Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(5A):1510-1514 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Original Research Article

Effect of Ambient Temperature on Cardiovascular Sympathetic Function Test on Medical Student

Chaturvedi Mukesh Kumar[1], Binawara Bijendra Kumar[2], Bijaraniya Kuldeep[3], Agarwal Nitesh[4], Sharma Sudhir Kumar[5]

[1]Tutor, Department of Physiology, S. P. Medical College, Bikaner, Rajasthan, India
[2]Associate Professor, Department of Physiology, S. P. Medical College, Bikaner, Rajasthan, India
[3]Tutor, Department of Physiology, R. N. T. Medical College, Udaipur, Rajasthan, India
[4]Assistant professor, Department of physiology, Govt. Medical College, Kota, Rajasthan, India
[5]Medical Officer, Satellite Hospital, Bikaner, Rajasthan, India

***Corresponding author**
Bijaraniya Kuldeep
Email: drkuldeep5789@gmail.com

Abstract: Humans have the capability to withstand large variations in environmental temperatures, while relatively small increases in internal temperature (i.e. as little of ~3 °C) can lead to injury and even death. This study evaluated the effects of ambient temperature on autonomic sympathetic variable in medical students. In the present study a group of having 100 medical students between age 18-25 years of either sex were studied in the morning hours in peak winter season (temperature 2-10 degree Celsius) and peak summer season(temperature 40-48 degree Celsius) to see the effects of ambient temperature on autonomic function tests. This study was conducted in the department of physiology S. P. Medical College, Bikaner (Rajasthan). Sympathetic non invasive autonomic function test were performed that is hand grip test and postural change test including resting blood pressure. The results were statistically analysed by applying paired "t" test. On comparison sympathetic function test like orthostatic variation of blood pressure and hand grip test were statistically significantly lower ($p<0.05$). The present study shows that no significant correlation in anthropometric parameter changes in ambient temperature in boys and girls.
Keywords: Sympathetic functions, Blood pressure, Hand grip test, cold pressor test

INTRODUCTION

The dynamically changing climatic scenarios worldwide have drawn attention of scientists, human being and everybody concerned about environment. It has been increasingly alarming the ill effect of meteorological factors on not only on human health but also of animals and living beings on this earth and universe.

Health is a dynamic state of complete physical, mental, spiritual and social wellbeing and not merely an absence of disease or infirmity [1].

Humans have the capability to withstand large variations in environmental temperatures, while relatively small increases in internal temperature (i.e. as little of ~3 °C) can lead to injury and even death. Elevations in skin blood flow and sweating are the primary heat exchange mechanisms in humans that protect against a heat-related injury. The importance of these mechanisms is exemplified in the calculation that if heat was not liberated from skin, internal temperature would reach the upper 'safe' limit within 10 min of moderate exercise [2]. These heat-dissipating responses are accompanied by important, even critical, cardiovascular adjustments, which, if they were not present, would compromise thermal regulation during exercise and/or exposure to elevated environmental temperatures.

Cooling of the skin surface induces peripheral cutaneous vasoconstriction. In contrast, heating induces peripheral cutaneous vasodilatation [3]. Hyndman *et al* [4] first reported that blood pressure variability (BPV) with a typical period of about 10 s (referred to as Mayer waves; Pe'naz, 1978) reflects vasomotor activity associated with thermoregulation. Akselrod *et al* [5] proposed the spectral analysis of heart rate variability (HRV) as a powerful tool for assessing the function of

the short-term regulation of cardiovascular control system.

Human Beings have an Autonomic Nervous System (ANS) that is the body's automatic regulatory system of nerves and controls that do all the background tasks that keep the body operating. The ANS is comprised of three separate subsystems, the Parasympathetic Nervous System, sympathetic Nervous System and enteric nervous system.

The Parasympathetic Nervous System is responsible for many of our resting functions such as lowering heart rate, increasing digestive & gland activity and sexual arousal, the Sympathetic Nervous System is mainly associated with modulation of hormones and neurotransmitters relating to "flight or fight" responses.

MATERIALS AND METHODS

Subjects who are healthy medical students of S. P. Medical College, Bikaner were examined for the cardiovascular autonomic function test.

Sample size

In the present study a group of having 100 medical students between age 18-25 years of either sex were studied in the morning hours in peak winter season (temperature 2-10 degree Celsius) and peak summer season(temperature 40-48 degree Celsius) to see the effects of ambient temperature on autonomic function tests. This study was conducted in the department of physiology S. P. Medical College, Bikaner (Rajasthan).

Inclusion criteria

1. Subjects with age ranging between 18-25 years of both the gender.
2. Cooperative and capable of understanding the procedure.
3. Informed consent was taken from subjects.

Exclusion criteria

1. Patients suffering from hypertension, diabetes mellitus, pulmonary tuberculosis, asthma, chronic bronchitis and no other allergic condition.
2. Absence of any major psychiatric illness. They should not be on any medication of mental illness.

Evaluations

The following tests were performed for assessment of sympathetic activity

Resting blood pressure

Blood pressure was recorded with standard sphygmomanometer by auscultatory method. Before recording the blood pressure, subjects were allowed to rest for 5 minutes in a quiet room to reduce the anxiety. The onset of sounds (kortkoff's phase 1) was taken as indicative of systolic blood pressure and disappearance of sound (kortkoff's phase 5) as indicative of diastolic blood pressure.

Lying to standing test (LST)

The subject was asked to rest in a supine position for 5 minutes. The resting BP was recorded. The subject was then asked to stand unaided and remain standing unsupported for 3 minutes. The BP was recorded at 30 seconds and 3 minutes after standing up. The difference between the resting and standing BP levels was calculated.

The fall in systolic BP at 30 seconds on standing noted. A fall of 30 mm Hg or more was defined as abnormal, fall between 11-29 mm Hg as borderline and fall of 10 mm Hg or less was considered normal.

Cold pressor test (CPT)

The subjects were directed to immerse his hand (up to the wrist) in ice cold water (water temperature 10C) for 1 min. The blood pressure was monitored after immersion of the hand at 1 min. In cold pressor test, diastolic blood pressure was measured at the end of the 1-min immersion of hand in the 10ºC water.

Isometric handgrip test (HGT)

In this test, sustained muscle contraction is measured by a handgrip dynamometer, causes a rise in systolic and diastolic blood pressure and heart rate. The dynamometer is first squeezed to isometric maximum, and then held at 30% maximum for 5 min. if possible, although even 3 minutes may be adequate. Blood pressure was recorded in the non exercising arm thrice at 1-minute interval during the procedure. The maximum reading of the diastolic blood pressure was taken as the final value. Then the rise in diastolic blood pressure was calculated by subtracting resting diastolic blood pressure from this value. A rise in DBP of less than 10 mm Hg was defined as abnormal, 10-12 mm Hg as borderline and 13 mm Hg or more as normal

Analysis of Observations:

Standard statistical methods were applied for analysis of the observation. The mean values of various parameters were calculated separately in various groups of the subjects.

The quantitative data was expressed as Mean ± S.D. and the student's paired 't' test was used to compare the differences between the respective means. All p values were 2 tailed, p value of <0.05 was considered significant.

RESULTS

Table 1: Show the total no. of subjects (Male & Female)

Normal subjects	No. of Subjects
Male	50
Female	50
Total no.	100

Table 2: Anthropometric measurements and Sympathetic reactivity test in Boys

Parameters		Summer		Winter		P Value
		Mean	SD	Mean	SD	
BMI (kg/m^2)		21.11	3.60	25.67	0.133	0.867
Blood Pressure (mmHg)	Systolic	109.00	11.67	107.15	7.36	0.2538
	Diastolic	74.05	8.50	75.23	6.11	0.1049
Sympathetic Reactivity Test	LST	6.044	2.651	6.7369	0.043	0.0014
	HGT	14.06	2.009	14.312	2.102	0.0001
	CPT	79.86	7.65	86.2	7.74	0.0001

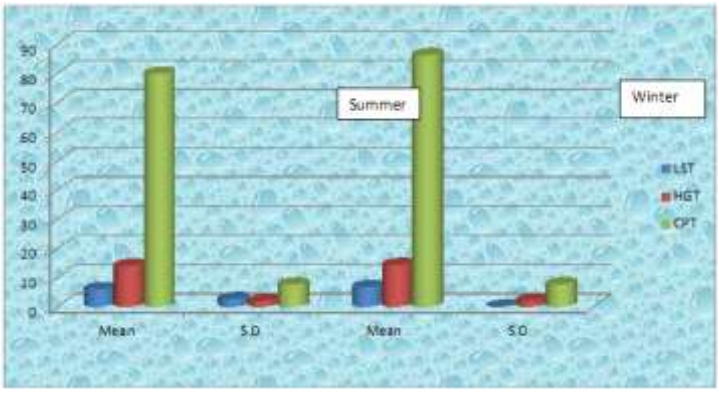

Fig-1: Sympathetic Reactivity Test comparison of mean and standard deviation in boys

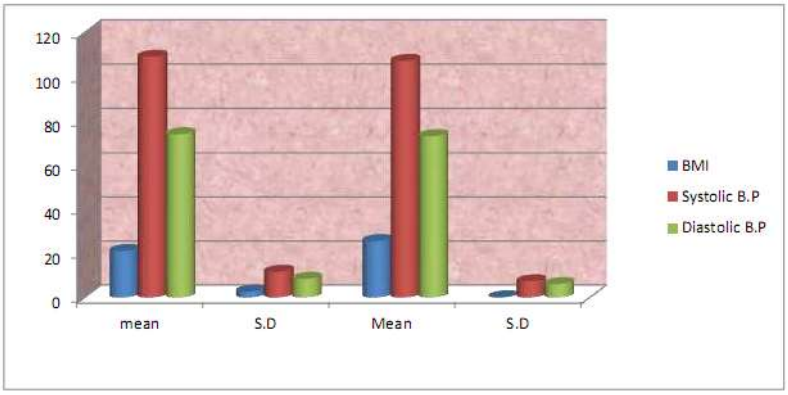

Fig-2: Anthropometric Comparison of mean and standard deviation in boys

Table 3: Anthropometric measurements and Sympathetic reactivity test in Girls

Parameters		Summer		Winter		P Value
		Mean	SD	Mean	SD	
BMI (kg/m^2)		20.21	3.03	22.17	0.133	0.865
Blood Pressure (mmHg)	Systolic	107.42	11.65	105.72	7.83	0.2703
	Diastolic	73.32	2.958	73.88	2.076	0.2760
Sympathetic Reactivity Test	LST	5.720	0.783	6.121	0.895	0.0194
	HGT	13.606	2.471	13.1761	2.132	0.0001
	CPT	78.13	7.03	85.4	7.34	0.0001

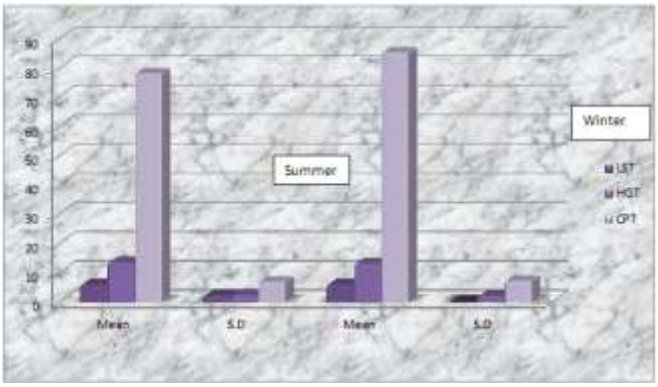

Fig-3: Sympathetic Reactivity Test comparison of mean and standard deviation in girls

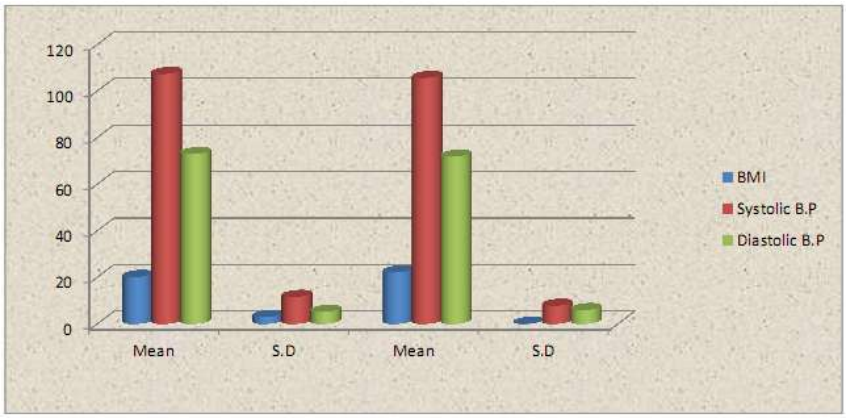

Fig-4: Anthropometric Comparison of mean and standard deviation in girls

Data presented in above table 2,3 shows that orthostatic variation of blood pressure, cold pressor test and hand grip test were statistically significantly lower ($p<0.05$) between summer (High ambient temperature) and winter season (Low ambient temperature) in both the male and female group. The present study shows that no significant correlation in anthropometric parameter changes in ambient temperature in boys and girls. In both the group resting blood pressure were lower but not statistically significantly ($p>0.5$).

DISCUSSION

Our present study results shows that the sympathetic activity increase in summer weather (High ambient temperature) in healthy subjects. There was no significant relation in autonomic function with ambient temperature in gender in our study. The results significantly correlated with Banjar *et al* [6], Bruce-Low *et al* [7], Liu *et al* [8] who studied on High and uncomfortable ambient temperatures increase sympathetic nervous system activity at the expense of the parasympathetic nervous system, manifested as changes in heart rate variability. Diastolic blood pressure tends to rise in cold weather than summer [9, 10].

Our findings are in accordance with earlier studies done by Deswal *et al* [11], Woap SJ *et al* [12], Mourot *et al* [13] and Ishii K *et al* [14].

With change of posture from supine to standing the autonomic nervous system acts to produce a rise in heart rate & vasoconstriction in order to maintain blood pressure [15]. Vasoconstriction is mediated through sympathetic innervations to blood vessels during standing.

D. J Ewing *et al* first showed that during sustained hand grip, there was a sharp rise in diastolic blood pressure (DBP) due to increase in peripheral vascular resistance [16].

Gender differences in the Autonomic Nervous system may be present because of developmental differences or due to effects of prevailing levels of male and / or female sex hormones. Differences in the autonomic functions with ambient temperature may be due to differences in afferent receptor stimulation, in the central reflex transmission, in the efferent nervous system and in the post synaptic signaling. At each of these potential sites of difference, there may be effects due to different size or number of neurons, variations in receptors, differences in neurotransmitter content or

metabolism as well as functional differences in the various components of the reflex arc [17].

CONCLUSION

We conducted longitudinal study having 100 medical students between age 18-25 years of either sex were studied in the morning hours in peak winter season and peak summer season to see the effect of ambient temperature on autonomic function tests. Evaluation of status of autonomic nervous system was done with the help of three non-invasive tests. Sympathetic function was assessed by Blood pressure response to orthostatic test, Blood pressure response to sustained hand grip and cold pressor test.

Our present study results shown that the sympathetic activity increases in summer weather (High ambient temperature) in healthy subjects. There was no significant relation in autonomic function with ambient temperature in gender in our study. The high temperature condition increased heart rate and consistent with the sympathetic activating effect of high ambient temperature. The high temperature condition failed to have any effect on either systolic or diastolic blood pressure. However, an increase in heart rate may also be secondary to vagal withdrawal.

REFERENCES

1. Definition of Health Available from http://www.sas.upenn.edu/~dludden/HealthDefine.htm
2. Kenney WL, Johnson JM; Control of skin blood flow during exercise. Med Sci Sports Exerc., 1992; 24:303-312.
3. Kerslake DM, Cooper KE; Vasodilation in the response to heating the skin elsewhere. Clinical Science, 1950; 9:31-47.
4. Hyndman BW, Kitney RI, Sayers BMCA; Spontaneous rhythms in physiological control systems. Nature, 1971; 233:339-341.
5. Akselrod S, Gordon D, Ubel FA, Shannon DC, Barger AC, Cohen RJ; Power spectrum analysis of heart rate fluctuation: a quantitative probe of beat to beat cardiovascular control. Science, 1981; 213: 220-222.
6. Banjar WM, Gazzaz J, Langley RW, Bradshaw CM, Szabadi E; Effects of high ambient temperature on parasympathetically mediated cardiovascular reflexes in normal man. Br J Clin Pharmacol., 2000; 50: 360–365.
7. Bruce-Low SS, Cotterrell D, Jones GE; Heart rate variability during high ambient heat exposure. Aviat Space Environ Med., 2006; 77: 915–920.
8. Liu W, Lian Z, Liu Y; Heart rate variability at different thermal comfort levels. Eur J Appl Physiol., 2008; 103:361–366.
9. Jehn M, Appel LJ, Sacks FM, Miller ER; The effect of ambient temperature and barometric pressure on ambulatory blood pressure variability. Am J Hypertens., 2002; 15:941–945.
10. Halonen JI, Zanobetti A, Sparrow D, Vokonas PS, Schwartz J; Relationship between outdoor temperature and blood pressure. Occup Environ Med., 2011; 68:296–301.
11. Deswal K, Bajaj SK, Sircar SS; Effect of ambient temperature changes in autonomic responses: Indian J Exp Biol., 1994; 32(6):402-4.
12. Harinath K, Malhotra AS, Pal K, Prasad R, Kumar R, Sawhney RC; Autonomic nervous system and adrenal response to cold in man at Antartica. Wildrness Environ Med., 2005; 16 (2): 81-91.
13. Mourot L, Cluzeau C, Regnard J; Physiological assessment of a gaseous Cryotherapy device; Thermal effects and changes in cardiovascular autonomic control. Ann Readapt Med Phys., 2007; 50(4): 209-17.
14. Ishii K, Kuwahara M, Tsubone H, Sugano S; The telemetric monitoring of heart rate, locomotor activity, and body temperature in mice and voles (Microtus arvalis) during ambient temperature changes. Lab Anim., 1996; 30(1):7-12.
15. Van Dijk JG, Koenderink M, Aeilko H, Hann ZJ, Cor GS, Heijer JCD; Autonomic nervous system tests depend on resting heart rate and blood pressure. Journal of the Autonomic Nervous system, 1991; 35: 15-24.
16. Ewing DJ, Campbell IW, Burt AA, Clarke BF; Vascular reflexes in autonomic neuropathy. The Lancet, 1973; 15:1354-1356.
17. Anthony DM, Xiao-Jun D, Bronwyn KA; Gender, sex hormones and autonomic nervous control of the cardiovascular system. Cardiovascular Research, 2002; 53: 678-687.