Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr UGC approved journal no. 63854

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805 SJIF (Impact factor) 2017= 6.261; Index Copernicus value 2016 = 76.77

Original Article

Assessment of Impact of Cold Stress on Heart Rate and Blood Pressure in Healthy Offspring with and Without Parental History of Type II Diabetes Mellitus: A Comparative Study

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***ABSTRACT*:**
Background: There is a rich ANS supply to major organs of glucose metabolism which includes liver, pancreas and skeletal muscles. Therefore, ANS changes and metabolic alterations are linked to each other. **Aim of the study:** To assess the impact of cold stress on heart rate and blood pressure in healthy offspring with and without parental history of type II diabetes mellitus. **Materials and methods:** A total of 50 subjects were selected for the study, 25 patients were healthy and non-diabetic without parental history of T2DM; and other 25 patients were healthy and non-diabetic subjects with at least one parent with T2DM. A written informed consent was obtained from each patient before the study after verbally explaining to them the procedure of the study. **Results:** Mean age of study group was 20.20 years and control group were 19.80 years. Mean height in study group was 1.79 cm and in control group was 1.69 cm. Mean weight of study group was 63.28 kg and in control group was 65.87 kg. We observed that comparison of heart rate before CPT and during CPT at study group and control group was statistically non-significant. After CPT, the comparison of heart rate between study group and controls at various time intervals was statistically significant. **Conclusion**: The HR response to CPT was comparable, but after CPT the recovery of HR was smooth and gradual in the controls, whereas it was abrupt in cases.
Keywords: CPT,heart rate, ANS, Diabetes mellitus.

Received: 2 May 2018 Revised: 20 June 2018 Accepted: 20 June 2018

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This article may be cited as: Bansal S, Agarwal M, Yadav K, Yadav Y, Choudhary R. Assessment of Impact of Cold Stress on Heart Rate and Blood Pressure in Healthy Offspring with and Without Parental History of Type II Diabetes Mellitus: A Comparative Study. J Adv Med Dent Scie Res 2018;6(7):65-68.

INTRODUCTION:
Stress and anxiety being such an intense emotion is accompanied by a rise in arousal level and stimulation of the autonomic nervous system. As a result, there is change in physiological parameters. These changes indicate the person's reactivity to stressful conditions.[1, 2] Examples of such parameters are changes in blood pressure, cardiac output, stomach acid output and salivary secretion etc. Autonomic nervous system (ANS) dysfunction at the subclinical level seems to be the predisposing condition that occurs far earlier before developing an overt diabetic condition.[3] There is a rich ANS supply to major organs of glucose metabolism which includes liver, pancreas and skeletal muscles. Therefore, ANS changes and metabolic alterations are linked to each other.[4] Impaired autonomic activity may trigger hyperglycemia in non-diabetic individuals. Studies have shown that autonomic dysfunction is often detected among the population even at the time of diagnosis of T2DM. This provides a hint that impaired autonomic activity might have developed even during

normoglycemic stage.[5, 6] Hence, the present study was planned to assess the impact of cold stress on heart rate and blood pressure in healthy offspring with and without parental history of type II diabetes mellitus.

MATERIALS AND METHODS:

The present study was conducted in the Department of Physiology, Dr. S.N. Medical College, Jodhpur, Rajasthan, India. A total of 50 subjects were selected for the study, 25 patients were healthy and non-diabetic without parental history of T2DM; and other 25 patients were healthy and non-diabetic subjects with at least one parent with T2DM. A written informed consent was obtained from each patient before the study after verbally explaining to them the procedure of the study. Exclusion criteria was patients with history of cardiac, respiratory, endocrine, metabolic, psychiatric and neurological diseases, those who are smokers or alcoholics or drug abusers, those on regular medications affecting cardiovascular and respiratory system, those undergoing any physical conditioning programme. Cold Pressor Test: Subjects were instructed to immerse the hand till the wrist in cold water (1-4 degree C) for 2 minutes or until toleration whichever is earlier. Care was taken to ensure that the subject avoided any isometric contractions, breath holding or performance of Valsalva maneuver. HR, SBP and DBP using BPL cardiac monitor was obtained from the other arm at 30 seconds interval till subject removed the hand or completion of two minutes. After removing the hand, the HR was recorded at an interval of 30 seconds for 3 minutes.

RESULTS:

Table 1 shows demographic variables of study group and controls. Mean age of study group was 20.20 years and control group were 19.80 years. Mean height in study group was 1.79 cm and in control group was 1.69 cm. Mean weight of study group was 63.28 kg and in control group was 65.87 kg. Mean BMI in study group was 21.68 kg/m^2 and in control group was 23.45 kg/m^2 [Fig 1]. Table 2 shows the comparison of heart rate before CPT, during CPT and after CPT. We observed that comparison of heart rate before CPT and during CPT at study group and control group was statistically non-significant. After CPT, the comparison of heart rate between study group and controls at various time intervals was statistically significant [Fig 2].

Table 1: Demographic variables of study group and controls

Mean values of variables	Study group	Controls	p-value
Age (years)	20.20	19.80	0.12
Height (cm)	1.79	1.69	0.28
Weight (kg)	63.28	65.87	0.11
BMI (kg/m^2)	21.68	23.45	0.23
W/H ratio	0.88	0.84	0.99

Fig 1: Demographic variables

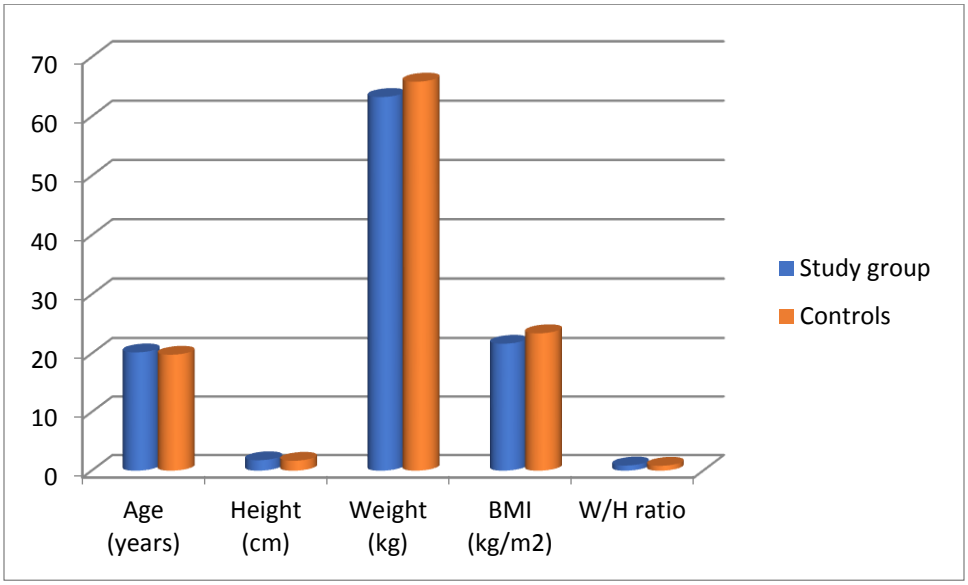
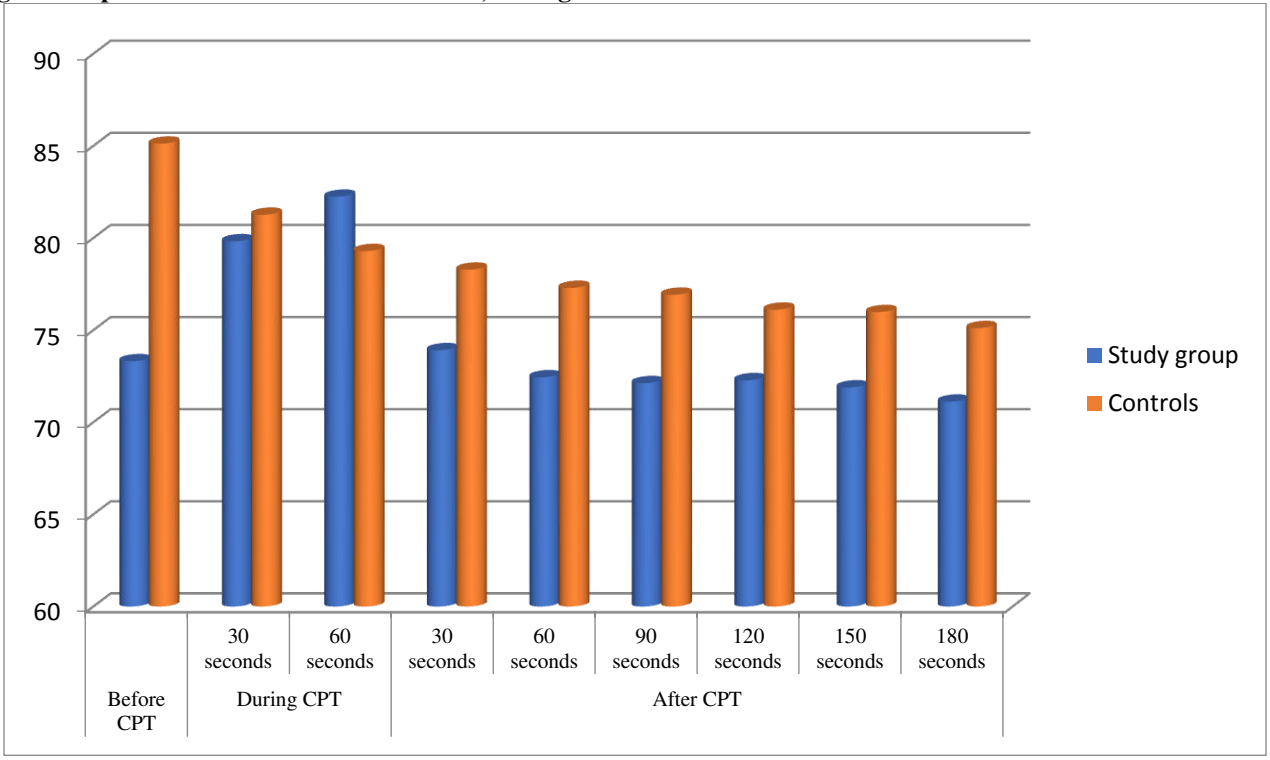


Table 2: Comparison of heart rate before CPT, during CPT and after CPT

Heart rate (bpm)		Study group	Controls	p-value
Before CPT		73.31	85.12	0.19
During CPT	30 seconds	79.82	81.26	0.70
	60 seconds	82.24	79.29	
After CPT	30 seconds	73.91	78.28	0.02*
	60 seconds	72.44	77.29	
	90 seconds	72.12	76.92	
	120 seconds	72.28	76.11	
	150 seconds	71.89	75.98	
	180 seconds	71.12	75.11	

Fig 2: Comparison of heart rate before CPT, during CPT and after CPT



DISCUSSION:

The hypothesis is that autonomic status and its reactivity to physical stress is heightened and sustained in offspring with parental history of diabetes.[4]The present study intended to evaluate the autonomic status and its reactivity among healthy offspring with parental history of diabetes and compare the same with age and gender matched offspring without parental history of diabetes. The present study showed that comparison of heart rate before CPT and during CPT at study group and control group was statistically non-significant. After CPT, the comparison of heart rate between study group and controls at various time intervals was statistically significant. The results were compared with previous studies from the literature. Grewal S et al assessed and compared the cardiovascular response to cold pressor test in non-obese and obese healthy adults. The study included 400 subjects, of which the study group included 200 adults who had body mass index (BMI) of more than 30 Kg/m,2 and 200 non-obese adults were enrolled as controls with BMI less than 25 kg/m2. The study was conducted for a period of two months. CPT was used to assess cardiac response to acute cold exposure in the present study. Baseline systolic and diastolic blood pressure recording was done using mercury sphygmomanometer during resting condition and following cold pressor test. The mean change in systolic blood pressure before and after cold pressor test (CPT) was less in obese (7.12 ± 5.28) as compared to non-obese subjects (10.38 ±6.35). This was statistically significant which indicates impaired sympathetic function in otherwise healthy obese. The study concluded that blood pressure response to cold pressor test was reduced in obese compared to non-obese subjects indicating reduced sympathetic activity in healthy obese adults. Banoo H et al tested the hypothesis that blood pressure and heart rate is

altered during the cold pressor test. Students performed the cold pressor test, to study the change in blood pressure following an environmental stress. 40 medical students from the Ist year MBBS batches were selected and tested for cold pressor test during 1 to 2 min immersion of one hand in ice water. This test used cold as a stressful stimulus. The response of the subject was measured by the change in blood pressure and heart rate after the application of cold stimulus. The study showed that the correlation between Anxiety state scores and cold pressor test response was not significant statistically. The correlation between Anxiety trait scores and cold pressor test response was also not significant statistically. The results indicated that the blood pressure and heart rate increases following an environmental stress. This activity can be easily adapted and students can learn about the test and carry out the test on their classmates.[7, 8]

Verma A et al compared the cardiovascular reactivity in male and female subjects with hypertensive and normotensive parents. Three different stressors: cold pressor task, cycling and videogame were used. Total 120 subjects were taken for the study in which 77 were male and 43 were female. Male subjects of normotensive parents had slightly higher HR rate (mean: 76.73/min) compared to the female subjects (mean: 75/min) with p value >0.05. Female subjects of hypertensive parents had higher HR rate (mean: 82.72/min) compared to the male subjects (mean: 73.95/min) with p value <0.001. They concluded that the male subjects with normotensive parents had higher resting HR, SBP &DBP than Female subjects with normotensive parents, but the difference was significant only in SBP. Krishnaveni GV et al tested the hypothesis that offspring of gestational diabetic mothers (OGDM) have high cortisol and cardiosympathetic responses during the Trier Social Stress Test for Children (TSST-C). Adolescents from a birth cohort in India, including 26 OGDM, 22 offspring of diabetic fathers (ODF), and 165 offspring of nondiabetic parents (controls) completed 5 minutes each of public speaking and mental arithmetic tasks in front of two unfamiliar "evaluators" (TSST-C). Cortisol and cardiosympathetic parameters increased from baseline during stress. OGDM had greater systolic BP, cardiac output, and stroke volume increases and a lower total peripheral resistance rise than controls during stress. It was concluded that maternal diabetes during pregnancy is associated with higher cardiosympathetic stress responses in the offspring, which may contribute to their higher cardiovascular disease risk. [9, 10]

CONCLUSION:

From the results of the present study, this can be concluded that the HR response to CPT was comparable, but after CPT the recovery of HR was smooth and gradual in the controls, whereas it was abrupt in cases.

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Source of support: Nil **Conflict of interest:** None declared