RESEARCH ARTICLE

Role of Gender and the Waist-Hip Ratio (WHR) on Heart Rate Variability (HRV) in Adolescent Age

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ABSTRACT

Background: The Heart rate variability (HRV) as a measurement of autonomic function assumes great clinical importance. Children are vulnerable during the adolescence since in this period dietary and lifestyle patterns are initiated that have implications for coronary heart disease (CHD) and other morbidity risk in later adult life.

Aims & Objective: This study was devised to correlate HRV with WHR in male and female adolescent school children.

Materials and Methods: 195 school children of both sexes (boys 93 and girls 102) in the adolescent age participated in this study. Their WHR was measured and HRV was recorded during rest, immediately before exercise, 5 minutes and 30 minutes after exercise with deep breathing. On the basis of waist-hip-ratio, these students were divided into lesser group, those having WHR less than the average of the respective groups and more group of those having WHR more than the average.

Results: The result showed that the HRV of girls were more than boys but it was lesser than boys immediately after exercise. In girls with lesser WHR recorded much less than others.

Conclusion: During adolescent age, girls have better parasympathetic control and comparatively during adolescent period, the lean people have better sympathetic activity. This findings is in oppose to adulthood autonomic control where male have better parasympathetic activity and in obese people sympathetic activity is more. The reason for paradoxical autonomic control in adolescent age lies in the onset of secretion of sex hormones during the adolescent period.

KEY WORDS: Adolescent; HRV; Waist-Hip-Ratio; Sympathetic System; Parasympathetic System

INTRODUCTION

The Heart rate variability (HRV) as a measurement of autonomic function at present assumes great clinical importance. Time and frequency domain analyses of heart rate variability (HRV) provide a noninvasive method to evaluate the autonomic regulation of heart rate. A reduced HRV is a powerful and independent predictor of an adverse prognosis in patients with heart disease and in the general population.[1,2]

It is well known that particular patterns of body fat distribution increase coronary heart disease (CHD) risk both in adult & children. Abdominal adiposity ("apple" shape) show a less favorable CHD risk profile than with a gluteal femoral ("pear" shape) fat pattern distribution.[3,4] But some authors have the view that only after the onset of puberty do measurements which estimate visceral fat distribution become an indicator for body fat distribution and associated cardiovascular risks.[5,6] On the other hand, Children are vulnerable during the adolescence since in this period dietary and lifestyle patterns are initiated that have implications for coronary heart disease (CHD) and other morbidity risk in later adult life.[7] Abdominal obesity is evaluated clinically by measuring waist- hip ratio (WHR). Men with WHR of 0.95 or more and women with WHR of 0.85 or more are considered to be at increased cardiovascular risk.[8-10] As there is not enough data available in this regards with children, this study was devised to find out the influence of WHR on Heart Rate Variability (HRV) in evaluating cardiac function.

Objective: This study was devised to correlate HRV with WHR in male and female adolescent school children.

MATERIALS AND METHODS

In this study, 195 school children of 13 to 19 years [93 male and 102 female,) in and around Mangalore, Udupi, Karnataka, India participated voluntarily.

A brief history was elicited and physical examination performed in their institutions and the subjects were advised about the risks and benefits of the procedure. During the study period, the subjects were instructed not to eat or drink caffeinated beverages 3 hours prior to testing. The following data of the students were recorded: age, sex, waist, hip measurement & HRV.[11]

Procedure for HRV Recording

The subject was asked to lie in supine position on a table comfortably in a quiet room with their eyes closed for the purpose of isolating their sensual perception.

After 5-minutes of rest in supine position, ECG (lead II with speed of 25mm/sec) was recorded for five minutes with deep breathing of 5second each for inspiration and expiration (6 cycles/minute).

The subjects were pre-trained to perform an exercise (Harvard-step test exercise) and the students were asked to be ready for exercise. At that time ECG was recorded once again and let them perform the exercise. After they finished the exercise either for 5 minutes or until onset of ischaemic response whichever was earlier; their ECG was recorded for a minute each 5 minutes and 30 minutes after stopping exercise in the recovery phase.

Heart Rate Variability (HRV) was calculated by measuring RR interval manually with a scaled calliper to the nearest 0.5mm.The measurement was checked by another observer so as to minimise the errors. Heart rate variability was calculated by using the formula 1500/ shortest RR interval minus 1500/longest RR interval.

Statistical Analysis

The data were expressed as mean ± SE. A paired t- test was used for the dependent variables. An unpaired 't' test was done for normally distributed variables. P value<0.05 was considered significant.

RESULTS

Group division on the basis of Waist-Hip Ratio (Table 1)

Table-1: Waist-Hip Ratio based Groupings of Subjects

Subjects	WHR - Mean	WHR < mean	WHR >mean
All students	0.82 = T group (n=195)	T_1 group (n=96)	T_2 group (n=93)
Boys	0.85 = M group (n=93)	M_1 group (n=45)	M_2 group (n=43)
Girls	0.78 = F group (n=102)	F_1 group (n=52)	F_2 group (n=52)

The mean WHR of total students was (n=195) was 0.82; those who has less than the mean value (n=96) form the lesser (T_1) group and more than mean termed (n=99) as higher (T_2) group.
Similarly, the mean WHR among male students was 0.85 (n=93) and that of lesser value than mean form M_1 group (n= 45) and higher mean value (n=48) constitute M_2 group and in female (n=102), the mean value of WHR was 0.78 and divided into F_1 group (n= 51) and F_2 group (n= 51) as those who has less or more WHR than mean respectively.

HRV analysis of different groups (Table 2)

At rest: The mean HRV recorded during resting period showed that of the female (26.08 ± 2.32) had significantly higher value (P< 0.005 for both) than that of male (16.50 ± 2.35) and also mean HRV of total students (21.51 ± 0.74). But grouping on the basis of WHR did not show any significant variation among their HRV (Table2)

Just before exercise (HRVx): The HRV calculated immediately before exercise revealed the following results. It was increased in total students (25.31 ± 1.87) and male (28.30 ± 2.81) but was decreased in female (22.58 ± 2.44) with their respective resting period value but were statistically not significant.

During this period, the HRV of T_2 group (P<0.01) and M_2 group (P<0.03) only showed significant increase with their respective resting value. On the other hand HRV of group F_1 showed significant decrease (P<0.02) over its resting value. The HRV of other groups did not vary with their respective resting HRV. (Table 2)

5 minutes after exercise (HRV5x): The HRV5x of all groups with & without WHR grouping showed significantly decreased HRV value with both their respective resting and immediately before exercise values (P<0.001 for all). (Table 2)

30 minutes after exercise (HRV30x): During this period the HRV increased over HRV5x in all groups except F_2 group though the rise was insignificant except in M_2 group where the increase was significant (P<0.001). This period HRV was significantly less (P<0.01) when compared with their respective HRVs of just before exercise in all the groups and also in resting period values with the exception of boy groups where the difference is insignificant. (Table 2)

Table-2: HRV of Different Groups (mean ± SE)

Group	HRV			
	At Rest	Just before exercise	5 minutes after exercise	30 minutes after exercise
'T'	21.51± 1.74	25.31± 1.87	11.85± 1.19	14.57± 1.21
'T_1'	20.47± 2.75	27.85± 3.35	11.35± 1.20	13.53± 1.25
'T_2'	22.52± 2.19	22.85± 1.69	12.34± 2.05	15.57± 2.06
"M"	16.50± 2.34	28.30± 2.81	10.36± 1.46	16.11± 1.94
"M_1"	15.81± 3.88	34.07± 4.88	11.34± 1.68	12.36± 1.45
"M_2"	17.15± 2.84	22.89± 2.40	9.44± 2.34	19.61± 3.31*
'F"	26.08± 2.32	22.58± 2.44	13.22± 1.83	13.17± 1.49
'F_1"	24.58± 3.70	22.35± 4.31	11.36±1.76	14.58± 1.98
'F_2"	27.57± 2.87*	22.81± 2.47	15.07± 5.21	11.78± 2.22

M2 vs. HRV of others in 30 minutes after exercise
F2 vs. HRV of others in rest; * P< 0.05

DISCUSSION

The HRV is due to autonomic modulation over the cardiac activity and it is well known that the decrease in HRV indicates sympathetic activity and increase in HRV is due to parasympathetic influence. Deep breathing activates parasympathetic nerve system whereas during exercise the sympathetic activity is kindled. In the present study, the basal HRV (resting period) of girls are more than boys indicating the parasympathetic control more pronounced in girls than the boys. This result of adolescent period is contrary to adulthood condition in which normal sympathetic activity is more in female than male.

These students were asked to perform exercise to assess their sympathetic activity. When HRV was taken immediately before exercise, while the boys HRV value was more and the girls HRV was less than their respective resting HRV though not significant; indicating the anticipatory response of exercise which is mediated through sympathetic activity is more in girls. But during this period, the boys with better WHR (M_2 group) had an increase in HRV whereas the girls with lesser WHR (F_1 group) had a decrease in HRV. The WHR is the measure of obesity, though in this study all the students were within normal range, they were divided into leaner side (lesser group) and tendency towards obesity (higher group). This result indicates that in adolescent age, the lean people have more sympathetic activity. During the recovery phase of exercise, the sympathetic effect due to exercise not return to normal in 5minutes. Even 30minutes after exercise, the HRV did not come back to resting level except in males that too only in boys with better WHR in whom it almost come back to normal.

CONCLUSION

Thus the present work concluded, during adolescent age, the girls have higher parasympathetic control and also regardless of sex leaner people have more sympathetic activity. This is contrary to adulthood condition where female and obese people have more sympathetic activity. The probable reason for this paradoxical condition of adulthood situation may be priming effect of sex hormones which begins to act only from this adolescent period.

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