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Autonomic Function test in person with Obesity aAmong Mid-Western Population of Nepal

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ABSTRACT

Objective: Autonomic dysfunction qualifies a major public health problems owing to their high prevalence and incidence globally. Among many predisposing factor of autonomic neuropathy such as age, gender, genetic, diabetes etc, obesity also has significant impact. Although a lot of progress has been achieved in past decade on accessibility and awareness about health, the obesity remains impending and burgeoning health concern in Nepal. With this trend, we can foresee that the Body Mass Index (BMI) one of the commonly used indirect measure of obesity, might potentially turn out to be one of the leading factor of autonomic dysfunction. **Methods**: 100 healthy subjects were screened and divided into 2 groups- Group I (BMI>30) and Group II (BMI< 30). Height & weight were measured & BMI was calculated. Resting heart rate (RHR) was recorded with Lead II of ECG. Blood pressure (BP) and Heart Rate (HR) were recorded in supine position and on immediate standing. Cold pressure test (CPT): Resting BP was recorded in sitting position. Then the subjects were asked to immerse the hand in cold water, and the BP was measured from other hand. Data was analyzed using SPSS 16 (Statistical Package for Social Science). **Result:** Our result showed that RHR of Group I (79.32±4.22) was higher than that of Group II (74.38±7.26). However, on student –T test, BP and HR response to immediate standing (P=0.34 &P=0.23 respectively) were non-significant between group I and group II person. When the correlation was done for the change in BP in response to CPT in between obese and non-obese person it was found to be significant (P=0.04). **Conclusion:** Our data suggests that the BMI can be a predictor of autonomic dysfunction.

***Key words**: Autonomic function, body mass index, cold pressor test, resting heart rate,*

INTRODUCTION:

The prevalence of obesity is rising in developed and developing nations and has been called as "New World Syndrome"[1]. Obesity is associated with the metabolic risk factors such as high blood pressure (BP), body fat abnormality, and glucose intolerance which may influence the morbidity and mortality due to cardiovascular diseases (CVD)[2,3]. Most of these deleterious effects are more likely if the excess body fat is mainly stored in the upper body, with abdominal visceral fat being the most critical when evaluating the health risks of obesity[2]. Decreased physical activity, increased consumption of calorie-dense foods and psychosocial stress are few among many factors behind increased obesity among population[4]. Beside being a risk factor for cardiovascular disease, certain cancers and type II diabetes, obesity has also been suggested to be a risk factor for autonomic nervous system (ANS) dysfunction because the energy metabolic balance and cardiovascular system (CVS) is controlled by the ANS[5-7].

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Body Mass Index (BMI) is a statistical measure of body size based on an individual's weight and height which is regarded as indirect & easy measure of obesity[8]. Body Mass Index (BMI) as well as other measures of fat distribution including Waist Circumference (WC) and Waist Hip Ratio (WHR) has been correlated with the cardiovascular autonomic dysfunction in many studies[9,10].

In the past decade, ANS dysfunction and consequently CVD has become burgeoning problem in South Asian population due to changing diet and lifestyle, it is imperative to have similar studies in this population[11]. High-caloric intake increases norepinephrine (NE) turnover in peripheral tissues, raises resting plasma NE concentrations- an indirect measurement of Sympathetic Nervous System (SNS) activity and amplifies the rise of plasma NE in response to stimuli such as upright posture. Moreover high dietary content in fat and carbohydrate has been suggested to acutely stimulate peripheral alpha & beta-adrenergic receptors, leading to elevated sympathetic activity[12]. So far, only few studies confined to specific population has been conducted the south Asian population. Moreover studies have suggested that people of this origin have increased cardiovascular risk due to more centralized deposition of body fat with higher mean of WC & WHR to Europians[11,13,14]. It has recently been shown that South Asian children have higher body mass adjusted Blood pressure (BP) levels than white American–Caucasian children[15]. Furthermore, World Health Organization (WHO) has also lowered the cut offs for overweight and obesity for the Asian population, which again points to the fact that Asian and especially south Asian population suffers from an overall higher obesity related autonomic hypofunction risk[16]. Therefore understanding the relation of adiposity with cardiovascular autonomic dysfunction into specific population is essential. Although a lot of progress has been achieved in past decade on accessibility and awareness about health, the obesity remains impending and burgeoning health concern in Nepal. With this trend, the aim of this study was to evaluate the autonomic neuropathy in obese person by evaluating the sympathetic and parasympathetic tests.

MATERIAL AND METHODS

This cross sectional prospective study was conducted in Department of Physiology, Nepalgunj Medical College Teaching Hospital (NGMCTH) from 2016-12-5 to 2017-4-6. Total 100 healthy subjects of the age range 30 to 55 years who gave the consent were included from the staff and student population in the study and were divided into two groups- Group I (BMI>30) and Group II (BMI< 30). The subjects with the history of diabetes, hypertension (HTN) and known history of chronic illness, and known neuropathy of any other illness, current smokers were excluded from this study.

Anthropometric Measurement:

The anthropometric measurement was measured by standard procedures. The height was measured by stadiometer with subjects having their shoes removed.[17] The body weights of the subjects was measured in light clothing, without shoes[17]. BMI was determined by dividing weight in kilogram (kg) by height in square meter (m^2)[18].

Autonomic Function Test:

Resting heart rate (RHR) was recorded with Lead II of ECG. On the ECG, instantaneous R wave-to-R wave (RR) interval was evaluated and heart rate was calculated by using the formula: 1500/ RR interval (mm)[19].

Heart Rate (HR) response to immediate standing from supine position

Heart Rate (HR) was recorded in supine position when subjects are in fully resting state and on immediate standing with Lead II of Electrocardiograph (ECG).

Blood Pressure (BP) response to immediate standing from supine position

BP was recorded with the help of mercury sphygmomanometer in supine position when subjects are in fully resting state and on immediate standing. The measurements of systolic (SBP) and diastolic blood pressure (DBP) were taken and Mean arterial blood pressure (MAP) was calculated for each of the two readings taken for SBP and DBP[20,21].

Cold pressure test (CPT): Resting BP was recorded in sitting position. Then the subjects were asked to immerse the hand in cold ice water with temperature maintained at 4-6° C, and the BP was measured from other hand after 1 minute.

Data Analysis:

Data was analyzed with statistical IBM SPSS statistics version 16. Different anthropometric and cardiovascular variables were compared between the groups using Students's independent *t* test and the data are represented as mean standard deviation (SD).

RESULT

Distribution of subject according to gender	Male	Female	Total
Group I	37	13	50
Group II	35	15	50
Total	72	28	100

Table I: Showing demographic representation of the subjects. Among the 100 subjects examined (age 30 to 55 years) females were 28 and the males were 72 in number

	Group I Mean± S.D	Group II Mean± S.D	P value (Independent T-Test)
Difference in SBP	11.08±5.48	12.5±6.65	0.24
Difference in DBP	7.68±4.26	7.48±3.72	0.80
Difference in MAP	8.81±3.65	8.81±3.65	0.64
Difference in HR	4.04±4.04	4.66 ±2.59	0.36

The $p < 0.05$ was considered statistically significant

Table II: Blood Pressure (BP) & Heart rate (HR) response to immediate standing from supine position of group I & group II

Variables	Group I	Group II	P- value
Age	44.24±4.82	43.52±7.04	0.24
BMI	32.5±1.84	27.88±1.99	0.02*
SBP(Supine)	126.84±6.88	123.22±8.54	0.69
DBP(Supine)	90.98± 6.47	80.84±7.26	0.47
MAP(Supine)	102.93±5.38	94.96±7.27	0.08
SBP(Standing)	115.76±6.40	110.72±7.26	0.23
DBP (Standing)	83.42±6.74	73.36±6.69	0.86
MAP(Standing)	94.19±5.34	85.81±6.73	0.83
RHR	79.32 ± 4.22	74.38 ± 7.26	0.00*
HR(Supine)	79.32 ± 4.22	74.38 ± 7.26	0.10
HR(Standing)	83.36±7.03	79.02 ± 4.51	0.01*
SBP (Baseline)	126.84±6.88	123.10±8.33	0.62
DBP(Baseline)	91.24± 6.42	80.64±7.06	0.53
MAP(Baseline)	103.01±5.19	94.79±7.04	0.75
SBP(CPT)	133.34±6.03	128.68±8.54	0.18
DBP(CPT)	97.94±5.16	86.80±6.44	0.20
MAP(CPT)	109.71±4.87	98.09±6.50	0.80

*The $p < 0.05$ was considered statistically significant

Table III: Showing the anthropometric and hemodynamic variable of groupI & group II

	Mean ±S.D (Before CPT)	Mean + S.D (After CPT)	P value
SBP	126.56±6.61	133.34±6.032	0.00*
DBP	91.2±6.42	97.94±5.16	0.00*
MAP	103.01±5.19	109.97±4.87	0.00*

*The $p < 0.05$ was considered statistically significant

Table IV: Comparison of blood pressure (BP) before and at 1 minute after Cold Pressor Test (CPT) of Group I

	Mean ±S.D (Before CPT)	Mean + S.D (After CPT)	P value
SBP	123.10± 8.33	128.68±8.54	0.00*
DBP	80.64±7.06	86.80±6.44	0.00*
MAP	94.73±7.04	98.09±6.50	0.00*

The $p < 0.05$ was considered statistically significant

Table V: Comparison of blood pressure (BP) before and at 1 minute after Cold Pressor Test (CPT) of Group II

	Δ in BP Group I	Δ in BP Group II	P value (Independent T-Test)
SBP	6.94±3.86	5.58±2.67	0.04*
DBP	6.7±4.5	6.16±3.27	0.49
MAP	6.7±4.5	3.3±3.28	0.00*

The $p < 0.05$ was considered statistically significant

Table VI: Difference (Δ) in BP before and after the Cold Pressure Test (CPT)

DISCUSSION

The present study was designed to evaluate any alternation in cardiac autonomic function in obese and non-obese person by evaluating the sympathetic and parasympathetic tests. Many studies have reported the relation of Autonomic Dysfunction, especially of Cardiovascular System with anthropometric parameters such as BMI, WHR, WC, Hip Circumference (HC), Subcutaneous Fat (SF) etc[2-3, 22-23]. There are inconsistencies in their finding, which can be ascribed to the diversity in sample population. Additionally, there might be some methodological differences behind inconsistency in results. However one should not undermine that correlation of anthropometric variable with fitness parameters such as BP and pulse rate (PR) can be affected by lifestyle, exercise habits, over all environment and genetics among the population. Therefore our study was aimed to determine the relationship of parameters in small cohort of population in Nepal, where any of such studies has not been reported.

The study screened 128 random subjects attending NGMCTH; among which 100 subjects who met the inclusion criteria were selected. Provided the subjects included in this study were not diagnosed with HTN in past five years. Among the 100 subjects 28% of the study population were female and 72% were male.

The present study provides the significance of BMI with RHR, change in BP & HR from supine to immediate standing, and change in BP before & after the CPT suggesting the better anthropometric for predicting Autonomic dysfunction in both sexes.

The results presented in the table II indicates that the RHR of Group I was higher than that of Group II. Our result also confirms with some of other studies that have found that both RHRst (standing) and RHRsup (supine) are significantly greater in persons having general obesity or central obesity as compared to non-obese individuals[24]. Obesity and the cardiac autonomic nervous system are intrinsically related. A 10% increase in body weight is associated with a decline in parasympathetic tone, accompanied by a rise in mean HR, and conversely, HR declines during weight reduction[25-27].

Reductions in vagal activity with increment in weight may be one mechanism for the arrhythmias and other cardiac abnormalities that accompany obesity. The result also indorses the statement from one of research article that higher heart rate might predispose to the development of obesity and diabetes mellitus (DM), implying the role of sympathetic system in the development of obesity and DM[28]. In obese subjects a reduction in body weight exerts a marked reduction in sympathetic activity owing to central sympathoinhibition. This could be the consequence of a restoration of the baroreflex control of the cardiovascular system with weight loss[29].

However, on student–T test, BP and HR response to immediate standing (P=0.64 & P=0.36 respectively) were found to be non-significant between obese and non-obese person as shown in the **table II.** The non-significant relation of BP and HR with change in posture in the present study might be due to fewer sample size of different age groups. Moreover the HRstanding was statistically significant in between two groups (p=0.01). Nevertheless the association with HR has been reported in many studies[24].

In **table VI** when the significance was seen for the change in BP in response to CPT in between obese and non-obese person it was found to be significant for SBP & MAP (P=0.04, 0.00 respectively). However, the difference in mean DBP recorded before and after CPT was non-significantly (p=0.49) more in group I (6.7±4.5 mmHg) as compared to group II (6.16±3.27 mmHg). The DBP is the direct measure of total peripheral resistance (TPR) and is less fluctuating that SBP which is mainly a direct measure of cardiac output[21]. However earlier studies have reported affect in DBP associated with obesity[30]. MAP shows strongest statistical significance with CPT. Results of our study correlate with observations made by other workers[31].

It may be because of the fact that the CPT triggers the sympathetic nerve activity, and impaired CPT in overweight persons may be due to hypo function of sympathetic Nervous System[31]. The causes of impaired sympathetic activity in obesity are not fully understood, but recent studies suggest that hormones, such as leptin, released from fat cells may directly stimulate multiple regions of the hypothalamus, which, in turn, have an excitatory influence on the vasomotor centers of the brain medulla[32].

Therefore our study have found that BMI is a good indicator of cardiovascular autonomic dysfunction risk factors, and should be incorporated into a public message and awareness programs.

CONCLUSION

Thus our study shows that in person with obesity with higher BMI are at high risk for autonomic dysfunction as compared to person with normal weight. Relevant anthropometric index can serve as excellent indicators if used based of scientific validation.

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