

Research Article

## Correlation between abdominal fat and myocardial blood flow in sedentary and non sedentary male workers at rest

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### Abstract

**Background:** Sedentary life has emerged as a risk factor for various negative health. Abdominal obesity plays a major role in the pathogenesis of several metabolic and cardiovascular medical problems. The myocardial blood flow can be easily measured by knowing hemodynamic predictors the heart rate and systolic blood pressure which correlate better with the myocardial oxygen consumption.

**Method:** In this cross sectional study 70 sedentary and 70 non-sedentary (30-40 years) age matched male workers were selected. Their waist circumference, waist hip ratio, heart rate and systolic blood pressure were measured at rest. The rate pressure product was calculated to assess the myocardial blood flow.

**Results:** The waist circumference and waist hip ratio and the systolic blood pressure were significantly ( $P < 0.05$ ) lower in non-sedentary group compared to sedentary group. The heart rate and rate pressure product both showed very highly significant ( $P < 0.0001$ ) reduction in non-sedentary group compared to sedentary group.

**Conclusion:** This study shows that the sedentary workers' myocardial oxygen consumption is much high at rest and they are more prone to ischemia due to stress and exercise.

**Keywords:** abdominal obesity, myocardial blood flow, myocardial oxygen consumption, sedentary workers

### 1. Introduction

Prolonged sitting time is a health risk. The workplace is a key setting for prolonged sedentary time. In the contemporary work place, many workers spend more than half of their entire work day seated<sup>1</sup>. Prolonged sitting time (as a specific instance of sedentary behavior), independent of physical activity, has emerged as a risk factor for various negative health. Literature survey shows the associations of prolonged sitting time with premature mortality<sup>2</sup>, chronic diseases such as cardiovascular disease, diabetes, cancer<sup>3,4</sup>, metabolic syndrome<sup>5</sup>, and obesity<sup>5</sup>. Attempts to reduce sedentary behavior at work through the introduction of devices to stimulate breaks in sitting time have shown beneficial health profiles.<sup>6</sup>

Obesity, and in particular abdominal obesity, plays a major role in the pathogenesis of several metabolic and cardiovascular medical problems including type 2 diabetes, hypertension, atherosclerosis and coronary artery disease (CAD)<sup>7,8</sup>. Waist hip ratio and waist circumference can be easily measured and therefore are frequently used in large-scale epidemiologic studies to find out the health hazards caused by obesity. Over the last few years, it became quite clear that central adiposity is more strongly associated with these metabolic and cardiovascular problems than total adiposity<sup>9,10</sup>. This observation led researchers and clinicians alike to believe that clinical diagnosis of visceral adiposity may be more important than the current diagnosis of obesity using the body mass index (BMI).

The myocardial blood flow (MBF) can be easily measured by knowing hemodynamic predictors the heart rate (HR) and systolic blood pressure (SBP) which correlate better with the myocardial oxygen consumption<sup>11</sup>. The workload on the myocardium is indicated by the oxygen consumption of the whole heart. In healthy subjects it can be calculated by the rate-pressure product (RPP) termed the double product, is the product of peak systolic blood pressure (SBP) and the heart rate (HR). It relates closely to the directly measured myocardial oxygen consumption and coronary blood flow in healthy subjects over a wide range of exercise intensities<sup>12-14</sup>. Previous studies show that central obesity would be more strongly related to the risk of cardiovascular diseases<sup>15-16</sup>. A physically active lifestyle is well established as a central component in the maintenance of good health and disease prevention. Previous studies have not considered the association of myocardial blood flow with the abdominal obesity in the sedentary workers at rest. The present study was aimed to investigate the association of myocardial blood flow with the abdominal obesity in sedentary and non-sedentary workers.

### 2. Material and method

This is a cross sectional study. A total of 140 subjects were included in this study. The case group (sedentary workers) consisted of 70 male employees (aged 30-40 years) who worked in the air conditioned environment of a private motor vehicle showroom for a minimum of 6 years. The employees in the study group were not regularly doing any type of exercise. The control group (non-sedentary workers) consisted of 70 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.

**2.1 Waist circumference (WC)** measurement was done with minimal, adequate clothing (light cloths) with feet 25–30 cm apart and weight equally balanced with a tailor's measuring tape in a plane perpendicular to the long body axis at the level of umbilicus without compression of the skin with nearest to 0.1 cm ( $WC \geq 90$  cm) was defined as abdominal obesity using WHO Asia Pacific prospective guidelines

**2.2 Hip circumference (HC)** measurement was done with minimal, adequate clothing (light cloths) across the greater trochanter with legs and feet together by a measuring tape without compressing the skin fold.

**2.3 Waist-hip ratio** is the ratio of WC and HC was calculated and is the measure of central pattern of fat distribution. ( $>0.9$  for male and  $>0.8$  for females).

**2.4 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.

**2.5 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  $>140/90$  mmHg, 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.

**2.6 Rate Pressure Product:** Is calculated using the following formula.

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

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

**Table 1: Comparison between abdominal fat and myocardial blood flow.**

Parameters	Sedentary (n=70)	Non Sedentary (n=70)	P value
Waist circumference ( cm)	81.6 $\pm$ 8.597	77.95 $\pm$ 8.32*	0.0102
Waist hip ratio( cm)	0.86 $\pm$ 0.047	0.84 $\pm$ 0.06*	0.0298
Heart rate( beats per minute)	83.12 $\pm$ 6.33	76.48 $\pm$ 7.346***	0.0001
Systolic pressure(mmHg)	120 $\pm$ 7.958	116 $\pm$ 10.396*	0.0117
Rate pressure product	9854.76 $\pm$ 1025.96	8998.73 $\pm$ 1246.21***	0.0001

(n is the number of subjects). Values expressed as Mean  $\pm$  SD.

P < 0.05\*, P < 0.0001\*\*\*

### 3. Result

In the present study the waist circumference and waist hip ratio was significantly ( $P < 0.05$ ) lower in non-sedentary group compared to sedentary group. The systolic blood pressure also showed a statistically significant ( $P < 0.05$ ) reduction in the non-sedentary group. The heart rate and rate pressure product both showed very highly significant ( $P < 0.0001$ ) reduction in non-sedentary group compared to sedentary group.

### 4. Discussion

Physical inactivity is commonly associated with cardiovascular diseases<sup>14,15</sup>. Obesity is a well-known risk factor for coronary heart diseases. From the recent studies it is clear that the central obesity is a high risk factor for developing cardiovascular diseases<sup>16</sup>.

The resting coronary blood flow in human is about 225 ml/min. which is about 4 to 5 percent of the total cardiac output. The cardiac output (CO) under severe exercise may increase six fold to nine fold. While, the coronary blood flow increases three fold to fourfold during severe exercise to supply the extra nutrients needed to the heart, which is not as much as the increase in work load. Therefore the O<sub>2</sub> supply to the myocardium could not meet its energy requirement. Increased myocardial demands during exercise or other stress must be met by equivalent increased the coronary blood flow. Myocardial ischemia results from imbalance between O<sub>2</sub> supply to the myocardium and its O<sub>2</sub> requirement<sup>17</sup>. The heart rate, the frequency of cardiac contraction is a very important determinant of oxygen consumption of the whole heart as there is a linear relation between increases in heart rate and increases in cardiac O<sub>2</sub> requirement. Another important determinant of myocardial oxygen consumption is the peak systolic blood pressure (SBP) or the peak systolic tension developed by the left ventricle<sup>18</sup>. Under normal conditions, the product of systolic blood pressure by the heart rate has been found to adequately reflect changes in myocardial oxygen consumption. In this study, the sedentary workers had a significantly high RPP compared to non sedentary workers at rest. This shows that the sedentary workers' myocardial oxygen consumption is much high at rest and they are more prone to ischemia due to stress and exercise. Research with heart disease patients has shown a physiologic correlation between the RPP, the onset of angina pectoris, and the electrocardiographic abnormalities during exercise<sup>18, 19</sup>. RPP provides an objective yardstick to evaluate the effect of cardiac performance in various clinical, surgical, or exercise intervention.

### 5. Conclusion

This study establishes the ill effects of sedentary life style on the myocardial blood flow. The decreased flow is evident as early as age 30-40 years. This shows the importance of exercise in adult's life. Our findings provide a possible mechanistic explanation for the consistent observation that central obesity is a strong risk factor for cardiovascular impairment. Public health efforts are urgently needed to promote an active life style and provide weight control methods that can be successful and sustained over a lifetime to prevent the development of reduced myocardial blood flow and ischemia in young adults in future.

### References

- Marshall S, Gyi D. Evidence of health risks from occupational sitting. Where do we stand? *Am J Prev Med* 2010; 39(4):389-91.
- Patel AV, Bernstein L, Deka A, Feigelson HS, Campbell PT, Gapstur SM, et al. Leisure time spent sitting in relation to total mortality in a prospective cohort of US adults. *Am J Epidemiol* 2010; 172(4):419-29.
- Katzmarzyk PT, Church TS, Craig CL, Bouchard C. Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Med Sci Sports Exerc* 2009; 41(5):998-1005.
- Owen N, Bauman A, Brown W. Too much sitting: a novel and important predictor of chronic disease risk? *Br J Sports Med* 2009; 43(2):81-3.
- Hamilton MT, Hamilton DG, Zderic TW. Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. *Diabetes* 2007; 56(11):2655-67.
- Healy GN, Dunstan DW, Salmon J, Cerin E, Shaw JE, Zimmet PZ, et al. Breaks in sedentary time: beneficial associations with metabolic risk. *Diabetes Care* 2008; 31(4):661-6.
- Saxena Y, Sidhwani G, Upmanyu R. Abdominal obesity and pulmonary functions in young Indian adults: a prospective study. *Indian J Physiol Pharmacol*. 2009; 53(4):318-26.

8. Calle CE, ThunMI, Petrelli JM, Rodriguez C, Heath CWJ. Bodymass index and mortality in a prospective cohort of U.S. adults. *N Engl J Med* 1999; 341:1097-105.
9. Zamboni M, Armellini F, Sheiban I, De Marchi M, Todesco T, Bergamo Andreis IA. Cominacini L, Bosello o. Relation of bodyfat distribution in men and degree of coronary narrowingsincoronary artery disease. *Am J Cardiol* 1992; 70: 1135-1138.
10. Bjorntorp P. Abdominal obesity and the development of noninsulin dependent diabetes mellitus. *Diabetes Metab Rev* 1988; 4: 615-622.
11. Jorgensen CR, Kitamura K, Gobel FL, Taylor HL, Wang Y: Long term precision of N2O method for coronary flow during heavy upright exercise. *J ApplPhysiol* 30: 338, 1971.
12. Kitamura K, Joregensen CR, Gobel FL, Taylor HL, Wang Y: Hemodynamic correlates of myocardial oxygen consumption during upright exercise. *J AppiPhysiol* 32: 516, 1972.
13. Nelson RR, Gobel FL, Jorgensen CR, Wang K, Wang Y, Taylor HL: Hemodynamic predictors of myocardial oxygen consumption during static and dynamic exercise. *Circulation* 50: 1179, 1974.
14. Laukkanen, J. A., T. A. Lakka, R. Rauramaa, et al. Cardiovascular fitness as a predictor of mortality in men. *Arch. Intern. Med.* 161:825–831, 2001.
15. Pais P, Pogue J, Gerstein H, et al. Risk factors for acute myocardial infarction in Indians: a case-control study. *Lancet* 1996; 348:358–63.
16. Dagenais GR, Yi Q, Mann JF, Bosch J, Pogue J, Yusuf S. Prognostic impact of body weight and abdominal obesity in women and men with cardiovascular disease. *Am Heart J* 2005; 149: 54–60.
17. Ardern CI, Katzmarzyk PT, Janssen I, Ross R. Discrimination of healthrisk by combined body mass index and waist circumference. *Obes Res* 2003; 11:135–142.
18. F L Gobel, L A Norstrom, R R Nelson, C R Jorgensen and Y Wang. The rate-pressure product as an index of myocardial oxygen consumption during exercise in patients with angina pectoris. *Circulation.* 1978; 57:549-556.
19. SaiChuenHui, Andrew S. Jackson, and Larry T. Wier. Development of normative values for resting and exercise rate pressure product. *Medicine & Science in Sports & Exercise.* 1998; 1520-1527.