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Sociodemographic, anthropometric and physical fitness parameters in healthy individuals with and without family history of Hypertension and/ or Type 2 Diabetes Mellitus

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ABSTRACT
Hypertension and Type 2 Diabetes Mellitus are serious health problems which are on the rise world-wide. A positive family history is a key risk factor for having these diseases later in life. The present study was attempted to compare anthropometric and physical fitness parameters in healthy individuals with and without family history of hypertension and/ or diabetes and to examine if the magnitude of relevant associations vary with sociodemographic characteristics. The study was conducted on 177 healthy subjects of both sexes. Height, weight, waist circumference and hip circumference were recorded. Body mass index (BMI), waist to hip ratio (WHR), waist to height ratio (WHtR) were calculated. Information regarding socio-economic status and family history of hypertension and / or type 2 diabetes mellitus was obtained. Subjects were made to exercise using modified Harvard step test protocol. Physical fitness index (PFI) was calculated from the total duration of stepping exercise and the post exercise pulse count during recovery. The results were analysed using unpaired students t-test and one way ANOVA to study association of family history with BMI, WHR, WHtR, PFI and socio-economic status. Observations showed that most subjects with a positive family history had significantly higher BMI, WHR, WHtR and lower PFI as compared to those without a positive family history. It can be concluded that apparently healthy individuals with a positive family history have higher anthropometric values and lower physical fitness, therefore at risk for developing these diseases later in life.
Keywords: *Anthropometry, Physical fitness index, family history, hypertension, type 2 diabetes mellitus.*

INTRODUCTION

Hypertension and Type 2 Diabetes Mellitus are two chronic non-communicable conditions which are co-morbidities of obesity, often coexist and pose a major public health challenge due to their role in the causation of Cardiovascular disease (CVD). In India the burden of CVD has increased many folds in recent times due to shift towards a westernized diet and lifestyle and increasing mean age of population. It is now the leading cause of death, accounting for 24% of total deaths in the country [(1)]. The risk of developing CVD in adult

life is related to a positive family history of type 2 diabetes mellitus and/or hypertension and to the prevalence of risk factors in childhood [2]. Physical fitness has also been demonstrated to be a powerful predictor of low rates of subsequent CVD [3]. Physical fitness is a multidimensional concept that has been defined as a set of elements that people acquire relating to the capability to perform physical activity [4]. The physical fitness index (PFI) measures the physical fitness for muscular work and the ability to recover from the work.

There is abundant epidemiological evidence that socio-demographic factors and anthropometric variables are directly and consistently associated with cardiovascular morbidity, mortality and levels of cardiovascular risk factors in developing countries like India [5]. Simple anthropometric measurements like Body Mass Index (BMI), Waist-to- Hip Ratio (WHR), Waist- to- Height Ratio (WHtR), Skin fold thickness have been used in a vast number of studies to see their association with adverse CVD risk factors [6]. However there are very few systematic studies comparing socio-demographic, anthropometric and physical fitness parameters in healthy individuals with and without family history of hypertension and/or type 2 diabetes mellitus.

OBJECTIVES

The objectives of the present study were

1) To explore and compare BMI, WHR, WHtR and PFI in healthy individuals with and without family history of hypertension and/or type 2 diabetes mellitus.
2) To examine if the magnitudes of relevant associations vary with socio-demographic profile.

METHODOLOGY

The study sample consisted of 196 students of both sexes in the age group of 18-22 years studying in first and second year MBBS. After an overnight fast, blood samples were collected for blood sugar estimation. Systolic and diastolic brachial blood pressures were measured with standardized aneroid sphygmomanometer and stethoscope, following the recommendations of American Heart Association. Students with fasting blood sugar >110mg/dl and blood pressure >120/80 mm Hg were excluded from the study. History of hypertension and type 2 diabetes mellitus in first degree relatives was enquired.

The Socioeconomic status (SES) of the students was measured by using a modified version of Kuppuswamy's socio-economic status scale for the year 2015[7]. The scale includes the education, occupation of the head of family and income per month from all sources. Accordingly students were classified into upper, upper middle, lower middle, upper lower and lower class.

Anthropometric Measurements were taken in the standing position using standard anthropometric techniques [8]. The participants wore light clothes without shoes. Weight was measured on an electronic personal scale to the nearest 0.1Kg and height with a stadiometer to the nearest 0.1cm. BMI was calculated as weight/height^2 (Kg/m^2). Waist circumference was measured half way between the lower ribs and the iliac crest in a horizontal plane while hip circumference was measured at the level of greater trochanters. WHR was calculated as WC/HC and WHtR as WC/Height.

Physical fitness index was calculated by using modified Harvard Step Test. Subjects were required to step up and down on a 20 inches high platform at a rate of 30 steps per minute for 5 minutes or until exhaustion. Exhaustion is defined as when the subject cannot maintain the stepping rate for 15 seconds. Pulse rate was counted between 1 -1.5 minutes for 30 seconds after completion of the test [9].

PFI score = 100X test duration in seconds/5.5 X pulse count between 1 and 1.5 minutes

PFI score below 50 is interpreted as poor, between 50-80 as average and above 80 as good [10].

STATISTICAL ANALYSIS: The information collected was converted into a computer based

spreadsheet using Microsoft Excel software. Statistical analysis of the data was done on the SPSS software 17.0. Simple descriptive tables describing socio-demographic profile of study subjects were made. Univariate association of gender with absence or presence of family history of diabetes and/or hypertension was ascertained using chi-square. Socio-economic status was re-categorised into two categories namely 'Upper' and 'Others' wherein others comprised of upper lower, lower middle and upper middle into 'Others'. Unpaired students t-test was applied to study the association between socio-economic status and family history of diabetes and hypertension. One way ANOVA was applied to study association of family history with BMI, WHR, WHtR and PFI and Games Howell post hoc test was applied to study within group differences among the four groups (on the basis of absence or presence of family history of diabetes and hypertension) with BMI, WHR, WHtR and PFI. p value of 0.05 was taken to be statistically significant.

RESULTS

None of the students were found to be diabetic, however two students were found to be hypertensive and hence excluded from the study. Eighteen students dropped out of the study for personal reasons. Data has been obtained from 177 students. The subjects were further subdivided into following four groups-

Group I- No family history of diabetes mellitus / hypertension

Group II- Positive family history of diabetes mellitus only

Group III- Positive family history of hypertension only

Group IV- Positive family history of both diabetes mellitus and hypertension

Distribution of subjects according to gender, socio-economic status and presence or absence of family history of diabetes and/or hypertension is shown in Table 1.

Table 2 reports the means and standard deviation of anthropometric parameters and PFI across the four groups. It can be seen that the average BMI, WHR and WHtR are higher and PFI lower in subjects with positive family history, particularly those with family history of both Hypertension and Diabetes Mellitus.

Assumption of equal variances was violated as shown by Levene's test ($p = 0.037$), therefore, Games Howell post hoc test was used to determine differences between the groups. Table 3 shows the pair wise comparison of the four groups in terms of mean anthropometric parameters and PFI. Group 2, 3 and 4 had a higher BMI as compared to group 1 and this was found to be statistically significant.

Groups with family history had a higher mean WHR compared to Group 1 with no family history. However, this difference is statistically significant only between Group 1 and 4 Group 4 had a significantly higher WHR as compared to Group 1. Group 2, 3 and 4 had a higher WHtR as compared to group 1 and this was found to be statistically significant. Group 1 had a significantly higher PFI than other groups.

Table 4 illustrates the differences in anthropometric parameters and PFI between the socio-economic classes. Since there were no subjects in lower class and only 4 subjects in upper lower class, therefore the categories in socio-economic status were collapsed and re-categorized into upper class and others. The mean BMI, WHR, WHtR were found to be higher among those belonging to upper class as compared to others ($t= -1.64, -0.287, -1.30$ respectively) and the mean PFI higher among those belonging to middle and lower classes put together as compared to upper class ($t = 1.81$). However none of the differences was found to be statistically significant.

A positive family history of diabetes and or hypertension was found to be higher among females as compared to males. However, this was not found to be statistically significant ($p = 0.463$) (Table 5).

Table 1: Baseline characteristics of study subjects

Socio-demography	N	Percentage
Gender		
Male	96	54.5
Female	80	45.5
Socio-economic status		
Upper	32	18.2
Upper middle	116	65.9
Lower middle	24	13.6
Upper lower	4	2.3
Family history		
Group 1 (No family history)	134	76.1
Group 2 (Family history of diabetes present)	13	7.4
Group 3 (Family history of hypertension present)	16	9.1
Group 4 (Family history of both diabetes and hypertension present)	13	7.4

Table 2: Means of anthropometric parameters and PFI across the four groups

	Mean ± S.D.			
	Group 1	Group 2	Group 3	Group 4
BMI	21.1 ± 2.42	27.75 ± 4.77	23.76 ± 2.9	31.59 ± 3.38
WHR	0.82 ± 0.047	0.85 ± 0.042	0.84 ± 0.043	0.88 ± 0.059
WHtR	0.45 ± 0.038	0.52 ± 0.035	0.49 ± 0.036	0.58 ± 0.065
PFI	53.77 ± 7.2	46.35 ± 3.5	49.72 ± 4.6	44.6 ± 2.35

Table 3: Pair wise comparison of the four groups on anthropometric parameters and PFI

Dependent variable	Groups		Mean difference	p value
BMI	Group I	Group II	-6.64811	**0.001**
	Group I	Group III	-2.65907	**0.012**
	Group I	Group IV	-10.49349	**0.000**
	Group II	Group III	3.98904	0.07
	Group II	Group IV	-3.84538	0.113
	Group III	Group IV	-7.83442	**0.000**
WHR	Group I	Group II	-0.02714	0.173
	Group I	Group III	-0.01729	0.452
	Group I	Group IV	-0.05714	**0.021**
	Group II	Group III	0.00986	0.925
	Group II	Group IV	-0.03000	0.459
	Group III	Group IV	-0.03986	0.204
WHtR	Group I	Group II	-0.06709	**0.000**
	Group I	Group III	-0.03521	**0.008**
	Group I	Group IV	-0.12863	**0.000**
	Group II	Group III	0.03187	0.10
	Group II	Group IV	-0.06154	**0.034**
	Group III	Group IV	-0.09341	**0.001**
PFI	Group I	Group II	7.41812	**0.000**
	Group I	Group III	4.05038	**0.025**
	Group I	Group IV	9.17120	**0.000**
	Group II	Group III	-3.36774	0.144
	Group II	Group IV	1.75308	0.461
	Group III	Group IV	5.12082	**0.004**

Table 4: Comparison of anthropometric parameters and PFI between the various socio-economic classes

Dependent variable	Socio-economic class	Mean ± S.D.	t statistic	P value
BMI	Upper class	23.96 ± 5.27	-1.64	0.102
	Others	22.31 ± 3.83		
WHR	Upper class	0.83 ± 0.06	-0.287	0.774
	Others	0.82± 0.48		
WHtR	Upper class	0.48± 0.06	-1.30	0.194
	Others	0.47 ± 0.05		
PFI	Upper class	50 ±7.14	1.81	0.071
	Others	52.6 ± 7.16		

Table 5: Association between gender and family history of diabetes mellitus and/or hypertension

	Group 1	Group 2	Group 3	Group 4	Chi-square	p value
Male	77 (80.2%)	7 (7.3%)	7 (7.3%)	5 (5.2%)	2.571	0.463
Female	57 (71.3%)	6 (7.5%)	9 (11.3%)	8 (10%)		

DISCUSSION

Non communicable diseases particularly diabetes mellitus and hypertension, are an important determinant of morbidity and mortality of people all over the world[11]. An increased risk of becoming hypertensive for an individual with a positive family history of hypertension has been estimated to be up to four times higher than average[12]. The risk of becoming diabetic for an individual with a positive family history of type II diabetes mellitus increases by two-to-fourfold [13]. Obesity and body fat distribution are also associated with type II diabetes and hypertension. In the present study we evaluated and compared the extent to which three different anthropometric variables of obesity and PFI are associated with a positive family history of diabetes and/or hypert-ension and with gender and socio-economic class.

A significantly higher BMI, WHR, WHtR in groups II, III, IV as compared to group I is suggestive of increased risk of developing diabetes and hypertension in those with a positive family history of either or both diseases. This is in accord with the results from other studies [14]. The association though significantly strong in all three conditions i.e. positive family history of diabetes alone / hypertension alone / both diabetes and hypertension is strongest when there is a positive family history of both diseases and least strong when there is a positive family history of hypertension alone. Diabetes and hypertension are well connected diseases. In a previous study, Nayak et al have reported an increase in the prevalence of type 2 diabetes with an increase in the severity of hypertension[15]. In contrast, Sande et al in a previous study did not find an increased risk for developing hypertension in those with positive family history of the condition though their adjusted mean blood pressures were higher [16]. A review of studies on the effect of positive family history on blood pressure also concluded that the majority of such studies could not demonstrate a directly increased risk for hypertension[17]. Since hypertension is a relatively late manifestation of the disease process, therefore blood pressure is expected to rise later in life and the prevalence of hypertension would thus be higher among first-degree relatives.

In the present study we also observed that PFI was higher in group I as compared to groups II, III, IV. This could be due to higher anthropometric values in groups II, III, IV. This also reflects that subjects without a positive family history for diabetes / hypertension are physically more fit. In a prospective study of 14 yrs by Sawada et al in Japanese men, it was reported that a low cardiorespiratory fitness (measured by submaximal exercise on cycle ergometer) is associated with a higher risk of developing Type-2 diabetes [18]. Wei et al found a significant inverse

relationship between cardiorespiratory fitness (measured by treadmill time) and the incidence of type 2 diabetes [19].

Abnormal health traits such as high BMI, WHR, WHtR and low PFI present in young age may track into middle age and may lead to many of the noncommunicable lifestyle diseases. The present study revealed that all the studied anthropometric variables were significantly higher and PFI lower in those who had a positive family history of diabetes and/or hypertension. Most of such subjects belonged to upper class. It can be concluded that identifying subjects of upper class with a positive family history for the above diseases and encouraging them to adopt healthier lifestyle habits will serve as a practical and useful approach for public health and preventive medicine.

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