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Original Research Article

Rate Pressure Product in Sedentary and Non-Sedentary Workers of Different Body Mass Index Categories

Anupama N[1], Subbalakshmi NK[1], Vishnu Sharma[2], Nayanatara AK[1], Rekha D Kini[1], Bhagyalakshmi K[1]

[1]Department of Physiology, Center for Basic Sciences, Kasturba Medical College, Manipal University, India.
[2]Department of Pulmonary Medicine, A J Institute of Medical Sciences, Kunticana, mangalore, Karnataka, India.

Corresponding Author: Subbalakshmi NK

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ABSTRACT

Background: Rate pressure product is a measure of the stress put on the cardiac muscle based on the heart rate and the systolic blood pressure that it is pumping against. It allows us to calculate the internal workload or hemodynamic response and is a direct indication of the energy demand of the heart. Increased incidence of sedentary lifestyle and obesity in developed and developing countries is one of the major risk factors for the development of cardiovascular diseases. This study was undertaken to analyze the differences in certain anthropometric and cardiovascular parameters in sedentary and non-sedentary male subjects of different body mass index.

Material and method: This cross sectional study consisted 60 male employees of 30-40 years who worked in the office was taken as cases and control group consisted of 60 male age matched physical laborers. Institutional Medical Ethical committee approval was obtained and written consent was obtained from all participants. Their anthropometric measurements were taken and were divided into low, normal and high Body Mass Index (BMI) groups based on the WHO recommendations. Their heart rate and systolic blood pressure were recorded and rate pressure product was calculated. Statistical analysis was done by using Student's unpaired 't' test. P value was taken as significant at 5 percent confidence level ($p < 0.05$).

Result: The heart rate of high BMI sedentary (85.85±8.74) subjects was increased and had statistical significance ($P< 0.05$) compared to non-sedentary high BMI [79.72±8.59 ($P=0.0312$)] subjects. The heart rate of low and normal BMI of sedentary subjects is more compared to that of non-sedentary subjects but without any statistical significance. The systolic blood pressure and the rate pressure product of sedentary subjects of different BMI group is higher compared to that of non-sedentary subjects, but without any statistical significance.

Conclusion: Increased heart rate in sedentary high BMI people is due to minimal vagal tone and sympathetic over activity. Accumulated adipose tissue in high BMI group will cause damage to the myocardium by pressure induced atrophy or by causing lipotoxicity of the myocardium induced by free fatty acids, causing apoptosis of lipid-laden cardiomyocytes. This will reduce the efficiency of the heart making it more prone to ischemia during exercise and stress. This study shows that the easily measurable heart rate is one of the important hemodynamic predictor to assess the functioning of the heart.

Key words: heart rate, systolic pressure, rate pressure product, body mass index.

INTRODUCTION

Rate pressure product is a measure of the stress put on the cardiac muscle based on the number of times it needs to beat per minute (heart rate) and the arterial blood pressure that it is pumping against (systolic blood pressure).Rate pressure product allows us to calculate the internal workload or hemodynamic response. It will be a direct indication of the energy demand of the heart and thus a good measure of the energy consumption of the heart. [1,2] The increased use of technology is leading to higher level of physical inactivity in people of all age group. This sedentary lifestyle is reducing the physical activity and has become one of the major risk factors for the development of cardiovascular diseases in the developing countries. Long-term, large epidemiological studies says that there is a strong, inverse, and independent association between physical activity, health, and cardiovascular and overall mortality in apparently healthy individuals [3–9] and in patients with documented cardiovascular disease. [6]

Reports show that, sedentary men with low levels of physical activity were at a significantly higher risk for heart failure than those who were more active. [10] Therefore, this study was undertaken to analyze the differences in certain anthropometric and cardiovascular parameters in sedentary and non-sedentary male subjects of different body mass index [11] in the age group of 30-40 years.

MATERIALS AND METHODS

This is a cross sectional study. A total of 120 subjects were included in this study. The case group consisted of 60 male employees (30-40 years) who worked in the office for a minimum of 6 years. The employees in the study group were not regularly doing any type of exercise. The control group consisted of 60 male age matched physical laborers. Institutional Medical Ethical committee approval was obtained and written consent was obtained from all participants. The subjects having any type of cardiac or respiratory diseases, chest wall deformity, subjects under medication were excluded from this study. The volunteers were asked to avoid beverages like tea, coffee and other stimulants and to report with light breakfast in the forenoon to avoid diurnal variations. The subjects were divided into three groups based on the Body Mass Index according to the WHO recommendations [11] for Asian population into normal group (BMI18.5-25), low BMI group (BMI ≤18.5) and high BMI (BMI 25-30).

Anthropometric measurements:

The subject's anthropometry was taken at the point of entry using the standard procedures and instruments.

Standing height was recorded without shoes and with light cloths on a wall mounted measuring tape to the nearest of centimeters.

Weight was recorded without shoes and with light cloths on a Krups weighing machine with a least count of 100 grams.

Body mass index was calculated by the formula of weight (in Kg) and height (in meters). BMI =Weight (Kg)/ (height in m2).

Heart rate measurement:

Heart rate was measured when subject was relaxed, in supine position, by finding the radial artery pulsation and counting the pulse rate for one minute.

Blood pressure measurement:

Blood Pressure was recorded in the supine position in the right arm to the nearest 2mm Hg using the mercury sphygmomanometer. Two readings were taken 5 minutes apart and the mean of two was taken as the blood pressure. For those whose BP>140/90mmHg, three BP recordings were recorded with a gap of 1 day in between. The average of second and third was considered as the final blood pressure.

Rate Pressure Product:

Is calculated using the following formula.

Rate Pressure Product (RPP) = Heart Rate (beats per minute) X Systolic Blood Pressure (mmHg).

Statistical Analysis:

Statistical analysis was done by using *Student's unpaired 't' test.* P value was taken as significant at 5 percent confidence level ($p < 0.05$).

Table1: Comparison of heart rate, systolic pressure and ratepressure product between sedentary and non-sedentary subjects of low, normal and high BMI category.

Parameters	Sedentarygroup			Non-sedentarygroup		
	Low BMI	Normal BMI	High BMI	Low BMI	Normal BMI	High BMI
Heart rate	84.4±8.54	72.26±9.09	85.85±8.74	80.158±7.174NS	70.95±14.09 NS	79.72±8.59 P=0.0312*
Systolic pressure	112.2±8.5	121.5±8.870	126.7±14.71	110.3±6.06 NS	120.9±9.04NS	122.26±7.30 NS
Rate pressure product	9460±1112.74	8412.97±1186.60	10440±1698.70	9312.93±798.96 NS	8145.1±1796.01 NS	10364.50±1408.51 NS

(n=20; n is the number of subjects).Values expressed as Mean ± SD.
P< 0.05* P value is significant.
NS- not significant.

RESULT

The heart rate of low and normal BMI of sedentary subjects is more compared to that of non-sedentary subjects but does not show any statistical significance. High BMI subjects had statistically significant (P< 0.05) increased heart rate compared to non-sedentary high BMI subjects. The systolic blood pressure and the rate pressure product of sedentary subjects of different BMI group is higher compared to that of non-sedentary subjects, but without any statistical significance.

DISCUSSION

Our study shows a strong association between sedentary lifestyle and increased heart rate, systolic blood pressure and rate pressure product. Sedentary life style is one of the well-known major contributing factor for obesity and development of cardiovascular diseases. [1,12]

In the present study there was a significant increase in heart rate in sedentary high BMI people. Minimal vagal tone and sympathetic over activity contributed to the increased heart rate in sedentary workers. [13] Our study shows increased systolic blood pressure in the sedentary group. Normal endothelium lining of blood vessels release nitric oxide to maintain vessel diameter. In sedentary people reduced nitric oxide production by the abnormal endothelium causes structural changes in the vessels resulting in hypertension leading to reduced blood flow to myocardium. [14]

The oxygen consumption of myocardium which reflects the myocardial blood flow can be calculated by the easily measurable hemodynamic predictors like heart rate and systolic blood pressure. [2] In healthy subjects the rate pressure product is the product of peak systolic blood pressure and heart rate. So the rate pressure product indicates the oxygen consumption of whole heart and coronary blood flow in healthy subjects over a wide range of exercise intensities. [1,15] In our study the rate pressure product is high in the high BMI sedentary people compared to non-sedentary people at rest indicating that their myocardial blood flow and in-turn oxygen consumption is high at rest. During exercise and stress the myocardial oxygen demand increases drastically which cannot be met by neural regulation or auto-regulation in myocardium thus leading to ischemia.

Sedentary lifestyle leads to weight gain causing overweight and obesity which is associated with cardiovascular diseases

and increased morbidity and mortality. In obesity there is gradual accumulation of fat between the cardiac muscle fibers resulting in myocyte degeneration and cardiac dysfunction. [(16)] Accumulated adipose tissue results in pressure induced atrophy [(17)] or it could be due to the lipotoxicity of the myocardium induced by free fatty acids, causing apoptosis of lipid-laden cardiomyocytes. [(18)] Adiposity, assessed as elevated body mass index is associated with increased risk of ischemic heart disease. [(19)] This will reduce the efficiency of the heart making it more prone to ischemia during exercise and stress.

CONCLUSION

The present study focuses on the need for implementation of effective interventions that should promote the increase of outdoor activities in sedentary men such as sports, walking, bicycling, climbing stairs and entertainment activities. Further, this study shows that heart rate is one of the important easily measurable hemodynamic predictor to assess the functioning of the heart. Thus, public health programs should take these factors into consideration when planning strategies for the prevention and management of obesity.

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