ORIGINAL RESEARCH

Influence of Induced Stress on Autonomic Activity in North IndianYoung Adults: A Cross Sectional Study

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ABSTRACT

Introduction: The autonomic nervous system is key to balance a human activity within aphysiological condition. But exaggerated sympathetic response increases metabolic function.Daily stress also plays an important role in activating sympathetic activity, but chronic stressdysfunctions sympathetic activity and has diverse pathophysiological consequences.

Aim:Thisresearch was planned to see the impact of stressors on sympathetic activity inIndian youngadults.

Methods and Methodology: This cross-sectional study was done in the Department ofPhysiology, of TMMC and RC,Moradabad for a period of six months(July – December2017) after the clearance from ethical & college research committee, Healthy young adults(N = 140) aged 18–25 years were enrolled for this study after receiving written consent. Eighty-six male subjects were in Group -1 having normal BMI (18.5-24.9kg/m2) and fifty- fourmales were enrolled in Group-2 having BMI (>25kg/m2). Their BMI was calculated bythequetelet index(kg/m2). after taking individuals height in meters and weight in kilogram.Basal systolic blood pressure and diastolic blood pressure were measured by aneroidsphygmomanometer and heart rate were calculated from lead II of ECG. These parameterswere again observed after inducing stress by Cold pressure test (CPT), bicycle ergometer, andVideo Game (VG).

Results: There was no significant difference obtained in cardiovascular activity (Heart rate,Systolic & Diastolic blood pressure) at the baseline position (>0.05) but just after inducingstress (CPT, ergometer, VG) the sympathetic activity was more noticed in Group-2 withhighly significant difference(<0.01) Most significant difference was found after the physicalstressor (ergometer) in heart rate, systolic and diastolic blood pressure (<0.001). After theCPT significant difference was found in heart rate, systolic blood pressure (<0.05) diastolicblood pressure (<0.001). Post mental stress (VG) there was significant difference in heart rateand systolic blood pressure (<0.05) and diastolic blood pressure (<0.001).

Conclusion: The sympathetic activity was maximum in Group-2 individuals with highlysignificant difference (<0.01), so they are more prone to hypertension.As a result, Group 2 isadvised to take precautionary measures by following healthy lifestyle

Keywords: Sympathetic Activity, Body Mass Index, Blood Pressure (BP), Heart Rate (HR),Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Cold Pressor Test.Ergometer, Video Game.

INTRODUCTION

The economic burden of cardiovascular diseases increases with obesity in terms of treatmentcost, reduced work efficiency as well as loss of wages, contributes substantially to family andultimately to the country and its growth. Therefore, rigorous attempts are made to reduce theprevalence of above-mentioned diseases by promoting a healthy lifestyle (exercise and byconsuming low calories diet), identification of individual who are susceptible forhypertension so that they may be counselled to take suitable precautions at adolescent age.Stress within physiological limits is not harmful for health because the autonomic nervoussystem maintains the homeostasis, exposure to chronic stress is responsible for dysfunction ofsympathetic and parasympathetic activity by acting on hypothalamo-pitutary-adrenocorticalaxis to release more and more adrenal hormone. Central nervous system plays a vital role tocontrol autonomic nervous system that is responsible for changes in behaviour and cognitionin various parts.[1,2] According to different studies, the intensity of the stress level effectsthe cardiovascular system and nervous system and leads to structural & finally functionalchanges (vascular endothelial layer) in terms of exaggerated heart rate and blood pressure onincreasing sympathetic activity by increase release of adrenal hormone via stimulatinghypothalamic pituitary axis [3-6], which results in modifications in the functioning ofvascular endothelial cells and increases thrombosis, ischemia, HR and BP. So many studieswere planned to observe cardiovascular reactivity by inducing different experimentalstressors. This study was planned to observe the increased sympathetic activity by inducing 3different types of stress (Cold Pressure test,ergometer, and VG) to observe cardiovascularreactivity (CVR). Exaggerated sympathetic activity (effect on CVR) due to different stresshas been associated with future hypertension, coronary heart disease, stroke, and many morediseases due to ischemia. Various studies have reported the successful use of the cold pressortest in predicting future hypertension.[7]

AIM

Influence of induced stress on autonomic activity in North Indian young adults

METHOD AND METHODOLOGY

This cross-sectional study was planned in the department of Physiology, of TMMC and RC, Moradabad. After following ethical protocol and receiving written consent, for a period of sixmonths (July 2017 to December 2017). One hundred forty healthy young male adults (aged18-25 years) were enrolled after the calculation of sample size (by statistician). Males aremore prone to hypertension, so this study was planned to detect north Indian male who's areinfluenced by daily stress and more susceptible to hypertension. After the random sampling,subjects were divided into two groups on the bases of their (basic parameter height in metersand weight in kilogram) BMI by quetelet index.

Eighty-six male subjects were selected in Group -1 having normal BMI (18.5-24.9kg/m2); and fifty- four male were enrolled in Group-2 BMI (> 25kg/m2). Study was done between 9 a.m. and 1 p.m. (after a gap of 2 hours oflight breakfast).

INCLUSION CRITERIA

Normal healthy male, BMI (>18.5kg/m2),

EXCLUSION CRITERIA

Subjects with higher blood pressure (140/90 mm Hg), increasedHR(<90/min), bone injury in their dominant hand, frequently alcohol users and self-reportedacute /chronic illness were barred from participating in this study. Their baseline heart rate(HR), was calculated by ECG recordings, using Lead 2 [8]. systolic blood pressure (SBP) anddiastolic blood pressure

(DBP) measured by aneroid sphygmomanometer.[9] All the healthyparticipants went through three stressor tests: coldpressor test (CPT)[9], bicycleergometry[10], and most wanted video game[11]. with a gapof one hour between each stress test. Stress was suggested to stimulate sympathetic activity.[12] In a quiet room maintained atnormal room temperature the study subject was seated andbaseline heart rate and bloodpressure were recorded.

COLD PRESSURE TEST

The subject was instructed to immerse his non-dominant hand withpalmdown 5 cm above the base of container, containing cold water and ice separated withthe helpof aluminium separator into a circulating water bath having a temperaturemaintained at 0-1^{o}C. Time of immersion (1 min) was recorded using a stopwatch.

BICYCLE ERGOMETRY(ISOTONIC EXERCISE)

Subject was asked to sit on the ergo-meter andperform cycling for a period of 5 minutes. The tension developed was recorded as change inHeart rate and blood pressure immediately after 5 after moderate exercise.[10]Most wanted video game-The subject was given the relevant instructions about the game,and assured thatthe result obtained didn't matter, after a practice time of 1 minute on thepersonal computerHCL, Video Game (NFS/most wanted) in which the subject had to savehimselffrom policeattack. The subject was allowed to play videogame for 10 minutes, heartrate and bloodpressure were recorded again.

STATISTICAL ANALYSIS

All statistical analyses were performed using SPSS version 25. Patientdemographiccharacteristics were analysed using the t-test for independent groups. Theresults werepresented in number, mean and standard deviation as appropriate. Parameters forCVR interms of difference in HR rate, systolic/diastolic pressure were analysed usingStudent T –Test. A p-value of <0.05 (2-tailed) was considered statistically significant. Thisprocedurecalculates the difference between the observed means in two independent sample.Asignificant value and 95% confidence interval of difference in reported. The p-value is theprobability of obtaining the observed difference between the samples if the null hypothesiswere true.

RESULTS

This comparative study consists of 140 individuals with normal body mass index (Group-1)and increased body mass index (Group -2). Individuals in both groups were well matchedwithage (18-25 years). On comparing of basal parameter (age, BMI, heart rate, systolic bloodpressure anddiastolic blood pressure). There was only significate difference was found in theBMI onlysympathetic activity was more noticed in Group-2 with highly significantdifference. Mostsignificant difference was found after the physical stressor (ergometer) inheart rate, systolicand diastolic blood pressure (<0.001). After the CPT significant differencewas found in heartrate, systolic blood pressure (<0.05) diastolic blood pressure (<0.001).Post mental stress(VG)there was significant difference in heart rate and systolic bloodpressure (<0.05) and diastolicblood pressure (<0.001).

Table 1: Parameters for CVR in terms of difference in HR rate, systolic/diastolic pressurewere analysed using Student T –Test Group-2 male subjects had higher value of body massindex with significant difference (p-value is <0.05). comparison of resting heart rate (HR),systolic blood pressure (SBP)and diastolic blood pressure (DBP). Heart rate was recordedslightly higher in group-2 than group-1 male with no significant difference (p-value >0.05),But Group-2 showed increased values of SBP & DBP with statistically nonsignificantdifference because the p-value>0.05.

Table 2: Post Cold pressure test, we observed that difference in heart rate (dHR), systolicblood pressure (dSBP)with statistically significant difference (<0.05) & diastolic bloodpressure(dDBP) had highly significant difference (<0.001) in individual Group-2 than Group-1 which was calculate by student- t test.
Table 3: Post subjection of physical stress sympathetic reactivity was statisticallysignificantly higher heart rate, systolic blood pressure & diastolic blood pressure (dHR,dSBP, dDBP), in Group-2 than Group-1(<0.05), calculate by student- t test.
Table 4: The difference was obtained in heart rate (<0.05), systolic blood pressure anddiastolicblood pressure(dHR, dSBP, dDBP) (<0.001) in Group-2 than Group-1 which werestatisticallysignificant, which was calculate by student- t test.

Table 1: Comparison of Basal Parameters of Group-1 and Group-2 Individuals.

Basalparameter	AGE	BMI	HR	SBP	DBP
Group-1(n=86)	21.31±0.82	24.18±2.82	75.88±5.52	116.97±6.91	71.88±6.34
Group-2(n=54)	21.24±0.88	31.47±1.42	74.94±5.77	118.59±7.87	74.14±7.54
P-value	0.63	0.0001	0.342	0.217	0.07

* Cardiovascular reactivity after each stress of every individual subject was expressedin terms of increased heart rate (HR) as dHR (in per/min), systolic (SBP) and diastolicblood pressure (DBP)as dSBP&dDBP(mmHg) by calculating difference betweenresting parameter with increased sympathetic reactivity. So, the values, in the table arerevolving around this concept

Table 2: Comparison of sympathetic activity in Group-1 and Group-2 after Coldpressure test

Sympathetic activity	dHR	dSBP	dDBP
Group-1(N=86)	1.11±1.22	2.46±1.35	2.09±0.95
Group-2(N=54)	2.31±1.22	2.92±1.14	2.74±0.97
P-value	0.0001	0.039	0.0001

Table 3: Comparison of sympathetic activity in Group-1 with Group-2 after bicycleergometer

Sympathetic activity	dHR	dSBP	dDBP
Group-1(N=86)	1.19± 1.06	2.32±1.45	2.30±1.34
Group-2(N=54)	2.12± 1.16	3.14± 1.37	2.92±1.14
P-value	0.0001	0.0011	0.0055

Table 4: Comparison of sympathetic activity in Group-1 and Group-2 after mostwanted Videogame

Sympathetic activity	dHR	dSBP	dDBP
Group-1(N=86)	0.43± 0.51	0.81±1.07	0.76±1.14
Group-2(N=54)	1.22± 0.71	1.88± 0.90	2.14±1.21
P-value	0.0001	0.0001	0.0001

DISCUSSION

On comparison of basal parameter (heart rate and blood pressure between Group-1(18.5-24.9kg/m2) and Group -2(>25kg/m2) individuals, increased HR was observed in Group-1than Group-2. with statisticallyinsignificant difference & basal blood pressure was recorded higher in the individuals havingincreased body weight (Group-2). This difference in blood pressure was also statisticallyinsignificant.

On comparison of cardiovascular activity after inducing stress, Most significant differencewas found after the physical stressor (ergometer) in heart rate, systolic and diastolic bloodpressure in Group-2 than Group-1. After the CPT significant difference was found inheartrate, systolic blood pressure diastolic blood pressure in Group-2 than Group-1. Postmental stress (VG)there was significant difference in heart rate and systolic blood pressureand diastolic blood pressure in Group-2 than Group-1. According to de Kloet increased bodymass index is responsible for the high blood pressure in Group-2 [2].

Rajalakshmi et al. studied on 245 healthy individuals and concluded that the body weightwasstrongly associated with heart rate and blood pressure [13]. It was suggested that BMI isthe better predictor for systolic as well as diastolic blood pressure. Since BMI differing vastlyfrom the normal range can affect blood pressure and consequently, the results. Subjects withBMI <18 (underweight) was excluded from this study.

This study evaluated the effect of induced stress on sympathetic activity in terms ofdifference in HR and BP. After subjection of stress (CPT, video gaming, and bicycleergometry),sympathetic reactivity was recorded in the Group-1 (BMI-18.5-24.99kg/m2)individual than Group-2(BMI- >25kg/m2) subjects. On comparison, the augmentedsympathetic activity obtained to stressors with Group-2 was significantly higher values ofdHR, Dsbp&dDBP than with Group-1. Though this study did not consider consanguinity, itwas focused on the reactivity of cardiovascular system to different stimuli [7] Many authorsshowed a positive association between cardiovascular diseases and stress [13-15] andreported that acute stress is responsible for quick rise in blood pressure for small duration, butthe long history of stress debilitates the sympathetic and parasympathetic function [16-18].According to the Mathews et al. [19], American young adults had low resting heart rate andblood pressure than Indian young adults. As the different studies was resultant that theincreased blood pressure is more prone to hypertension. According to different studiescardiovascular activities were higher after inducing stress in the individuals of increasedBMI(>25kg/m2) than normal BMI (<18.5- 24.99kg/m2) [20-22]. According to Hebert S etal., the group those how were playing game with the sound, had higher cardiovascularactivity than the group how were playing game with muted sound. So according to Hebert,music was responsible for releasing cortisol hormone which increases cardiovascularreactivity on video gaming [21]. Another study compared cardiovascular reactivity aftersubjection of physical (Hand grip dynamometer) and pain stress (Cold Pressor Task), foundsignificant increase in the group of obese individuals by physical and pain stress than normalbody mass index, as well as increased heart rate and systolic and diastolic blood pressure inoverweight and obese individuals. This study was also use three stressor mental stress (videogame) physical stress (bicycle ergometer) and pains stress (cold pressure task) as stressors,which demonstrated that participants in Group-2 had significantly higher diastolic bloodpressure than Group-1. Some authors results suggest that all stressors are not bad for health,moderate and emotional stress improve memory, performance, and regular physical activityact as buffers [23-24]. This study was different from Kumar et al.'s study, that study didn’tconsidered weight of the individuals and there was no significant difference was obtained onsubjection of mental stress (Video game) [25]. Phillips had observed that the severe obesityand the depression diminished the Cardiovascular reactivity due to self-reported health issues[14].

CONCLUSION

In Basal parameter, Group-1 Individuals (BMI <18.5-24.99kg/m2) had higher basal heart ratethan the Group-2 (BMI >25 kg/m2) individual but Systolic and diastolic blood pressure werehigher in group-2(>25 kg/m2) with statistically insignificant difference. Post stress,sympathetic reactivity was higher in Group-2(BMI >25 kg/m2) individuals with significantdifference. The physical stress (bicycle ergometer) showed maximum

cardiovascularreactivity in the Group-2 (BMI >25 kg/m2) individuals than other stressors (cold pressor testand videogame) of group-1(<18.5-24.99kg/m2) individuals.

LIMITATIONS

More subjects should be strengthening the result.We will further plan to analyse Genetic effect gender-based study with their body massIndex.

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