Original Article

Anthropometry and physical fitness in individuals with family history of type-2 diabetes mellitus: A comparative study

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ABSTRACT

Context: The risk of becoming a diabetic for an individual with a positive family history of diabetes increases by two- to fourfold. **Aim:** To record the anthropometric indices and the physical fitness in individuals with family history of type-2 diabetes mellitus and compare these results with those of controls. **Settings and Design:** This is a comparative study done in the department of physiology. **Materials and Methods:** Thirty-two apparently healthy medical students with family history of type-2 Diabetes Mellitus were chosen for the study and matched with equal number of controls. Anthropometric measurements (height, weight, waist circumference, hip circumference, thigh circumference, upper segment and lower segment) were recorded. Body mass index (BMI), waist–hip ratio (WHR), waist–thigh ratio (WTR), and upper to lower segment ratio (US/LS ratio) were calculated. Blood pressure and heart rate were measured. Physical fitness was evaluated using Queen's College step test protocol. Rate Pressure Product (RPP) and Physical Fitness Index (PFI) were calculated before and after exercise. **Statistical Analysis:** Statistical analysis was done using SPSS software. **Results:** BMI, WHR, US/LS ratio, and RPP at rest were significantly higher ($P < 0.05$), whereas WTR, PFI, and RPP after exercise lower ($P > 0.05$) in cases as compared to controls. **Conclusions:** It can be concluded that apparently healthy individuals with family history of type-2 diabetes mellitus have higher anthropometric values and lower physical fitness than the controls.

Key words: Anthropometry, family history of type-2 diabetes mellitus, physical fitness index, queen's college step test, rate pressure product

INTRODUCTION

India is one of the highly populated countries and is now leading with other Western countries in having increased number of people suffering from noncommunicable diseases, such as cardiovascular disorders and type-2 Diabetes Mellitus, which are the major determinants of morbidity and mortality. The risk of becoming a diabetic for an individual with a positive family history of diabetes increases by two- to fourfold an offspring's chance and individuals with a positive family history of diabetes have higher body mass index (BMI) than controls.[1] Obesity and body fat distribution,[2] lifestyle,[3] impaired glucose tolerance (IGT), and a family history of type-2 Diabetes Mellitus,[4,5] represent risk factors for type-2 Diabetes Mellitus. First-degree relatives of patients with type-2 Diabetes Mellitus frequently show abnormal glucose tolerance and share several metabolic abnormalities of the full blown disease and have a 30%–40% risk of developing type-2 Diabetes Mellitus themselves.[5] Simple anthropometrical measurements have been used as surrogate measurements of obesity and have more practical value in both clinical practice and for large-scale epidemiological studies.[6] BMI, which relates weight to height, is a simple measure of

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body size. Waist circumference and waist–hip ratio (WHR) are alternatives to BMI. Waist circumference is the best simple measure of both intra-abdominal fat mass and total fat.[7,8] A larger hip circumference is associated with a lower prevalence of self-reported type-2 diabetes and lower fasting glucose concentrations, independently of BMI and waist circumference.[9,10] Individuals with a family history of diabetes have higher WHR.[11] It is a well-known fact that physical activities are less in obese individuals, and obesity is one of the important and most common risk factors of type-2 diabetes mellitus. Several studies have identified a higher heart rate as well as blood pressure as a key component of metabolic syndrome.[12] However, there are no studies relating anthropometry and cardiorespiratory fitness in children whose parents are suffering from type-2 diabetes mellitus. The present study is aimed to compare the anthropometry and physical fitness in individuals with a family history of type-2 diabetes mellitus.

MATERIALS AND METHODS

Materials
The study was done on 32 apparently healthy medical students of 1st year, SNMC, Bagalkot, in the age group of 18–20 years. Family history of type-2 diabetes mellitus was enquired. Controls were selected from the same age group with no family history of type-2 diabetes mellitus. Informed consent was obtained from all the participants and ethical approval for the study was obtained from the local ethical committee.

Anthropometric measurements
Weight and height were measured while subjects were barefoot and wearing light clothes only. Weight was measured to the nearest 0.1 kg using a digital weight recorder. Height was measured to the nearest 0.1 cm using a wall fixed stadiometer. BMI was evaluated as weight divided by height squared (kg/m²). Waist circumference was measured at a level midway between the lowest rib margin and the iliac crest in a horizontal plane using a steel measuring tape. Hip circumference was measured at the widest point over the buttocks. Thigh circumference was measured directly below the gluteal fold in the left leg.[13] WHR was calculated as waist circumference divided by hip circumference and WTR was calculated as waist circumference divided by thigh circumference. Lower segment was measured from the pubic symphysis to the plantar surface of the foot and upper segment was calculated by subtracting the lower segment measurements from the height.

Assessment of physical fitness
Resting blood pressure and heart rate were measured in

sitting position in the left upper arm after the participant had rested for at least 15 min, with digital BP recorder (*Braun Company*). Then the subject was made to exercise for 3 min according to Queen's College Step Test protocol.[14] Blood pressure and heart rate were recorded immediately after exercise. Rate Pressure Product was determined as the product of heart rate and systolic blood pressure divided by 1000, at rest and immediately after exercise.

Physical Fitness Index[15] was calculated by

$$\frac{\text{Duration of exercise in seconds}}{5.5 \times \text{heart rate (1-1.3 min after exercise)}} \times 100$$

Statistical analysis
Statistical analysis between cases and controls was done by unpaired *t*-test for parameters, such as BMI, WHR, WTR, US/LS, PFI, and RPP, using SPSS software (version 15.0).

RESULTS

The results are expressed as mean ± standard deviation. The mean age and the distribution of cases and controls with respect to gender are shown in Table 1. Table 2 and Figure 1 show the various anthropometric indices among cases and controls. There is a significant increase ($P < 0.05$) in the BMI, WHR, and US/LS ratio in cases, whereas WTR was not significant ($P > 0.05$). The anthropometric values are high in apparently healthy individuals with a family history of type-2 Diabetes Mellitus than in the controls.

The individuals with a family history of type-2 Diabetes Mellitus have lower physical fitness index than the controls [Table 3]. The resting rate pressure product (RPP) was more in cases than in controls and increase in RPP after exercise was less in cases [Table 4, Figure 2].

Table 1: Distribution of cases and controls

	Cases	Controls
Mean age (years)	18.56 ± 1.6	18.8 ± 1.9
Males	17	18
Females	15	14

Table 2: Anthropometric indices

Anthropometric indices	Cases (n=32)	Controls (n=32)	t value	P value
BMI	23.7 ± 5.2	19.6 ± 3.79	3.52	< 0.05*
WHR	0.84 ± 0.08	0.80 ± 0.06	2.27	< 0.05*
WTR	1.47 ± 0.195	1.43 ± 0.141	1	> 0.05
US/LS	0.69 ± 0.079	0.74 ± 0.048	3.06	< 0.05*

BMI: Body mass index, WHR: Waist–hip ratio, WTR: Waist–thigh ratio, US/LS: Upper to lower segment ratio
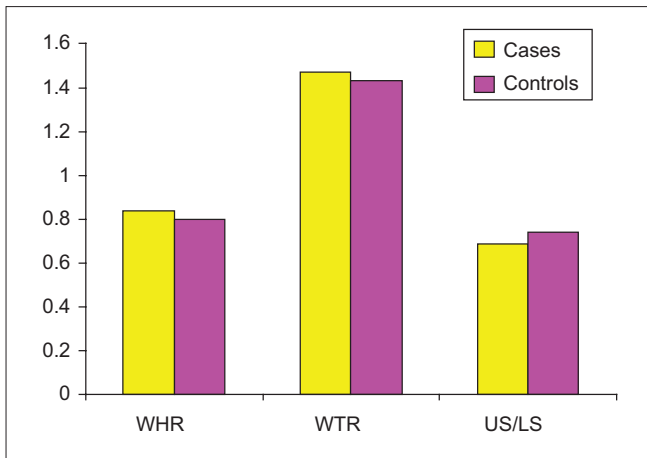
Figure 1: Anthropometric indices

Table 3: Physical fitness index

Cardiovascular index	Cases (n = 32)	Controls (n=32)	t Value	P value
PFI	61.32 ± 2.16	64.18 ± 1.88	5.72	< 0.05*

PFI: Physical fitness index

Table 4: Rate pressure product

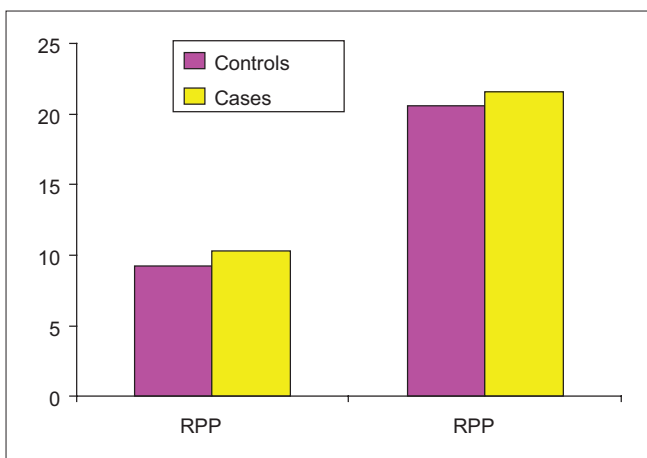| Cardiovascular index	Controls (n = 32)	Cases (n = 32)	t Value	P value
RPP (resting)	9.26 ± 1.48	10.32 ± 1.52	2.8	<0.05*
RPP (after exercise)	20.61 ± 3.81	21.58 ± 3.44	1.06	>0.05
Mean difference	11.34	11.25		0.00**
t Value	17.5	21.7		

RPP: Rate pressure product

Figure 2: Rate pressure product before and after exercise

Discussion

In a prospective study of 14 years by Sawada *et al*.,[16] in Japanese men, it was reported that a low cardiorespiratory fitness is associated with a higher risk of developing type-2 diabetes. Wei *et al*.[17] found a significant inverse relationship between cardiorespiratory fitness (measured by treadmill time) and the incidence of type-2 diabetes. Anthropometric indices in obese and type-2 diabetics are gaining lot of importance at present because of its feasibility and accuracy. There are no studies till date regarding the anthropometry and cardiovascular fitness in offsprings of type-2 diabetics who are the probable future sufferers of either diabetes or cardiovascular disorders or obesity. The present study reveals a lower physical fitness in individuals with a family history of diabetes, which could be due to their higher anthropometric values, and this could also predispose to type-2 diabetes.

The lesser thigh circumference in cases goes in favor of type-2 diabetes, which was studied and proved by Snijder *et al*.,[13] wherein it was found that there was a better glucose tolerance with larger thigh and hip circumference.

The limitations of this study were that we did not consider 1° relatives or 2° relatives in particular. Grossly their family history of type-2 diabetes was taken into consideration. This study is a pilot study with a small sample considering only the 1st MBBS students of SNMC, Bagalkot. The study needs to be extended to the entire population of Bagalkot urban, which is our future project.

It can be concluded that apparently healthy individuals with a family history of type-2 Diabetes Mellitus have higher anthropometric values and lower physical fitness than the controls. Hence, a check on these parameters may help in controlling the predisposing factors and therefore diabetes.

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