

Correlation Of BMI with Sympathetic skin response and Galvanic skin resistance In Healthy Women

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Abstract

Introduction: Body Mass Index (BMI) is the marker for body fat content and is one of the most commonly used parameters to quantify and grade obesity. Obesity, a global epidemic is considered to be a state of Sympathovagal imbalance. BMI ($>25\text{kg/m}^2$) is not only risk factor for cardiac disorders but also altered autonomic functions. Sudomotor activity refers to electrical skin conductance of sweat glands by post ganglionic sympathetic type C nerve fibres. Sympathetic skin response (SSR) and Galvanic skin resistance (GSR) are the tools to measure the Sudomotor activity in an individual. The present study is conducted to find correlation of BMI with that of SSR and GSR in healthy women.

Materials and Methods: In present study 35 healthy women in the age group of 25-40 years were recruited for the study. The Subjects with known autonomic disorders, those on medications for autonomic dysfunction and pregnant women were excluded. After measuring height and weight, BMI was calculated using the Quetelet's index to the nearest decimal. SSR and GSR were recorded in Electrophysiology lab using the standardized procedure by AD instrument with lab chart 8 software. Results were analyzed using Pearson's correlation coefficient.

Results: In present study the BMI (kg/m^2) observed as 24.8 ± 4.7 , SSR latency was $1.36 \pm 0.21\text{sec}$ showing a decreasing value with increasing BMI and was statistically significant. SSR Amplitude was $3.11 \pm 1.72\text{mv}$, GSR supine was $15.69 \pm 4.01 \mu\text{s}$, GSR Standing was $3.75 \pm 3.30 \mu\text{s}$.

Conclusion: Individuals with higher BMI have faster conduction of the sympathetic skin response as shown by the decreasing SSR latency. This supports the previous studies that People with higher BMI values in near obesity range have an increased sympathetic activity and that sudomotor activity can be used to assess cardiac autonomic dysfunction in these individuals .

Keywords: SSR Amplitude, GSR, Sudomotor activity, BMI.

Introduction

Obesity is the current serious public health problem with established cardiovascular comorbidities and a major cause of sudden death in developed as well as developing countries [1,2,3]. BMI is a simple index of weight for height commonly used to classify underweight, normal, overweight and obesity in adults. It is defined as the weight in kgs divided by height in metres square (kg/m^2) [7,10] WHO has set standards for overweight and obesity by defining it as BMI $\geq 25 \text{ kg/m}^2$ and $\geq 30 \text{ kg/m}^2$ respectively. But the BMI cut off point for overweight ($\geq 23 \text{ kg/m}^2$) and obese ($\geq 25 \text{ kg/m}^2$) for Asians

are lower than the WHO criteria. Previous studies have shown that obesity might be linked with not only higher risk factor for Cardiovascular Heart Disease (CHD) but also reduced ANS activity. [9,11]. Sudomotor function can be assessed by several methods; however, the absence of reliable, simple, quick, and quantitative methods of evaluating sweat-gland function has limited their widespread use.[12] The electrochemical skin conductance (ESC) test is a widely accepted noninvasive and objective method for quantification of sudomotor function.[13] The test is also simple and rapid, requiring <2 min for completion. The ESC test is based on the principle of an electrochemical reaction between the chloride-ions in sweat and the electrode plates in contact with the soles/palms and the results are reported as ESC values. [13,14] Sympathetic skin response (SSR) is a change in potential recorded from the surface of the skin and represents sudomotor activity. In literature, SSR is described by several terms such as electrodermal activity, electrodermal response, psychogalvanic reflex, peripheral autonomic surface potential, endosomatic skin response. However, the most frequently used term is sympathetic skin response. [5,6] The galvanic skin resistance or conductance (GSR) refers to the resistance of the skin to a very small galvanic current (5 μ A) and is caused by the activity of the sweat glands [12] The early detection and analysis by using simple non-invasive autonomic function tests like SSR and GSR may help to detect subclinical affection of the ANS before the appearance of symptoms or signs of autonomic dysfunction. Thus, the present study has been attempted.

Materials and Methods

In present study 35 healthy women in the age group of 25-40 years were recruited for the study. The Subjects with known autonomic disorders, those on medications for autonomic dysfunction and pregnant women were excluded. After measuring height and weight, BMI was calculated using the Quetelet's. Index to the nearest decimal [7], SSR and GSR were recorded in Electrophysiology lab using the standardized procedure by AD INSTRUMENTS WITH POWER LAB 26 T data acquisition unit (version 8 1.3 01-03-2016) with LAB CHART 8 software. POWER LAB 26 T with an 8-channel bio- amplifier with a ML 408 5 channel dual amplifier cable with lead wires to connect to ECG electrodes was used. Results were analyzed using Pearson's correlation coefficient.

SSR was recorded in the supine position using deep inspiration as a stimulus. The latency of the SSR was calculated by the time lag in seconds between the onset of EMG of nares and the onset of the SSR waveform. The amplitude of the SSR was given by the peak to peak distance between the positive and negative waves of the SSR.[5]GSR finger electrodes were fixed to the volar aspect of the index finger and middle finger of the non-dominant hand by the Velcro attachment. Initially the supine or basal GSR value is recorded. And Subsequently during the act of standing, the change in GSR was recorded at the sweep speed of 100 mm/sec and change in conductance was noted in micro-Siemens.[5,6]

Results

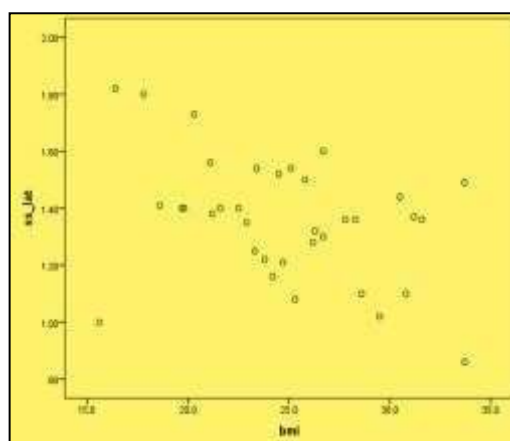
In present study the BMI(kg/m²) observed as 24.8 $\pm$ 4.7 kg/m², SSR latency was 1.36 $\pm$ 0.21 sec, SSR Amplitude was 3.11 $\pm$ 1.72mv, GSR supine was 15.69 $\pm$ 4.01 μ S, GSR Standing was 3.75 $\pm$ 3.30 μ S (Table 1)

Table 1. Showing the parameters of study

Parameters	MEAN $\pm$ S.D
BMI (kg/m ²)	24.8 $\pm$ 4.7
SSR Latency (Sec)	1.36 $\pm$ 0.21
SSR Amplitude (mv)	3.11 $\pm$ 1.72
GSR supine (μ s)	15.69 $\pm$ 4.01
GSR Standing (μ s)	3.75 $\pm$ 3.30

Parameters	Pearson's rho r value	p value
SSR Latency	-.392*	.020*
SSR Amplitude	.095	.588
GSR Supine	.135	.438

*P value significance at 0.05 level



$r = -0.392$, $p < 0.05$

Discussion

Present study conducted to find Correlation of BMI with SSR and GSR parameters in healthy women. In present study the BMI(kg/m²) observed as 24.8 $\pm$ 4.7 kg/m², SSR latency was

1.36±0.21 sec, SSR Amplitude was 3.11±1.72mv, GSR supine was 15.69±4.01 μ s, GSR Standing was 3.75±3.30 μ s. Our study revealed decreased SSR latency which was statistically significant implying a strong negative correlation with the BMI, however other parameters showing not much variation or significance. Thus agreeing with the Study done by Keller N et al concluding that sudomotor function impairments were detected in female patients with obesity compared to the controls with normal BMI. Their study also showed Cardiovascular autonomic dysfunction by other autonomic function tests like Valsalva-ratio suggesting the presence of parasympathetic dysfunction. Sudomotor dysfunction, which frequently occurs in autonomic neuropathy, was examined with Neuropad® screening tests in their study subjects. The tests revealed a decreased perspiration in patients in comparison to controls both on the right and left sole, confirming the deterioration of autonomic function in female patients with obesity and also impairments in peripheral sensory neuronal and sudomotor function in female patients with obesity compared to controls with a normal BMI value [17] It is known that obesity is associated with sympathetic nervous system overdrive, which is considered as a compensatory mechanism for the increase in energy consumption, thus enabling restoration of the energy equilibrium (18, 19,20). Accordingly, sympathetic nervous system activity was demonstrated to have a correlation with visceral fat accumulation (20) In contrast to the above , Studies done by shivprasad C et al and also by vinik et al showed no effect of sex or body mass index on ESC. They have performed this analysis on 217 healthy adults to derive normative data for Indians. This sample size ensures the reliability of the study results as a reflection of the population at large which can be the limitation in our study. However no differences were observed in relation to BMI and gender. A slight decrease in ESC was noted with increasing age. [15,16]. Study done by Pal GK et al using the HRV indices to assess the cardiovascular risk in obese and non-obese also revealed basal Cardiovascular parameters were significantly increased in overweight and obese subjects compared to controls. Low-frequency to high-frequency ratio (LF-HF ratio), marker of sympathovagal imbalance (SVI) was increased in overweight and obese subjects compared to controls. Total power (TP) and high frequency component expressed as normalized unit (Hfnu) which reflects the overall vagal drive to heart, was significantly decreased and low frequency component expressed as normalized unit (Lfnu) which reflects the sympathetic cardiac modulation, was significantly increased, in overweight and obese subjects compared to controls. These CV risks were predominately more in obese compared to overweight subjects. [3]. Nica A E, Rusu E, Dobjanschi C G, et al. (March 29, 2024) in their study to assess the Importance of Evaluating Sudomotor Function in the Diagnosis of Cardiac Autonomic Neuropathy (CAN) revealed that Electrochemical skin conductance was lower in the CAN positive group than the CAN negative group in hands (67.34±15.51 μ S versus 72.38±12.12 μ S, p=0.008) and feet and Sudoscan-CAN score remained significantly associated with age and high BMI. [21]

Conclusion: Obese individuals have faster conduction of the sympathetic skin response as shown by the decreasing SSR latency. This supports the earlier findings that obesity is associated with increased sympathetic activity. limitations of this study being the small sample size, gender preference and the other Obesity indices such as waist circumference, hip circumference, waist–hip ratio (WHR) were not studied. Thus higher BMI individuals can be screened for sudomotor activity which can identify patients with an increased risk of Cardiac autonomic neuropathy. Its integration into clinical practice can improve patient outcomes through early detection, risk stratification, and personalized treatment approaches.

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