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RESEARCH ARTICLE

Ulnar nerve motor conduction velocity correlates with body mass index in Indian young healthy subjects

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ABSTRACT

Background: The prevalence of obesity is on rise globally, which poses a risk of vascular inflammation and metabolic dysregulations. Nerve conduction is affected by altered lipid metabolism, inflammation, and oxidative stress. Motor nerve conduction velocity (NCV) is a routine electrodiagnostic technique for detecting changes in nerve conduction parameters. There are contrasting results in studies done to investigate the relationship between NCV and body mass index (BMI). Few studies show increased conduction velocity with an increase in BMI, while others found either decreased or no change in conduction velocity with change in BMI. **Aims and Objectives:** The objective of this study was to investigate the relationship between motor NCV and BMI. **Materials and Methods:** In this study, we selected 27 individuals with normal weight, overweight, and obese categorized based on BMI and performed ulnar and median NCV. Correlation statistics were applied to see the relationship between BMI and motor NCV. **Results:** We found significant positive correlation between BMI and ulnar motor NCV ($P = 0.027$, $r = 0.43$). Ulnar and median NCV was also found correlating significant ($P = 0.021$, $r = 0.45$). **Conclusion:** The findings of our study suggest that the NCV correlates with BMI in lower BMI groups due to the maintenance of local optimum temperature, while in people with higher BMI inflammatory changes impair nerve conduction, a comparison in larger sample size is required to substantiate this observation is required though.

KEY WORDS: Obesity; Body Mass Index; Nerve Conduction Velocity; Indian Obesity

INTRODUCTION

The prevalence of obesity in India ranges from 10% to 40%.[1] The obesity is characterized by increased body fat (BF), which is observed with dyslipidemia, insulin resistance, cell organelles stress, and vascular inflammation.[2-4] Altered lipid metabolism and oxidative stress associated with obesity may affect nerve conduction velocity (NCV). Motor NCV is an important and routine electrophysiological recording with high sensitivity to report conduction abnormalities of nerve. NCV along with quantitative sensory tests have been found highly reproducible and complementary to each other in diagnosing early changes in disorders affecting nerve diameter or myelination, for example, diabetic neuropathy.[5]

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A study performed in 18 male athletes demonstrated an inverse linear correlation between BF percentage (BFP) and tibial NCV.[6] In another study, there was inverse correlation between compound action potential and body mass index (BMI), but no correlation was observed between BMI and NCV.[7] In a study performed on healthy subjects, the conduction velocity of calcaneal sensory nerve action potential (NAP) and distal posterior tibial and lateral plantar motor NAP was found to decrease with height and BMI.[8]

In the same line, another study reports decreased sensory NAP amplitude decreases with increasing BMI.[9] A study performed on Indian defense personnel could not find any correlation between NCV and BMI,[10] while another study conducted on Type II diabetes mellitus patients concluded that BFP was positively correlated with NCV of motor-sensory ulnar nerve and motor peroneal nerve and negatively correlated with distal latency of sensory ulnar nerve, sensory superficial peroneal nerve, motor peroneal nerve, and motor amplitude of peroneal nerve.[11] In a study intended to study the effect of BMI on ulnar NCV, ulnar neuropathy at the elbow, carpal tunnel syndrome observed increasing BMI directly correlated with increasing ulnar motor NCV across the elbow but not with forearm NCV. Across-elbow ulnar motor NCV may be falsely increased in patients with a high BMI. Not only do relatively slender individuals have comparatively slower across-elbow ulnar NCVs but also they are also at increased risk for developing ulnar neuropathy. People with high BMI are at increased risk of developing carpal tunnel syndrome.[12]

Therefore, there are inconclusive results regarding nerve conduction and body composition in studies conducted in obese individuals. In this study, we studied the correlation of BMI with median and ulnar NCV in otherwise healthy individuals.

Objectives

This is aimed to study the correlation between BMI and ulnar and median nerve motor conduction velocity in apparently healthy young subjects.

MATERIALS AND METHODS

A total of 27 obese/overweight otherwise healthy subjects (13 males and 14 females) aged 28.27 ± 3.49 years of BMI 24.99 ± 3.14 kg/m^2 were recruited from outpatient clinic facility after obtaining informed written consent.

Weight of the subjects was recorded using digital weighing machine with precision of 50 g. Height was measured using stadiometer under standard prescribed guidelines. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2).

Recording of NCV was performed on AD instruments stimulation and recording devices. First of all, distal and proximal surface stimulation of the ulnar and median nerve is done on the elbow and wrist, respectively. The stimulus type was rectangular pulse of supramaximal current strength with the duration of 200 µs. Recording of summated motor unit action potential from thenar (for median nerve) and hypothenar (for ulnar nerve) eminence was done using bipolar surface electromyography (EMG) electrodes.

The difference in latencies of distal and proximal stimulation EMG was calculated for both nerves. Forearm distance between distal and proximal stimulation sites was measured and was divided by the difference in latencies to get the corresponding motor NCV.

Subjects were in post-absorptive state at least for 2 h and were given 10 min rest in quite surroundings. Room temperature while recording was maintained at 25°C-28°C.

Statistical normality was determined using KS normality test. Pearson correlation was used to study the correlation between NCV and measures of indices of obesity.

RESULTS

The significant Pearson correlation was observed between BMI and ulnar NCV (Table 1 and Figure 1), while numerically similar change was observed with BMI and median NCV (Table 1 and Figure 2). Ulnar and median NCV correlated significantly with each other (Table 1).

DISCUSSION

In this study, ulnar motor NCV significantly correlated with BMI, while median motor NCV has found to have a positive correlation but did not achieve the statistical significance. This finding was in contrast to the observation where it was shown a tendency toward delay or slowing in impulse transmission in nerve fibers in obese individuals in comparison to non-obese subjects, and it was suggested that obesity *per se* has some degree of deleterious influence

Table 1: Correlation between NCV and weight and BMI

Parameters	Pearson correlation coefficient (*r*)	Two-tailed significance (*P*)
Weight (kg) versus ulnar latency (ms)	0.118	0.565
Weight (kg) versus median latency (ms)	0.099	0.632
Weight (kg) versus median NCV (m/s)	0.107	0.605
BMI versus ulnar latency (ms)	−0.385	0.052
BMI versus ulnar NCV (m/s)	0.433	0.027*
BMI versus median latency (ms)	−0.255	0.209
BMI versus median NCV (m/s)	0.147	0.475
Median NCV versus ulnar NCV	0.450	0.021*

*Correlation is significant at the 0.05 level (2-tailed). NCV: Nerve conduction velocity, BMI: Body mass index

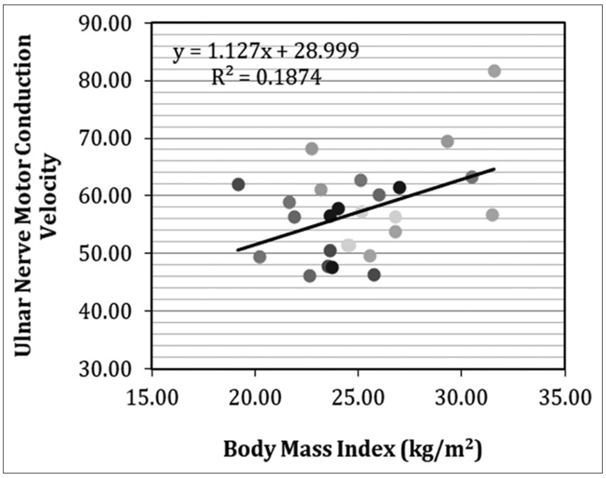

Figure 1: Correlation graph of ulnar nerve motor conduction velocity and body mass index

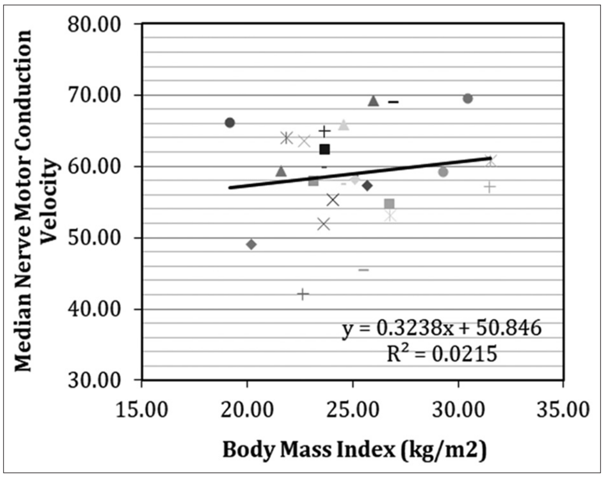

Figure 2: Correlation graph of ulnar nerve motor conduction velocity and body mass index

on axonal functions.[13] Another group reported similarly in Malaysian subjects, i.e., age and BMI can affect the conduction velocities. They observed a reduction in velocities of the median, ulnar (except sensory conduction), common peroneal, and sural nerves across different age and BMI groups.[8,14] There can be attenuation in conduction current by thicker subcutaneous tissue in persons with higher BMI is suggested as a reason for decreased conduction velocity and amplitude of action potential.[9]

Other groups could not find a statistical difference in NCVs of different BMI groups.[7,10]

The attributable reason postulated in the studies where NCV was either negatively correlating with or not affected by BMI was the effect of obesity *per se* causing inflammation leading deterioration of nerve function or subcutaneous fat pad causing hindrance in conduction recordings.

One study done in Indian population has findings similar to as of the present study where they observed prolongation of distal motor latency in motor ulnar, median and tibial nerve with increasing BMI except in motor peroneal nerve.[15] The reasons for increased NCV in people with higher BMI in this study and our study might be related to the extent of epineural fat[15] which acts as insulator for the nerve and thus maintains the temperature, optimum of which is one of the most important factors affecting nerve conduction parameters. The difference in our study was selection of subjects; we considered ICMR classification and consensus statement of physicians of India to categorize subjects into normal, overweight, and obese.[14,-17]

CONCLUSION

The findings of our study suggest that the NCV correlates with BMI in lower BMI groups due to the maintenance of local optimum temperature, while in people with higher BMI inflammatory changes impair nerve conduction, a comparison in larger sample size is required to substantiate this observation is required though.

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