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RESEARCH ARTICLE

Waist-hip ratio and cardiac responses to exercise in young adults with parental history of coronary heart disease

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ABSTRACT

Background: Coronary heart disease (CHD) has become a major health challenge in India in 21st century. Family history is a major risk factor for CHD which strongly predisposes to atherosclerotic process at a younger age. The purpose of the study was to assess whether the parental history of CHD had any influence on waist-hip ratio (WHR) and cardiac responses to exercise in young adults aged 18-30 years. **Aims and Objective:** (1) The aim of the study is to measure the WHR and assess cardiac responses to exercise in young adults with parental history of CHD. (2) To compare the WHR and cardiac responses to exercise with the control group without parental history of CHD. **Materials and Methods:** Comparative study was conducted including 100 individuals with age group of 18-30 years. Study group included 50 individuals with parental history of CHD. Control group included 50 individuals without parental history of CHD. WHR was measured in both groups. Heart rate (HR) and blood pressure (BP) were recorded at rest. As per the Modified Bruce protocol, individuals performed submaximal exercise on treadmill. HR and BP were recorded during exercise and post-exercise recovery. The results were statistically analyzed. **Results:** Control group had excellent WHR (male < 0.85, female < 0.75, $P = 0.05$) than study group. There was no significant change in HR and BP at rest in both groups. During post-exercise recovery, systolic BP was higher 1 min ($P < 0.001$) and 5 min ($P = 0.006$) after exercise in study group. Moreover, HR recovery was delayed ($P < 0.001$) in study group as compared to control group. **Conclusion:** Young adults with parental history of CHD showed increased WHR and delayed recovery of HR and BP after exercise. Awareness has to be created in offspring of CHD patients regarding future risk of CHD. They must be advised to maintain ideal weight and cardiorespiratory fitness by regular physical exercise.

KEY WORDS: Coronary Heart Disease; Exercise; Parental History; Post Exercise Recovery

INTRODUCTION

Non-communicable diseases (NCDs) have become the major health challenge in India. NCDs contribute to around 5.87 million deaths that account for 60% of all deaths in India. Cardiovascular diseases (CVDs) contribute to 45% of all NCDs deaths.[1] Coronary heart disease (CHD) is the largest killer disease in developed countries and its occurrence is increasing in developing countries. The WHO reports that one-fifth of the deaths in India are caused by CHD. In the year 2020, it would account for one-third of all deaths and many of the Indians will be dying young. There are an estimated 45 million patients of CHD in India.[2]

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CHD is a condition in which there is an inadequate supply of blood and oxygen to a portion of the myocardium; it typically occurs when there is an imbalance between myocardial oxygen supply and demand.[3] CHD is a degenerative and

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progressive disease that is known to have its origin from early childhood. CHD occurs at a much younger age in Indians as compared to those in North America and Western Europe, as Indians have smaller coronary blood vessels compared to them.[4] In addition, family history is a major risk factor for CHD which strongly predisposes to atherosclerotic process at younger ages. Other risk factors being hypertension, diabetes mellitus, obesity, abnormal lipids, high fat and energy rich diet, smoking, psychological stress, and physical inactivity.

There is a strong relationship between CHD family history and presence and severity of CHD in relatives, independently from other traditional risk factors, particularly in young adults.[5] Hence, early detection of cardiac dysfunction has to be made in offspring of CHD patients. Identification at younger age those who may be at excessive risk of future CHD offers the possibility of preventing and delaying the disease by altering lifestyle. The purpose of the study was to assess whether the children of CHD patients had increase in waist-hip ratio (WHR) and any changes in cardiac responses to exercise as compared to age- and sex-matched controls without parental history of CHD.

MATERIALS AND METHODS

A comparative study was conducted in Bengaluru including 100 individuals of age group 18-30 years. Ethical clearance was taken from Institutional Research and Ethical Committee of Bangalore Medical College and Research Institute. Study was conducted at life style laboratory, Victoria Hospital campus, BMCRI, Bengaluru. Individuals were chosen based on inclusion exclusion criteria. Study included both males and females of age group 18-30 years. Study group (Group A) included 50 individuals (30 males, 20 females) with parental history of CHD. Control group (Group B) included 50 individuals (30 males, 20 females) without parental history of CHD. Individuals having diabetes, hypertension, hypothyroidism and other comorbidities, musculoskeletal disorders, smokers, alcoholics, pregnancy, and any respiratory pathology were excluded from the study.

Individuals were explained about the study protocol and informed consent was taken. Individuals were asked to avoid caffeine for 3 days. Study was conducted between 10 am and 12 pm in the morning, after a light breakfast at least 2 h before the study. Waist circumference (WC) measured at the midpoint between the iliac crest and the lower margin of the last palpable rib in the mid axillary line.[6] Hip girth measured around the largest circumference of the buttocks, over the minimal clothing, individual standing erect with weight evenly distributed on both feet and legs slightly apart[6] and WHR was calculated. Heart rate (HR) was recorded by radial pulse palpation, systolic blood pressure (SBP), and diastolic BP (DBP) were recorded after 20 min of rest, in sitting posture in all the individuals using sphygmomanometer. Both Group A and Group B performed submaximal exercise on the treadmill as per the Modified Bruce protocol[7] and reached submaximal HR at stage 4 of the protocol. Treadmill was connected to medical emergency clinic pulmonary function test system, which had electronic data systems software for interpretation of electrocardiography (ECG) and ECG was recorded throughout the procedure. HR, SBP, and DBP were noted from the monitor during peak exercise. During post-exercise recovery, HR (noted from the monitor) SBP and DBP was recorded using sphygmomanometer by auscultatory method.

Descriptive and inferential statistical analysis was carried out in the present study. Results on continuous measurements were presented on mean ± standard deviation (minimum-maximum) and results on categorical measurements were presented in n (%). Significance has been assessed at 5% level of significance. Student *t* test (two tailed, independent) was used to find the significance of study parameters on continuous scale between two groups (inter group analysis) on metric parameters. Leven1s test for homogeneity of variance was done to assess the homogeneity of variance. Chi-square/ Fisher exact test has been used to find the significance of study parameters on categorical scale between two or more groups.[8-10] Statistical software used was SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, and Systat 12.0 and R environment version 2.11.1.

RESULTS

The present study was a comparative study consisting of 50 individuals with parental history of CHD (Group A) and 50 individuals without parental history of CHD (Group B). Individuals in both groups were well matched with respect to age ($P = 0.756$) (Table 1) and gender ($P = 1.000$). Table 2 shows Comparison of anthropometric parameters among both groups. 44.2% of individuals in control group had excellent WHR (male <0.85,female <0.75)[11] as compared to 20.0% of individuals in study group ($P = 0.05$). 2% individuals in study group had extremely high WHR (male > 1.00, female >0.90). There was no significant change in HR, SBP, and DBP at rest and during exercise in both groups. During post-exercise recovery, HR was more in study group ($P < 0.001$) as compared to control group, i.e., immediately after cessation of exercise and 1, 2, 3, and 5 min after exercise. HR recovery was faster in control group than study group. SBP was significantly higher in study group as compared to control group, at 1 min ($P < 0.001$) and5 min ($P = 0.006$) after exercise. There was no significant change in DBP in both study group and control group.

DISCUSSION

In our study, we found that the study group had increase in WHR. As per Table 3, Control group had excellent WHR (male <0.85, female <0.75) as compared to study group($P = 0.05$).

Table 1: Age distribution of two groups studied

Age in years	*n* (%)	
	Group A (study group)	Group B (control group)
18-20	15 (30.0)	15 (30.0)
21-25	18 (36.0)	21 (42.0)
26-30	17 (34.0)	14 (28.0)
Total	50 (100.0)	50 (100.0)
Mean±SD	23.30±3.77	23.06±3.94

Samples are age matched with *P*=0.756. SD: Standard deviation

Table 2: Comparison of anthropometric parameters in two groups studied

Anthropometric parameters	Group A (study group)	Group B (control group)	*P*
Height (cm)	160.82±7.19	159.72±6.76	0.432
Weight (kg)	59.86±7.05	57.84±6.17	0.131
BMI (kg/m^2)	23.11±1.95	22.63±1.43	0.166
WC (cm)	73.90±3.22	72.68±5.85	0.200
HG (cm)	87.58±4.45	87.8±5.07	0.818

BMI: Body mass index, WC: Waist circumference, HG: Hip Girth

Table 3: Comparison of WHR in two groups studied

WHR	Group A (%)	Group B (%)
Excellent (male <0.85, female <0.75)	10 (20.0)	22 (44.0)
Good (male: 0.85-0.90; female: 0.75-0.80)	26 (52.0)	19 (38.0)
Average (male: 0.90-0.95; female: 080-0.85)	12 (24.0)	7 (14.0)
High (male: 0.95-1.00; female: 0.85-0.90)	1 (2.0)	2 (4.0)
Extreme (male >1.00, female >0.90)	1 (2.0)	0
Total	50 (100.0)	50 (100.0)
Inference	Excellent WHR is significantly more associated with Group B (44.00%) compared to Group A (20.0%) with *P*=0.050*	

WHR: Waist-hip ratio, *Significant value, *P* = 0.05

2% individuals in study group had extremely high WHR (male >1.00, female >0.90). WHR above 1.0 in men and above 0.9 in women is an independent risk factor for higher incidence of CHD.[12] The advantages of WHR include low measurement error, high precision, and no bias over a wide range of ethnic groups.[13,14] During exercise (Table 4), there were no significant changes in both groups. However, during post-exercise recovery, HR was significantly more in study group ($P < 0.001$) as compared to control group-immediately after cessation of exercise 1, 2, 3, and 5 min after exercise. HR recovery was

Table 4: HR and BP responses in both groups

Parameter	Group A	Group B	*P*
At rest			
HR (bpm)	72.00±3.43	71.28±3.40	0.294
SBP (mm Hg)	118.56±6.62	118.00±6.34	0.667
DBP (mm Hg)	72.8±4.35	73.44±4.52	0.472
During exercise			
HR (bpm)	154.20±3.31	154.06±3.79	0.845
SBP (mm Hg)	153.60±4.12	154.32±4.97	0.432
DBP (mm Hg)	72.32±4.17	72.84±4.39	0.545
After exercise-0 min			
HR (bpm)	142.16±4.9	135.40±5.24	<0.001**
SBP (mm Hg)	144.32±4.11	144.20±4.41	0.888
DBP (mm Hg)	72.4±4.33	73.16±4.61	0.398
1 min after exercise			
HR (bpm)	110.72±13.62	103.00±5.39	<0.001**
SBP (mm Hg)	136.96±4.66	133.56±3.67	<0.001**
DBP (mm Hg)	72.64±4.42	73.12±4.59	0.595
2 min after exercise			
HR (bpm)	97.48±9.14	89.64±4.98	<0.001**
SBP (mm Hg)	130.32±3.51	130.68±3.04	0.585
DBP (mm Hg)	72.6±4.43	73.12±4.59	0.566
3 min after exercise			
HR (bpm)	80.72±8.53	74.80±3.45	<0.001**
SBP (mm Hg)	125.20±4.24	125.48±4.12	0.738
DBP (mm Hg)	72.64±4.42	73.12±4.59	0.595
5 min after exercise			
HR (bpm)	73.36±5.32	70.92±2.66	0.005**
SBP (mm Hg)	121.08±7.16	117.56±5.24	0.006**
DBP (mm Hg)	72.64±4.42	73.12±4.59	0.595

HR: Heart rate, BP: Blood pressure, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, *Significant value, *P* = 0.05

delayed in the study group. SBP was higher in study group as compared to control group, at 1 min (P < 0.001) and 5 min ($P = 0.006$) after exercise. There was no significant change in DBP in both the groups during recovery after exercise.

CHD is a chronic process that begins during childhood and slowly progresses throughout life. Atherosclerosis begins in childhood as deposits of cholesterol and its esters, referred to as fatty streaks, in the intima of large muscular arteries. Moreover, long-range prevention of atherosclerosis and its sequelae by control of the risk factors for adult coronary artery disease should begin in adolescence and young adulthood.[15] Central obesity is more strongly associated with CVD risk than general obesity. The deposition of adipose tissue is associated with systemic inflammation, which has a direct effect on CVD risk.[13]

Our study is similar to study done by Grottol et al. in which they assessed the association between obesity and parental

CHD history. Analyzed data from an on-going, large-scale survey over a period of 11 years from January 1989 to December 1999, it was found that those with positive history of CHD in either parent had higher body mass index (BMI) or a greater risk of being obese than those who reported no parental history.[16]

Our study is in agreement with Gupta et al., they conducted epidemiological study to determine the association of obesity, measured by BMI, WHR, with multiple risk factors in an urban Indian population. Analysis showed significant positive correlation of BMI, WHR with SBP, DBP, fasting blood glucose, and low-density lipoprotein (DL) cholesterol and negative correlation with physical activity and high DL in both men and women with increasing BMI, WC, and WHR, the risk factors increased significantly in both men and women.[17]

We did not find any significant changes during exercise in both groups. Our study differs from study by Treiber et al., which showed individuals with family history of myocardial infarction (MI) had higher HR and higher SBP and DBP during exercise, as compared to those without the family history of MI.[18]

This study is in agreement with study done by Rajalakshmi et al. where the study group showed delay in HR recovery compared to normal group. SBP and DBP was more in study group than normal group during post-exercise recovery. HR recovery (HRR), an important independent risk factor for CVD and mortality[19] is often used in research to study the cardiac autonomic status of an individual. HR recovery is mainly thought to be a function of parasympathetic or vagal reactivation; hence, delayed HR recovery reflects a reduction in vagal tone.[20] Elevated SBP immediately after exercise and during recovery may also reflect the over activity of sympathetic nervous system.[21] Similar results of autonomic imbalance were found in other studies.[22,23]

Resting cardiovascular parameters and cardiac responses to exercise has to be evaluated so as to know the early cardiac involvement in presence of risk factors and for earlier intervention. BP response to exercise testing is useful to assess cardiac status. Our study was conducted on a limited sample over short duration of time. Large scale studies are required to assess the basal autonomic balance in offspring of CHD patients at an early age.

CONCLUSION

We found increased WHR in offspring of CHD patients which in turn leads to altered cardiac responses to exercise suggesting autonomic imbalance. There was delayed recovery of HR and BP that shows over activity of sympathetic system. Awareness has to be created in offspring of CHD regarding risk of having CHD at a young age. They should be advised about the ideal weight management and maintenance of cardiorespiratory fitness by regular physical exercise to prevent or lower the risk of CHD in the future.

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