1). There are several studies demonstrating the role of physical inactivity in the etiology as well as the beneficial effects of exercise in both the prevention and treatment of type-2 diabetes and its related morbidity (2) physical inactivity is an important modifiable life style risk factor associated with hyperglycemia, hypertension, dyslipidemia, and risk of developing cardiovascular disease in both healthy individuals and those with type-2 diabetes. A sedentary person may become even more metabolically unfit over the years therefore various forms of physical activity may be necessary to short circuit unhealthy molecular signals causing metabolic disease (3).

Health related physical fitness includes maximal aerobic capacity (VO₂ max), muscle strength, body composition parameters. Identifying which health related physical fitness parameters are impaired in patients with newly diagnosed type-2 diabetes could contribute to the development of more beneficial physical rehabilitation strategies.

The aim of this study was to investigate health related physical fitness parameters such as maximal aerobic capacity, muscle strength, body composition and body fat distribution in newly diagnosed type-2 diabetics and compared with healthy controls.

Material And Method

The study was designed as a comparative association analysis between newly diagnosed type-2 diabetics and healthy controls regarding physical fitness and anthropometric parameters. The study protocol was approved by ethics committee. Written informed consent was taken from all participants. Total 100 subjects were studied. 50 newly diagnosed (non treated) 40-50 years old type-2 diabetes who were referred from department of medicine depending on their clinical presentation and diagnosis included in study. The patients were considered to have type-2 diabetes mellitus e.g.: Fasting plasma glucose level was ≥ 126 mg/dL and post meal blood glucose ≥ 200 mg/dL or random plasma glucose ≥ 200 mg/dL. The value of HbA1c was $\geq 6.5\%$ in addition to hyperglycemia symptoms (4).

The healthy non-diabetic controls were recruited randomly from general population. Both groups were equally sedentary, matched for age and gender.

No formal diet or life style advice and anti diabetic medicine was given before study enrollment.

Exclusion criteria – Patients with Acute infection, Dehydration, Cardio pulmonary and renal disease, Malignancy, Beta blocker users, Musculoskeletal disorders, Psychiatric diseases, Other metabolic diseases.

Anthropometric Measurements

Standing height was recorded in centimeters with bare feet and weight was recorded with Krups weighing machine in light clothing. BMI was calculated as body weight in kilograms divided by square of height in meters. Waist circumference was measured at the level of umbilicus and hip circumference was measured at maximum protrusion of hip. Waist to hip ratio was calculated

Body composition parameters were determined with a biometric impedance analysis (BIA) system Bodystat.

The basic principle of BIA procedure is that the volume of fat free tissue in the body is proportional to the electrical conductivity of the body (5). The participants were instructed to avoid eating or drinking 4 hours, using diuretic for 7 days, participating in strenuous exercise for 24 hours and consuming alcohol for 48 hours prior to test procedure (6,7). The body fat percentage and lean body mass was determined.

Fasting and post meal blood sugar was estimated by semi auto analyzer Transia Erba, Cam-5 Plus. Glycated hemoglobin (HbA1c) was estimated by cation exchange resin method.

The maximum volume of oxygen consumed to produce energy was estimated by Astrand test protocol. A valid submaximal exercise test for estimating VO_2 max. (aerobic exercise capacity or cardio respiratory fitness) (8).

Handgrip strength was measured with a digital dynamometer. The patients were asked to hold dynamometer parallel to the side of body and squeeze the dynamometer as hard as possible while taking care not to hold breath (Valsalva maneuver). The test was repeated 3 times with each hand and highest of three scores was recorded (9).

Statistical Analysis

The data was analyzed using SPSS version 17.0 software. Difference between group was determined by student 't' test. The correlation coefficient was analyzed by Pearson's correlation test.

Results

Newly diagnosed type 2 diabetics and controls were age matched. The mean HbA1c % values was 8.41 ± 0.45 in newly diagnosed type-2 diabetics and 5.10 ± 0.73 in controls. Fasting and post prandial blood sugar, glycated hemoglobin was significantly higher in type 2 diabetics than controls. Body mass index, body fat %, abdominal

circumference, waist circumference, hip circumference, waist hip ratio was significantly higher in newly diagnosed type 2 diabetics.

Lean body mass, maximal aerobic capacity and muscle strength was significantly less in type 2 diabetics. The fasting blood sugar and glycated hemoglobin showed positive correlation with body fat percentage, waist hip ratio and negative correlation with maximal aerobic capacity, right and left hand grip strength in newly diagnosed type 2 diabetics.

Table 1: Body composition, Blood sugar, Glycated Hemoglobin, Vo2 max and Hand grip strength in newly diagnosed type -2 Diabetics and control

Parameters	Newly diagnosed type-2 diabetes	Control	P value
Age (years)	48.2 ± 6.7	48.4 ± 5.7	> 0.05
BMI (kg/m ²)	26.46 ± 1.3	24.98 ± 1.2	< 0.05
Body fat (%)	36.8 ± 7.7	33.5 ± 6.4	< 0.05
Lean body mass (kg)	49.8 ± 7.5	53.9 ± 7.9	< 0.05
Abdominal circumference (cm)	104.0 ± 8.9	98.9 ± 9.2	< 0.05
Waist circumference (cm)	98.05 ± 5.50	82.05 ± 6.8	< 0.05
Hip circumference (cm)	110.75 ± 4.0	102.04 ± 3.5	< 0.05
Waist hip ratio	9.8 ± 0.05	8.2 ± 0.04	< 0.05
Blood sugar fasting (mg/dL)	140 ± 22.5	93 ± 15.6	< 0.05

Blood sugar (post meal) (mg/dL)	255 ± 24.5	120 ± 20.6	< 0.05
Glycated Hemoglobin (%)	8.41 ± 0.45	5.10 ± 0.73	< 0.05
VO2 max (liter/min)	1.74 ± 0.43	2.36 ± 0.50	< 0.05
Right Hand grip strength (kg)	37.0 ± 5.5	43.2 ± 6.7	< 0.05
Left hand grip strength (kg)	36.3 ± 7.1	40.3 ± 6.6	< 0.05

Table 2 : The correlation of fasting blood sugar with Body fat %, Waist hip ratio, Vo2 max and Hand grip strength in newly diagnosed type -2 diabetics

Parameter	r value	P Value
Body fat %	0.243	P < 0.05
Waist hip ratio	0.436	P < 0.05
VO2 max. lit/min.	- 0.482	P < 0.05
Right hand grip strength (kg)	-0.259	P < 0.05
Left hand grip strength (kg)	-0.257	P < 0.05

Table 3: The correlation of glycated Hemoglobin with Body fat %, Waist hip ratio, Vo2 max and Hand grip strength in newly diagnosed type -2 diabetics

Parameter	R value	P value
Body fat %	0.451	< 0.05
Waist hip ratio	0.3491	< 0.05
Vo2 max (L/min)	-0.3631	< 0.05
Rt hand grip strength (Kg)	-0.353	< 0.05
Lt hand grip strength (Kg)	-0.363	< 0.05

Discussion

None of the patient reported problem during strength or aerobic exercise test. The epidemic of overweight and obesity has caused a dramatic increase in the number of

individuals with metabolic abnormalities and premature cardiovascular disease (9). Daniel et al found that sedentary diabetes had higher waist circumference, waist to hip ratio and worse health related quality of life.(10)

The VO₂ max. is considered to be the gold standard for the evaluation of cardio respiratory. Fitness or physical functional capacity (11).

Oz dirone et al. evaluated body composition, cardio pulmonary musculoskeletal and motor fitness level in 30 patients with type 2 diabetes and 30 healthy non diabetic controls matched for BMI and age. They found that body fat percentage was higher and VO₂ max. and hand grip strength was lower in diabetics as compared to control group.(12)

The skeletal muscle mass is a large part of the lean body mass impaired aerobic exercise capacity and whole body strength might lead to disease muscle mass. Both aerobic resistance training are important for individual with diabetes.(13)

Kim et al. suggested that BMI and central obesity are good predictor of type 2 diabetes risk in Korean. (14)

Kai Zu et al divided total of 4870 Japanese type-2 diabetes patient into eight groups according to their leisure time and physical activity. They found that leisure time physical activity was dose dependently associated with BMI and waist circumference. (15)

Wei et al. found that cardio respiratory fitness is significantly associated with impaired fasting glucose and type-2 diabetes as well as independent predictor of all cause mortality in men with type-2 diabetes .(16)

Eriksson and Lindgarned showed progressive decrease at VO₂ max. as glucose regulation declines from normal to impaired tolerance and type 2 diabetes.(17)

Kaplan et al. (18) concluded that insulin plays an important role in the regulation of mitochondrial anion transporter function during krebs cycle. Oxygen

consumption for oxidation of Acetyl CoA produced by glycolysis. The abnormality could be earlier impairment of insulin sensitivity or low number of mitochondria in diabetes explains altered consumption of glucose and oxygen which may impact an individual ability to achieve an acceptable fitness level and consequently have low VO₂ max.(18).

Positive correlation of fasting blood sugar and glycated hemoglobin (HbA1c) with fat percentage, waist hip ratio and negative correlation with maximal aerobic capacity and hand grip strength was found in newly diagnosed type – 2 diabetics

Decreased maximal aerobic capacity, hand grip strength and increased central obesity, fat mass is among the earliest indicators for type- 2 diabetes mellitus therefore an important risk factor for disease progression.

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