Original article

Evaluation of Cardiovascular Sympathetic Nerve Function Status by Cold Pressor Test in Healthy Adult Male Sedentary Individuals

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Abstract

Background:
Sedentary lifestyle is an issue of great concern because of its deleterious health implication. It is associated with limited physical activity. Regular physical activity with good physical fitness are widely accepted as factors that reduce all cause of mortality and improve number of health outcome.

Objective:
To assess the cardiovascular sympathetic nerve function status by the cold pressor test in healthy adult male sedentary workers.

Methods:
This cross-sectional analytical study was conducted from January 2019 to December 2019 in the Department of Physiology, Rangpur Medical College, Rangpur. After obtaining permission, a total 60 subjects who were met the inclusion criteria was enrolled in the study after briefing them objectives of the study. Among them 30 were healthy adult male heavy workers (Group-A) and 30 were healthy adult male sedentary workers (Group-B). The basal systolic and diastolic blood pressure was recorded in resting condition. The evaluation of sympathetic nerve functions in selected individuals was done by cold pressor test. The individuals were selected from different areas of Rangpur district. For statistical analysis unpaired t-test was performed by computer-based software SPSS-23.0 version for windows.

Results:
The resting systolic and diastolic blood pressure are non-significant in selected individuals. Diastolic blood pressure response by cold pressor test was significantly lower in sedentary workers. ($p < 0.05$).

Conclusion:
The study thus concluded that decreased diastolic blood pressure response by cold pressor test in sedentary individuals indicate impairment of the sympathetic nerve function.

Keywords: Sedentary workers, Heavy workers, Cold pressor test, Sympathetic nerve function.

Introduction:

Man were created for activity and energy, so a sedentary lifestyle goes against human nature. Our grandparents were also active and engaged in vigorous activities.[1] Technical advancement and increase in knowledge have provided man with so many facilities that reduce physical activities and increased in amount of time spent sitting down at work place.[2,3] According to World health organization (WHO) about 60 to 85% of people in the world from both developed and developing countries lead sedentary life style, making it one of the more serious yet insufficiently addressed public health problem of our time.[4] Bangladesh is one of the developing countries where nationally representative and internationally comparatively data on physical activity (PA) level are still inadequate.[5]

Physical activity can be measured in metabolic equivalents or METS. One METS is the energy expanded while sitting at rest. An activity with a METs value of 5 means expanding five times the energy and calories than we would at rest.[6,7] The individuals spend in various behaviors that require low energy expenditure such as sitting or standing, studying, talking are sedentary worker. METs value of these workers are1.5-2.5.[6,7] The person who work like this –Manual labor or in forestry work,

climbing, basketball, football, swimming, running is strenuous or heavy worker. METs value of these workers are 7.5-12.[6,7]

Sedentary lifestyle leads to many health complications and various media campaigns aim to encourage more physical activity and promote a healthy lifestyle. In developed economies, knowledge workers typically have a work style that requires them to sit for long periods of time. Many studies showed; Sedentary work leads to a number of health complications, including type 2 diabetes, high blood pressure and obesity.[8,9]

Physical inactivity may increase risk of cardiovascular disease due to changes in central pathways involved in autonomic nervous system regulation. Whilst research linking physical activity (PA), sedentary behaviors and autonomic function is limited, available evidence suggests that some relationship exist.[10,11] The autonomic nervous system is responsible for regulation and integration of internal organ functions.[12] The autonomic nervous system (ANS) comprises of sympathetic and parasympathetic components responsible for stimulation or energy release and recovery respectively. Altered autonomic function, for example, enhanced sympathetic and reduced parasympathetic tones, may predispose individuals to poor cardiovascular health due to reduced baroreflex sensitivity, reduced endothelial function and hypertension.[13] The sympathetic nervous system is closely linked with cardiovascular system, of which over activity can lead to detrimental structural and functional change to the vasculature, and arterial stiffness.[14,15] Chronic physical inactivity affects the excitability of rostral ventrolateral medulla (RVLM) neurons directly and contributes to sympathetic overactivity.[16] Sympathetic over activity caused an increase in BP, which in turn could influence vascular structure and tone, via stiffening of carotid artery, aorta resulting in reduced baroreceptor responsiveness (or baroreceptor sensitivity; BRS) to change in BP.[14] A reduction in BRS is associated with regulation of BP, electrical instability of the heart and therefore increased risk of CVD morbidity and mortality[17] the integrity of the autonomic nervous system (ANS) may be assessed with a simple, reliable and non-invasive by cold pressor tests based on cardiovascular reflexes is useful tool for evaluation of sympathetic modulation of the heart.[18]

Sedentary behavior related health problems are not uncommon in our community. Cardio metabolic changes resulting from a sedentary lifestyle may take many years to be clinically detectable. The present study would be done to clarify the cardiac autonomic nerve functions changes among sedentary workers. Therefore, emphasis should be laid on early detection of the autonomic dysfunction in sedentary population.

Methods:

This is cross sectional analytic study was conducted in department of physiology, Rangpur Medical college Rangpur from January 2019 to December 2019. A total number of 60 individuals, which are apparently healthy adult male and their age ranged from 25-45 years were included in this study. Sample of heavy workers are collected from day labor who works in constructing building, sedentary workers are collected from bank workers in Rangpur district. All subjects are matched with age. Before perform the sympathetic nerve function test and collection of sample all the subjects are briefed about the objective of study. Informed written consent of the study subjects was taken in easy understandable Bengali phase All information was recorded in a preformed questionnaire after taking history and through clinical examination.

All the subjects were divided into two groups on the basis of their working style. Among them 30 are heavy workers denoted as group A and 30 are sedentary workers Denoted as group B. They are matched with age. Study was carried out with prior protocol approved by thesis protocol review committee and ethical committee of Rangpur Medical College. Obese, overweight, history of diabetes mellitus, Chronic obstructive lung diseases, smoking and alcohol abuse, any neurological disorder, psychiatric disorder(depression) taking any neurotoxic drugs, Endocrine disorder (thyroid, adrenal etc.) and previous history of head injury were taken as exclusion criteria.

From the previous night up to the examination, they were not undergoing any physical or mental stress and not to take any sedatives or any drugs affecting central nervous system. Then the autonomic nerve function parameters were

assessed by cardiac reflex tests using sphygmomanometer and ECG machine. Blood glucose, serum creatinine level and serum alanine amino transferase was measured to exclude diabetes mellitus, chronic renal failure and liver diseases respectively. Cold pressor test was conducted in a comfortable environment in the department of physiology laboratory from 9.00am - 2.30pm.

Resting blood Pressure:
The subjects were asked to take rest for 10 minutes in supine position and blood pressure were recorded in supine position and expressed as mm/hg. Three reading are taken and the average of three was taken as the resting blood pressure.

Cold pressor test:
After recording basal blood pressure, subjects were asked to immerse left hand (up to 2 inches proximal to wrist crease) in the cold water for 2 minutes and temperature was maintained at 4-6°C throughout the procedure. Blood pressure measurement was made from right arm at pain threshold time, which is defined as time between immersion of hand and subjective feeling of pain. Maximum increase in systolic and diastolic pressure was recorded. A rise of diastolic pressure ≥ 10 mm of Hg and increase in the systolic pressure 10-20 mm of Hg will be taken as normal response and less than this considered as abnormal.

All data were recorded systematically in a preformed history sheet and all statistical analysis was done by computer using the software SPSS 25.0 version for windows. Comparison between the experimental group with control group was done by unpaired t test. In the interpretation of result, <0.05 level of probability was accepted as significance.

Result:
The mean ± SD of age are 39.70±2.98 years in group A and 40.96± 2.51in group B. The mean ± SD of height was 161.133±4.43 in group A and 163± 5.55 in group B. The mean ± SD of weight was 54.93± 2.43 in group A and 62.50± 2.36 in group B. The mean ± SD of BMI was 20.83 ± 1.01 in group A and 21.63 ± 0.912 group B. The age, height, weight and BMI were statistically non-significant between the groups. (Table-I)

Table-I: The mean ± SD of age, height, weight and body mass index of the study subjects of in group A and group B

Variable	Group A	Group B	p-value
Age	39.70±2.98	40.96±2.51	.299^{NS}
Height	161.133±4.43	163±5.55	.089^{NS}
weight	54.93±2.43	62.50±2.36	.972^{NS}
BMI	20.83±1.01	21.63±0.912	.943^{NS}

Data were expressed as mean ± SD. Unpaired t-test were done.
Group A: Apparently healthy adult male heavy workers.
Group B: Apparently adult male sedentary workers.
n= number of subjects
P value < 0.05 was taken as level of significance.
SD=Standard deviation
NS = P > 0.05.
Table- ll showed, the mean ± SD of resting systolic and diastolic Blood pressure were in group A 121.50± 8.82 and 78.50± 5.43 and resting systolic and diastolic blood pressure were 125.00 ± 9.13 and 83.66 ± 6.00 in group B. The mean resting systolic and diastolic blood pressure were non-significant (p>0.05) in group B then group A.

Table-II: The mean+-SD of resting blood pressure of the study subjects in Group A And Group B

Variable	Group A	Group B	p-value
Resting systolic blood pressure	121.50±8.82	125.00±9.13	0.086^{NS}
Resting diastolic blood pressure	78.50+5.43	83.66±6.00	0.672^{NS}

Data were expressed as mean ± SD. Unpaired t test were done.
Group A Apparently healthy subjects of heavy workers.
Group B Apparently healthy subjects of sedentary workers.
n= number of subjects
P value < 0.05 was taken as level of significance.
SD= Standard deviation
NS = P > 0.05
The mean±SD systolic and diastolic pressure in

cold pressor test were in group A 11.8333 ± 2.450662.45 and 8.6667± 2.24888 and in group B 12.166±5.363 and 9.8333 ± 3.34338, The mean values were significant (p<0.01) lower in group B than group A (Table-III).

Table-III : The statistical analysis of mean ± SD of systolic and diastolic blood pressure changes in cold pressor test in study subjects of different groups

Variables	Group A	Group B	p-value
Systolic blood pressure in Cold pressor Test	11.8333 ± 2.45066	12.166±5.363	.009*
Diastolic blood pressure in Cold pressor Test	8.6667± 2.24888	9.8333 ± 3.34338	.013*

Data were expressed as mean ± SD. Unpaired t test were done.
Group A Apparently healthy subjects of heavy workers.
Group B Apparently healthy subjects of sedentary workers.
n= number of subjects
P value < 0.05 was taken as level of significance.
SD =Standard deviation
*=p< 0.01.

Discussion:
The present study was carried out to observe the cold pressor test between apparently healthy adult male heavy and sedentary workers. In sedentary workers significantly (p<0.05) lower systolic and diastolic blood pressure was found in cold pressor tests, when compared to heavy workers. This finding is consistent with that of some other investigators. In contrast some other researchers did not find any significant difference in cold pressor test in sedentary and heavy workers.

Sedentary workers are less responsive to blood pressure changes to cold stimulus than the heavy workers. The afferent fibers for this response are the pain fibers which are stimulated by placing the hand in cold water and the efferent fibers are the sympathetic fibers. A lesser increase in the blood pressure after the cold-water immersion points towards sympathetic insufficiency in sedentary subjects. This decreased sympathetic insufficiency might be due to defect in sympathetic nerve activation or in peripheral adrenoreceptor behavior.[19,20]

In heavy workers have increase in blood pressure is due to increased sympathetic activity mediated by the alpha-adrenergic receptors of the autonomic nervous system. An increase in sympathetic activities due to impulses from the limbic cortex, motor cortex and the proprioceptors within small hand joints acting as afferent inputs into the medullary cardiac centers causing increase in blood pressure, both systolic and diastolic.[20,21]

From this above discussion it may be concluded that significantly lower values of systolic and diastolic blood pressure in response to cold pressor test in sedentary workers, indicate decreased sympathetic activity may be due to defect in sympathetic nerve activation or in peripheral adreno- receptors.

However, the exact mechanisms involved for the impairment of sympathetic nerve function in sedentary workers of the present studies cannot be elucidated. In addition, the present study also shows that higher the spending time in sedentary works, the more number of subjects are involved with autonomic impairment. These has been associated with the cardiac autonomic activity and potential risk factor for cardiovascular morbidity and mortality.

Conclusion:
The result of the study suggested that with the help of simple, noninvasive cold pressor test, it has been shown that cardiovascular sympathetic nerve function activity was decreased in sedentary individuals. This might provide diagnostic information about early subclinical sympathetic dysfunction and is a useful tool to monitor the efficacy of therapeutic and lifestyle modification. As our study was cross sectional and limited in sample size. We recommend studying this test in a larger population in different age and workers groups for more asses the sedentary individuals to decreased non-communicable disease burden in Bangladesh.

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